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THE EFFICIENCY OF STEAM JACKETS.

In the articles on "Steam Engine Economy," and in the consequent correspondence on the subject, which have appeared in our columns, there is a factor in the problem which has scarcely been touched upon, and which ought to be carefully examined and discussed—namely, the effect of a steam jacket on the efficiency of the steam used in the cylinder of an engine. We have been favoured by Professor Thurston, of Cornell University, with the advance copy of a paper which he read at a recent meeting of the American Society of Mechanical Engineers, entitled "Authorities on the Steam Jacket; Facts and Current Opinions." If this paper does not settle much, it at least gives a great deal of information and useful data relating to engines of different types, and working under different conditions, which will enable engineers to form opinions regarding the different cases which occur in their daily practice. Professor Thurston heads his paper with a quotation from Hirn, which states that the useful effects of the steam jacket have been alternately affirmed and denied so often that the public do not know what to believe regarding them. This may be true of the general public, but almost all intelligent engineers have been able, partly from instinct and partly from experience, to use the steam jacket in such a manner as to increase the efficiency of the steam. We must confess, indeed, that we have known some exceptions to this rule, but these cases were sufficiently astounding to lead us to doubt whether those who were responsible for them had ever devoted any serious attention to the matter.

In considering this subject we desire, in the first place, to take exception to a remark made by a contemporary when discussing Professor Thurston's paper, to the effect that "it is a curious thing that while those versed in thermodynamics hold that jackets must be economical, those who build and use engines constantly assert that they are of no economic value whatever, or that at best they are not worth what they cost." The first part of this statement is certainly not correct. The state of the matter is clearly put in an opinion quoted by Professor Thurston, to the effect that the use of a steam jacket as ordinarily designed is a violation of a fundamental law of maximum efficiency of heat engines. This law requires that the engines should receive all their heat at the maximum and give it out at the minimum temperature, and not, as in the case of an engine with a steam jacket, at temperatures between these, and at times when the heat imparted lessens the efficiency, which it evidently must do at and near the end of the stroke. The steam jacket may thus be looked upon as a necessary evil, justified only by the physical properties of steam and of the materials hitherto used in the construction of engines. The advantage to be derived from the use of a steam jacket, therefore, varies according to the circumstances under which it is employed, and in some cases—as, for instance, when low rates of expansion are used—the jacket may not only be useless, but wasteful. On the other hand, when high rates of expansion are used, by preventing the temperature of the cylinder from falling below the boiling point corresponding to the initial pressure of the steam, the economy resulting from the action of the jacket is considerable. The necessity for a careful study of the conditions of efficiency of a steam jacket, of care in its application, and of experiments to test its effects are thus evident.

The teachings of theory and the results of practice are thus the same, as should be expected. Of course the theory must be formed by taking all the conditions of the problem into account. The interesting historical *résumé* of the question which Professor Thurston gives amply confirms this statement, and proves that if the steam jacket be employed under proper conditions it leads to an increase of efficiency. Like many other improvements on the steam engine, the steam jacket owes its origin to James Watt, but there is not sufficient evidence to show whether he fully understood its action, or whether instinct led him in the direction in which economy was to be obtained. His immediate successors certainly did not understand it, the common opinion being that it only served to prevent radiation from the external surface of the cylinder, and as the jacket presented a greater surface than the cylinder they inferred that it was not only unnecessary but wasteful. Its use was, therefore, abandoned to a large extent in land engines, and entirely in marine engines. Professor Thurston traces the history of the subject from the time of Watt, and dwells especially on the writings of Clark, Isherwood, Rankine, and Clausius, as these writers in later days directed attention to the importance of the action of the sides of the cylinder on the steam, and the re-action of the steam jacket. Then the investigations of Zeuner, Hirn, and his fellow-workers, and the work of a large number of writers and experimenters who in recent years have directed their attention to the subject, are passed under review. The field of review is, however, so wide, and the opinions expressed so various, that it is impossible to give any statement which might be regarded as the outcome of the whole. Professor Thurston has evidently recognised this fact, for he has not attempted a summary of his investigations, but has contented himself with merely stating opinions and facts on the authority of those whose names he gives. It would have added much to the value of his paper if he had at least stated the thermodynamic principles of efficiency in a more distinct manner. He might then have classified the results of experiments according to conditions, and shown how these agreed with what might have been expected from the teaching of theory. We hope he may still do this in a supplementary paper, which will afford a more definite basis for discussion than the one we are considering. We must confess, however, that we have not very much faith in any of the experiments which have yet been made, for it is utterly absurd to go on discussing the subject so long as we have practically no information regarding the nature or quality of the steam which is used. We have recently drawn attention to this, and we hope that future experimenters will consider it their duty to at least try to ascertain the percentage of water in the steam supplied to the engine under experiment. We are quite aware of the difficulties of the problem, but unless these are faced and overcome all experiments must be very unsatisfactory.

There is at least one point on which all the opinions quoted are unanimous, and that is that it is absolutely necessary that the jacket should be supplied with steam at a higher pressure than that used in the engine. This may seem so self-evident that it is almost unnecessary to state it, but cases are not unknown even yet where engineers are content if they get steam of any kind into the jacket. With regard to marine engine practice, the opinion of Dr. Kirk is, of course, valuable. He says : "No doubt, in the earlier non-compound engines, when the steam was worked through a large range of temperature, jackets were a very valuable addition ; but, as far as he had observed, with the ranges of temperature in the best compound, and in the modern triple-expansion engine, he could not trace any advantage. The ideal function of a steam jacket was a neutral one : simply to prevent condensation. Unfortunately it also acted as an evaporator. When so acting it was in fact a boiler, in which a higher pressure steam was employed to generate steam of a lower pressure. Without going into the ultimate value of its action in the single-acting Cornish engine, it was clear that to expend boiler steam to generate lower pressure steam in the low-pressure cylinder, or even in the intermediate, was not an economical way of using it, the more so as the steam generated in the low-pressure cylinder had little opportunity of doing any work, but went immediately into the condenser. Better it should go in as water. Jacketing the high-pressure cylinder seemed to add nothing perceptible to the heat economy, but contributed sensibly to the wear and tear. The very large volume of water that came from a steam jacket, although the range of temperature in its cylinder was small, led him to think that the steam thus condensed would be better employed if put into the cylinder itself." Mr. Dyer's opinion, quoted by Professor Thurston, seems to give a *résumé* of the position. He said that "the gain by the use of the jacket may be, in actual work, anywhere from 0 to 30 per cent. ; that it should be employed when the ratio of expansion in the same cylinder is large : when the variations of pressure, expansion, and range of temperature are great, its value is doubtful ; that superheating is a better method of reducing wastes ; that the higher the engine speed the less the value of the jacket ; from a theoretical point of view the jacket would be considered desirable on the small cylinder, but practically it is found that it is better to omit it from the cylinder, as it observably exaggerates wear ; that the use of the steam jacket is contrary to the thermodynamic principles of efficiency." It will be seen that Professor Thurston's paper contains much information and leads to many points of discussion. We shall be glad to have the opinions of some of our engineering readers regarding it, as supplementary to the discussion on "Steam Engine Economy" which has been recently carried on in our columns.—*Industries.*

A PROPOSED SHIP 1,000 FEET LONG AND 300 FEET WIDE.

At the recent convention of the Iron and Steel Institute, at Pittsburg, Sir Nathaniel Barnaby, K. C. B., constructor for the British Navy, read a paper on "The Protection of Iron and Steel Ships against Foundering from Injury to their shells : including the Use of Armor." In this he gave expression to his own theories as to the value of armor. He said that we are greatly worse off in these days of steel and iron than when ships were built of oak, teak and pine, as to the perils arising from perforation of the shells or hulls of ships. Increased speed and increased momenta in collisions had increased the risks, and at the same time the material of which the hull is composed submits so easily to perforation that he was inclined to value the opinion of many eminent men who are strongly opposed to the abandonment of wooden bottoms, both in commerce and war. One-fiftieth of the value of the vessels in the mercantile marine, he said, was required annually to make good losses and repairs entailed by collisions alone. He prophesied that America, possessing nearly one-sixth of all the wooden sailing ships of 100 tons net and upward in the world, would probably find it to her advantage for many years to come to continue the use of wooden ships.

In the course of his paper the essayist suggested a most interesting possibility in the development of passenger steamships. He said :

"I have never thought that size is a disadvantage in merchant ships, supposing they can be worked financially. On the contrary, the advantages arising from size in passenger ships seem to me to be so great that I do not see where we shall stop.

"I was consulted some years ago by a business man, well known on both sides the Atlantic, as to the possibility of building a steel ship which would not roll, or pitch, or heave in the sea, and in which, therefore, the bulk of passengers would be in a less desperate hurry to get ashore. He thought fifteen knots an hour sufficient speed.

"It appeared to me to be perfectly practicable with a draught of water of twenty-six feet. I thought the minimum length and breadth would be 1,000 feet long and 300 feet broad. I estimated that with engines of 60,000 horse power an ocean speed of fifteen knots could be obtained.

"Two sets of apparent difficulties had to be overcome, viz., those connected with the building of the ship afloat, and those relating to receiving and discharging cargo. The ship would be a steel island, incapable of entering any docks. The building difficulties soon disappeared. They had no real existence. To meet the other difficulties, I proposed to form shallow still-water harbors or docks within the ship, entered by gates in the sides, and to carry, always afloat there the loaded barges and tugs, turning the barges out and taking in fresh ones already loaded at the ports of discharge and shipment.

"Such a ship would require to be fortified and garrisoned like a town. She could be made absolutely secure against fatal injury arising from perforation. The subdivisions required for this purpose might be made to serve effectually against the spread of any local fire. I do firmly believe that we shall get the mastery over the seas, and shall live far more happily in a marine residence capable of steaming fifteen knots an hour than we can ever live in seaside towns." —*Scientific American.*

A NAUTICO-TERRESTRIAL VELOCIPEDE.

Trials have just been made at Marseilles of a velocipede that operates with the same ease upon water as upon land, without its being necessary to make the least change in its arrangement or the least halt in its running. The apparatus is of the tricycle type. It is actuated by pedals, is provided with a brake, is controlled by hand through a transverse lever, turns around with ease, and passes without transition from land into water, and *vice versa.* Let us imagine two plates connected by their edges (that we shall suppose the wheels of a tricycle), flanked upon their faces by two iron plate half shells, four inches deep and of a diameter equal to that of the wheels, and we shall have two hollow, light and strong double convex lenses in which rigidity is secured by cross braces. These lentiform wheels are provided on the edge with a channel for the reception of a strong rubber tire for preventing jolting, as in all velocipedes. In addition, they are provided externally with a dozen small copper paddles, that act like the float boards of the wheel of a paddlewheel steamer as soon as the apparatus enters the water. The accompanying figure shows the arrangement of the parts so well that it is useless to dwell upon details. It represents the apparatus returning to land after operating upon the sea. The wheels of the first model were truncated cones placed base to base. Those of the second model, here represented, are, as above stated, lentiform shells. In this model the small wheel is placed in front as in ordinary tricycles. A piece fixed to the center of the triangle formed by the three wheels supports the seat, double pedal, and the guide bar governing the direction. Motion is transmitted by an endless chain, as in bicycles. The diameter of the wheels is 4½ feet, their distance apart is 4 feet, and their thickness at the axle is 8 inches. The seat is situated 24 inches above the axle. Finally, with the rider in the seat, the wheels enter the water to a depth of but 16 inches. A few figures gathered with care, during the course of a series of experiments that the inventor and manufacturer made expressly in order to permit us to give our readers further information, will be seen to be very satisfactory. The apparatus started from Castellane Place, traversed, in ten minutes, the 2½ mile long Prado Avenue (which was obstructed by reason of the autumn horse races), entered the Roucas-Blanc bathing establishment, and then entered the water, wherein it continued its motion without stoppage or effort. The sea was calm and tractable, but there was a little swell. The first trials gave a mean speed of 2¼ miles an hour with the use of six 2 inch wide paddles per wheel, instead of the twelve 3¼ inch wide paddles that the apparatus will carry. The speed in running backward (for which the apparatus is wonderfully adapted) was a quarter less. The muscular effort giving this speed is scarcely equal to that necessitated by a tricycle on a good road. The complete evolution can be effected in a circle of a diameter of about eleven feet. In order to prove this, the manufacturer, in 130 seconds, made the following motions: A rapid immersion, a run of 33 feet, a volt, a run forward, two successive volts forward, then two backward, a volt, a run, another volt and a resumption of the motion toward the water. The apparatus then traversed the somewhat rough water of the establishment, and, followed by the primitive model, left the basin and took to the sea.

After half an hour's evolutions, the two apparatus returned to within sixty yards of the shore for experiments on stability. A tall swimmer then imitated a man in danger, clinging in all directions and in the least supposable poses to all parts of the apparatus, These experiments were made as follows: A man mounted at the back and stood upright upon the axle. The feet of the cyclist then remained out of water. The swimmer took his place upon the seat and his companion leaned upon the brake bar. The effect was the same. The swimmer held on to the axle, the paddles, and the upper edge of the wheels without being able to upset the apparatus, and the cyclist was not unseated. He lifted the apparatus by the front wheel, and the result was the same. The stability and the resistance to upsetting were surprising.

The last test was made near the shore. The swimmer, having taken to his feet, and having a firm position, was finally able, with the aid of the cyclist, to place the tricycle upon the side, and then to ovdrturn it completely. The two men then mounaed upon the apparatus, which had become a simple raft, and, afterward, jumping into the water and standing, they righted it. It is indisputable that two men at least (exclusive of the cyclist) might hang on without inconvenience, to any part whatever of the apparatus, and, after having thus escaped an immediate peril, allow themselves to be carried by the apparatus, even when upturned, for many hours.

NEW WATER VELOCIPEDE RECENTLY TRIED AT MARSEILLES.

The apparatus is, however, only in its experimental period, and its inventor, Mr. Romanès, a naval mechanic, and its constructor, Mr. Rousseau, foreman of a large velocipede manufactory at Marseilles, are about to add some improvements, such as watertight compartments, larger paddles, lighter wheels, etc., so as to be able to attain a speed of 4½ miles in the water without any trouble.

It is clear that in a heavy sea the apparatus will be difficult to manage, but a rowboat would be in the same situation, and this is not a normal case. What seems to us to result from the experiments is that the lightness of the apparatus, its easy management, the feeble resistance experienced in complete immersion, and especially the ease with which it permits of passing from a road to a lake or pond, or even to an agitated sea, and, inversely, from a river, etc., to a road, without any preparation, class this velocipede among the useful inventions.—*La Nature.*

THE MACHINIST'S SHIBBOLETH.

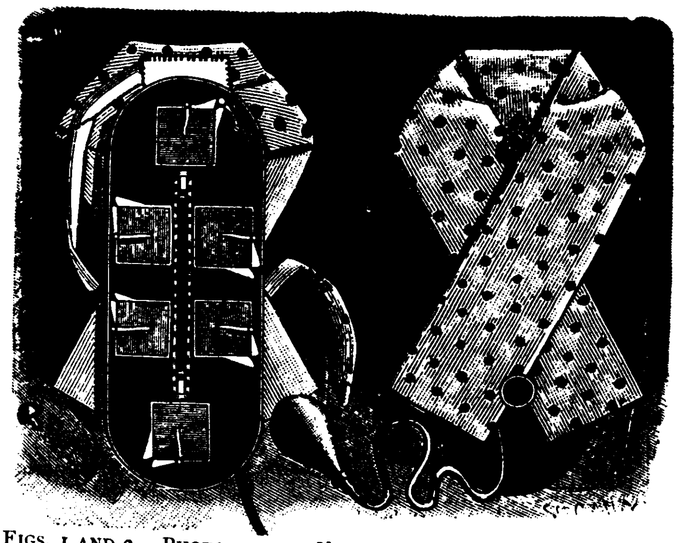
To form an estimate of a machinist's ability, in these days of improved methods, is not so easy a matter as it was thirty years ago. Almost everything is now done on machine tools, and the hammer, chisel, and file are little used. In the old time, it was by his manner of using these that we were accustomed to gauge the skill possessed by the new man. If he took hold of his hammer handle at the middle, and struck as if his elbow had no joint, or took up a file with his thumb under the handle and shoved it across the work with a teetering, jerky motion, he would at once be put down as an impostor.

Sometimes worse blunders than these were committed. For instance, grinding the cutting edge of a drill on the wrong side, or attempting to put a belt on a pulley from the wrong side.

The file test is a good one, and, if followed up, may put to shame some who claim to be good workmen. We wonder if any one in ten of the thousands of machinists who read your paper can file a spot on a round iron bar, perfectly straight, crosswise. We have seen such a surface concaved by the slight rotundity of the file. One of the interesting features of this performance is the nice vibratory movements of the joints in the arms and body that are necessary to secure the perfectly parallel motion of the file. Comparing these with the mechanism in the beam engine, the latter is very simple, for in this there is but one point to be kept in a parallel line (the crosshead), while with the file both ends must be controlled and held true to a line. Yet the operation seems very easy when, by practice, the art is acquired.

