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NOTE AND COMMENT.

So much interest was shewn in Canada on the completion last summer of the Allan Steamship "Parisian" that we are glad to be able to give this month an illustration of her engines taken from the *Engineer*. They represent one of the latest types of English marine engines, as built by R. Napier & Sons, Glasgow. The vessel itself is 450 feet long and 46 feet wide, and has 10,000 tons displacement.

As will be seen, the engines are vertical compounds of the "tandem" type; that is, with the cylinder in line with the keel.

There are one high-pressure and two low-pressure cylinders, which are 60 inches and 85 inches respectively, with 5 feet stroke of piston. The crank shaft is of steel, 20 inches diameter, while the crank pins are 21 inches diameter, by the same length. Steam of 75 pounds pressure is used.

The general arrangement of the engines is well shown in the engraving, so that we need add but little by way of explanation. The valves are of the piston variety, and are worked by a link motion, which is peculiar in some details, especially the rock shaft and levers which connect the link motion with the valve stems.

These engines are handled for reversing or going ahead by a single steam cylinder which is located behind the central main cylinder, connecting directly by a rod with the reverse shaft, the arm of which is shown in the extreme left of the engraving, and the air pumps are worked directly from the cross head of the main engines instead of a separate engine.

With the propeller blades four feet out of water (owing to light draught of the ship) these engines were run at 85 revolutions per minute, at which speed they indicated 6,020 horse power.

This is very high piston speed for such large pistons —850 feet per minute—and it shows to what perfection modern workmanship has attained when it is possible for even a short time.

SINCE the U. S. Senate has approved unanimously of what is known as Capt. Eads' bill for a ship railway across the Isthmus of Tehuantepec, guaranteeing six per cent. dividends, for fifteen years, upon fifty millions of dollars, the subject is attracting considerable attention abroad, and so eminent an authority as *Engineering* says: "We shall watch the progress of the bill with interest, and hope to see it passed in such a form as will enable an undertaking so important to the commerce of the world to be proceeded with and completed at no distant date." It seems that the objections to the engineering practicability of this scheme which were at first urged are rapidly vanishing. The most eminent English, European, and American Engineers and naval architects are unanimous in favor of the practicability of transporting fully laden ships in the way Capt. Eads proposes, with perfect safety, and it is the general opinion that this can be done with less possibility of straining than ships frequently meet with at sea. From an economical, commercial and military point of view, this plan of a ship railway across the Tehuantepec, is much more favorable to the United States than the rival canal at Panama and Nicaragua. It is 1,250 miles nearer this country than Panama; it is on Mexican soil, and that government has granted very liberal concessions to Capt. Eads, so that he will be able to discriminate in favor of the commerce of any nation which aids in building the work. The Isthmus is 143 miles wide where it is proposed to make the railway, but a portion of this distance is traversed by the Coatzacoalcas river, a broad stream, with twenty-five feet of water, for thirty miles up, where it meets a tributary stream which carries the deep water channel twenty miles further inland to a bend at Ceiba Benita, where the work of the railway will begin. Thus fifty miles of the 143 is already provided for. The railway will be straight, will run through a very fertile country, and its highest elevation will be but 650 feet.

HONEST WORK.

It should be the aim of every true man, no matter what his occupation may be, to strive to excel, and to no body of men does this apply with greater force, than to the skilled artisan. The great inventors in every age have generally been artisans who have kept this maxim before their eyes and have studiously endeavored to perfect themselves in their calling. In the first place, to take the lowest ground, it *pays*. When hard times and depression of business come, then even a good workman finds difficulty in obtaining employment, but to an inferior one it is an impossibility, for no employer of labor will give a job to a man who does not understand his business, when there are ready to his hand dozens of men who will give a good return for their wages. When work is rushing and the supply of skilled labor is inadequate to the demand, the employer who knows the effect of introducing a careless or slovenly workman into his workshop, tries his best to do without such, and only takes him on when he can do no better, and at the first convenient opportunity discharges him without any scruples. Like the bad sheep that affects the flock, one slovenly workman has a contaminating effect upon the whole workroom. If one man's poor work is passed, then another better man may slight his job, and the general effect is demoralizing. So the employer finds by experience that a bad workman is dear at any price, and seizes the first opportunity to get rid of him. The workman who has a reputation for good work can always, when there is any opening at all, obtain employment, and his services are generally in demand.

Again, a man should, for his own satisfaction, take sufficient pride and interest in his work to strive to rise to the highest attainable position in his avocation, whatever it may chance to be.

It is also a duty a man owes to his employer, whether that employer be the general public or some individual or firm, to give a "fair day's work for a fair day's wage." It is the honest way and the experience of every one is that the honest way is the best way, and a man serves his God more effectually by doing his duty on week day to his fellow-man, be he employer or fellow craftsman, than by neglecting it on week days, and sitting on "the front seets at meetin'" on Sundays. The true remedy for poor work is for the inferior workman to work for wages equivalent to the value of his labor, until increased experience and continued improvement give him a claim to better pay and a higher position. Were all men to do their work well from a sense of duty, the world would be proportionately better and happier than it now is, and there would be no doubtful answer to the question, "Is life worth living?" —*American Artisan.*

IS COLD WEATHER HEALTHFUL?

The notion that cold weather is healthful has doubtless sufficient foundation in fact to prevent it being classed among "popular fallacies," but, like the Constitution of the United States, it may, perhaps, suffer amendment to advantage. Of course, by cold weather is not meant that which the thin-blooded, the effeminate and the invalid consider such. Anything approximating the freezing point is sufficient to set them quaking and complaining. We demand for cold weather a temperature that any healthy, vigorous individual will concede to be such—zero is about right. Yes, it is cold when the snow crackles, when the very best varnish will occasionally crack on the sleigh, and when the cheeks and ears of the sleigh's occupants wear a hectic color, while their noses and fingers, and presumably their toes, are of a frigid blue. We take it that all but those of exceptional robustness are vulnerable at these points to a zero temperature. These tingling fingers and aching toes are trifling matters, to be sure, but it will not be claimed that they are the indication of a sudden influx of health. May they not be warnings? The effect of extremely cold air upon the lungs or on a rheumatic shoulder is often unmistakeably bad. It seems to us that right here is indicated where the line should be drawn between a healthy and unhealthy degree of cold. Let the test be comfort—fingers and toes included. Down to the point where the brisk air continues to produce a pleasurable exhilaration, it is probably healthful, but when the extremities, though well protected by wraps without and a good circulation within, grow cold, this should be regarded as a warning that the healthful limit has been passed. We beg to suggest caution in drinking these drafts of health proffered by old Boreas, as, like some other iced beverages, they might be more wholesome without the ice.—*Metal Worker.*

THE STRUGGLE FOR LIFE AGAINST CIVILIZATION AND ÆSTHETICISM.

A report of papers read before the Academy of Medicine in New York on the general subject of plumbing, has appeared in our columns from time to time. A paper bearing the suggestive title which appears above, was read before that body quite recently from the pen of Dr. Frank H. Hamilton, in many portions of which our readers will find matters of interest. The following report is from the *Times:*

"We need not to be reminded," said the essayist, "how our hearts were touched when Doctor Doremus told us how this insidious enemy to human life—sewer gas—entered his own home and took from him a beloved son, and prostrated another with a lingering and almost fatal sickness. He declared that he would rather have exposed them to the most deadly gases in his laboratory than to this sewer gas, for the poisonous effects of which we have no remedy. Is it surprising that, considering the deadly nature of these gases, and the impracticability or inefficiency of all, or nearly all, of the measures for their exclusion which have been suggested, there should be hesitancy in accepting the statement sometimes made, that it is "foolish" to talk of the risks to health from modern improvements when plumbing can be made absolutely safe? Or is it strange that a scientist well known should declare that if he were to build a house, he would not have it connected in any way with a sewer! He would have all the closets, drains and pipes in an annex; and this is the conclusion, it may be here said, to which many of our most wealthy citizens have already arrived. Not a few of our lately constructed and most elegant mansions have not an inch of plumbing in those portions of their building which are usually occupied by their families, and I have conversed with at least one very intelligent plumber who favors the same practice. What, then, is the upshot of all this matter? With all respect to the gentlemen whose views have been presented to us in past discussions, I must say that they have suggested nothing of any importance which is new; nothing that was not known before; nothing, indeed, which has not been tried, and which has not, for one reason or another, proved itself to be either impracticable or insufficient, and in many cases totally inefficient. Science has not kept pace with civilization, and without concessions on the part of civilization there is at present no adequate remedy for the evils we suffer. Since Bede's day we have had occasion to observe that when men left the open plains and the small hamlets, and crowded themselves into the narrow limits of cities, the ratio of sickness and death was proportionately increased. When, also in the progress of civilization the fire-places disappeared, with their great open throats—the best ventilations ever invented—and decorated cast-iron stoves were substituted, house sanitation experienced a loss which no sanitary engineer or architect has ever repaired; and when, in obedience to the same inexorable demands of progress in luxury and æstheticism, gas was substituted for oil, and hot-air or hot-steam furnaces for stoves, the hand was again moved forward another point on the dial of human life.

"Possibly nothing will so forcibly illustrate the magnitude of the evil we are considering as the fact that it has given birth to a new profession. The calamities necessarily incident to the progress of civilization long since made it necessary that there should be a class of educated men whose duties it should be to look after the rights of citizens, and another class to attend the matters of health, and now a condition has arisen which renders necessary a new class of specialists or professional men called "sanitary engineers," who are supposed to be well informed in matters of hygiene, architecture, or house construction and engineering, and who for the present seem to find plenty of occupation, and are, no doubt, performing a much needed and very useful service; but of whom it may be said that up to the present time there is no evidence that they have done anything more than to investigate the evils they have been asked to remove; and, indeed, there may be found many notable examples in which the best sanitary engineers have failed to effect even a mitigation. I repeat that in order to render pure and innocuous the atmosphere of our houses it will be necessary, first of all, that civilization should make some concessions. The concessions demanded as a condition of the successful application of our present knowledge of the laws of hygiene are:

"1. That all plumbing having any direct or indirect communication with the sewers shall be excluded trom those portions of our houses which we habitually occupy—in other words, that it shall be placed in a separate building or annex.