The plumber takes pride in his "wiped joint;" the slater in shearing and punching his brittle material, like so much putty; the blacksmith his perfect weld; and the machinist will ever esteem his dexterous use of the file as one of his best proofs of skill.

One of the modern tests, we believe, is the use of the scraper; and the fitting together of two surface



FIGS. 1 AND 2.—PHOTOGRAPHIC NECKTIE.—FRONT AND BACK VIEW.

plates so perfectly that they can only be separated by sliding them apart, may be considered no mean art.—QUIRK in the *Scientific American.*

THE PHOTOGRAPHIC NECKTIE.

Where will the progress of instantaneous photography end? In view of the admirable results obtained by scientists, and especially by Mr. Marey, inventors have for several years been setting their wits to work to devise small apparatus for allowing amateurs to take photographs without any one seeing them do it. We have already made known the photographic opera glasses and hat; but here we have something cleverer, and designed to meet with great success among practicians: it is a question of a necktie provided with a pin. The latter is an objective, and the necktie is a camera. When any one approaches you and speaks to you at a distance of 2 or even 3 ft. you press a rubber bulb concealed in your pocket, and you have the portrait of your interlocutor.

This ingenious little apparatus, with which also general views may be taken, was devised by Mr. Edmond Bloch, who has operated it in our presence, and, although the instrument is not yet being manufactured for sale, we have decided to make it known to our readers at once.

Fig. 1 represents the photographic necktie, and Fig. 2 gives a front view of it as it is to be worn by the operator, the metallic camera, which is flat and very light, being hidden under the vest. Fig. 1 gives a back view, the cover of the camera being removed to show the interior mechanism, comprising six small frames which are capable of passing in succession before the objective, and which permit of obtaining six negatives. The instrument may be constructed with 12 or 18 frames. The apparatus is operated as follows: The necktie having been adjusted, the shutter is set by a pull upon the button, A (Fig. 1, No. 2), which passes under the vest. In order to change the plate, it is necessary to turn from left to right the button B, which has been introduced into a button hole of the vest, and which simulates a button of that garment. This button must be turned until the effect of a locking, which occurs at C (Fig. 1, No. 1), is perceived, and which puts the plate exactly before the objective. In order to open the latter, it is necessary to press the rubber bulb, D, which has been put into the trousers pocket. The rubber tube, E, passes under the vest and serves to transmit the action of the hand.

FIG. 4.—FACSIMILE OF PORTRAITS OBTAINED WITH THE APPARATUS.

In order to charge the apparatus, it is opened at the bottom by turning the small springs, G G G; the sensitized plates are put into the frames, and the springs are turned back to their former position.

The apparatus is scarcely any thicker than the ordinary necktie called "Régate." The camera that contains the plates is not more than 0-2 inch in thickness. The six frames are carried before the objective through an endless chain, as shown in the figure.

Mr. Bloch has shown us some of the photographs that he has taken with this first apparatus, which he considers as yet but an experimental instrument. We reproduce herewith three portraits obtained with the apparatus, Fig. 3, through the minute objective skilfully concealed in the centre of the pin. These photographs are about 1½ inch square, and are sufficiently sharp to allow the portraits to be recognized. If this apparatus can be well constructed, we predict a great demand for it.—*La Nature.*

THE VALUABLE MAN.

There is no trade or business which does not require more or less energy and judicious management. Skill is needed in financiering; skill is necessary in superintendence; skill is required in manipulation of materials; and, although this skill may be acquired easily by some, it is generally only obtainable by constant application, concentration and perseverance. There are mechanics to-day in England who have served an apprenticeship of five or six years; who have been as regular as clockwork in attending to their daily employment; and who are valuable to their employers as steady skilled workmen. But what has made them so? They have learned only one branch of the business, and by constant practice have gradually improved in the rapidity and execution of their particular work. There are hundreds of such men who year in and year out have never changed their manual work for anything higher or more lucrative; nay, they have not even changed their "job," but, like some of the machines they attend, will break down only when sheer old age and wear and tear compel them. In England proficiency in manual dexterity seems to be the highest aim of the mechanic. To be a "first-rate workman" is to have the respect of their fellow workmen and the highest approbation of the superintendent. Beyond this,—the fact of accomplishing more work in a given time and doing it in a better manner, than usual,—the British workman has but little ambition. He is generally illiterate; and though he can plumb, square, lay out work, exhibit ingenuity, and invent all kinds of contrivances, and is equal to almost any emergency, he is frequently only able to write and read imperfectly. Hence we find mechanics and workmen coming to this country from British soil who are expert, and that remarkably so, in some particular branch of business, and that very expertness is their hobby. Here in this country, the spirit among those learning a business is different. Frequently the aim seems to be to learn as much of everything in as short a time as possible, with the least trouble and labor. Who does not know of apprentices working a year at some business, and then leaving to go somewhere in order to get a journeyman's wages? Who does not know that in every factory and workshop in this country great differences exist in the capabilities of men engaged in different occupations? Who does not know that the most valuable man is he who understands his business thoroughly? And who does not know that the man who has worked hardest and longest, studied his business, made observations in it, read upon it, thought upon it, used brains as well as hands in it, is the man who holds a higher position and obtains a better remuneration for his services than his fellow workmen.

But mark the difference between English and American workmen. The former are content to serve an apprenticeship, to learn one particular branch which they mean to follow as their business, it may be for life; the latter expects to learn three or four branches or the whole business in three or four years. At the expiration of such a term, it is frequently found that he has acquired a smattering of several things, but made himself master of none. He has rushed forward, looking only at the dollar when he should have been intently studying his business; he has been thinking how much work he could do, instead of how well he could finish it; he has been thinking, talking and agitating on more pay and shorter hours, rather than fair pay for a fair day's work; he has rambled from shop to shop, doing first one thing and then another (for he has served his apprenticeship, and of course must be considered to be master of his business), and all this for a little more pay, which pay seldom satisfies him for any length of time. There is not much surprise expressed on being informed of his "changing his business."

There is no royal road to learning; skill and proficiency are not obtainable by dollars and cents. Therefore, after a business has been decided upon with the determination to make it a business for life, with a resolution that will combat with all the difficulties, misfortunes, vicissitudes which attend more or less every undertaking, the great and grand object to be held constantly in view is to use all the available means for acquiring a practical and thorough knowledge of that business. In the "Memoirs of Robert Chambers" may be found the following passage:—

"After an interval of fifty years, I recollect the delight I experienced in working off my first impression; the pleasure since of seeing hundreds of thousands of sheets pouring from machines in which I claim an interest, being nothing to it! If the young and thoughtless could be made to know this,—the happiness, the dignity of honest labor conducted in a spirit of self-reliance; the insignificance and probably temporary character, of untoward circumstances while there is youth, along with a willing heart; the proud satisfaction of acquiring by persevering industry instead of by compassionate donation,—how differently they would act!"—*The American Engineer.*

THE CURABILITY OF GALLOPING CONSUMPTION.

The announcement by so well known a physician as Dr. McCall Anderson that acute phthisis, or galloping consumption, is curable, excites a good deal of surprise and quite as much incredulity, yet Dr. Anderson reports in the *British Medical Journal* seven cases of this character, of which five recovered.

Acute phthisis is considered by Dr. Anderson to have two forms, acute tuberculosis and acute pneumonic phthisis. Some of his cured cases were of the tubercular character. The treatment advised is given in detail and contains no especially new feature.

"The principal indications," he says, "are 1, to keep up the strength; 2, to keep down the fever; and 3, to treat any special symptom or complication which may arise.

"1. Two thoroughly trained and reliable nurses are indispensable, one for day and the other for night duty, for without admirable nursing no hope of improvement can be entertained; and the hygienic and other surroundings of the patient should be satisfactory, so that we need not be surprised that when the disease occurs in the homes of the working classes it is almost necessarily fatal, and that hospital patients have the best chance of recovery. The patient must be fed constantly on fluid food (soup being avoided if diarrhea is present), both day and night, and stimulants (from ℥ ij. to ℥x) are required early in the attack, but should be given in small quantities, frequently repeated and along with the food. In fact, the dietetic treatment should correspond with that of a case of fever presenting symptoms of a similar degree of severity.

"2. At bedtime a subcutaneous injection of sulphate of atropine (gr. $\frac{1}{100}$ to gr. $\frac{1}{60}$) is given. This checks perspiration when present, acts as a sedative to the system, indirectly helps to reduce the fever, and diminishes the secretion from the lungs.

"3. Remedies are given with the view of lowering the temperature. This is a point of the utmost consequence, because the majority of the patients die consumed by the fever. Some benefit is derived by allowing the sufferer to suck ice freely, by giving the food and drinks iced, by sponging the body with iced vinegar and water, or even by using iced enemata. But our main reliance is upon one or more of the following methods :

"(*a*) Niemeyer's antipyretic pill or powder every four hours, containing gr. j. quinine, gr. $\frac{1}{2}$ to gr. j. digitalis, and gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$ opium. The portion of opium may even have to be increased beyond this if there is much diarrhea. The effect of the digitalis must be carefully watched, and it must be omitted for a time if the pulse becomes preternaturally slow and irregular and the secretion of urine very scanty.

"(*b*) The administration daily—particularly shortly before the temperature tends to be highest—of from ten to thirty grains of quinine, given, as suggested by Liebermeister, either in a single dose or, at all events, within an hour.

"(*c*) The application of iced cloths to the abdomen for half an hour every two hours so long as the temperature exceeds 100°. The application of iced cloths is made in this way :

"The nightdress is pulled well up over the chest, so as to avoid any possibility of its being wet, and, for a similar reason, a folded blanket is placed across the bed under the patient's body. The usual bedclothes are arranged so they reach up to the lower part of the chest only, which latter is covered by a separate blanket in order to prevent unnecessary exposure while the cloths are being changed. Two pieces of flannel are employed, each being sufficiently large when folded into four layers to cover the whole of the front and sides of the abdomen. One of these, wrung out of iced water and covered with a piece of dry flannel to protect the bedclothes, is applied, while the other is lying in a tub of iced water at the side of the bed. The pieces of flannel are changed every minute, or so often that they still feel cold when they are removed. The changing of the flannel, particularly when two persons are in attendance, one to remove the bedclothes and the flannel, the other to apply the piece which is freshly iced, can be accomplished in a few seconds."—*Medical Record.*

HOW TO VARNISH IN COLD WEATHER.

When varnish is laid on a piece of cold furniture or a cold carriage-body, even after it has been spread evenly and with dispatch, it will sometimes "crawl" and roll this way and that way as if it were a liquid possessing vitality and the power of locomotion. It is sometimes utterly impossible to varnish an article at all satisfactorily during cold weather and in a cold apartment. In cold and damp weather, a carriage, chair, or any other article to be varnished should be kept in a clean and warm apartment where there is no dust flying, until the entire woodwork and ironwork have been warmed through and through, to a temperature equal to that of summer heat—say eighty degrees. That temperature should be maintained day and night. If a fire is kept for only eight or ten hours during the day, the furniture will be cold, even in a warm paint-room. Before any varnish is applied, some parts of the surface which may have been handled frequently, should be rubbed with a woolen cloth dipped in spirits of turpentine, so as to remove any greasy, oleaginous matter which may have accumulated. Table beds, backs of chairs, and fronts of bureau drawers, are sometimes so thoroughly glazed over that varnish will not adhere to the surface any more than water will lie smoothly on recently painted casings. The varnish should also be warm—not hot—and it should be spread quickly and evenly. As soon as it flows from the brush readily and spreads evenly, and before it commences to set, let the rubbing or brushing cease. One can always do a better job by laying on a coat of medium heaviness, rather than a very light coat or a covering so heavy that the varnish will hang down in ridges. Varnish must be of the proper consistency, in order to flow just right and to set with a smooth surface. If it is either too thick or too thin, one cannot do a neat job.

TO THE NORTH POLE IN A BALLOON.

The north pole, despite the long, ominous list of martyrs to scientific or commercial curiosity, continues to exert a fascination over many minds. This fascination Jules Verne has graphically depicted in his "Adventures of Captain Hatteras." The problem at present discussed is whether there is land, ice, or an open polar sea at the pole. An attempt is soon to be made to solve the problem by a Parisian aeronaut and a Parisian astronomer, Messrs. Besancon and Hermite, neither of whom has attained the age of thirty. The plan they propose to adopt, while original with them, is by no means new. In 1870 Silbermann, and in 1874 Sivel, published studies dealing with the practicability of reaching the north pole by balloon. In complete ignorance of these researches, Messrs. Hermite and Besancon conceived the same idea. In honor of these researches, which they later discovered, and as a tribute to the memory of an illustrious martyr to aeronautic science, they decided to call their balloon by the name of "Sivel."

The "Sivel," when inflated, will measure 16,250 yards, and have a diameter of 32½ yards. It will be capable of carrying 17½ tons, and will have an ascensional force of three pounds to the cubic yard. The envelope will be composed of two thicknesses of Chinese silk, covered with a new specially devised varnish, which renders it absolutely impermeable, and augments the resistance of the envelope, rendering it

FIG I.—THE BALLOON UPON ITS JOURNEY.

capable of supporting, without rupture, a pressure of 6,400 pounds to the square yard.

The balloon, which is spherical in shape, will contain an immense internal balloon so constructed as to be perfectly and permanently inflated by 3,250 cubic yards of gas under the same pressure. This is intended to remedy, in great part, the grave inconveniences—the chief cause of balloon instability—which result from hygrometric and thermometric variations produced by altitude changes. The interior balloon is furnished with two valves of automatic certainty which will be in communication with a ventilator moved by electric action. If the gas becomes thinner, the interior balloon can be depleted. If it becomes thicker the interior balloon can be inflated. The "Sivel" is thus always inflated. The internal balloon represents about one-fifth of the entire balloon, a needed proportion, since balloons raised 2,700 feet lose about one-tenth of their gas, independently of the loss occasioned by temperature variation. The "Sivel" will carry several pilot balloons to be used in studying aerial currents, and sixteen balloonets to supply, through its valves, the gas of the interior balloon of

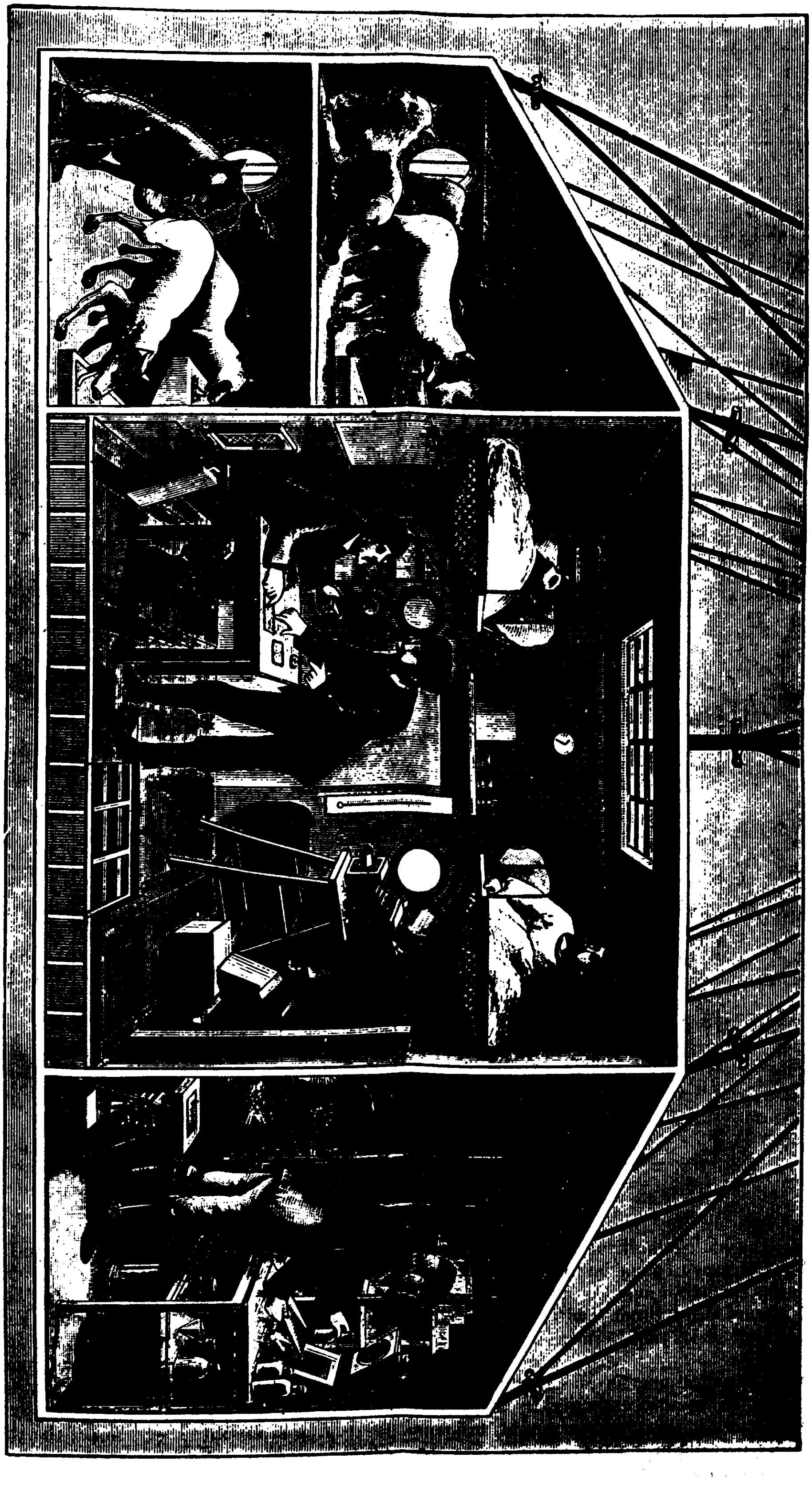


Fig. 2.—View of the Interior of the Car.