"2. That we return to the open fire-place or the grate as a means of warming our houses.

"3. A diminished consumption of oxygen by gas burners. It is still an open question whether we shall be able to light our dwellings with electricity, but so long as we are obliged to depend upon gas we must content ourselves with light, and not insist upon illumination.

"The concessions demanded are named in the order of their importance. The necessity for each is urgent, but the first admits of no compromise. But there are many other possible sources of ill-health, and physical decay incident to the civilization than those I have referred to especially. The wholesome light of the sun is partially excluded from the apartments of wealth and luxury, because it fades the costly rugs and drapery and offends the educated eye by its vulgar and intrusive garishness, and not unfrequently at large receptions the light of day is excluded wholly, in order that the more æsthetic and kaleidoscopic effects of gaslight may be substituted, regardless of the fact that the air is thus rendered unfit for respiration. Our social habits demand that both children and adults shall devote the hours nature intended for sleep to amusements, which amusements are rendered more intoxicating and pernicious by the prolonged respiration of heated and poisonous air. Dress makes its contribution. Utility and regard for health are almost invariably made subservient to the caprice of fashion and the study of effect. Flimsy head-dresses, low necks, short sleeves, tight corsets, high heels and narrow toes do not contribute the sum total of the æsthetic requirements of civilization in matter of dress. Walking as a means of locomotion and of exercise is rendered difficult and sometimes impossible. To romp, or even to move with rapidity and sharp angularity, is unseemly in young ladies. And such young men as "move" in the most refined and polished circles, neglecting robust and manly outdoor ekercises, pose in attitudes which demand the least possible muscular exertion, or dawdle in effeminate dissipation. In the "best" society there is neither muscle nor backbone. Almost all respectable citizens ride when they might walk and complain of the want of breath when the absence of an elevator compels them to ascend a flight of steps, even when travel, overheated cars, long confinement in one position, hurried and irregular meals, dust and smoke, bring us to the end of our journey, weary and often sick. Railroads have enabled us to accomplish more in life than was possible when men travelled in coaches or on horseback; but it is doubtful whether, in the shortening of human life it has effected, the loss is not greater than the gain. All of these evils, and thousands not enumerated, are the necessary incidents to civilization, and medical men are painfully familiar with the impediments they present to the preservation of individual and public health; indeed, as has been already suggested, it was the presence of these evils chiefly which has rendered our existence as an integral part of society necessary. Nor do I assume too much in saying that were it not for the teachings of medical men the physical decay of the human race, under the adverse influences of civilization, would be rapid and complete.

Dr. Hamilton's paper was discussed by Dr. Billings, of the National Board of Health, and by Dr. Doremus, Dr. A. H. Smith, and Dr. E. G. Janeway. The academy voted to join with the Sanitary Reform Association in asking the Legislature to permit no tampering with the law for the registration of plumbers, etc., enacted last winter.

Engineering, Civil & Mechanical.

HOW TO CALCULATE SPEED.

We publish the following plain statement of a simple rule for calculating speed, taken from an exchange, as we believe it will prove interesting and instructive to many readers:

In selling machinery, the maker usually recommends that it be run at a certain rate of speed which has been demonstrated by experience to be most favorable to its successful operation. To fix upon relative size of pulleys to be used in communicating this motion from the "line shaft" is a calculation which seems to be very imperfectly understood by the average mechanic. Conversation on the subject with a large number of engineers, millwrights, and others has led us to think there was a demand for more light, and we accordingly offer the following system, the convenience and accuracy of which have been proven by years of practical use. This simple example will illustrate: Given, a 20-inch pulley revolving 100 revolutions per minute, how fast will a belt from it drive a ten-inch pulley?

The "rule" laid down in the book says: "Multiply the diameter of the driving pulley by its revolutions per minute, and divide by the diameter of the driven pulley." I find no fault with this rule, but would suggest that the teacher and text book of the future will be successful in proportion as they abound in "reasons why," and give the student principles from which to form his own rules. As every rule must be based upon a principle, when one is familiar with the latter the former becomes self-evident and not easily forgotten. The speed of a driven pulley will bear exactly the same relation to the speed of its driver as its diameter does to the diameter of the driver.

In the above instance, the driven pulley being smaller, let its size represent the denominator of a fraction, of which the diameter of the driving pulley shall stand as a numerator, thus:

$$\frac{20}{10} \text{ of } 100 = 200.$$

Or, suppose the diameter of the driver was 25 inches, its speed 180, and a speed of 600 was required, what must be the diameter of driven pulley? Reasoning: Since the speed must be greater, its diameter must, of course, be less than that of the driver. How much? As much less as its speed is greater; thus its size will be.

$$\frac{180}{600} \text{ of } 25 = \frac{75}{10}, \text{ or } 7\tfrac{1}{2} \text{ inches.}$$

This not only leaves less room for a misstatement of the problem, but in most cases the multiplications and divisions may be made mentally, thus saving time and avoiding liability to error.

These advantages are of still greater importance where intermediate pulleys or "counter" shafts are used to multiply motion. For instance, it is required to "set up" a planing machine, the cylinder of which must run 3,500; it has a pulley 4 inches; the counter shaft has pulleys 6 and 24 inches, respectively; the line shaft runs 160; what size driving pulley will be required? Reasoning: The 4-inch pulley being driven from one 24 inches, the larger pulley will revolve as much slower as 24 is greater than 4, and the drive pulley on line shaft must be as much larger than the driven or counter shaft, as its speed is slower than that of the counter shaft which it drives. The entire operation may be analysed as follows: for the sake of clearness, I will suppose that the motion was communicated direct from the line shaft to the 4-inch pulley, in which case the drive pulley must be.

$$\frac{3{,}500}{160} \text{ of } 4, \text{ or } 87\tfrac{1}{2} \text{ inches.}$$

The use of a counter shaft will decrease the size of driver exactly in proportion to the relative size of its pulleys. In the above instances the pulleys on counter shaft are 6 and 24 inches; consequently the driving pulley will only require to be 6-24ths as when no counter shaft was used, and this being understood, the whole problem may be disposed of as follows:

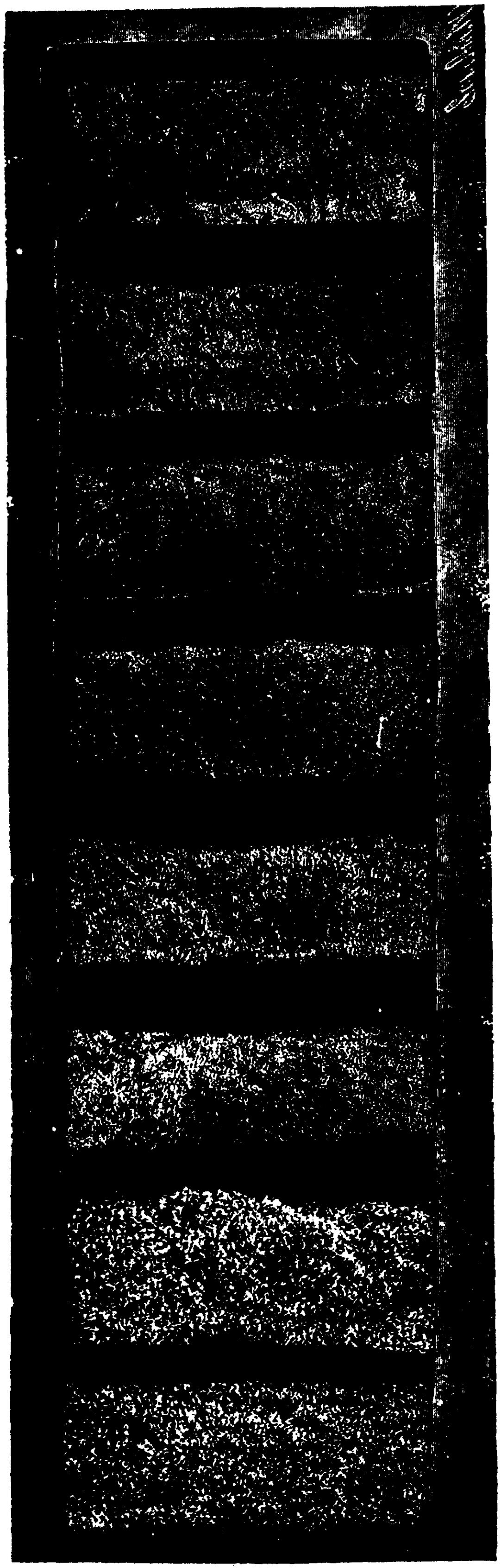
$$\frac{3500}{160} \text{ by } \frac{6}{24} \text{ by } 4 = \frac{175}{8}, \text{ or } 21\tfrac{7}{8} \text{ inches.}$$

—*Apprentice's Journal.*

EFFECTS OF HEAT UPON STEEL.

The illustration shows the effect of heat upon steel. To produce these effects take a bar of steel of ordinary size, say about an inch by a half, and heat six or eight inches of one end to a low red heat, and nick the heated part all around the bar at intervals of half to three quarters of an inch, until eight or nine notches are cut. The nicking is done at red heat, to determine the fracture at the nicks. Next place the end of the bar in a very hot fire and heat it white hot until it scintillates at the the extreme end leaving the other parts enough out of the fire to heat them only by conduction. Let the end remain in the fire until the last piece nicked is not quite red red-hot, and the next to the last barely red hot.

Now, if the pieces be numbered from one to eight, commencing at the outer end, No. 1 will be white or scintilating hot, No. 2 will be white hot, No. 3 will be high yellow hot, No. 4 will be yellow or orange hot, No. 5 will be high red hot, No. 6 will be red hot, No. 7 will be low red hot, No. 8 will be black hot.



THE EFFECTS OF HEAT UPON STEEL.