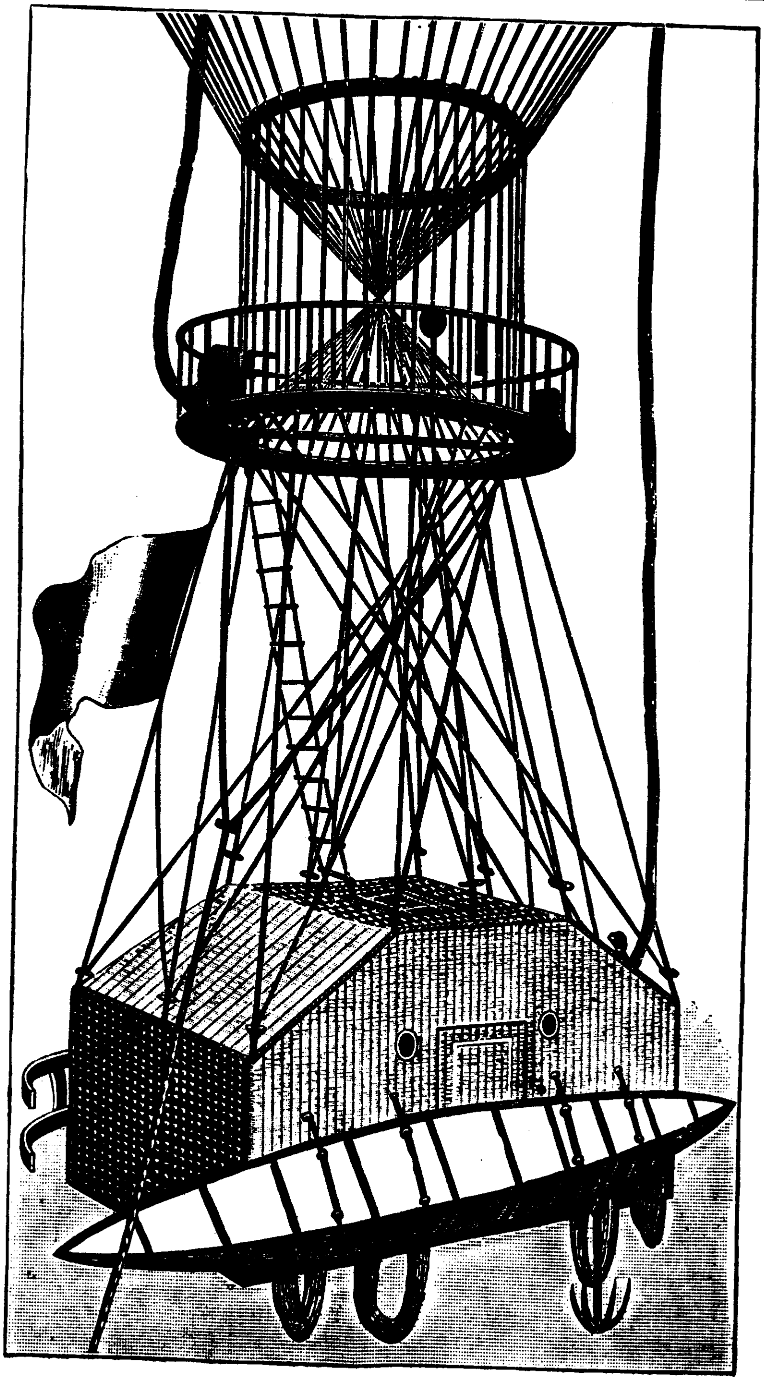


FIG. 3.—EXTERIOR OF THE CAR.

the "Sivel." The balloon's altitude will be regulated by means of a trail rope of considerable weight, which trails as a species of anchor over the ice.

Fig. 1 represents the "Sivel" with its circlet of supply balloonets and its mobile anchor trailing over the ice.

The car, which is of osiers, is so strengthened by steel armatures as to be absolutely rigid. It is so arranged as to maintain in its interior a regular temperature. A safety petroleum heater is used for the purpose. The car will be prepared for all emergencies by making it unsubmersible and furnishing it with runners for use as a sledge. It is ten feet wide by sixteen long, and will contain, besides the two explorers and their three aids, eight Esquimaux dogs, a sledge, an unsubmersible canoe, provisions and water rendered unfreezable by a chemical procedure. The total weight of car and contents is fifteen tons. Above the car is a bridge accessible by a rope ladder.

Fig. 2 represents a section of the car with its contents.

The explorers will sail from France in two steamships in the latter part of May, 1892, so as to arrive in Spitzbergen in July. There they will depart as soon as practicable by favorable winds from the south. The exploration will last in all six months. Its cost will be $108,000, of which $12,000 is required for the construction of the "Sivel." The cost is defrayed by Mr. Hermite and some English capitalists of scientific aspirations. While the idea of reaching the north pole by balloon is not a new one, it has had its details on this occasion for the first time worked out with great care.—*L'Illustration.*

OLD AND NEW SHOP METHODS.

My pet scheme was a failure. I mean my favorite plan for an engine to be cast in one piece, or as near that as possible. The first, and I may say the chief trouble came from having no lathe long enough to bore the cylinder and slide surfaces. A new one of suitable size would cost $2,000. So I must either bolt the cylinder to a short bed-plate, or give up this plan. I decided on the latter, for an overhanging cylinder could not be reconciled with my notion of stability and appropriate design. This course was cheerfully seconded by my employer. He was wedded to his old engine, holding these old patterns in some such veneration as one feels for the home of his childhood. I could see much to do in mending matters about the shop, but no way was open for doing any great thing; and taking this philosophical view of it, that after all, the great work of life is made up of doing little things well, I set myself about practising these precepts.

COSTLY POWER.—The engine driving the shop was speeded to 75 revolutions per minute, and being only 50" stroke, I concluded to run to 120 turns, but before doing this lengthened its valve $\frac{3}{8}$" on each end, and put on a new eccentric that would give the proper movement. This change made a saving of about one-eighth in fuel consumed, and by the use of a heater and filter, the purer water gradually removed the scale from the boiler and effected a further saving of about 10 per cent. in fuel.

One of the most inviting fields for improvement in this machine shop I found to be the drilling department. The practice has long prevailed of boring holes in castings whenever possible, and when drilling has been necessary, it was put into the hands of the youngest apprentices and done on rickety and inferior machines. With the old style flat drill nothing was more uncertain than making a straight or round hole; and if it had any considerable depth it was no uncommon thing to twist off the point of the drill in the bottom of an unfinished hole. It was about as easy to recover a drill from the bottom of an artesian well a thousand feet deep as to get out one of these pieces. The modern drill press is one of the expensive tools of the shop, but a first class Radial drill was purchased with a complete set of twist drills, with uniform sockets to fit other machines; and, also, an emery drill grinder. Gigs and templates were made for duplicating parts of machinery, and round files for correcting imperfect holes gradually fell into disuse. Cast holes, that were of advantage to flat drills, were not only of no use, but actually hurtful to twist drills.

MACHINE SHOP MORALS.—This is something very noticeable in the moral effect of good tools and system, on the men in a machine shop. Just as a man will step more proudly when his boots are blacked; so, a machinist working on a bright and clear machine, will have more respect for himself than if wallowing in grease and rubbish.

The care exercised by workmen in Eastern shops over their personal appearance, forms a wide contrast with Western customs, and, especially, when appearing on the streets. These men generally have dust-tight clothes presses at their shops, and go and come from their work dressed as neatly as those whose hands and faces are seldom soiled. The effect of this is refining, to say the least, and tends to enhance the value of such men's services. A young lady in a Western town once said "she could smell a mechanic a square away." This was probably indiscreet, for she has never married; and, yet, she may have been half right.

TOOL ROOM ESTABLISHED.—But to go on with my shop experience: Many little appliances have now been introduced for cheapening and doing better work; enough to form a nucleus for a tool room. It contained the drill grinder, one small lathe, a milling machine, a small drill press, grindstone, emery, grinder and a small forge.

Tom, the young Yankee, was installed here as custodian of tools. The new regime worked well,but caused some comment. When, for instance, a hole was to be drilled for a $\frac{3}{4}$ tap, the men had been in the habit of fitting calipers to the top and then grinding a drill to set, the two arriving at the same size. The tool man now handed out the tap with a drill to suit it. The question of size was not debatable.

The time thus saved by this and similar conveniences, more than paid the wages of the attendant. Aside from keeping dulled tools in order, much of his time could be spent in making new tools and on regular work.

It is not surprising that radical changes like these in shop methods should cause some dissatisfaction; for, when men have been accustomed to having things their own way, it is apt to be distasteful to be circumscribed by new methods and fixed rules.

To those who have been accustomed to the use of working drawings, it is a matter of surprise how any uniformity can be had in the construction of work without these helps. In such a shop there is an oracle for reference when disputes arise, and it is an unfortunate day when this person is removed. To avoid such a calamity and to facilitate work, card-board drawings were produced with figures and letters for all important measurements and with varnished surfaces, admitting of washing. For drawings of a temporary character, blue prints were used. The ability to comprehend and interpret these was something the men must acquire. Teaching the older ones was slow work, but the young men were apt and some of them were anxious to form a night class to receive instructions in drawing and mathematics. This was promised them during the coming long winter.—*The Tradesman.*

TIPS TO INVENTORS.

There are many smart men running after perpetual motion, and such like impossible and useless things, who have brains enough to produce, if set to work on almost any practical problem, whatever is called for. The faculty of invention is a great one. It is as much a faculty as an ear for music or an eye for painting and sculpture. There are hundreds of lines in which those who have the heaven-born, inventive gift, might by a hint be made to start after some certain thing that the world really needs, would believe in when shown and would be willing to pay for when it was in practical working shape For such men—and among our readers we doubt not that there are many hundreds at least—the following paragraphs have been prepared; and they will also serve to call the attention of specialists who are not professional and inveterate inventors, to the desirability of working in these lines.

There is a need of a device by which a train can be stopped at any point in its run from any station of a line. This is needed not only in the case of "wild" engines which have escaped control, but for trains which have gone past a signal, or have not heeded it, or are not within signaling range.

There is a chance for practical inventors to change the whole idea of railway train braking. The brake should be applied to the rail and not to the wheels of the train. Brakes applied to the wheels simply permit the train to skid, and cause flat places on the wheels. Brakes applied to the rails would ease up the momentum of the train in friction between it and something not within itself.

The whole art of making castings under pressure needs to be learned. It is but in its infancy. There is required a casting machine which will do in iron and brass what the type casting machine does in type metal.

Half-tone printing needs the inventor's aid. As it is now, ordinary presses for printing from type forms must have engraved blocks, the printing surfaces of which are either type high or below that, and print from only those portions which are type high, losing the half-tone effect.

Car starters for street railway lines have not been given enough attention. There must be something which will store up enough power when the car is in motion to start it easily when fully loaded, after it has been brought to rest. If it can be still further developed so as to store up while on down grades a certain amount of power and give it out again on the up grades in aid of the horses, there will be money in it.

The storage battery or secondary battery is far too heavy, complicated, costly, and liable to deterioration; and gives off fumes which do not commend it to proper approval. There is ample opportunity for inventors to do good and paying work here.

Strange as it may seem, there has not yet been put upon the market a good ball bearing or roller bearing for engine shafts and machinery generally. The manufacturers of bicycles seem to have got what is wanted, but in larger sizes the field is yet open.

Electric cooking has been but little more than suggested. In many houses now having electric lights, a good device for cooking by electricity taken from the same wires which supply the light could be very readily introduced.

It is strange that the steam road wagon has been so little developed. Self-propelling steam road rollers are common enough and some of them act as traction engines, also on good roads; but the steam carriage for ordinary roads is of the near future. Perhaps the naphtha launch motor idea can be adapted to service on our ordinary streets and highways.

The rotary engine which will use steam expansively, be durable, and not give trouble from leakage, has not yet been evolved. There is a chance for it yet.

The chemist, who will make from cotton seed either a drying or a non-drying oil, should not want for cash if he manages his affairs properly.

The superheated steam oven is an invention which should pay to develop into practical form for every day use by ordinary baking establishments. The idea of baking by steam has been tried and found very successful in large institutions. Who will give the baker around the corner, at a reasonable price, an oven which will run by steam only and give better satisfaction than the present coal heated or wood heated affairs?

Electro-deposition needs looking into. There are several metals which as yet cannot very well be deposited by the galvanic current; and the art of depositing alloys has as yet but very little practical application.

There is more money in a good cotton picker than there has been in the cotton gin, and that is saying a good deal.

An oil stove which will permit of broiling, can be used in the open air or where there are heavy draughts, and may be kept burning ten hours at a time, should find hundreds of thousands of purchasers.—*The Practical Mechanic and Electrician.*

RUSSELL SAGE ON WEALTH.

Russell Sage carved out his own great fortune of $50,000,000. He is a notable example of a self-made man. He is believed to have more ready money than any single individual in the world. There are larger fortunes than Mr. Sage's, but they are invested in securities, property and business. Mr. Sage has large investments, but so carefully selected that no general financial disaster would make a difference of ten per cent. in them. The reason that he keeps so much money on hand is to accommodate men and corporations that require loans. How to make money is a problem that every man tries to solve. When Mr. Sage was asked for his solution by the *New York Herald*, he replied: "I believe that any man of good intelligence can accumulate a fortune, at least a moderate one, by adopting three principles—industry, economy, and patience. I place no reliance in luck. A mind capable of directing one in the right course makes success almost certain. A young man should start out in life trusting in God and resolved to attain a position of self-dependence. He must so conduct himself as to command the respect and confidence of all with whom he comes in contact. The way in which he is regarded by others will have a powerful influence on his future. To disregard the opinions of others would be to invite failure.

Without economy no man can succeed, even if he should be placed in circumstances where there are large gains. His gains would not be lasting, for he would not be prepared to withstand reverses which are liable to come to any one. A man must be ready for set-backs. I see striking illustrations in Wall street of the lack of foresight in men. Great displays are made, and when the course of speculation changes to an adverse direction the money that is needed to tide the speculators over the trouble has been dissipated. It is the careful, prudent way that makes a man master of the situation—the controller instead of the follower. This is true not only in business, but also in politics, religion and every occupation in life.

"A man should make it a point to save. What percentage of his salary or income he should put aside it is difficult to say. That should be governed by circumstances. Men's surroundings are different, and a rule that one could follow another could not. Judgment must be exercised in saving as well as in spending. It is safe to advise a young man to save all he can, and he will find that the saving of his first hundred dollars will teach him to save the second, and so on, until he has laid the foundation for a fortune that may, by good management be made a large one.

"A man's health has much to do with his success in life, and it behooves him to look well after his bodily condition. Ill health will deprive him of energy, which he must use to achieve success. The young man must work on a salary until he is able to comprehend the value of money, and also the source of supply and the ease with which it may be dissipated. He must read books and newspapers to keep posted on the topics of the day and the course of human events. It would be well for him to attend debating societies to qualify himself to stand on his two feet and express himself in an intelligent manner. Learning acquired by a young man in his own room after his labours of the day are over is hard gained, and, for that reason, more lasting than the education acquired in the great institutions of culture. The young man taught in a fashionable college is a house plant, while the young man who cultivates himself is an out-door growth, and better able to stand a severe drought or a severe storm, which all are subject to in the variations of life.

"It is very seldom that large fortunes are made by spreading out. The risk of disaster is too great. A man should never allow his affairs to get beyond his control. He should thoroughly master his business, and let it grow to its natural dimensions.

"Intelligence is a prerequisite to success. One of the wealthiest men in America recently said that he considered intemperance the greatest cause of poverty. It is a great cause of poverty; but the lack of intelligence, coupled with the lack of industry and economy, is a greater cause. There is a wide difference in men. Some men have no more intelligence than a dumb animal. It is also with animals as with men. Some animals are almost human in their intelligence, and others are the merest brutes, with only instinct, and that of the lowest order, to direct them. The intelligence of horses and dogs is often astonishing.

"Close application is necessary in every business. If I did not give personal and careful attention to my own business I could not hope to prosper. All are free and equal in this country, and every man makes of himself what he will. His mind directs his course in life. If he has the will power to adopt wise principles success will come to him."—*Manufacturer and Builder.*

WHAT IS A HAZE?

BY DR. J. G. MCPHERSON, F. R. S. E. *(Lecturer on Meteorology in the University of St. Andrew's).*

Till very recently, meteorologists were not certain how to account for the varied phenomena of the cloud-world. The haze so familiar in summer, the fogs of winter, the drizzling mists, and thin rain, as well as the great thunder-rain, and hail, and the feathery snow, are now all believed by physicists to be intimately connected with the dust particles in the air, on which the water-vapour settles, and forms, under different circumstances, the varied phenomena referred to.