As soon as heated, let the bar be quenched in cold water and kept there until quite cold. After cooling, the bar should be carefully wiped dry, especially in the notches. An examination by the file will reveal the following, if high steel has been used :

No. 1 will scratch glass; Nos. 2, 3 and 4, excessively hard; Nos 5 and 6 well hardened; No. 7 about hard enough for tap steel; No. 8 not hardened. In breaking off the pieces over the corner of the anvil they should be caught in a clean keg or box, to keep the fractures clean and bright.

No. 1 will be as brittle as glass; No. 2 will be nearly as brittle as glass; Nos. 3, 4, and 5 will break off easily, each a little stronger than the other; Nos. 6 and 7 will be very strong, and much stronger that No. 8, or the bar unhardened.

Place the pieces in the order of their numbers fitting the fractures, then upend each one, beginning with No. 1, and following with each in the order in which they lie, and the result will be fractures as shown so beautifully in our illustration, each differing from the other.

No. 1 will be coarse, yellowish cast, and very lustrous; No. 2 will be coarse and not quite so yellow as No. 1; No. 3 will be finer than 1 or 2, and coaser than No. 8, and will have fiery lustre; No. 4, like No. 3, not quite so coarse, yet coarser than No. 8; No. 5 will be about the same size grain as No. 8, but will have fiery lustre; No. 6 will be much finer than No. 8, will have no fiery lustre, will be hard through and very strong. This is what is called REFINING by hardening. No. 7 will be refined and hard on the corners and edges, and rather coarser, and not quite so hard in the middle. This is about the right heat for hardening taps, milling tools, etc., the teeth of which will be amply hard, while there will be no danger of cracking the tool. No. 8 illustrates the original grain of the bar.

In nine cases out of ten the bar will crack along the middle to the refined piece. In the illustration the crack shows very plainly in No. 4, but we have never known this crack to extend into the refined piece, although we have repeated the experiment many times. We learn from this experiment the following:

FIRST, "*a*" Any difference in temperature sufficiently great to be seen by the color will cause a corresponding difference in the grain. "*b*" This variation in grain will produce internal strains and cracks.

SECOND, Any temperature so high as to open the grain so that the hardened piece will be coarser than the original bar will cause the hardened piece to be brittle, liable to crack, and to crumble on the edges in use.

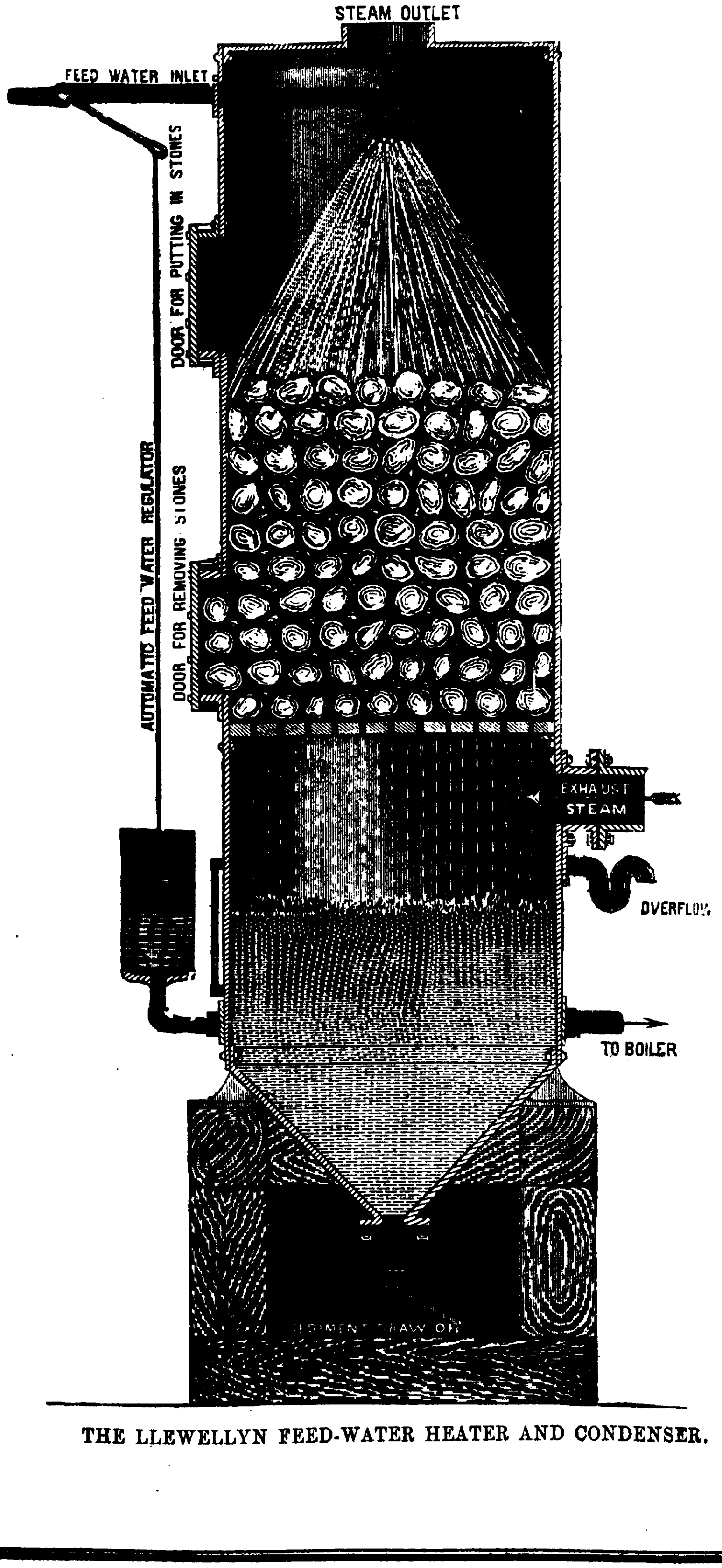
THIRD, A temperature high enough to cause a piece to harden through, but not high enough to open the grain, will cause the piece to REFINE, to be stronger than the untempered bar, and to carry a tough, keen cutting edge.

FOURTH, A temperature which will harden and refine the corners and edges of a bar, which will not harden the bar through, is just the right heat at which to harden taps, rose-bits and complicated cutters of any shape, as it will harden the teeth sufficiently without risk of cracking, and will leave the mass of the tool soft and tough, so that it can yield a little to pressure to prevent the teeth tearing out. These four rules are general, and apply equally well to any quality of steel or to any temper of steel.

Steel which is so mild that it will not harden in the ordinary acceptance of the term will show differences of grain corresponding to variations in temperature.

To restore any of the first seven pieces shown in No. 8 it is only necessary to heat it through to a good red heat, not to a high red, allow it to stay at this temperature for ten minutes to thirty minutes, according to the size of the piece, and then to cool slowly. If upon the first trial the restoration should be found incomplete, and the piece upon being fractured should still show some fiery grains, a second heating continued a little longer than the first would cause a restoration of the fracture. This property of restoration is not peculiar to any steel, and its performance requires no mysterious agencies beyond those given above.

It should be distinctly borne in mind that a piece restored from overheating is never *quite* as good as it would have remained if it had never been abused, and we strongly advise that no occasion should ever be given for the use of this process of restoration except as an interesting experiment. The original and proper strength of fine steel can never be FULLY RESTORED after it has once been destroyed by overheating.—*Treatment of Steel.*



THE LLEWELLYN FEED-WATER HEATER AND CONDENSER.

THE LLEWELLYN FEED-WATER HEATER AND CNODENSER.

The evil consequences following the use of impure water for feeding steam boilers, both with respect to the loss of useful heating effect and the serious dangers following the overheating of the plates, have been so often pointed out in this journal, and are already so well known to all intelligent steam users, that their repetition in this place appears to us to be quite unnecessary. The subject, in fact, has come to be a stereotyped warning, and we shall boil it down to the briefest statement of facts.

The attachment of scale to the heating surfaces of a boiler, means the interposition between the iron shell and the water to be heated, of a stratum having about 50 times less heat-conducting capacity than the metal. The interposition of this non-conducting substance presents a serious obstacle to the rapid transfer of heat to the water—so serious, in fact, that when the deposit is permitted to accumulate until it attains a notable thickness, it represents an enormous loss of heating effect, or, to put it differently, an enormous waste of fuel. The attachment of scale to the heating surface, again, is also attended with serious danger to the plates of the boiler, because of the necessity of excessive firing to produce the required amount of steam. With water in contact with clean metallic surfaces, no amount of firing can work any injury, the plates can never be overheated, and the consequence will be simply the more rapid and energetic formation of steam. Where the metallic surface, however, is covered with a firmly adherent layer of cement-like scale, which opposes the free transmission of heat, the fire must be correspondingly increased, and the metallic surface exposed to the flame, not being able to transmit the heat freely to the water through the opposing stratum of non-conducting material, is liable to suffer severely from overheating. Where the evil is allowed to go on unchecked by carelessness or ignorance, or where, from the exigencies of business, the removal of the scale is not effected at frequent and regular intervals, the evil consequences here spoken of soon become apparent in the serious deterioration of the iron from overheating. Disastrous explosions, due to the weakening of the boiler plates from this cause, are not uncommon.

Knowing the wastage and danger of scaling in their boilers, intelligent steam users have adopted various methods of meeting and avoided them. As all natural waters (whether derived from springs, wells, rivers, lakes, etc.) invariably contain scale-forming impurities, preventives of this form of trouble are almost universally in use. They are in many cases simply mechanical; the boiler being shut down and emptied, and when cooled off, entered by a workman who removes the scale as far as it is possible to reach it, with a hammer. Another plan which is generally practiced, is the chemical method. It consists generally in putting into the boiler from time to time a quantity of some anti-incrustator, which shall have the effect of precipitating the scale-forming impurities of the water in floculent or pulverulent form, so that they will not adhere to the plates or boiler. The loosely aggregated mass is permitted to accumulate in the mud drum, from which it may from time to time be blown out. By another plan of a similar nature, the purification of the feed water is sought to be effected before its admission to the boiler, by employing large settling or precipitating tanks, and adding the chemical precipitant in sufficient quantity to effect its deposition.

Another system, which effects much the same results in a more practical and less circumstantial manner, is represented by the use of what have been popularly named feed-water heaters and purifiers. These, as the name implies, accomplish the purification of the feed-water by heating it in a suitable apparatus in connection with the boiler, to the point where the separation of its scale-forming constituents occurs, provide for the retention of these separated impurities, that would otherwise attach themselves as scale to the boiler surfaces, in the chamber of the apparatus, either by subsidence or filtration, and pass the purified water into the boiler.

Many devices of this nature have been invented, all of them exhibiting more or less mechanical ingenuity in their construction, and as a class they have been found to be so convenient and efficient in practice, that they have come to be very generally used. It is hardly necessary to add that the exhaust steam is invariably employed to furnish the heat necessary to effect the precipitation of the mineral impurities. They not only, therefor, measurably purify the feed water, but utilize more or less perfectly the heat of the exhaust steam, which would otherwise be wasted, to heat the feed, putting this into the boiler at a temperature at or near the boiling point, thus accomplishing at once two desirable objects.

We have occasion from time to time to present to our readers new devices of this character, embodying some novel or meritorious features of construction or operation and will take the opportunity in this article to describe one of the latest of these —the Llewellyn feed-water heater and condenser, which has been largely and successfully employed by steam users on the Pacific coast during the past year, and it comes to our notice with a high reputation for simplicity of construction and effectiveness in service.

It consists of a cylindrical shell or case of wrought iron, furnished above with a flat covering having a central orifice for the escape of any uncondensed vapors, and terminating below in a hopper-shaped base of cast iron bolted to the shell, which is provided with a pipe and valve for drawing off the sediment and precipitated material which accumulates therein. The feed-water is admitted through an inlet pipe, seen at the upper left-hand side of the apparatus, and provided with a rose-jet, by which the water is distributed in the form of a fine spray. A little below the centre of the heater a grating is placed across the shell, resting on an angle-iron flange, and dividing the cylinder horizontally into an upper and lower part. This grating is intended to support about 3 feet of stones of irregular shape and size (stones of from 4 to 6 inches diameter are preferred), cobble stones being the most desirable if they can be procured. For the admission and removal of these stones two doors are provided, seen in the cut, on the left-hand side of the shell.

Below the grating, on the right-hand side, is seen the opening for the admission of the exhaust steam: below this, on the same side, the pipe communicating through a pump or injector to the boiler; and between the two an overflow pipe to draw off the surplus should the heater act faster than the boiler requirement. To provide against this contingency, however, a float regulator is employed (seen on the opposite of the chamber), which automatically governs the valve of the feed-water pipe and regulates its supply.

The action of the apparatus is as follows: The cold feed-water entering through the inlet at the top, is distributed uniformly in spray over the surface of the stones, and trickles down through them. The exhaust steam entering from below, is thus met with an extended condensing surface of cool water, by which it is quickly and completely condensed before it reaches the upper surfaces of the stones, The mineral matter held in solution is more or less perfectly separated by the heating of the water, and is deposited chiefly upon the surfaces of the stones, while the heated and purified water finds its way through the grating into the reservoir below, from which it is fed to the boiler, the surplus of sediment and precipitate accumulating in the hopper below from which it can be blown out from time to time by opening the valve provided for the purpose.

This apparatus differs from most of the feed-water heaters of its class, by bringing the exhaust steam into direct contact with the feed-water; its condensation, is, therefore, very rapid and complete, and a material saving in water is thus effected, which, in some situations where water is measured through a meter, will amount to a substantial saving in the year. The heater delivers the water into the boiler at or near the boiling point, and materially free from scale-forming impurities. After a certain period, variable according to the quantity of impurities the water contains, the interstices between the stones become filled up, and they must then be removed and replaced by others. This state of things is indicated by the fluctuations of the load on the water gauge.

The makers claim for this apparatus that it is a simple and rapid condenser; that it can be placed in any convenient position near to or removed from the boiler; that it assists the engine by affording immediate relief to the exhaust; that its construction is so simple that there is nothing about it to become disordered; that the inflow of feed-water is automatically controlled, making the apparatus self-regulating; and that as a heater, purifier, condenser and fuel-saver it represents a simple and effective device, from which the best results and highest economy possible with this class of apparatus may be realized.

Messrs. Parke & Lacy, of San Francisco, Cal., have purchased the Eastern state-rights for the manufacture and sale of this heater and condenser, and are now sole proprietors for this section. H. N. Black, 21 Park Row, New York is their representative there, and will receive and give prompt attention to all communications.—*Manufacturer and Builder.*

NEW TYPE OF OCEAN STEAMSHIPS.

The present style of ocean steamship building has long been criticized by those who hold that many of the vessels now afloat are unseaworthy, and faulty in model and construction. Commander Cheyne of the English navy, recently said that the vessels of the present day look like long narrow planks. "It is no wonder that so frequently comes the report that a ship is missing. They weather no genuine storms at sea without great chances against them of disaster or utter loss. Vessels to-day are built for speed and for little else. The consequence is that we have a grand collection of long, narrow vessels, almost without beam at all, vessels which are liable to break in two in a high sea. To ensure safety there must be a change. Beams must be broadened; otherwise there will be no security." Two or three new and novel steamships are now in course of construction on the Hudson. One of these was described on page 224 of Vol. 2 in the *Industrial News*. The keel of a new steamship has been laid at Nyack-on-the-Hudson, which Capt. Mersland, of the Cunard steamship "Batavia," and Mr. A. P. Bliven, of New York, the inventors, claim will cause a revolution in ocean steamship construction. This ship has been ordered by the American Quick Transit Steamship Company, of Boston. The attempt is being made to produce a boat that shall be self-righting, that shall be very fast, and that cannot sink unless entirely torn to pieces. The boat is comparatively small, as it is intended only for an experimental or model boat.

Her dimensions will be ;—length over all 151½ feet; on the water-line, 135¼ feet; extreme breadth of beam 22 feet; depth of hold from crown deck to keelson, 16½ feet; draught forward, 5½ feet; draught aft, 10½ feet; capacity measurement, 512⅗ tons. The engines, boiler and machinery of this new vessel, the Meteor, are of entirely new designs, and are said to be capable of developing an enormous power. She will have three screws, the main one being four bladed and of such a pitch as to develop a speed of twenty knots an hour, allowing thirty per cent. for loss of power. The other screws are two bladed, of smaller diameter than the main one, and are auxiliary, to be used only in case of accident. They are fitted in the stern, forward of the main screw, and are locked in an upright position, with a plate over them flush with the hull. In case the rudder and the main screw should be carried away the auxiliary screws can be unlocked, and the plates covering them may be used to steer with.

After a successful trial trip of the model, ocean steamers upon the same principle will be constructed. The sides of this new ship will be carried over the deck in the form of a dome, making what is called a "turtle back." Says a writer in *The Century*:

"The side frames are made continuous and meet over the centre of the hull, or, in other words, the frames begin at one side of the keel, rise directly at an angle of about forty-five degrees in the water-line, and then curve inward over the deck and back on the same lines to the keel. A section of the hull taken in the centre is thus of a wedge shape, with a sharp edge below and rounded top above. This wedge form is preserved through the entire length of the hull. There are no hollow lines in the boat, and the sharp, overhanging bow is intended to part the water near the surface and to form a long, tapering wedge. The widest part of the hull is exactly at the middle, both ends being precisely alike. This is quite different from the flat bottom and straight sides, with comparatively bluff or rounded bows, of the ordinary ocean steamship. The boat is intended to be much deeper aft than forward, and the deck will be much lighter above water at the bows than at the stern.

There will be no houses or raised constructions of any kind on the deck, except the dome-shaped pilothouse, the ventilators, and the smoke-stacks. There will be an open railing around the centre of the deck, so that it can be used as a promenade in pleasant weather or whenever the seas do not break over the boat. The object of this unbroken dome-shaped deck is to enable the boat to throw off all waves that break over the bows or sides in rough weather. It is thought that, instead of shipping tons of water and retaining it on deck till it can be drained off, the boat will shed or throw off the water from the long, sharp bows and open deck, and will at once relieve herself of the weight of the water. Waves striking the rounded deck will have no hold on the boat, and their force will thus be spent harmlessly. The sharp wedge shape and rounded top of the hull, and the fact that even when fully loaded the centre of gravity will be below the water-line, makes the model self-righting.