According to Mr. Aitken, whose investigations have been recently laid before the Royal Society of Edinburgh, haze is generally only an arrested form of condensation of water-vapour. Cloudy condensation is changed to haze by the reduction of its humidity. To explain this he invented a simple apparatus for testing the condensing power of dust, and observing if water-vapour condensed on the deposited dust in unsaturated air.

He had first to collect the dust from the air. If inside a room, he placed a glass plate vertically and in close contact with one of the panes of glass in the window, by means of a little india-rubber solution. The plate being thus rendered colder than the air in the room, the dust was deposited on it. If the experiment was to be made on the air outside, the glass plate was kept at a distance from the pane by means of small pieces of sheet india-rubber at the corners of the plate. In this way the air circulated in the space between the plate and the window, and as this air, heated on the window pane, became warmer than the plate, the dust was attracted to and deposited on the cold surface of the outer plate.

Having thus obtained on the plate the particles of dust from the air, he set himself to test the condensing power of the dust, for which purpose he constructed a rectangular box, with a square bottom, 1½ in. a side and ¾ in. deep, and open at the top. The top edge of the box was covered with a thickness of india-rubber. The dusty plate—a square glass mirror 4 inches a side—was placed on the top of the india-rubber and held down by spring catches, so as to make the box water-tight. The box had been provided with two pipes, one for taking in water and the other for taking away the overflow, with the bulb of a thermometer in the centre. The dust was carefully cleaned off one half of the mirror, so that one half of the glass covering the box was clean and the other half was dusty. He poured cold water through the pipe into the box, so as to lower the temperature of the mirror, and carefully observed when condensation began on the clean part and on the dusty part, and took a note of the difference of temperature. By this experiment he estimated the condensing power of the dust. As the condensation of the water-vapour appeared on the dust-particles before coming down to the natural dew-point temperature of the clean glass, the difference between the two temperatures indicated the temperature above the dew-point at which the dust condensed the water-vapour.

Taking special kinds of dust, he brought out marked differences in their condensing power. Magnesia dust has small affinity for water-vapour; accordingly he found that it condensed at almost the same temperature as the glass. Gunpowder has great condensing power. All have noticed that the smoke from exploded gunpowder is far more dense in damp than in dry weather. Accordingly, in the experiment, he found that the dust from gunpowder smoke began to show signs of condensing the vapour at a temperature of 9° Fahr. above the dew-point. In the case of sodium dust, it condensed vapour from air at a temperature 30° above the dew-point.

He then examined the condensing power of dust in different specimens of air. Dust collected in a smoking-room showed a decidedly greater condensing power than that from the outer air. The condensing power of the dust in the air of the smoking-room varied from 4° to 8° above the dew-point; whereas that of the outer air varied from 3° to 5½°. Strange to say, he found that the depth of the deposited dust had no visible influence on the condensing power of the dust, as the amount of dust that was deposited on the mirror in one day gave an equal thermometric difference with that which had been collected for a fortnight.

We can now understand why the glass in picture frames, and other places, sometimes appear damp when the air is not saturated. When in winter the windows are not often cleaned, a damp deposit may be frequently seen on the glass. Anyone can try the experiment. Clean one half of a dusty pane of glass in cold weather, and the clean part will remain undewed and clear, while the dusty part is damp to the eye and greasy to the touch.

These observations indicate that moisture is deposited on the dust-particles of air which is not saturated, and that the condensation takes place while the air is comparatively dry, before the temperature is lowered to the dew-point. There is, then, no definite demarcation between what seems to us clear air and thick haze. The clearest air has some haze, and, as the humidity increases, the thickness of the air increases. But from what we consider clear air to haze there is no real difference in kind, but only in the amount of the thickening. In all haze the temperature is above the dew-point. The dust-particles are saturated with the moisture so as to form haze, before the fuller condensation takes place at the dew point. At the Italian lakes on many occasions, when the air was damp and still, he observed in close proximity every stage of condensation, not separated by a hard and fast line, but when no one could determine where the thick air ended and the cloudy began. Sometimes in the sky overhead we observe a gradual change from perfect clearness to thick air and then to cloud.

Mr. Aitken concluded that the dust in our atmosphere has in almost all degrees of humidity more or less water attached to it. A thick haze may be occasioned by an increased number of dust-particles, with little moisture, or of a diminished number of dust-particles with much moisture, above the point of saturation. The haze is cleared by the temperature rising so as to allow the moisture to evaporate from the dust-particles.

By a series of observations, he found that whenever the air was dry and hazy there was much dust in it, and that as the dust decreased the haze also decreased. For example, at Kingairloch, in one of the clearest districts of Argyleshire, on a clear July afternoon, he counted 4,000 dust-particles in a cubic inch of air; whereas, two days before, in a thick haze, he counted no fewer than 64,000 in the cubic inch. At Dumfries the number counted on a very hazy day in October increased twenty-fold over the number counted the day before when it was clear.

All know that thick haze is usual in very sultry weather. During the intense heat there is generally much dust in the atmosphere; this dust, by the high temperature, attracts moisture from the apparently dry air, though above saturation-point. In all circumstances then, the haze can be accounted for by the condensing power of the dust-particles in the atmosphere, at a higher temperature than that required for the formation of fogs, or mists, or rain.—*Knowledge*.

MACHINE SHOP IMPROVEMENT.

There is nothing which pleases a man with a mind of a "mechanical turn" more than the sight of a well-regulated machine-shop. The vast amount of work carried on in a large establishment, the great number and variety of tools and contrivances necessary for manipulating the work, are significant of the onward march of intellect and improvement; and where, by a single glance system, order, and neatness can be observed, the pleasure of examining into the curiosities of mechanism becomes enhanced in a two-fold degree. In many of our machine-shops, and most especially locomotive repair-shops, the master mechanics are developing their taste in the fitting of their department. The best of tools are kept clean and bright; taps and dies are arranged in order; the benches regularly swept down; gauges and templates are accessible and distinguishable for each particular use; oil-cups, packing, steam gauges, trenches and tool chests are all classified and ready when wanted. The giant engine emerges slowly from the "round-house" with every stuffing-box carefully packed, every gland properly screwed down, and every joint tight and strong. The paint is clean and bright, and the "finish work" looks as if it needed no rubbing up, scouring or repairs. Here the machine reflects the well-ordered mind, and no wonder if passers-by stop to admire the style which each engine presents when yoked to its train of freight or passenger cars. On some of our rail-roads there is quite a rivalry among the engineers (we include engine drivers) as to who can keep his engine in the cleanest and best condition, and run the greatest distance with the least consumption of material, such as fuel, tallow, oil, etc.; and in some cases a premium is extended for competition in the engineers' department. We should like to see this more general and the example noticed more by engine-builders and machinists. Our stationary engines are generally loaded with grease and dust, whereas a little painstaking and attention would save hundreds of dollars, and add to the character of those concerned.

There are few English machine-shops in which there cannot be found a fine specimen of workmanship in the shape of the "shop engine." Every employee will go in to look at "the engine running the works" and will find fault or praise, according to its condition. This serves also as a model to exhibit to contractors—a model of first-class workmanship and finish—a model of good working and economy—a model of neat and good arrangement—in short, a specimen of what can be made at the establishment. The idea seems to prevail *here* that any old engine which will turn shafting answers the requirements of a machine-shop, but we opine that contractors should not have to be directed to other establishments besides the machine shop for samples and specimens of work constructed there. There are other machinists, however, who do take pride in showing the "shop engine;" but where we find one that does there are scores of those who revel in oil, dust and dirt. The nature of the work is a poor excuse for such a state of things.—*The American Engineer.*

COVERING PIPES AND RESERVOIRS FOR THE CONSERVATION OF HEAT.

A writer in the *Builder*, in the course of a series of articles on "Hot Water Supply," says there is no branch subject in connection with hot water works deserving so much attention as that which forms the heading of this article. It is no exaggeration to say that very shortly no apparatus for hot water supply will be considered complete or finished if the whole system is not insulated, so to speak, so that almost every particle of heat absorbed by the water in the boiler will be obtainable from the taps, instead of nearly 50 per cent of it being radiated from exposed surfaces and worse than wasted.

There are at this moment hundreds, if not thousands, of hot water systems that, by being carefully covered, would be converted from miserably inefficient to highly satisfactory appliances—this in particular with the tank system, when the tank is so commonly fixed in a cold, draughty roof.

An interesting instance of the success attending the covering of pipes occurred quite recently, in which a residence was fitted with a complete system of hot water supply pipes on a scale sufficiently large for a good boiler in a 5 foot kitchen range, but owing to a delay experienced in obtaining the range in question, another of a smaller size, 3 feet, was fitted up and connected to the chimney and circulating pipes for temporary cooking and hot water supply. It was not supposed that this little range with its boiler would do much in the way of water heating, but to the astonishment of every one it gave a really abundant supply of very hot water in every part of the house as quickly in the morning and altogether as satisfactorily as a larger range would be expected to do.

This desirable result was wholly brought about by the pipes and cylinder being everywhere carefully covered with a sufficient thickness of felt, so that however hot the water was within the pipes, no heat could be felt outside the covering, a sure indication that no heat was being dissipated.

It really does seem opposed to all reasonable and workmanlike principles to allow such abundant opportunity for heat to be thrown away, while labor and fuel is being expended in the kitchen apparently for this object. If a fitter or maker of steam engines and appliances did not attend to the subject of this paper in a thorough and workmanlike manner, he would be considered to have hardly mastered the rudiments of his business. The waste of heat is not always the only ill result experienced, as in many instances the warmed air is very objectionable, and if a hot water pipe is carried alongside a soil pipe, it is possible for a very unpleasant feature to introduce itself. It is a very customary practice for a hot water fitter to carry his pipes up in the casing that is nearly always to be found passing from the bottom to the top of the house, this casing containing all the different pipes of the house, such as the cold service from the main, the cold service down from cistern, the water closet cold water service, and, very commonly, the soil pipe. There is no objection to his making use of this casing if it is large enough to hold a few more pipes, and it is often used of necessity, as to carry pipes openly through well decorated rooms is out of the question; but to carry hot water pipes up this case without felting them is an exceedingly bad practice, as they are not only brought into contact with the very cold surface (they have frequently been found wired on to cold pipes, four or five pipes in a bundle), but the heat radiated causes a draught or current of air to set in, as we find in a chimney.

When a casing contains pipes that radiate heat, that casing, within a few moments after the heat is felt within it, is converted into a flue, as by applying heat to air it can be made to circulate to all intents and purposes like water. Air that is brought in contact with heated surfaces becomes heated and rarified, and, being thus made lighter than the surrounding air, rises, and cold particles immediately flow in to take its place, they becoming heated and following the first particles, and so on, so that it resolves itself into a stream of warm air flowing out of the upper part of the casing, and cold air flowing in in corresponding volume below. This may be excellent in practice when hot water pipes are used for effecting ventilation; but it is fatal to hot water services which are particularly required to keep the heat within them. In many instances they are cooled at about the same speed as they would be if placed outdoors when a strong wind was blowing.

It may be argued that if the casing is stopped off at its two extremities, the trouble will be obviated; and so it would be if the casing was *perfectly* air tight everywhere, and had no cold pipes within it. But this is never the case. There are always numbers of crevices and apertures which permit of a tolerably free ingress and egress of air.

The best material for covering these pipes and also the reservoirs is hair felt. Hair is a naturally poor conductor of heat, and nothing surpasses it for this purpose, especially as it is so easy of application. This felt, which is readily obtainable in sheets, is usually cut up in strips for pipe work; the strips are wound upon the pipe spirally, being secured here and there with cord or wire, but where spiral winding is impossible, it can be tied on in lengths, which answers equally well, but has not such a good appearance.

The best and most complete arrangement for pipe work, but which entails a little greater expense, is to have the felt wound on spirally in one direction, say from left to right, and well secured with cord ; then over this with good canvas, also wound on but in the opposite direction, and this secured with wire.

It is most necessary, to secure the best results, to have the felt thick enough. Hair felt is sold in great quantities about three-sixteenths inch thick, but this is not thick enough for good work. If possible, have it half inch thick, and a marked benefit will be had by using even thicker than this, or say two thicknesses of three-eighths inch.

In felting cylinders, it is the best plan to take sufficient sheets of felt, and then sew the edges together to form one sheet large enough to go all around the reservoir. This sheet can then best be secured by bands of hoop iron or brass passed round at top and bottom and around the middle, these bands being tightened up by having a bolt to draw the two ends together. After this circular pieces can be cut for top and bottom, these pieces being sewed on to the top and bottom edges of the large sheet. Tanks can be covered in exactly the same way.

Sometimes it is desired to incase the tank or cylinder with woodwork. This makes by far the neatest job, though more expensive, and it causes a little trouble should it be necessary to open the reservoir under some circumstances. If it is decided to have a casing, it is very important that the space between the woodwork and the reservoir be well filled in with some poor conductor of heat, such as cow hair, (plasterers' hair) ; slag wool, or even dry sawdust answers very well when the casing can be filled from the top. If the casing is not "packed" with something, it would be much better to be without it, as it would have a current of cold air passing up through it the same as explained with the general pipe casing just referred to.

If the hot water service pipes are carried up through the house without entering the general pipe casing mentioned, and it is proposed to incase them for the sake of appearance, this casing must also be packed for the reasons explained ; but this is frequently neglected with the worst results, as the casing of pipes is frequently done for appearance sake only, the question of radiation not being considered.

Occasionally it is found practically impossible to carry the pipes up inside the house, in which case it becomes necessary to carry them outside. This is very objectionable, but where it cannot possibly be avoided the objections do not avail, but they must be guarded against. In the first place, the pipes *must* be incased, and the casing ought to be of fair size, so that $1\frac{1}{2}$ inches of packing can be filled in between the woodwork and any of the pipes. The packing must fill the case tightly, and it is imperative that the casing be well and tightly secured to the wall, as, should it get loose, the woodwork and the packing will come away from the pipes and leave them exposed.

When pipes are carried outside, the packing is not only needed to prevent great waste of heat, but there is a danger to be guarded against in cold weather, when the pipes are liable to be frozen and an explosion possibly ensue, as the only outlet for any steam that may be generated in the boiler is at the upper extremity of the expansion pipe, unless a safety valve is provided.

CLEANING MACHINERY.

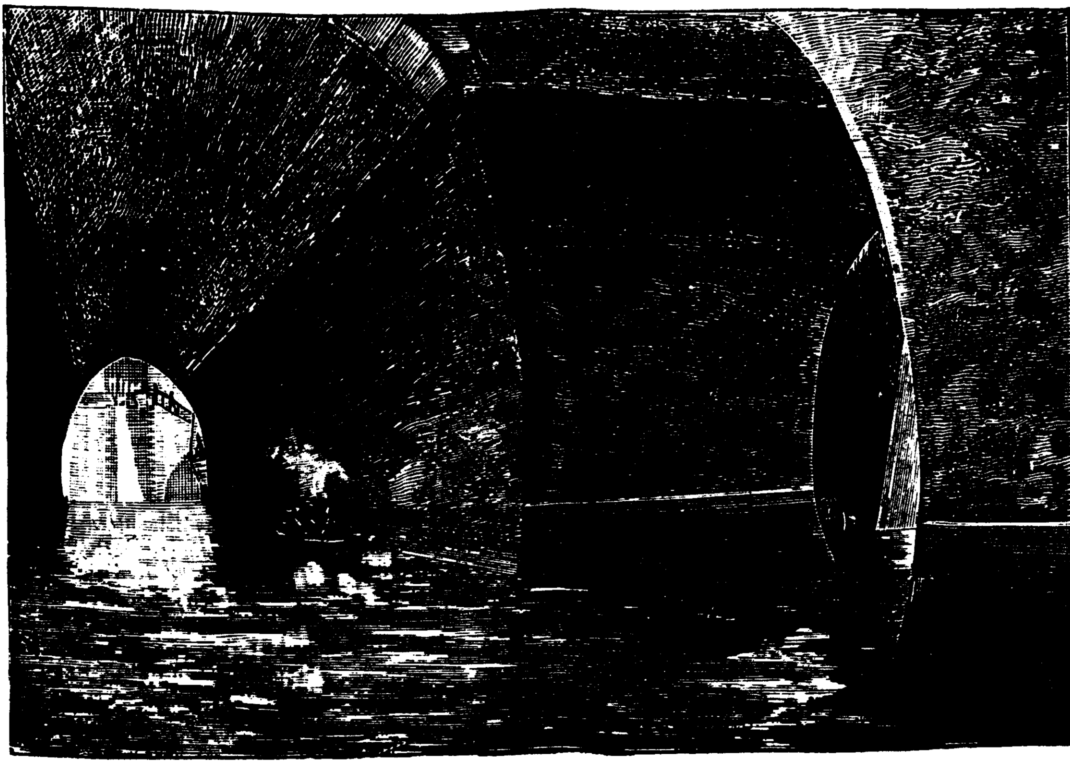
The simplest and most efficacious method of thoroughly cleaning the various parts of machinery that have become gummed and dirty by the use of fat oils for lubricating purposes is by using a strong soda lye. For each 1,000 parts by weight of water take about 10 or 15 parts by weight of caustic soda or 100 parts ordinary soda. Let the solution boil and enter the parts to be cleaned ; either boil them in this lye or let them steep in it for some time. All the dirt and oil resin is completely dissolved thereby, and it remains only to rinse and dry the parts. The action of the lye is such that it enters into combination with the oil and forms soap, which is readily soluble in water. In order to prevent the hardening of the lubricant on the machinery parts, it is only necessary to add about one-third kerosene. An occasional lubricating with kerosene alone is to be recommended.

TO EMPLOY ELECTRICITY.

General Manager John M. Orford, of the Bridgeport Electric Light Company, and John S. Follansbee, of the Follansbee Machine Company, have been examining the drawbridge of the consolidated road, Bridgeport, Conn., taking measurements and making examinations of that structure with a view of introducing machinery for opening and closing the draw by electricity. By the appliances as now in use fully fifteen minutes are required to open the draw and close it again, to say nothing of the delay to which trains and pedestrians are subjected when a vessel passes. Messrs. Orford and Follansbee believe that the electric motor and gearing such as has so successfully been applied to the lower bridge will do the work required for the railroad bridge in one half the time and at less expense than now. The machinery, however, will have to be on a larger scale, as in addition to turning the draw, the raising of the four rails at each end thereof, the unlocking and fastenings, etc., will have to be provided for, and it is proposed to study out a contrivance which will do the whole business at one time. As things are now the drawtender has to unlock and turn a crank which operates a cam to raise the rails, set the signals, etc., and then opens the draw. To close the draw he must by hand go through those operations reversed. With electricity the draw will be as easy to handle as that of the lower bridge. Mr. Follansbee is unable to say how soon he can complete the machinery, but says it will be in the near future.—*Modern Light and Heat.*

THE ROCK RESERVOIRS OF THE WATER WORKS OF NAPLES.

The city of Naples is in possession of a water supply, which, in some of its engineering features, is most remarkable, and, in some particulars, unique. The water is conveyed from the source of supply by a great aqueduct (the aqueduct of Serino), which is combined with a series of siphons which discharge into two great reservoirs, one intended for low and the other for high pressure service, from which the supply of the city is



A Gallery of the Rock Reservoir of Capodimonte for the Water Supply of Naples.

drawn. The peculiarity of these reservoirs lies in the fact that they have been excavated in the solid rock. This rock, which is known to geologists as tufa, was originally a volcanic ash, which has, since its ejection from the crater, become compact and massive, so that it is now sufficiently solid to be practically impervious; at the same time, it is sufficiently soft to make the task of excavating therein a comparatively easy one. The advantage which such admirable storage reservoirs possess over those of masonry, resides in their permanence, and in the preservation of the water from contamination by contact with the atmosphere, and from the influence of the exterior temperature.

The first of these reservoirs—that for the high-pressure service—is that of Scudillo. This is formed of three great galleries of oval section, and having a mean depth of 50 meters (164 feet) beneath the surface. Each gallery is 9½ meters high, 10 meters wide, and 114 meters long, and is separated from its neighbour by rock walls 10 meters in thickness. The total capacity of this rock reservoir is 20,000 cubic meters. The aëration of the water is secured by means of vertical shafts communicating with the open air. The galleries are in communication with each other by cross-cuts. The water enters the reservoir compartments through one of the abovementioned siphons.

The second of these rock reservoirs is that of Capodimonte, designed for low-pressure service. It is composed of five great galleries cut parallel to each other, at a mean depth of 50 meters below the ground surface. They are 10·8 meters in height and 9½ meters wide, separated by rock walls of the same thickness as those of the Scudillo reservoir. The combined capacity of these rock galleries is 80,000 cubic meters. Aëration is effected in the same manner as above described. The picture shown herewith gives the appearance of one of the galleries of the Capodimonte reservoir.

The great work of which these massive structures forms a part was commenced in November, 1882, and was finished in 1884. The works were formally inaugurated for public service in May, 1885.—*Manufacturer and Builder*.

MOSAIC.

Critics are divided in opinion as to the origin and meaning of the word *mosaic*, some deriving it from *mosaicum*, a corruption of *musaicum*, which in its turn was a corruption of *musivum*, the name by which it was known to the Romans. Scaliger derives the name from the Greek, and imagines that the name was given to this sort of work as being very fine and ingenious. The materials thus inlaid, or joined in small pieces, are very various, comprising precious stones, marble, stone of inferior quality, plaster, enamel, wood, &c.; and there is evidence that the art of working such fragments into an ornamental device was known in high antiquity, for the tesselated pavements of the ancients are clearly examples of mosaic work. We are told in the book of Esther that in the palace of Ahasuerus was "a pavement of red, and blue, and black marble."

The Romans carried the art of constructing such pavements to the greatest extent, since in all parts of Europe once included in the Roman Empire, specimens of them are from time to time discovered. One of the finest extant was discovered at a village near Seville, in the year 1799, at the depth of 3½ feet from the surface. It extends about 40 feet in length by nearly 30 feet in breadth, and contains a representation of the circus games in a parallelogram in the center, three sides of which are surrounded by circular compartments, containing portraits of the Muses, interspersed with the figures of animals and some imaginary subjects.

Another beautiful mosaic pavement was discovered at Lyons in the year 1806, and is supposed to be about 1,800 years old. It is composed of small marble cubes, sometimes interspersed with pastes of different colours, and extends 15½ feet in length by 9½ feet in breadth, exclusive of an ornamental border. The whole details of the games of the circus are represented here, from which it appears that no less than eight chariots started at a time ; some of the chariots are represented as broken, and the horses and charioteers fallen, as in the mosaic at Seville, for it was a point of address among the ancients to overthrow their competitors in the course.

Not only pavements, but other portions of large buildings also, were decorated in this manner, particularly at later periods than those to which the production of such objects as those just described must be referred. Justinian decorated the church of St. Sophia, at Constantinople, during the sixth century with mosaic-work, formed partly by daublets, or pieces of glass united horizontally, with a coloured foil interposed. Some of the earlier Popes decorated the churches of Italy with mosaic, but the art declined there in the fifth or sixth century, and appears to have been almost totally lost until Andrea Taffi learned it from a Greek artist named Appollonius, who was employed on the church of St. Mark, at Venice, in the thirteenth century. From that time the art of working in mosaic became much practised, and many eminent Italians distinguished themselves by their skill therein, among whom were Giotto, Tucca, Mancini, Calandra, Lafranco, Cristofi, Brughi, Calendrelli, and Camussi.

The most curious specimens of mosaic are those which, from the small size of the pieces composing them, enable the artist to produce tolerable representations of pictures, in which all the differently coloured portions are given by appropiately coloured pieces of enamel. Many specimens of this kind have been preserved. On the roof of the baptistery of the church of St. John at Ravenna, the baptism of Christ is represented in mosaic, ascribed to the fifth century. The ceremony is represented as being preformed partly by sprinkling and partly by immersion. A circular compartment in the centre is occupied by Christ standing upright in the river, while John, holding a misshapen cross in one hand, pours water from a shell or some vessel on His head. It likewise contains a human figure, inscribed "Jordann," rising out of the water, which is probably a personification of the sacred river. This compartment is environed by full-length figures of the twelve apostles, and the whole is surrounded by a border, consisting of pulpits, altars, and other sacred emblems.

Rome has been celebrated for the production of mosaic pictures. We are told of a portrait of Pope Paul V., in which the face alone consists of 1,700,000 pieces, each no larger than a grain of millet ! The enamel or other substances prepared for this singular kind of portrait-painting is tinted of a vast variety of different shades, in order to obtain the required gradations of colour in the picture. The present number of tints in mosaic is said to amount to no less than sixteen or seventeen thousand, proceeding by a nicety of gradation almost inconceivable.

In almost all specimens of mosaic the picture or other device is represented by pieces of the substance employed, formed into cubes, parallelopipeds, or other polygonal figures, and retained by one end in a strong cement, to preserve the union of the whole. The ancient mosaics consisted chiefly of marble and coloured glass or pastes, while those of later date have been composed of marble, glass, enamel, agate, cornelian, lapis lazuli, and even jewels. It has been observed by a writer on this subject :—

"Mosaic pictures seem to have taken their origin from pavements. The fine effect and use of pavements composed of pieces of marble of different colours, so well joined together as that, when dried, they might be polished, and the whole make a very beautiful and solid body, which, continually trodden upon and washed with water, was not damaged, gave a hint to the painter, who soon carried the art to a much greater perfection, so as to represent foliage, masques, and other grotesque pieces, of various colours, on a ground of black or white marble. In fine, observing the good effect which this kind of work had in pavements, and finding that it resisted water, they proceeded to line walls with it, and to take various figures by it for ornamenting their temples and public buildings. But Nature not producing variety of colours enough for them in marble to paint all kinds of objects, they bethought of counterfeiting them with glass and metal colours, which succeeded so well that, having given all manner of tints to an infinite number of little pieces, the workmen arranged them with so much art that their mosaic seemed almost to vie with painting."

The mode of procedure in the preparation of mosaic pictures is as follows :—The enamel employed is a kind of glass, coloured with metallic oxides, and is so fusible that rods of small size may be drawn out by the flame of a candle, without the use of a blow-pipe. The pieces of enamel are brought to the form of small oblong sticks, something resembling the types put up by the compositor ; they are all arranged in drawers, boxes, and cases, regularly labelled, from which they are withdrawn by the artist for his work, when wanted. In composing a large mosaic picture the foundation or back is made of a stone called *piperno* ; several oblong pieces, together equal to the whole surface, are taken, each several inches thick, whereby great strength and solidity are acquired ; and these united pieces are hollowed to the depth of about 3½ inches, leaving a border all round, which will ultimately be on a level with the surface of the picture. The excavated surface is intersected by transverse grooves, about an inch and a half deep, and somewhat wider at the bottom than the top, in order to retain a quantity of cement or mastic which fills them, the line of the grooves joining in an inclined direction from each side, so as to form an angle in the middle. The separate pieces are then nicely adjusted together by strong iron clamps behind. If the dimensions of the picture be not so large as to require a foundation built up in this way, a large marble slab is hollowed to the depth of three inches and a half, leaving a projecting border.

The foundation being thus prepared, the excavated bed is gradually filled with a strong and durable kind of cement or mastic, made expressly for this purpose. As the frame is filled, the picture is delineated on the cement in the same way as painting in fresco ; and the fragments of enamel being selected for a small portion of it at a time, they are successively beaten into the cement with a small wooden mallet until the tops of the whole are nearly on a level. When the artist observes that the fragments so arranged are not suitable to his taste and expectations he removes them, and substitutes others, which is easily done before the cement hardens ; but after the hardening this becomes a more difficult operation. Proper cement remains in a state to receive fragments during fifteen or twenty days by observing the necessary precautions. After the whole picture is composed its surface is ground down to a perfect plane in a manner similar to that which is practiced in grinding mirrors, and a polish is given to it with putty and oil. During the progress of these operations any crevices displayed at the joints are filled with pounded marble or enamel mixed with wax, which penetrates by passing a hot iron over it. Large compositions made in this way are, as was before observed, very tedious, requiring several years to execute, and the grinding and polishing of the surface of a picture are extremely laborious.

There is a kind of mosaic in which metals are combined with glass in ornamental devices. The method is not so much practised now as formely, but the mode of procedure is as follows. Crucibles full of melted glass are prepared in the usual manner, and metallic oxides are added to them, so as to produce in each crucible a glass of the requisite tint. When the oxides are thoroughly united with the glass the melted mixture is ladled out hot, and poured on a smooth slab of marble, where it is flattened with another piece of marble, and cut into strips about an inch and a half in width. These strips are then, with an instrument which the Italians call *bocca dicane*, cut into smaller pieces, of different sizes and shape, which are then deposited in separate cases. If it be desired to have gold, either in the ground of the painting or in the ornaments or draperies, the artist takes some of the pieces of glass, formed and cut in the manner just mentioned, and after having moistened them on one side with gum-water, lays pieces of gold leaf on the moistened parts. These gilt pieces are then placed on a fire-shovel, covered with an inverted glass vessel, and placed within a furnace or oven, where they continue until they have acquired such a degree of softness that the gold becomes firmly bound to the glass. Supposing the glass pieces to be thus prepared, and that the mosaic picture is to be formed on a wall, the wall is covered with a plaster made of ground stone, mixed with brick-dust, gum tragacanth, and white of egg. On the surface of this plaster, while still soft, the artist sketches his design, and then proceeds to work in his mosaic. He takes up the little pieces of glass by means of pliers, and sticks them one by one in the plaster, arranging them according to the lights, shadows, and tints required for the picture, and pressing or flattening them down with a ruler, which serves both to imbed them in the plaster, and to bring them to a level surface. The subsequent polishing is effected in a similar manner to that of the pictures before alluded to.

The tesselated pavements of which so many specimens are seen, both ancient and modern, are made in different ways. In some cases, the pieces of marble, chosen of such colours as may be required, are cut by the saw into the forms necessary to complete the design, and these pieces are then joined edge to edge, and secured with some durable kind of cement. In other instances, the ground-work consists of one solid block of marble, either white or black. The design having been drawn on the surface of this block, the mason chisels out those parts which are to be of different colour, making the cavities an inch or an inch and a half in depth, and as accurately formed as possible. Small pieces of marble are then contoured or fashioned to the design, and their thickness having been reduced to the depth of the cavities, they are inserted in their proper places, and secured with a mastic of lime and marble-dust. In other instances, after the design has been drawn on a block of marble, and chiselled out to the proper depth, the cavities are filled with a peculiar cement, composed of Burgundy pitch and other ingredients, and poured in while hot. The overflowing edges are then ground down and polished, and the resulting effect is often very beautiful.

A kind of mosaic of gypsum has been frequently produced formed of a coarse talc, or shining transparent stone, found in the quarries of Montmartre, near Paris, among the stones from whence plaster of Paris is made. Sometimes the ground of these mosaics is made of freestone, and sometimes of plaster of Paris: if the former the device is chiselled out as before described, but if the latter the following plan is observed. A wooden framework is formed of the length and breadth of the intended mosaic, and about an inch and a half thick, and so contrived that, the tenons being only joined to the mortices by single pins, they may be taken asunder, and the frame be dismounted when the plaster is dry. The frame is covered on one side with a strong linen cloth, nailed round the edge, and being placed horizontaly, with the linen at bottom, it is filled with wet plaster of Paris. When the plaster is half dry, the frame is set up perpendicularly, and left in that position till quite dry, after which the frame is dismounted, and the plaster ground taken out. The ground being thus prepared, it is covered with a layer, five or six inches thick, of prepared gypsum. The stone before alluded to is calcined in a kiln, beaten in a mortar, and passed through a sieve into a copper, where it is dissolved and boiled in the best English glue. Some colouring substance is then added, to give the mixture whatever tint may be desired, and the whole is worked up into a mortar or plaster. When the thick layer of this plaster, which has been laid on the ground of plaster of Paris, is hardened, the design is drawn upon its surface, and the cavities chiselled out as if it were stone, which it nearly equals in hardness. The cavities thus made are filled up with the same gypsum, boiled in glue, but differently coloured. The artist has a number of little cups or pots at hand, in which he mixes the gypsum with the respective colours which he may require. When the whole design has been filled up in this manner, and thoronghly hardened, it is slightly polished with brick-dust or soft stone, to show the effect more clearly. The artist then goes over the work in every part, cutting such places as are to be either weaker or more strongly shadowed, and filling them up with gypsum of the required tint. This retouching is repeated until the colours approach as near as practicable to those of the object imitated. The work being finished, it is scoured with soft stone, sand, and water; then with pumice-stone; and lastly, polished with a wooden rubber and fine emery. A final luster is given to it by smearing it over with oil, and rubbing it a long time with the palm of the hand, by which a gloss is produced in no way inferior to that of marble. —*Builders' Reporter and Engineering Times.*

INTERESTING OPTICAL ILLUSIONS.

One is five. Two are ten. Straight is crooked. Motion is quiet. These are strange and apparently contradictory statements; but if we are to rely entirely upon the evidence of our visual organs, they are true. Human visual apparatus has certain qualities which cannot be classed among defects, although under certain conditions they prevent seeing things as they really are. To persistence of vision, or the property of the retinal nerves by which an image is retained after the object by which it was formed has disappeared, are due the phenomena here described and illustrated.

A short time since the writer, in search of new optical illusions wherewith to amuse if not to instruct a little company of scientific persons, found in the store of the well known optician, Mr. T. H. McAllister, of this city, an instrument known as the anorthoscope, which was imported by him about thirty years ago. Although it was a novelty then, and probably well known to many, it is now rare. In fact, perhaps not one in the two or three hundred who have seen it had ever even heard of it.

The anorthoscope shown in Fig. 1 is a modified form of the instrument above referred to, and is adapted to experiments other than those belonging to the original apparatus. This instrument has a standard provided with a sleeve upon which is pivoted a movable arm. In the upper end of the standard and free end of the movable arm are inserted studs upon which are placed sleeves, each furnished with a pair of collars for clamping the paper disks—presently to be described—also a grooved pulley.