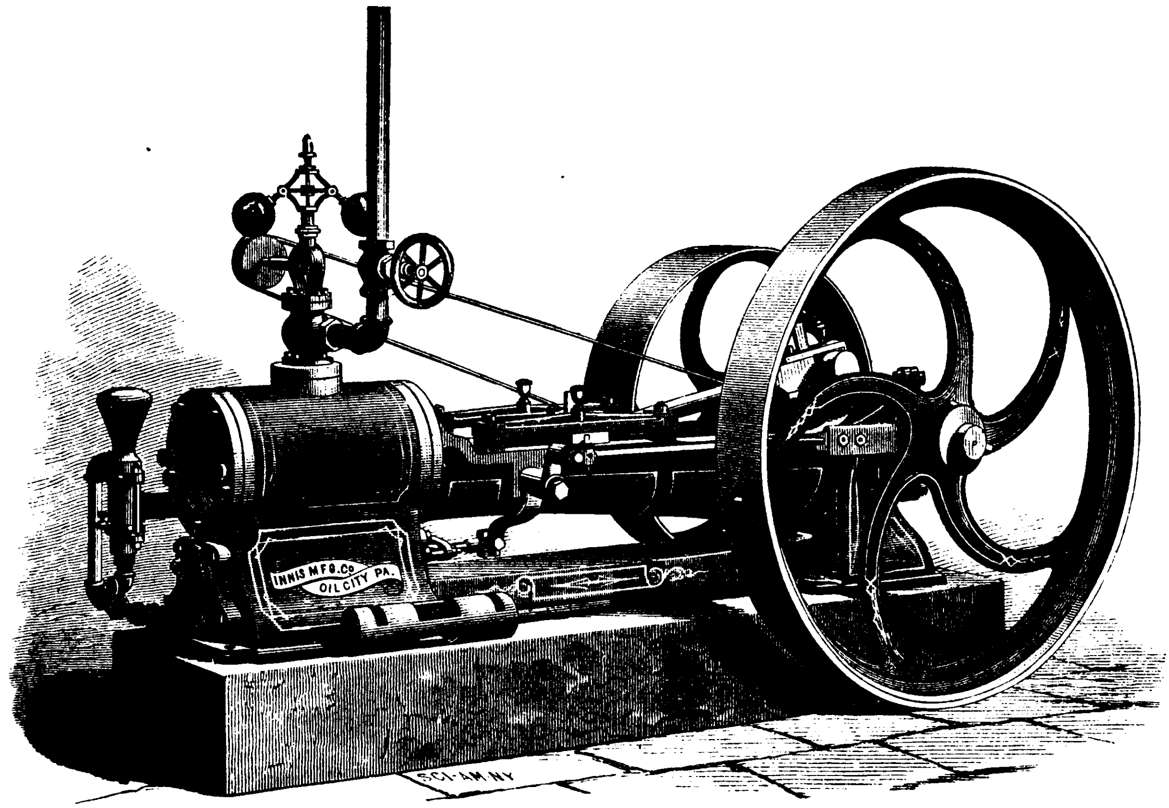
From experiments with a small model, this claim of the inventor seems to be clearly proved. In laying out the boat, only the spar deck will be used for passengers. the main deck and all below being intended for cargo, coal and engines. The staterooms will be arranged along the outside, each room having a port in the side of the boat, while the ceiling will be formed of the curved deck above. The saloons will be the whole width of the ship, and on the spar deck. For lighting the saloons there will be sky-lights in the centre, and as these in rough weather may be covered by the seas that sweep over the deck, they will be very strong, and will be air-tight. To secure ventilation there will be steam-fans, kept in motion at all times, and maintaining a good circulation of air through every part of the boat. For this purpose the fresh air will be taken through wind-sails on the deck, and the exhaust air from the rooms will be turned into the blast used in forcing the fires. No boats are to be carried on deck; the life rafts and boats will be kept in an apartment under the domed deck at the stern, and when they are to be launched, doors will be opened in the deck and the boats launched in the usual way from davits through these doors. The pilot-house will be at the bows, and will be entirely inclosed. It will not rise much above the deck, and will be entered from below.

There will be no masts or sails, as it is intended to depend wholly on the engines for propulsion. In constructing the hull, to secure great strength, three heavy trusses, or "hog frames" are to be placed on the keel, each one rising to the spar deck and securely fastened to the side frames of the boat. The ceiling will be double, and placed diagonally on the frames. In the larger steamships, the absence of sailing power will be compensated for by two extra engines and two supplementary screws, that can be employed in case the larger screw is lost or the main engines break down."

IMPROVED STEAM ENGINE.

The Innis Manufacturing Company, of Oil City, Pa., has, for several years, been making a specialty of building a 9 x 12 engine for oil well drilling, the design of which is represented in the accompanying engraving. This engine is fully secured by patents, and is made only by this company, who now have about 1,500 in use in the oil region. These engines having given universal satisfaction, the Innis Manufacturing Company have determined to introduce them for other uses. The demand in the oil regions for this particular size has been such as to enable this concern to arrange tools to build them on the duplicate plan, using templates and guages for all the parts, thereby reducing the cost, while unnecessary finish is dispensed with to meet the wants of a cheap steam power. All of the working parts are strictly first class. The cylinder, valve bore or chamber, exhaust chamber (which also acts as a portion of the heater), and the supports or leg of the cylinder, are all cast in one piece, to which the bed is firmly bolted. The valve, which is of the piston kind, is placed directly below the cylinder, and the exhaust chamber directly below that. By this arrangement the cylinder readily frees itself of condensed water, as the ports are open from the bottom of the cylinder downward to the heater when exhausting. There is a steam passage around the outside of the cylinder and under the jacket that conducts the steam into the central port of the valve, from which it passes up into the cylinder from the ports near the end alternately as the valve travels back and forth, and exhausts down past the end into the exhaust chamber or heater.

The valve (which is seen lying on the engine block) is claimed by the inventor to be a great improvement over the ordinary piston valve. It really acts as its own steam chest, being always full of steam up to as nearly boiling pressure as practical. It is a long hollow shell, very thin and light, having a large amount of bearing surface in proportion to its weight, and consequently subject to but very slight wear. We are informed that one in the manufacturer's shop, after five years' constant use, appears as good as new. It being a balanced valve, the wear of eccentric and all the valve gear is very slight. The bed is of a very rigid form, being trough-shape, the top edge of which forms the lower slide for the cross-head, and is on a line of the centre of the cylinder and main shaft, and takes the strain in a direct line of the power applied. The pump is worked in the usual way from the cross-head. The heater is composed of four one-inch pipes, the entire length of cylinder and bed, and delivers the water to the boiler very hot. Pump and heater are dispensed with when not required. All parts are easily accessible.



INNIS' STEAM ENGINE.

INTERESTING EXPERIMENTAL BOILER EXPLOSION.

The first experiment by Mr. D. T. Lawson, of Wellsville, Ohio, was exploding a steam boiler of practical size, which contained the usual working quantity of water. It took place on June 16, 1881, and was illustrated and described in the *Scientific American* and *Supplement* of December 24 and 31. As then stated, the object is to define the nature of the causes of boiler explosions, and to show the efficiency of the experimenter's patent device in the prevention of that class of explosions that occur upon opening the engine throttle valve or other principal steam outlet of the boiler after an interval of rest. Mr. Lawson's device consists of an arched perforated diaphragm fixed horizontally near the water line inside the boiler. An illustration of it, as applied to a horizontal two-flue boiler, was given in the *Scientific American* of July 4, 1880.

In accordance with a determination formed after his first experimental explosion, Mr. Lawson had two boilers made of the best iron, duplicates in form, size and materials of his first one. One of these contained the diaphragm and the other did not. They were horizontal cylinder boilers, thirty inches diameter by six feet long, the shell of two plates of three six-ninths inch and the heads of three eighths inch iron. The heads were stayed by a one-inch iron bolt which passed from end to end through the centre of each head. The diaphragm in one of these boilers was of three-sixteenths boiler iron, flanged and riveted to each boiler-head and along each side of the shell, as indicated by the rivet heads and dotted lines, Fig. 2. The top of the arch of the diaphragm was about seven inches below the summit of the cylinder. There was also in the patent boiler a man-hole of the usual size in the rear head. The opening was re-inforced by a strong wrought iron rim riveted to the boiler head. There was no man-hole in the other boiler.

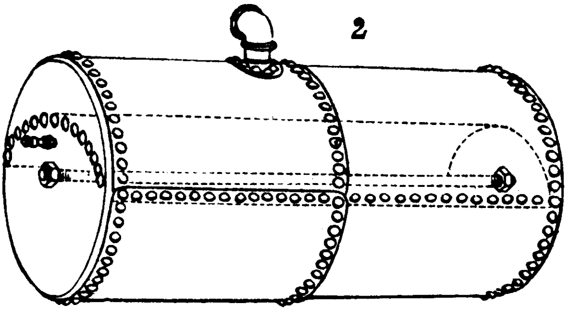


FIG. 2.—LAWSON'S PATENT BOILER.

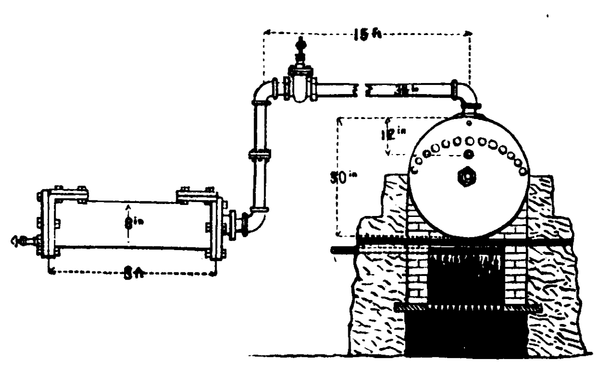


FIG. 3. ENLARGED ELEVATION OF LAWSON'S APPARATUS

FIG. 1.—VIEW OF THE MUNHALL VALLEY, SHOWING THE ARRANGEMENT OF LAWSON'S EXPERIMENTAL BOILER.

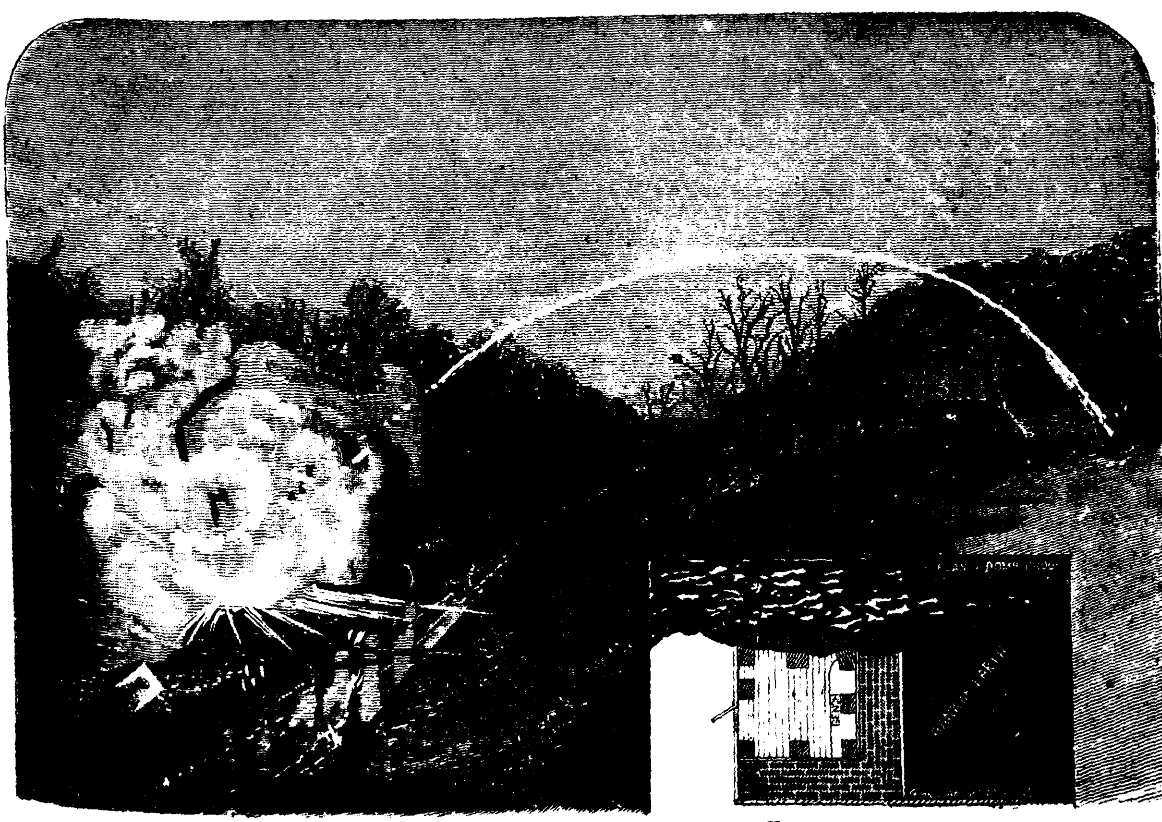


FIG. 4.—LAWSON'S EXPERIMENTAL BOILER EXPLOSION.

The second series began on February 17, and after an interruption of some time, occupied in perfecting arrangements and procuring standard pressure gauges, they were continued on and after March 7, and ended with the explosion, herewith illustrated, on March 22.

Fig. 1 shows the scene of explosion, Munhall Valley, on the west bank of the Monongahela, about eight miles from Pittsburg, Pa. It was here the government explosion experiments were conducted in 1878, the buildings shown being the bomb-proof structures erected by the commission. The sectional plan on the right of Fig. 1 is that of the bomb-proof used by Mr. Lawson. A large upright boiler and a high pressure steam pump remain in the pump house, and an unused steam boiler lies near the upper bomb-proof, relicts of the work of the commission. One of the building on the right (Fig. 1), also bomb-proof, was for the accommodation of visitors, who could there get a view of the whole line of operations through horizontal crevices cut in the joints of the heavy timbers.

On February 17, Mr. Lawson's patent boiler having been set up, as shown in Figs. 1 and 3, the second series of experiments began. The boiler was set in masonry, and connected with it were fifteen feet horizontal and about three feet vertical lengths of three and a half inch wrought iron steam pipe, leaving the top of the boiler at the middle of its length and entering the stuffing box of an old empty steam engine cylinder eight inches diameter and thirty-six inches long. Near the elbow of the pipe which turned downward toward the old cylinder was a three and a half inch quick-opening gate valve, seen in Fig. 3, and enlarged in Fig. 4, of the Eddy pattern. In the head of the old cylinder was a Mississippi gauge cock which could be operated from the interior of the bomb-proof. The boiler furnace was fitted with a half-inch iron pipe, which entered through the side wall just below the bottom of the boiler and extended in a perforated section across the furnace for the distribution, upon the incandescent coals, of liquid fuel supplied from a barrel placed at a safe distance in a cavity of the bluff (seen at the left of Fig. 1). The flow of oil from the barrel could be regulated by the valve at the door of the bomb-proof, as shown.

Inside the bomb-proof were two pressure gauges (only one at first experiment, February 17), both connected to the front head of the boiler, one above and the other below the diaphragm, to indicate the pressure and the disturbance in the steam and in the water pressure when the three and a half inch gate valve was suddenly opened.

At the first experiment of this series it was found that the apparatus was not complete, and especially that the pressure gauge was 50 to 100 pounds "too fast" when compared with the United States standard gauge used by the local inspectors of steam vessels, as far up as that standard reached. The pressure was, however, run up on this first occasion to 275 pounds by the imperfect gauge, which was estimated to be equal to 225 by the standard, and a number of shocks were made by pulling open the steam gate at various pressures below, and at the maximum pressure then obtained.

On the 7th of March, the plain boiler having been set up a little further from the bomb proof, the adjourned experiments commenced; but after several attempts to get a high pressure in this boiler (having no diaphragm or man-hole, but in all other respects like the patent one), it had to be abandoned, one of the heads having cracked on three short radial lines around the centre bolt, so as to cause a leak, which prevented the increase of pressure beyond 220 pounds. These cracks were apparently started by the violent use of a large drift pin, to enlarge the bolt hole, unmistakable marks of which appeared on cutting out the centre portion of the head for repairs. A prominent lip was turned all around the inner edge of the hole. The patent boiler was reset substantially as before, with more perfect appliances for handling the gate valve, the lever of which had proved insufficient, and on the 20th of March, steam was again raised, and shocks were made at every 25 pounds rise till 300 pounds pressure by the standard gauge was indicated, when a last shock was given without producing an explosion. The diaphragm was then cut out except a margin all round, through which the rivets passed, about three inches wide (see Fig. 5). The main portion, which was too wide to pass through the man-hole, was left loose in the boiler.

On the 22nd of March, the operations of the 20th were repeated, with twenty inches depth of water in the boiler. The pressure rose in six minutes from 175 pounds to 235, the valve having been opened every 25 pounds as before, and the last time after a rise of 10 pounds. When the gate was opened at 235 pounds pressure the boiler exploded with terrific force, all the water disappearing in an atomized form; each elementary globule of one thousand pounds of water, at 400o Fah., simultaneously (not progressively as powder burns) exploded and was diffused in practically ultimate atoms, like a cloud of steam in the air, Fig. 6.

The boiler was literally torn into shreds, beginning probably with the breaking of the one-inch stay bolt, which was the most heavily loaded section of the parts of the boiler. Thus, if the bolt sustained one-quarter of the load on the thirty-inch boiler head when the pressure reached 235 pounds, it would be subjected to a strain of 66,000 pounds to the sectional square inch, or 40,000 pounds upon the six-tenths of a square inch, which it had at the threaded ends—quite enough to break a threaded bolt. The sudden pulling of the nut through the boiler head would have been followed by similar phenomena, namely, an apparently simultaneous destruction of all the stronger parts of the boiler, which are then acted on by a moving and not a statical force, as when the boiler was whole; moreover, the force acts on the plates of the shell once broken open in a cross-tearing direction, as one tears a sheet of paper, instead of as one would break a string, or as the test samples of iron are broken in a machine. It will occur to the reader that this construction of these experimental boilers was admirably adapted to the end Mr. Lawson had in view.

The cracking of the head around the bolt of the plain boiler, at the experiments of March 7 and 8, probably rendered it impossible to get a breaking strain on the bolt, and the rupture of the iron was slow enough to prevent the pulling through of the nut in a sudden manner before the pressure fell and equilibrium of force and resistance was established.

The record of the commission appointed by the Secretary of the United States Treasury—Supervising Inspector of Steam Vessels, John Fehrenbatch, of Cincinnati, O., and Deputy Inspectors Atkinson and Batchelor, of Pittsburg, Pa.—show that the pressure always fell on opening the gate valve, and then the gauge fluctuated to a point above, settling at last sometimes at apparently the same, and sometimes at a lower point than that from which it started downward—a perfectly natural and often observed result of suddenly withdrawing one-tenth of the volume of the steam from a boiler to which a sensitive spring gauge is attached.

When the gate valve was opened it was equivalent to suddenly enlarging the steam chamber of the boiler about one-tenth of its capacity; but, inasmuch as the sudden lowering of the pressure was followed by an evolution of steam from the water, which had a normal temperature of 400° Fahr. when under a pressure of 235 pounds above the atmosphere, the theoretical effect of withdrawing one cubic foot of steam would, under these conditions, be a lowering of the pressure something less than one pound, provided no heat is entering the boiler at the instant or during the oscillations of the gauge pointer.

But the gauges used upon these occasions were graduated to five pounds, having no pound or half pound marks, and they were not reliable as indicators of actual variations. It appears, first, that the pressure at which these tests were made left but little margin of strength in the boiler; and, second, that the area of the opening from which the steam was suddenly withdrawn was about one two-hundredths of the surface area of the water, and these conditions, compared with the usual manner of opening the valves, will be recognized as immense exaggerations of the most vicious practices in the use of steam boilers.

While Mr. Lawson's experiments show that a boiler may explode while it contains a full supply of water, they do not, on the other hand, show that boilers do not sometimes explode from lack of water. While they also show that a big throttle valve may be suddenly opened with impunity while a proper maogin of strength remains, they do not prove that a weak boiler will or will not break at the instant the engine throttle is opened, producing a very mild shock.

On the whole these experiments, so far as they have gone, are simply confirmatory, almost a demonstration, of the opinions held and taught for many years, by many well informed writers and thinkers on the subject of boiler explosions.—*Scientific American.*

An interesting telephonic experiment was recently made in the French Senate; two apparatuses being placed right and left of the tribune, and speeches transmitted to the Petit Luxembourg, to the room of the President of the Senate, where they were distinctly heard and taken down in shorthand.

SOLIDITY IN MACHINERY.

The treatment of iron in machines has, for many years, been too much like its use for toys and ornaments, a pretense of lightness in imitation of other material The saving in the first cost of castings, and in the price of wrought iron has been a large, if not a principal element in the production of all machinery products of iron. Lightness of material and airy elegance of form have been frequently quoted as evidences of superiority. Lots of this sham trash have found their deserved way to the scrap heap and the foundry cupola, but much more remains to be relegated to the same destination.

The trifling with the capabilities of cast iron seen in common architectural ornaments and lawn and cemetery fences can be borne, as it is merely an offence to common sense and good taste; but the tricks shown by economic builders of machinery, especially machine tools, are reprehensible.