In the sleeve in the standard is journaled a shaft having at one end a crank, and a pulley of the same size as that above it at the upper end of the standard, and upon the other end a grooved wheel four times the diameter of the grooved pulley at the upper end of the movable arm. The small pulley below is connected with the small pulley above by a crossed belt, and the large grooved pulley is connected with the small pulley above it by a "straight" belt.

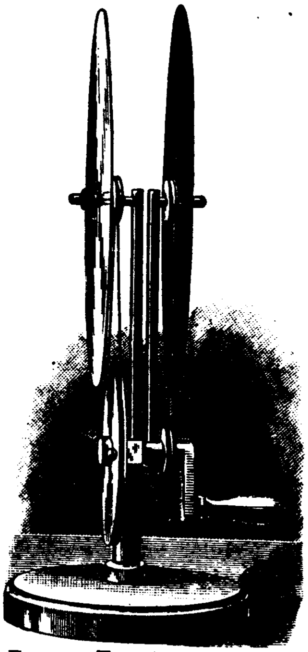


FIG. 1.—THE ANORTHOSCOPE.

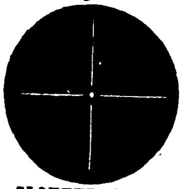
Between the collars upon the sleeve driven by the crossed belt is placed a black disk having four equidistant radial slots, and upon the other sleeve is secured a translucent disk bearing an anamorphased design which, viewed separately from the instrument, bears little resemblance to the object is is intended to represent, but when revolved in the anorthoscope and viewed through the slots of the black disk, the enormous distortion is corrected and five correct images are seen. This number of images is accounted for by the four revolutions in one direction of the disk carrying the design and the single revolution of the disk with radial slots in opposite direction, giving five views of the same object for every revolution of the radially slotted disk. The designs are distorted only in the direction of their rotation, the proportions in the direction of the radii of the disk being normal. A face view of the radially slotted disk is given in Fig. 2.

In Fig. 3 the distorted card design shown at A is seen in the anorthoscope as a hand of cards as shown at B. In Fig. 4 the design, C, produces the wreath, D, in the instrument, and in Fig. 5 the distorted flowers, E, produce the wreath, F. The distorted image is seen only in narrow successive sections, which by the retaining power of the retinal nerves are blended into an image which is shortened in the direction of rotation to one-fifth its real dimensions, while it is multiplied five times.

There are two methods of laying out the designs for this instrument, both based upon the development of the original picture in a subdivided rectangle. It is obvious that if a subdivided square can be produced in the anorthoscope from a distorted representation of it, any figure that can be inscribed in such a square can also be produced in the same way. In Fig. 6 is illustrated a method of laying out a rectangular parallelogram, A, divided into thirty-two equal squares, alternate square of the upper two rows being shaded.

To lay out the figure, from the center C, strike a circle bounding the periphery of the disk, draw a diametrical line, and at any convenient distance from the peripheral line lay out the rectangular parallelogram, as shown. From the center, C, describe an arc, touching the outer angles of the parallelogram, A ; locate a new center, D, below C, on the diametrical line, a distance equal to the versed sine of this arc. From this center describe circles tangent to the horizontal lines of the subdivided rectangular parallelogram. Lay off on the central circle spaces five times greater than and equal in number to the longitudinal divisions of the parallelogram.

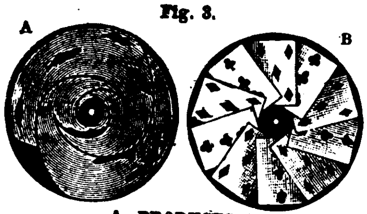
Fig. 2.



SLOTTED DISK.

Fig. 3.

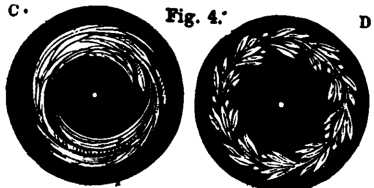
A B



A PRODUCES B.

Fig. 4.

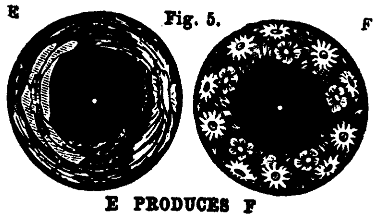
C D



C PRODUCES D.

Fig. 5.

E F



E PRODUCES F

From a point at the intersection of the diametrical line with the middle circle of the set thus drawn, draw lines intersecting the middle circle at the points set off. These lines radiating from the point, *a*, and the eccentric series of concentric circles bound spaces which appear as squares in the anorthoscope. The lines radiating from the point, *a*, must be increased five times in thickness to secure a line of normal width in the instrument. The spaces in the distorted figure representing the shaded squares are filled up solid with black, the whole forming the figure B, which, viewed in the anorthoscope, appears as at A. Any figure drawn on the subdivided parallelogram and projected on the distorted figure, B, would appear normal in the instrument.

When accuracy is immaterial, the figure may be developed on circular lines, as shown in Fig. 7, the horizontal spaces of the square, A, being developed on the circular lines by radial lines which intersect the middle circular line at equidistant points separated by spaces, each having five times the width

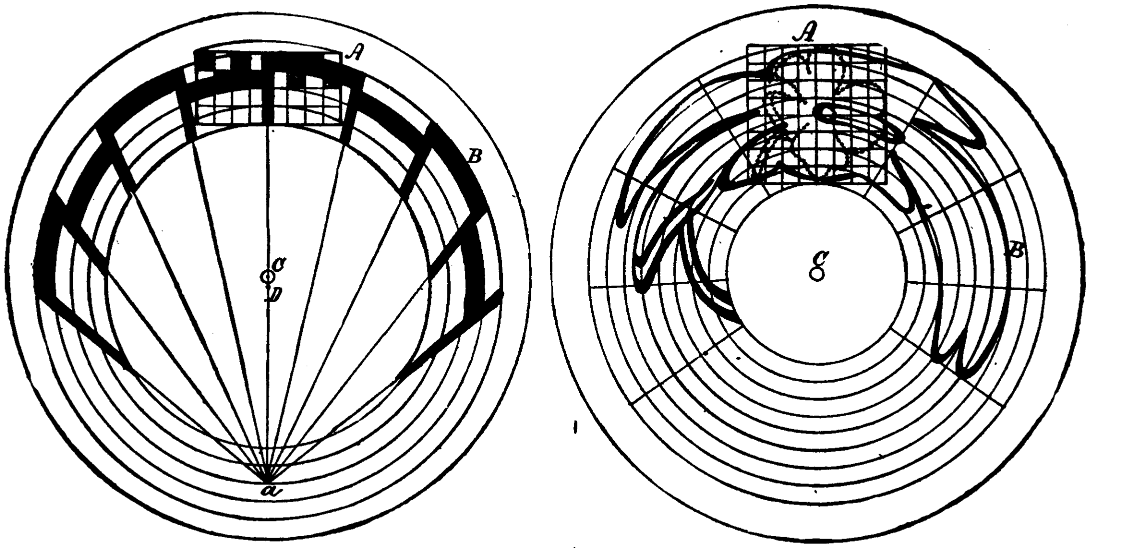


FIG. 6.—METHODS OF LAYING OUT ANORTHOSCOPE DISKS.—FIG. 7.

of one of the smaller squares. The distorted figure, B, viewed in the anorthoscope, appears very nearly like the outline drawing of the flower in the square, A. In this diagram everything is drawn with reference to the center, C.

Recently the writer has adapted these experiments to the lantern. The distorted pictures which are drawn on cardboard disks about thirty inches in diameter, are placed on a large rotator about twenty-five feet from the lantern, and in the lantern slide holder is placed the rotary disk shown in Fig. 8. This disk, which is provided with four narrow radial slots, is mounted on a small stud projecting from a plate of glass held by the frame of the apparatus. The slots are extended as nearly as possible to the center of the disk, and the segments of the disk are strengthened by triangular braces.

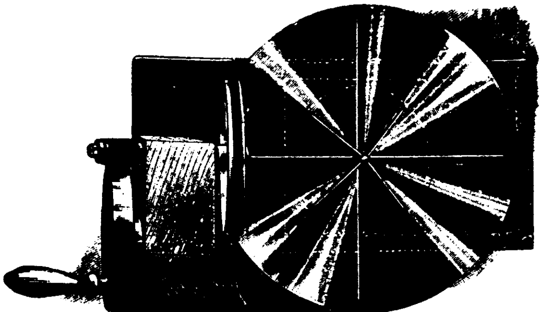
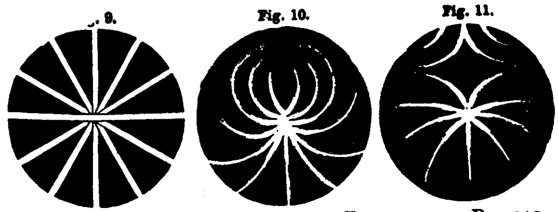


FIG. 8.—ROTARY DISK FOR THE LANTERN.

To avoid using a belt, the disk is driven from its periphery by rubber frictional gearing, as shown. A lantern objective of low power is used and the slots are sharply focused on the large disk. The disks are arranged with their axes in line, and when the revolutions of the smaller and larger disks are as one to four, and in opposite directions, the effects above described are produced on a scale sufficiently extended to be seen by a large number of spectators. In this experiment the axes of the disks must be in line.

By substituting the disk shown in Fig. 9 for the anorthoscope disk some very curious effects may be produced. When the axes of the disks are in line, the radial bands will be apparently multiplied or reduced in number according to the relative speeds and the direction of rotation of the disks. When the radially slotted disk in the lantern is arranged eccentrically with reference to the large disk having radial bands, the effect shown in Fig. 10 is produced when both disks are rotated in the same direction, and when they are rotated in opposite directions the effect is as shown in Fig. 11. These forms may be greatly modified by moving the slotted disk in the lantern across the field.



CURIOUS EFFECTS OF ROTATING DISKS WITH RADIAL BANDS.

These curious effects are due to the crossing of the white radial bands by the bands of light from the lantern and the retention of the images of these spots of light throughout their entire course, thus giving the appearance of curved bands.

By substituting a disk with radial bands for the anorthoscope disk in the instrument shown in Fig. 1, and swinging the movable arm of the instrument over, so as to arrange the disks eccentically with reference to each other, the effects last described may be viewed without the use of a lantern.—By GEO. M. HOPKINS, in the *Scientific American*.

WOODEN WATER PIPES.

The *Olympia Capital* describes the method of manufacture as follows:

A large pile of bright yellow wooden pipe was in one place, near by another pile of similar pipe, but with narrow steel bands coiled around them, like spiral springs, and another pile covered, consisting of pipe covered with asphaltum. These were in the different stages of manufacture. Inside the factory the green logs, as brought from the forest, are drawn up from the Sound and cut into lengths of eight feet. These are rolled to the boring machine. This consists of a hollow auger eight feet long. The log is securely fastened on a carriage, and the machinery set in motion. The rapidly revolving auger bores into the heart of the log, and in time appears at the other end. It has fairly eaten a hole clean through it. The core of the log is in the hollow of the auger, and when removed is in turn bored and made into pipe of a smaller size. When taken from this machine the inside of the pipe is complete, but the exterior, covered with knots and bark, is the same as when taken from the forest. The next process is to remove this bark. For this purpose a great turning lathe is used. The log is made to revolve at a rapid rate and a chisel securely fastened to a carriage slowly moves along, bearing away the bark and fiber. Backward and forward the chisel moves, and at each trip more fiber is torn away and the pipe grows thinner. When all but one inch of the wood is removed, it begins to show what it is intended for. The next process is to chisel the ends for an iron collar that serves to join the pipes when used. After the ends are cut down to the proper size, the pipes are placed in a dry kiln and seasoned. The next process is the wrapping. A pipe is placed in a machine similar to the turning lathe. A steel strap about two inches wide is fastened to one end, then the pipe slowly revolves, and the strap is wound around in a spiral form the entire length and fastened at the other end. After that a coat of asphaltum is applied, and the pipe is ready for market.

The first of these wooden pipes were made so one would fit into another. Now a steel collar is used, and when the pipes are fitted into it there is but half an inch between them, and the collar fits so tight that no water can escape.

The capital stock of the company is $50,000 and the profits of the factory for this year will be more than the capital stock. Over 500 miles of this pipe are now in use, in sizes from 1 to 12 inches, by water works companies, in mines, and for all kinds of conduits throughout the Northwest. Last year 200 miles of this pipe were made. If the company decides to remain in Olympia, the capacity will be increased to four times the present output, and new buildings will be erected. The company is now simply awaiting the action of the railroads coming to this city.

BEEF EXTRACT.

We may, for convenience, divide the factory into three departments: First, pressing; second, bottling; and third, finishing. To the first of these, supplies of the choicest parts of the ox are brought in the morning of every working day straight from the shambles. It is at once cut up into succulent steaks, each of which get a slight sprinkling of table salt, is then inclosed in a new muslin bag and an outer canvas bag, and with dozens more is placed between the perforated metallic plate of an hydraulic press. When the company commenced work, they were content with a press which took a charge of about 100 steaks at a time, but they have had to meet a greater consumption than was anticipated, so that lately they have installed an exceedingly powerful press, which would do perfectly for making bales of cotton, and this is tested to give a pressure of 400 tons. When the pile of steaks is put on the receiver, the whole is surrounded with a jacket (iced in the summer), and the pressure applied. We need not follow the process too minutely; it is so simple. The juice as it is collected is mixed with an innocuous preservative, set aside for a month to clear, and then transferred to the bottling department Here the liquor is filled into bottles by a siphon arrangement, so that the liquid comes into contact with as little air as possible; and the bottles when filled are transferred to a separate building, where they are corked, capsuled, labeled, and boxed. Our traveler observed that a girl examined each bottle before it was passed on to the capsuler, and any one which showed a speck of suspended matter, or was in the least cloudy, was set aside. It was explained that this is part of the principle of the manufacture; the liquor is the pure juice of beef, and in order that it may keep, the most rigid attention must be given to exclude foreign matter from it, and, as far as our representative could judge, the principle was adhered to throughout. And what becomes of the pressed steaks? Well, they are like cardboard when they come out of the press, and as dry as a stick.—*Chem. and Drug.*

A NEW USE FOR COTTON SEED OIL.

In a suitable metallic vessel of something more than one gallon in capacity is placed one gallon of pure cotton seed oil. There are now melted in a furnace in a suitable crucible or ladle twenty pounds of pure lead metal, care being taken that the entire quantity of the lead is in the molten state, which will insure a temperature thereof of not less than 334° of heat Centigrade. In this molten state the lead is then poured gradually in the one gallon of cotton seed oil, care being taken that the mixture is well stirred during the process of pouring, in order that, as far as possible, each molecule of the molten lead will be exposed to the action of the cotton seed oil. In this process of pouring the molten lead, as soon as the hot and molten metal strikes the surface of the oil it follows the law common to all molten metal when thrown in a liquid and separates into very minute globules, the bright and pure surfaces of which are brought in immediate contact with the cotton seed oil, and by the heat therefrom impart such affinity to the cotton seed oil in immediate contact therewith that a certain part of the lead will be absorbed by the cotton seed oil, which, when removed from the influence of the heated globule of lead, will immediately cool sufficient to retain therein the lead thus absorbed. When the entire twenty pounds of molten lead have been thus poured in the gallon of cotton seed oil, it is allowed to remain some little time to cool off, after which the oil is drawn off, and there will be found remaining in the bottom of the vessel in various forms about seventeen pounds of the pure lead, thus showing that in this one process of pouring about three pounds of lead have been absorbed by the one gallon of cotton seed oil. The remaining seventeen pounds of lead is now removed from the vessel, and the gallon of cotton seed oil, that has now about three pounds of lead therein, is returned to the vessel. The remaining seventeen pounds of pure lead is again heated and brought to the molten state, in which condition it is again poured into the cotton seed oil contained in the vessel, the same care being observed in stirring the mixture during the process of pouring as in the first pouring of the metal.

After this second process of pouring the molten lead in the cotton seed oil the mixture is allowed to cool sufficiently, when the oil is again drawn from the vessel, and there will now be found remaining about fifteen pounds of pure lead, thus showing that in this second process of pouring the molten metal two pounds of lead additional have been absorbed by the cotton seed oil, which will now contain about five pounds of lead combined therewith. This process of remelting the remaining lead and again pouring and mixing it with the same cotton seed oil is continued with advantage up to the fifth time of pouring the molten metal, after which the cotton seed oil will be found to have absorbed about ten pounds of the lead, after which there seems to be no further affinity of the oil for the metal. After the cotton seed oil has been brought to this stage it is allowed to thoroughly cool, when its consistency will be about that of ordinary paint. The compound is now in condition to be applied to those surfaces that it is desired to protect against corrosive or deteriorating influences, and may be applied with a sponge or brush, as in the application of ordinary paint. In applying the compound its adhesiveness will cause it to adhere tightly to the surface coated therewith. It is preferred to apply one coat and then allow it to remain about forty-eight hours, during which time it will have become sufficiently hard to resist ordinary abrasion, and after which a second coat may be applied with advantage.

Philip Helbig and Hermann Bertling, of Baltimore, Md., are the authors of this new article and process. They say: It has been found in practice that no other of the known oils, other than cotton seed oil, possesses the quality of absorbing the lead when treated as herein described, and that the cotton seed oil possesses the quality of absorbing certain proportions of other metals when poured therein in the molten state in the manner herein described.

As stated, the compound may be employed to portect metallic surfaces of any kind, and is claimed to be particularly useful for coating the bottoms of iron or steel ships to protect the surface thereof from rust and the adherence thereto of barnacles and other marine life. It is likewise of equal benefit for the protection of wooden surfaces that are to be buried in the earth or exposed to the action of water—such as fence posts, piles, etc.—*Scientific American.*

TEST PAPER FOR ACIDS.

BY S. J. HINSDALE, FAYETTEVILLE, N. C.

Cut white filtering paper of neutral reaction in pieces of about 6 inches square, and impregnate them with tincture of curcuma (1 part curcuma, 7 parts alcohol, and 1 part water). Place the paper on threads to dry. When dry pass a sheet of it through a bath composed of 40 drops of liquor potassæ and 100 c. c. water. Then immediately pass it through a bath of water (flat earthen dishes are convenient for the baths), and at once place it on a thread to dry. As soon as it is dry cut it in pieces and inclose them in tinfoil. The paper will not bear long exposure to light and air, but will keep well if inclosed in tinfoil.

It is much more sensitive than litmus paper, and will detect acid in a mixture of 1 part hydrochloric acid in 150,000 parts of distilled water, and will detect carbonic acid in spring water. If the water be boiled to expel carbonic acid, and a yellow color is produced, some free acid (besides CO_2) is shown to be present.

The best way to use the paper is to touch it with a glass rod which has been wetted with the liquid to be tested.

The paper can be freshly prepared in fifteen or twenty minutes.—*Amer. Druggist.*

[*Note by Ed. Amer. Drugg.*—The author has sent us a specimen of the paper. We have tried it, and find it to be all that is claimed for it.]

AMERICAN MARBLES.

The contributor of an article to the Indianapolis journal *Stone* points out that it is desirable that more active exploration should be made of the American marbles. In the matter of colour, he says, the American marbles now on the market leave much to be desired. In those from the Appalachian belt the prevailing hues are white through various shades of grey to deep blue-grey and nearly black; the figuration, where such exists, is often coarse and unattractive. For panellings and wainscoatings and other interior work they are not so desirable as many foreign stones, particularly in large rooms where considerable areas are to be covered. The Georgia stones are too coarse and gaudy when thus used; those of the Vermont belt too gloomy if the blue-grey varieties are used, and the white colours produce a dreariness not at all desirable. The Winooski marbles when so used would produce an effect altogether too fantastic. By all means the best stone for such purposes we now have are the chocolate red and pink marbles of Eastern Tennessee. These are beyond doubt the best of their kind in the world, and admirably adapted for many kinds of work, as is shown in the stairways and wainscotaings of the capitol building. But for the interior panellings of large halls they are not in all cases suited, owing to their colour and coarse variegation. A lighter shade is needed, something not obtrusive on account of colour or figure, and which will be pleasing and restful to the eye, and in complete accord with its surroundings. I confess I do not at present know where such a stone is to be found in America.

THE MAGNETIC MAGNIFYING GLASS AND THE BOX OF NUMBERS.

Should we want a new proof of the saying, *Nihil novi sub sole*, we might find it in the magnetic magnifying glass of which we here reproduce two very distinct forms, one of them dating back at least a century, since we find a detailed description of it in a work published in 1786.

The magnetic magnifying glass is the first of the magnetic recreations described by the author, Mr. Guyot, of the Literary and Military Society of Besancon. To describe the old apparatus is also to describe the modern one, and we cannot do better than to pass our pen over to the writer of the last century.

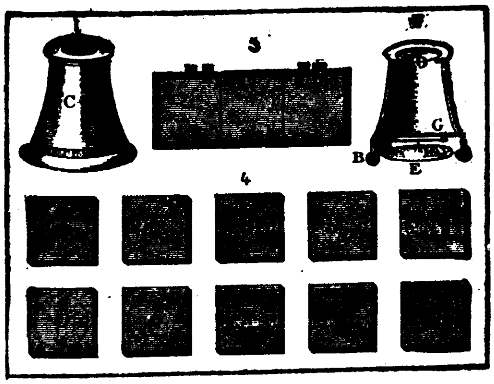


FIG. 1.—GUYOT'S MAGNETIC MAGNIFYING GLASS.

Nos. 1 and 2.—The Instrument. 3.—Cover of the box. 4.—Arrangement of the magnets.

"Have an ivory tube turned so thin that the light can pass into the interior of it. Give it a height of about two and one-half inches, and let it be nearly of the form shown in Fig. 1. Let the top, A, and the bottom, B, be screwed into this translucent tube, C. Let there be at the top of this tube a groove for the reception of a lense or ocular, D, whose focus is two inches. Let the ivory circle, B, be open in order that there may be placed therein a glass, E, that you will cover within with black paper and a small circle of cardboard. Put a pivot, F, in the center of this circle, and place thereon a very small magnetized needle, G, that is to say, a little smaller than the diameter of the circle. Cover the latter with a glass, so as to secure the needle and prevent it from leaving the top of its pivot. Finally, let this arrangement be a sort of compass placed at the bottom of an ivory tube translucent enough to allow the direction of its needle to be perceived, and the eye piece of which serves the better to distinguish the letters or figures that are to be drawn upon the cardboard disk at the bottom of this magnifying glass. Let it have, moreover, such a form as to give this compass the appearance of an ordinary magnifying glass, and make one imagine that he perceives by means of it the objects hidden and inclosed secretly in different boxes, as will be explained in the course of this work.

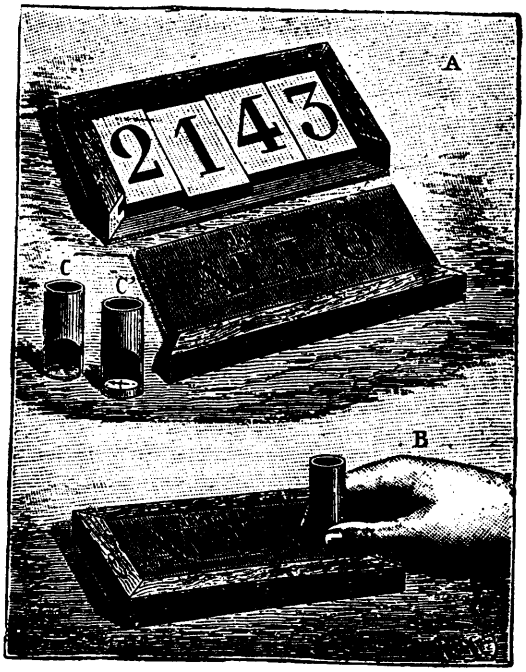


FIG. 2.—THE NEW FORM OF THE APPARATUS.

"When this magnifying glass is placed at a small distance above a magnetized bar or any box in which the piece that contains the bar is hidden, the magnetized needle contained therein will necessarily place itself in the same direction as this bar, and will, consequently, indicate which side is its north or its south. The north of the needle will indicate the south of the bar. . . . .

It is necessary to observe that the bar should not be too distant from the needle, particularly if it is very small, and that the pivot of the needle must be placed over the center of the bar, without which its indication might be erroneous, especially when in the pieces there are several bars that may act in unison upon the needle."

After thus describing the construction and effect of the magnetic magnifying glass, Mr. Guyot passes in review the different experiments that it permits of, beginning with the box of numbers represented in facsimile in Fig. 1. This box is capable of receiving three blocks selected from among a collection of ten, upon which are inscribed the first nine numbers and the zero, thus permitting of writing a great many numbers of three ciphers. In the interior of each of these wooden blocks there is concealed a small magnet, the position of which differs in each block, as shown in Fig. 1 (No. 4.) After marking the corresponding numbers on the bottom of the compass once for all, it suffices to place the magnifying glass successively over the centers of the three squares which indicate the place of the three numbers concealed in the box (in which they have been previously arranged in secret), in order to know each of them and to rapidly read through the cover the number formed.

Fig. 2 represents the modern form given to Mr. Guyot's device. The experiment is made by means of four rectangular blocks, the place of the magnets that they contain being indicated by the four letters of the word ALLO printed upon the cover. In lieu of a magnifying glass, two small cardboard tubes are used, one of which, C (the only one offered to the novice) is a simple cylinder closed at one end, for which the experimenter always substitutes another tube, C', of identical appearance and containing the indicating magnetizing needle.

Mr. Guyot describes no less than forty-six scientific experiments that are made for the most part with the magnifying glass and magnets. Our perspicacious readers will have no trouble in increasing the number of them, by taking advantage of the well known properties of magnets and the laws of magnetic action—*La Nature.*

MODERN METHODS OF TEACHING.

The almost complete revolutionizing of the methods of instruction in the elementary public schools, is one of the most instructive subjects for consideration by those who are interested in the work of educating the young. While the change

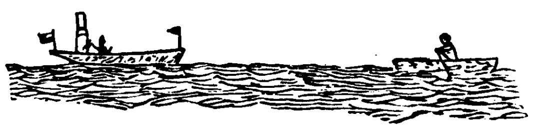


FIG. 1.

has not progressed so far in some localities as in others, there is everywhere observable in the schools of our principal cities a departure more or less radical from the old-time system of endless memorizing and reciting, in favor of methods by which

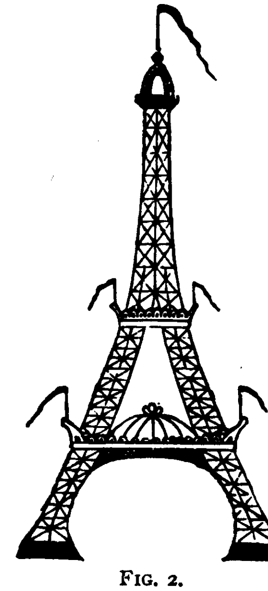


FIG. 2.

the youth is trained to cultivate the faculty of original observation and expression, with the concurrent training of eye and hand in delineation. Such teaching is infinitely more valuable than the old method of parrot-like repetition of tasks from books.

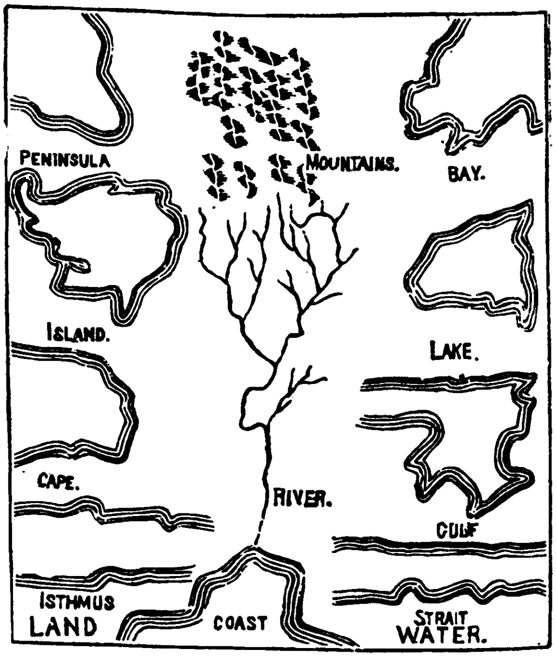


FIG. 3.

We have been led to these comments by the inspection of some of the work done in the elementary schools of Boston, where the modern idea of cultivating the thinking faculty appears to have been thoroughly incorporated in the method of

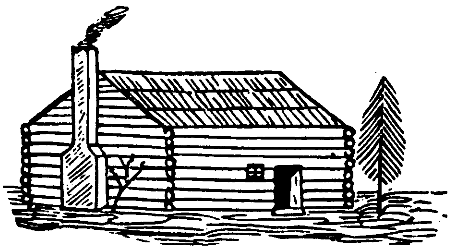


FIG. 4.—THE EARLY LOG CABIN.

teaching there practiced. One excellent feature to the school system in that city, is the "annual visitation day," upon which occasion parents by thousands visit the schools to examine the work of the children.

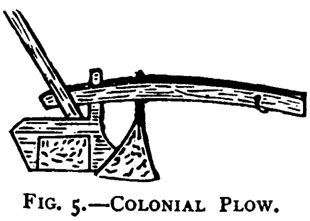


FIG. 5.—COLONIAL PLOW.

A fair estimate of the value of the system in vogue, may be made from the following description : One of the features of the school work exhibited on "visitation day" was the written and illustrated work. In one district there was, for example, on exhibition some representative work, from every class of every grade from the kindergarten to the highest class of the grammar school, so that the progress of the school work from the day the child enters the school was connectedly exhibited.

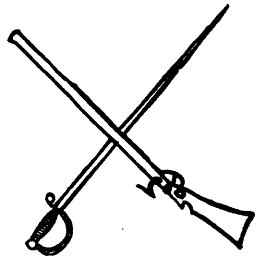


FIG. 6.—MATCHLOCK AND SWORD OF 1620.

One sample of the kind of work required of the pupils will serve to illustrate the value of the methods employed, and for this purpose we have selected the composition of language work. One part of the plan of instruction is to make every subject taught, in all the classes above the grade of the primary school, contribute to the acquisition of skill in speaking and writing correctly and fluently.

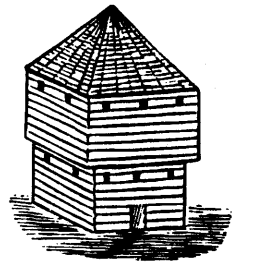


FIG. 7.—COLONIAL BLOCK HOUSE.

Thus, Fig. 1 is a child's illustration of the following example : A man in a row-boat goes 200 feet per minute ; a man in a naphtha launch goes 300 feet per minute. Allowing the row-boat 1,000 feet start, how long would it take the man in the launch to catch him ?

FIG. 8.—COSTUME OF PURITANS.

Fig. 2 is the illustration corresponding to the following problem : A man starts to climb the Eiffel Tower, and climbs 100 feet per minute. An elevator leaves the ground at the same time he does, and goes at the rate of 300 feet per minute. How much sooner will the elevator reach the top than the man, if the tower is 1,000 feet high ?

It must be obvious that with the acquired ability to present such appropriate illustrations of a subject, the pupil's comprehension of it, and the clearness and accuracy of his description of it must be greatly assisted; and more than this, the plan calls for the exercise of originality and independent thinking which is the true solution of the problem of mental training.

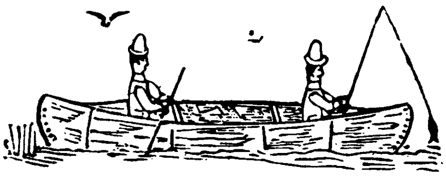


FIG. 9.—INDIAN CANOE, USED BY COLONISTS.

Fig. 3, for example, is one of a number of sketches to illustrate the resemblance, in outline, between bodies of land and water.

Figs. 4 to 9 belong to a series in one of the compositions on "Life in the Colonies." These sketches were as artistically placed in the writing of the composition as they would be in a page of print.

METALLO-CHROMES.

The production of Nobili's rings is a very simple and pleasing electro-chemical experiment which may be readily tried by any one having one or two batteries, or a small dynamo or magneto-electric machine, and figures of various kinds may be produced by the same process in brilliant colors.

To produce the rings, all that is required is a Bunsen or Grenet battery in good order, a strong solution of acetate of lead (sugar of lead) and a steel or nickel plated brass plate. The lead solution is placed in a common saucer, the steel or nickeled plate is placed in the bottom of the saucer and connected by a wire with the zinc pole of the battery, and the end of the wire, which is connected with the carbon pole of the battery, is held near the steel plate without touching it, as shown in Fig. 1. In a very short time a spot of color will appear on the plate, and in a minute or so the spot will spread rapidly and form concentric rings of prismatic colors, as shown in Fig. 2. A few trials will enable the operator to determine the time required for the production of the best effects. When the operation has proceeded far enough, the plate is removed from the solution, washed in clean water and dried. The beautiful color effect is due to the decomposition of the light by the exceedingly thin film of peroxide of lead deposited on the surface of the plate. It is quite permanent, and serves to protect the surface of the plate from oxidation.

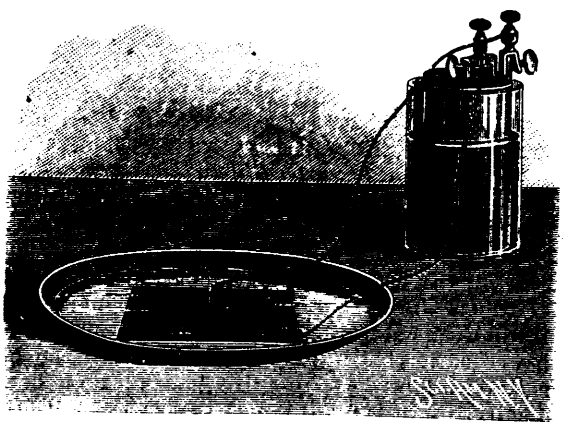


FIG. 1.—PRODUCTION OF NOBILI'S RINGS.