I know of an instance where a maker of ordinary household pumps, of cast iron, deliberately threw aside an entire set of patterns, because by a new set (costing more) he could save 20 cents on the cost of weight of castings for each pump. He probably lost on the price of the new patterns, on the baulks in the foundry by thinner patterns, on the after work by having harder iron, and on the additional grumble by purchasers of the "improved" pump, which they returned broken, a much larger amount than the supposed cheapening of the pump by the saving of iron. And yet this lightening the weight and decreasing the cost of the iron castings is to-day a considered element in machine building; and the manufacturer who can show the lightest castings—other requirements being equal—is the one who believes himself to have arrived the nearest to mechanical perfection. These iron savers seem to imagine that iron ranks amongst the precious metals, and is valued solely by its weight, and hardly by its usefulness. Or, they assume to be æsthetic in its use, and desire to be recognized by their artistic taste in forming it.

All this is nonsense. Iron is not adapted to works of art, the cast iron statues of modern times and the wonderful forgings of mediæval times to the contrary notwithstanding. There have been surprising achievements in the fashioning of iron by hand, and remarkable results from the molten metal; but none of them prove the proper application of the metal to be that of furnishing tasteful forms or artistic products.

In the mechanic art iron is a resistant. It occupies in mechanics a place similar to that of granite in architecture; it is to resist, and bear, and sustain, and hold. In fact it is shown at its best in the anvil, and this idea should be the prevalent one in the building of machines, especially those that are worked by reciprocating motion. It is of less importance that rotary working machines should be unusually stiff, as the strain is mostly continuous.

But the planer and the header (of rivets and screws) test the capacity of iron. Think of a planer platen with a load of five tons or more—in many cases double that amount—moving in one horizontal direction at the rate of 20 feet per minute, brought to a sudden stop, and started on a reverse, or return, speed of 30 feet per minute; what sort of material, but iron, could stand such shocks, repeated over and over, day by day, for years? And yet one may stand by the heads of planers and with the finger feel the "give" as the chip "takes," and as for the shock of the return, the entire floor responds to it.

It is quite evident that exact work is impossible under such circumstances. One fault with many of our planers is that the uprights and the cross bar are not strong enough; they have not iron enough; they give to every chip-take. So little is this matter considered that in one shop recently visited one planer had its uprights of solid web and gradually curved in a convex radius from the top to the bed, while one other, of the same size, had a web with three great holes in it and the backward curve made into a section of an ogee molding. Yet both of these planers were used for similar work;

It is difficult to make tests of the failure of weak machine tools in operation, owing to the general tremulousness of the shop; but the writer has been assured, by one who has tried to ascertain the differences in machines in actual work, that he has made satisfactory experiments to the effect that the upper part of the upright of a 40-inch planer "winked" three-sixteenths of an inch on taking the chip. Possibly part of this was due to insecure foundation, as the planers tested were on a second, or supported story.

But there is another lack of solidity in the burden-bearing quality of machine tools. It may be a matter of doubt if the beds of planers loaded with a job are usually level, or straight. If some recent discoveries made by a prominent machine tool builder are true, the really level planer bed is the exception. Failing in getting good results from his heaviest planer, which frequently planed a load of nearly six tons, he instituted experiments that induced him to build a pier of masonry under the centre of his big planer, from the hard pan of the cellar, and mount on it two jack-screws, one under each planer "way" to keep the planer from sagging while at work. He stated that the sag in the length of 10 feet was "more than one-eighth of an inch." It is scarcely to be doubted that this experience could be duplicated in many shops.

If such discrepancies exist in general shops, similar ones may be possible in others where tools of precision are produced. If exactness is desirable in mechanical work, it should begin at the beginning. First let the tools—the machine tools—have have plenty of material, and then place them on secure foundations. This present plan of building storied buildings, and raising added additions above the ground, must be given up before tools of precision can be produced with absolute certainty. And our tool builders and machine manufacturers must cease to look upon iron as a costly material, but regard it as a convenient means to a desirable end.—*Cor. Boston Jour. of Com.*

Scientific.

M. CARPENTIER'S MELOGRAPH.

M. Carpentier describes, in *La Nature*, a small apparatus for reproducing music, which he devised and constructed some years ago, and which was made in the following manner: A small rectangular box was inclosed on all sides; in the interior there were thirty small harmonium reeds in juxtaposition, very delicate taking up but little space, and fastened in the usual manner. These reeds were inserted in mortises in the sounding-board. At the bottom of each mortise there was a small orifice leading to the outside of the box. On one side of the box was a tube for supplying air from any suitable blower. By means of a crank and cylinder a large band of paper was drawn over the perforated face of the box in a direction perpendicular to the line of the orifices. The paper was pierced with long and short slots, and in its progression the band of paper carried these slots over the mouths of the various pipes, givng escape to the wind through the reeds, when the melophone would play automatically the piece thus inscribed.

After the invention of this apparatus M. Carpentier heard of a similar instrument in America. He now turned his attention to the construction of the perforated bands, which were similar to those used in the Jacquard looms. He combined with the melophone a melograph, intended to record stenographically the pieces played upon an instrument with keys, but employing the characters adapted to the melophone. The melophone was modified and arranged to operate on larger bands suitable to an organ or piano.

This apparatus was exhibited at the International Exposition of Electricity at Paris.

This new instrument is capable of repeating automatically any piece and not only reproduces the manner of the player, but even any false notes which may be struck. By passing the band through a printing apparatus the piece, instead of being played, is written in ordinary characters. This musical press is not an experiment, but will prove to be of great practical value.

In describing the apparatus the harmonium should be considered as one part, and the melograph as another part. Fifty wires concealed beneath the floor put the two instruments in communication; they are about five metres distant from each other. Fifty of the keys of the harmonium are provided with such devices that their fall throws an electric current into the corresponding wires. These currents, which are controlled by the melograph, operate a series of perforators, which inscribe upon a band of paper the movements of the key which sends it. This band is carried along in the apparatus with a uniform movement. In a second unrolling of the band which has been rewound, fifty small brushes of silver wire placed in the instrument make contact through the holes with a crosspiece, against which they press the paper. When one hole permits the brush to touch the crosspiece a current circulates in one wire of the line, and puts in operation the opening mechanism of the corresponding key, and determines the emission of sound, sustaining the sound as long as the crosspiece remains in contact with the bar.

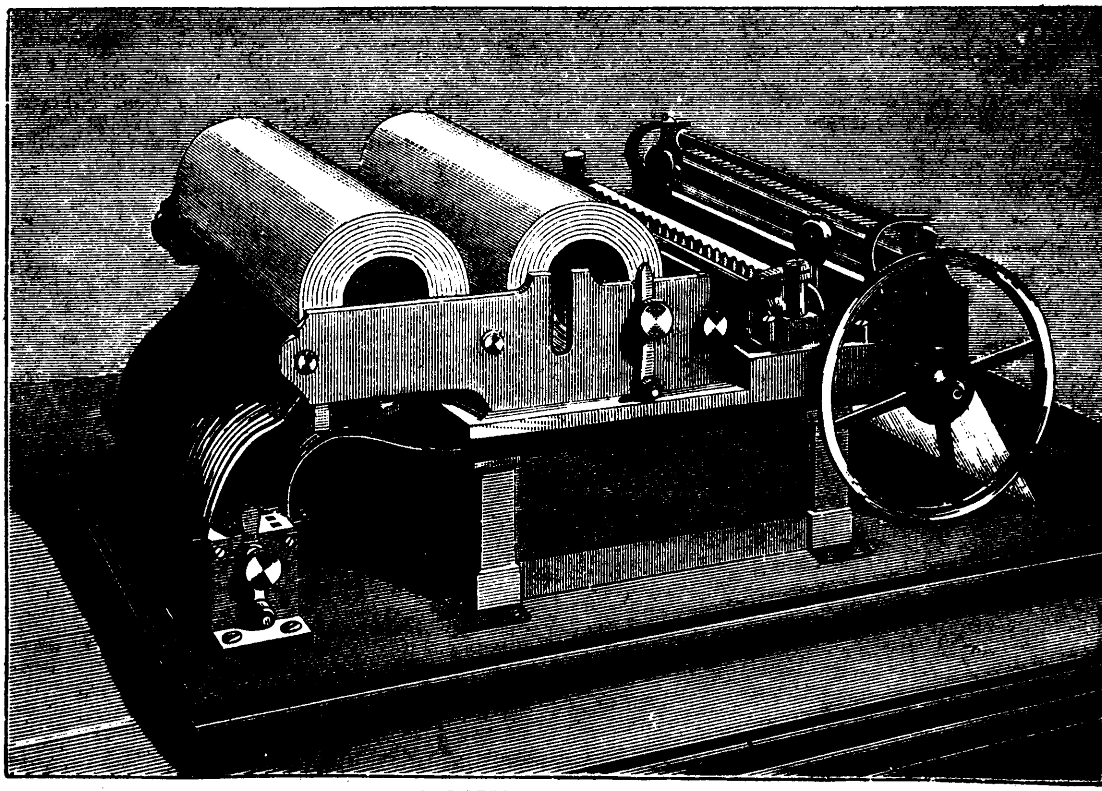


FIG. 1.—M. CARPENTIER'S MELOGRAPH FOR REGISTERING AND REPRODUCING MUSIC.

This general explanation having established the relation which exists between the different parts of the apparatus, M. Carpentier describes separately the principal organs which are represented in Figs. 2 and 3. Above each key there is a spring, *a* (Fig. 2), which is capable of touching a band of silver, *b*, reaching the length of the crosspiece, *c*, which covers the posterior part of the keys. A guide, *d*, attached to the key and moving easily in a hole in the crosspiece, *c*, keeps the spring raised when the key is in a position of repose. When the key is depressed the guide is carried with it, and the spring, *a*, is released and makes contact with the strip, *p*. Two regulating screws allow variations of the current and the tension of the spring. The current sent by the key is directed over a line wire in passing by a commutator, *e*.

The currents transmitted by the harmonium and received in the melograph, produce the movement of the parts through the agency of electro-magnets, *a* (Fig. 3), of special form. The movement of the armature, *b*. is transmitted by the rod, *c*, to the angled levers, *d*. At the extremity of the horizontal arm of each lever is found an embossing point, which rests upon the paper and marks there the trace of the pressure which the musician exercises upon the keys of the harmonium. This point, in marking the paper, pushes it up into one of the mortises in the plate, *f*, under which the band circulates, and it approaches thus to a rotary cutter having two teeth and revolving rapidly. The part of the paper which is thus presented to the action of this tool will be instantly cut, and the markings converted into perforations.