To secure the best results, the plate should be highly polished and the lead solution should be filtered.

By providing anodes of different forms, various ornamental figures may be produced on the surface of the plate. For example, a wire bent into the form of a letter or figure of any form may be used as an anode for producing a figure of the same general form on the plate. As it is sometimes difficult to hold the anode in the proper position, ordinary insulated wire (magnet wire) may be used. This permits of placing the anode down upon the plate, the insulation serving to prevent direct electrical contact.

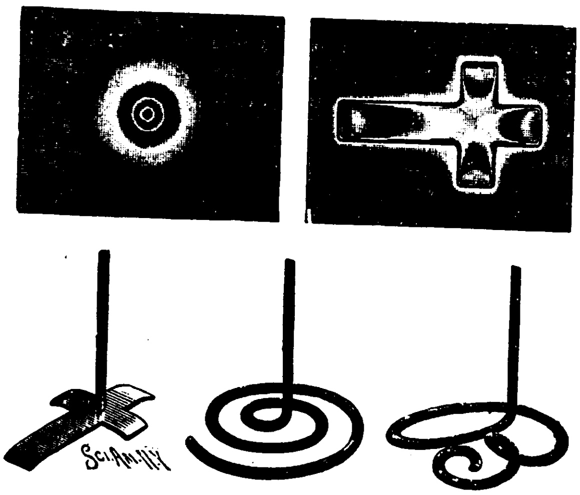


FIG. 2.—METALLO-CHROMES AND ANODES.

Very beautiful effects may be secured by cutting an anode of the desired shape from sheet copper and bending parts so as to vary their distance from the plate as in the case of the cross, Fig. 2. The result is that the film is deposited in beautifully graduated colors at the extremities of the figure, the arrangement of colors bearing some resemblance to those of a peacock feather.

The arrangement of the colors in these films is that of the solar spectrum. Nobili's rings resemble Newton's. The colors are fully as intense and more readily seen.

Nobili discovered this phenomenon in 1826. Since th time many modifications of the process have been devised, and some commercial applications have been made. It has been used to some extent in the ornamentation of small objects, such as buttons, articles of jewelry, etc., imparting to them an iridescence which cannot be imitated by any artificial coloring.

Becquerel suggested a solution for this purpose, the formula of which is as follows: "Dissolve 200 grammes of caustic potash in 2 quarts of distilled water, add 150 grammes of litharge, boil the mixture for a half hour, and allow it to settle. Then pour off the clear liquor and dilute with its own bulk of water."

This solution is adapted to other metals than those above mentioned, but the acetate of lead solution yields very satisfactory results and is sufficient for experimental demonstration. In conducting these experiments the poisonous nature of the solutions should be borne in mind.—By GEO. M. HOPKINS, in the *Scientific American*.

ELECTRICAL

A. C. C.—An abbreviation used in medical electricity for *Anodic Closure Contraction,* or the contraction observed on closing the circuit when the anode is lying over the muscle.

The term *anode* is sometimes, as above, used to indicate the positive terminal of an electric battery or source.

Aclinic Line.—The magnetic equator, or a line on the earth's surface connecting places where the magnetic needle has no inclination or dip.

The magnetic equator is not a circle. It cuts the geographical equator at 2° E. long., and at 170° W. long.

Acoustic Telegraph.—A non-recording system of telegraphic communication, in which the dots and dashes of the Morse system, or the deflections of the needle in the needle system, are replaced by sounds that follow one another at intervals that represent the dots and dashes, or the deflections of the needle, and thereby the letters of the alphabet.

Steinheil and Bright each invented acoustic systems of telegraphy in which electro-magnetic bells are used. Morse invented a *Sounder,* for this purpose, which is used very generally.

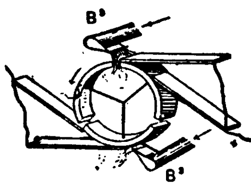


FIG. 8.

Action, Local.—An irregular dissolving or consumption of the zinc or positive element of a voltaic battery, by the fluid or electrolyte, when the circuit is open or broken, as well as when closed, or in regular action.

Local action is due to impurities, such as carbon, iron, arsenic, etc., in the positive plate. These impurities form with the positive element little voltaic couples, and thus direct the corrosive action of the liquid to portions of the plate near the impurities. Local action causes a waste of energy. It may be avoided by amalgamation of the zinc.

Action, Local.—A term proposed, but not generally adopted, to indicate the wasteful currents in the pole pieces or cores of dynamo-electric machines.

These currents are now generally known as *Eddy, Foucault,* or *Parasitical Currents.*

Action, Unit of.—A rate of working, which will perform one unit of work per second.

In C. G. S. units, the activity of one erg per second. This unit is very small. One *Watt,* the practical unit of power, is equal to ten million ergs per second.

The unit of activity generally used for mechanical power is one horse-power, or 746 watts.

Affinity, Chemical.—Atomic attractions.

The force that causes atoms to unite and form chemical molecules.

Atomic, or chemical attraction generally results in a loss of the characteristic qualities, or properties, that distinguish one kind of matter from another. In this respect it differs from *adhesion,* or the force which holds unlike molecules together. If, for example, sulphur is mixed with lamp-black, no matter how intimate the mixture, the separate particles, when examined by a glass, exhibit their peculiar color, lustre, etc. If, however, the sulphur is chemically united with the carbon, a colorless, transparent, mobile liquid, called carbon bisulphide, results, that possesses a disagreeable, penetrating odor.

Chemical affinity, or atomic combination, is influenced by a variety of causes, viz.:

(1) *Cohesion.* Cohesion, by binding the molecules more firmly together, opposes their mutual atomic attractions.

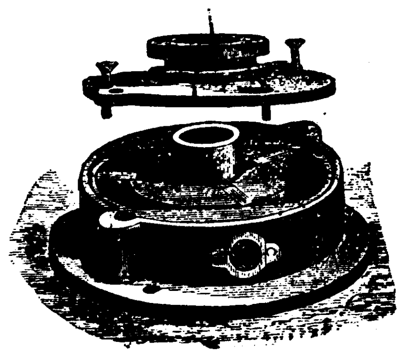


FIG. 9.

A solid rod of iron will not readily burn in the flame of an ordinary lamp, but if the cohesion be overcome by reducing the iron rod to filings, it burns with brilliant scintillations when dropped into the same flame.

(2) *Solution.* Solution, by imparting to the molecules greater freedom of motion, favors their chemical combination.

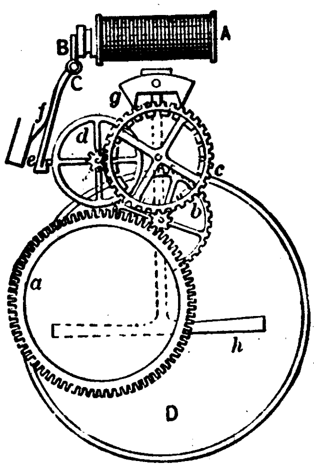


FIG. 10.

(3.) *Heat.* Heat favors atomic combination by decreasing the cohesion, and possibly, by altering the electrical relations of the atoms. If too great, heat may produce decomposition.

(4) *Light.* Decomposition, or the lessening of chemical affinity through the agency of light, is called *Actinism.* Light also causes the direct *combination* of *substances.* A mixture of equal volumes of hydrogen and chlorine unites explosively when exposed to the action of full sunlight.

(5.) *Electricity.* An electric spark will cause an explosive combination of a mixture of oxygen and hydrogen. Electricity also produces chemical decomposition.

Agone.—A line connecting places on the earth's surface where the magnetic needle points to the true geographical north.

The line of no *declination* or *variation* of a magnetic needle.

As all the places on the earth where the magnetic needle points to the true north may be arranged on a few lines, it will be understood that the pointing of the magnetic needle to the true geographical north is the exception and not the rule. In many places, however, the deviation from the true geographical north is so small that the direction of the needle may be regarded as approximately due north.

Air-Blast.—An invention of Prof. Elihu Thomson to prevent the injurious action of destructive sparking at the commutator of a dynamo-electric machine.

A thin, forcible blast of air is delivered through suitable tubes at points on the three-part commutator cylinder of the Thomson-Houston dynamo, where the collecting brushes bear on its surface. The effect is to blow out the arc and thus prevent its destructive action on the commutator segments. The use of the air-blast also permits the free application of oil, thus further avoiding wear.

The blast-nozzles are shown at B^8, B^8, Fig. 8, near the collecting brushes.

The air-supply is obtained from a centrifugal blower attached directly to the shaft of the machine. Its construction and operation will be readily understood from an inspection of Fig. 9, in which the top is removed for a ready examination of the interior parts.

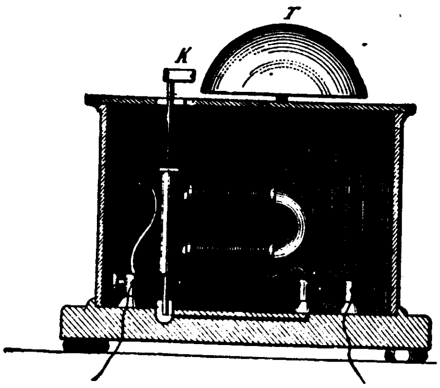


FIG. 11.

Alarms, Electric.—Various automatic devices by which attention is called to the occurrence of certain events, such as the opening of a door or window; the stepping of a person on a mat or staircase; the rise or fall of temperature beyond a given predetermined point; or to call a person to a telegraphic or telephonic instrument.

Electric alarms are operated by either the closing or the opening of an electric circuit, generally the former, by means of which an electro-magnetic or mechanical bell is rung.

Electric alarms may be divided into two classes, viz.:

1. Mechanically operated alarms, or those operated by clock-work, that is started by means of an electric current.

2. Those in which the alarm is both set into operation and operated by the action of an electric current.

In Fig. 10, is shown the general construction of an electrically started mechanical alarm. The attraction of the armature B, by the electro-magnet A, moves the armature lever pivoted at C, and thus releases the catch *e*, and permits the spring or weight connected with the clock movement to set it in motion and strike the bell.

Electrically actuated alarm-bells are generally of the automatic make-and-break form. The striking lever is operated by the attraction of the armature of an electro-magnet, and is provided with a contact-point, so placed that when the hammer is drawn away from the bell, on the electro-magnet losing its magnetism, the contact-point is closed, but when it is drawn towards the bell the contact is opened. When, therefore, the hammer strikes the bell, the circuit is opened, and the electro-magnet releases its armature, permitting a spring to again close the contact by moving the striking lever away from the bell. Once set into action, these movements are repeated while there is battery power sufficient to energize the magnet.

In Fig. 11, the battery terminals are connected with the right and left-hand binding-posts, P and M. The *hammer* K, is connected with a striking *lever*, which forms part of the circuit, and which is attached to the *armature* of the electro-magnet *e*. A metallic spring *g*, bears against the armature when the latter is away from the magnet, but does not touch the armature when it is moved towards the magnet. The movements of the armature thus automatically open and close the circuit of the electro-magnet.

This form of make-and-break is called an *automatic make-and-break*.

PROPER SAWING OF OAK AND HARD-WOOD LUMBER.

That careful attention to apparently trifling details may profitably be given to the matter of the proper sawing of oak and other hard wood, will be made apparent from the following hints from a practical lumberman, which explain how seriously a deviation from a very simple rule may affect the market value of lumber.

Fig. 1. for example, exhibits the method of sawing hard-wood logs in vogue in certain lumbering regions. The error is emphasized by the heavy line drawn through the heart of the log, and it is a serious one for the lumberman for two reasons. It

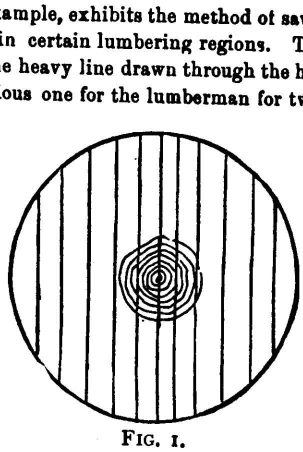


FIG. 1.

must necessarily open any heart rot and "shake" that may exist; and, according to the extent of these defects present, two of the widest boards or planks of the log become second quality, or refuse. If the log happens to be quite sound and free from shakes, these two boards will exhibit only a small pith (as shown in Fig. 2), which may appear to the sawyer to be of little importance. Nevertheless, they will be sufficient to cause the two logs to be classed as second quality, and so they will be sold in the market.

The reason for this reduced classification will be understood when it is stated, that in the process of seasoning, these two boards will show a decided tendency to split at the ends as shown in Fig, 3, or to open as in Fig. 4 ; and this tendency may extend the entire length of the board, rendering it quite worthless.

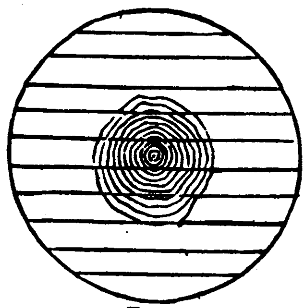


FIG. 2.

The rule, then, should be "never saw an oak or hard-wood log through the heart," and this is a safe one to hold fast to. One exception, however, may be allowed—namely, in sawing thin stuff. In such case, the heart may be sawed through, but the board should be split and the heart taken out before shipping. The best plan, of course, for the sawyer, will be to secure orders for both thick and thin stock, if possible. Then

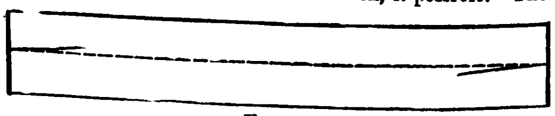


FIG. 3.

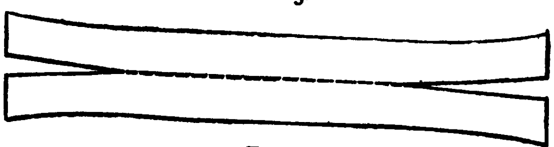


FIG. 4.

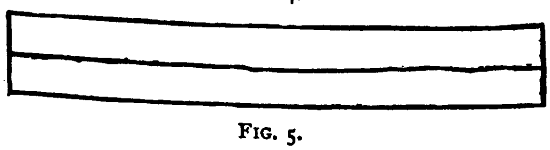


FIG. 5.

the thin stuff may be taken from the sides, and the heart portion may be left in the thick stock, the error above explained being carefully avoided by keeping the heart in the center of a thick piece (say 4 inches, or more). This practice will be exhibited in Fig. 5. An observance of these simple precautions, we are assured, will be found of the greatest value by saw-mill men.—*Manufacturer and Builder.*

PHOTO CARBON PRINTING.

BY T. C. ROCHE.

The principle or foundation of carbon printing is based on the action of light on bichromate salts when combined with organic matter. This discovery was first brought to public notice by Mungo Ponton in 1839. M. Becquerel, Mr. Fox Talbot, and others experimented on this new reaction, but M. Poitevin, in 1855, was about the first to bring out any real practical results. It was through him that photo-lithography, photo-mechanical printing and kindred processes were put into commercial use.

The first to introduce prepared carbon tissue and a practical formula for working the same, was Mr. J. W. Swan, in 1864. Since then there have been several important improvements made, simplifying the process still more. A suitable paper is coated in long rolls with a pigmented gelatine ; this is cut to the required size and sensitized for use in a bath of bichromate of potash, 15 to 20 grains per ounce of water. When dried in a dark room it is ready for exposure, under the negative, to the action of sunlight. It is important that the negative has a safety edge about half an inch all around it, to prevent the light from acting on the margin of the tissue. After exposure, which must be judged by a photometer, the tissue is placed in cold water until it lies limp and flat. Your glass or porcelain, which has been cleaned and coated with plain collodion, is wetted or washed in water, then laid on a table, some water sprinkled on, the carbon paper is laid face down on it, a thin rubber cloth laid over, and then a squeegee passed over lightly to bring the carbon paper in contact and drive out all air bells. It is now allowed to rest for a few minutes, then placed in a pan of tepid water and rocked. The first portion of the gelatine mixture to dissolve is that which had been protected by the safety edge on the negative. Now the paper which had been coated can be peeled off and the transferred picture washed out according to the gradation or tones in the negative and the action of light on the sensitive compound. The coating is rendered more or less insoluble, and all soluble portions will wash out in the warm water. The picture is then washed in cold water, and finally a solution of alum water is flowed over and the plate set up to dry. While the surface is wet it is very tender, but will dry, hard and sharp.

The collodion is used to prevent the delicate detail or half tone from washing away. In sensitizing or washing, the light has no effect on the material while wet. After sensitizing, the paper will keep two weeks if put in an air-tight tin box. Porcelain or zinc plates that have been cleaned, slightly waxed, and then collodionized, can have the proofs developed on them re-transferred when dry on to transfer paper by wetting the paper until it feels slimy, then squeegeeing it down on the picture, and when dry it can be peeled off easily. Proofs on porcelain or for lantern slides should be printed light ; those for window transparencies, deeper. The proofs can be, after printing, transferred to almost any material, such as celluloid. metals, or wood. When you hang the paper up to dry after sensitizing, it must be in a room well ventilated ; if not, the coating is apt to dry insoluble and will be of no use. All carbon pictures are considered permanent.—*Jour. Soc. Am. Photo.*

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