In order to avoid the double danger of piercing the paper imperfectly or of causing the collision of the embossing point with the teeth of the cutter, two bands of paper are superposed; the first is completely cut away, and the cutter enters only into the surface of the second one.

In reading the bands the melograph transmits the currents and the harmonium receives them. The commutator, *e*, may be turned so as to cause the melophone to transmit or receive currents. For each key of the harmonium there is an electro-magnet, *f*, similar to those of the melograph. Below the keyboard there is suspended to each key by flexible bands a small wooden shoe. These shoes are received by grooves in the cylinder, *h*, which turns with a continuous and rapid motion. When the electro-magnets are traversed by a current the armature presses the shoe against the cylinder, *h*, and the friction of the shoe against the cylinder draws down the key and permits the note to sound.

M. Carpentier says that the melograph is constructed with great precision, and that the movement of the parts is regulated to the hundredth part of a millimeter.—*La Nature.*

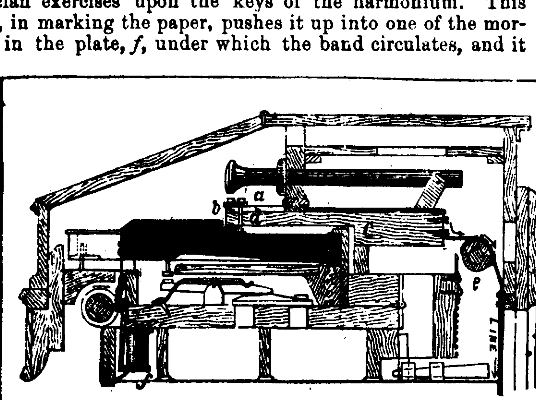


FIG. 2.—DIAGRAM OF HARMONIUM.

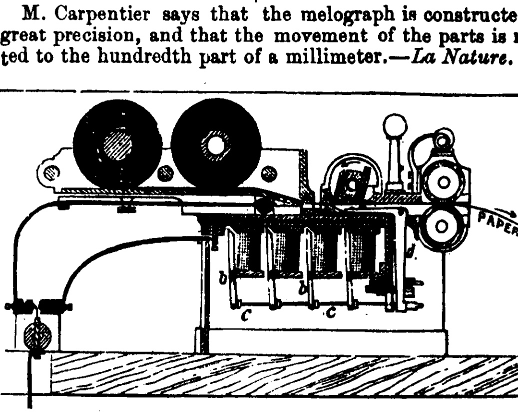


FIG. 3.—DIAGRAM OF THE MELOGRAPH.

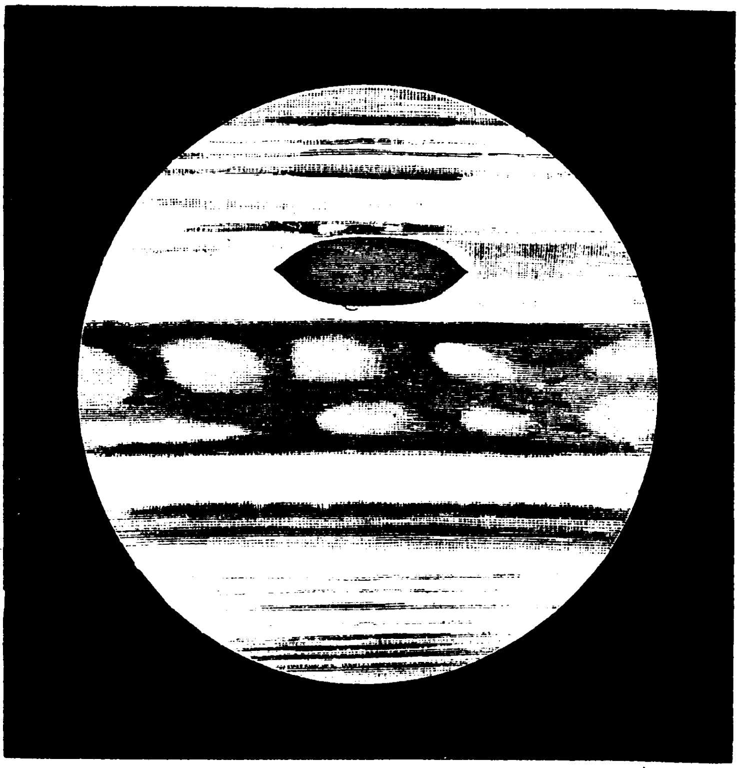


Fig. 1.—The great red spot in transit, December 7, 1881, 10h. 40m. There was a large white patch near the equator under the following side of the red spot. Immediately south of the red spot is a narrow belt with light and dark ovals upon it.

Fig. 2.—The bright spot in transit, December 18, 1881, 6h. 12m. The following side of the red spot is seen on the western limb. To the east of the light spot, and in nearly the same latitude, is a dark mass emerging from the great southern belt.

Astronomy and Geology.

JUPITER.

No planet of the system affords a more satisfactory study for the telescopic observer than the one that wins, for his giant size and beautiful appearance, the name of the Prince of Planets. The interest has been greatly increased during the last four years by marvelous changes that are taking place on its surface, all bearing testimony to the tremendous commotion that agitates his chaotic mass.

The most noteworthy markings on his disk at the present time may be classed in three divisions; the great red spot below his south equatorial belt, the rose-colored northern belt, and the luminous white spot near his equator. A great many astronomers have made careful notes of these markings, but those of Mr. Denning, of the Dun Echt Observatory, Bristol, England, commend themselves to special notice.

The red spot is the more familiarly known of the markings It first appeared in the summer of 1878, nearly four years ago, and has continued ever since with scarcely perceptible change of form or color, though there is now a slackening in its motion which may be the precursor of dissolution. It is situated south of the south equatorial belt, and is parallel to it. Its dimensions are variously estimated at from twenty-two to twenty-nine thousand miles in breadth, and from seven to nine thousand miles in width. It is at least one-fourth of the diameter of Jupiter. Our globe could be rolled over the spot, and probably leave many thousand miles of space for the commencement of a second revolution. Its form is elliptical, the ends tapering to a point. At a view we had of it not long since, when passing off the disk, it resembled in form a huge cigar. The color is a lovely rose tint in charming contrast with the soft, golden hue of the body of the planet. It has been a beautiful object for observation during the winter, even a two-inch telescope bringing it into view.

Many conjectures have been made as to its origin, which thus far rank simply as theories. Some observers consider it a rift in Jupiter's cloud atmosphere; some think it reveals the the red-hot planet beneath the clouds; and some perceive in the strange aspect the upheaval of a continent. The spot has been so long visible, and retained so unusual a condition of permanence, that careful computations of the time of its revolution have been made in the hope of determining the exact time of the planet's axial rotation. Four prominent astronomers reached a result within a second of the mean of their observations. The average was 9h. 50m. 34·5s.

The second study on the Jovian disk is the rosy belt in the northern hemisphere. Observers have actually seen the formation of this belt through the whole process. During the three closing months of 1880 there was an outbreak, and an outspread of a series of dusky spots, which were finally dispersed around the planet, and took the form of the rosy northern belt which still retains its permanence. The probability is that belt and spot are both the result of commotion in the cloud-atmosphere, which is supposed to surround the nucleus of the planet to the depth of many thousand miles.

The third and latest topic of interest on the face of our gigantic brother planet is the appearance of a number of bright spots or patches of light between the broad bands, known as the equatorial belts. These spots have been visible nearly as long as the great red spot, but did not at first attract as much attention. In 1880, however, it was discovered that they moved faster than the red spot, and interest was quickly concentrated on this remarkable phase. Several practical observers computed the time of their rotation, and found the period five and a half minutes less than that of the red spot. One luminous spot stands out from the others as the most conspicuous of its class, and may still be seen, for a short time, before Jupiter ceases to be an object of present telescopic attraction. Observers have found great enjoyment in watching the white spot as it gained upon the red spot, making, by its independent motion, a whole circuit of Jupiter, relatively to the red spot, in forty-four and a half days. The diameter of the white spot is variable, sometimes reaching nearly five thousand miles. It seems also to be subject to a kind of periodicity, presenting a bright aspect for about fifty-six days, then becoming obscure as if by the passage of clouds, and then resuming its former brightness and moving with accelerated velocity.

Mr. Denning has a theory in regard to this spot that deserves careful consideration. He thinks the spot is self-luminous, and emits light; that it is a projection from the real surface of the planet; that it is a permanent feature of the planet and that it lies far below the level of the dusky belts. If future observations should confirm this theory then we may have a reliable means of ascertaining the period of Jupiter's rotation on his axis, which, according to the bright spot, is 9h. 50m.

It will be seen that Jupiter leaves our neighborhood in a cloud of glory. He will not be of much account as an object of observation for some time to come, as he draws closer to the sun. But when the beautiful summer mornings come, and he shines as a bright morning star, the telescopes of the whole world will be turned upon the beaming star. Intense will be the interest to find out if the luminous spot still shines near the southern equatorial belt, like a permanent projection from the planet: if the great red spot remains unchanged in the southern hemisphere; and if the rosy belt still circles below the northern pole; or if new rifts, belts, and spots are taking the place of those which have become familiar to terrestrial observers for the last three or four years.

All observation points to the inference that we are watching the process of world-making on our giant brother planet four hundred million miles away. Such as Jupiter is now the earth was millions of ages ago, when she was without form and void. Jupiter, thirteen hundred times the earth's size, takes a proportionally longer time to cool off. But, larger or smaller, the planets follow the same inevitable law, development, perfection, decay. Thus, in the perfection of our own planetary development, we may watch the slow process by which our magnificent brother parts with his heat, and takes on conditions that will eventuate in the rudest forms of vegetable and animal life. Millions of ages, as we count time, must pass before he reaches our stage of existence. When that time comes the earth will probably have fulfilled her mission in the economy of the universe, and will have taken her place as a dead world, as the moon has done before her, as the larger planets will do after her. Even the glorious sun must succumb to the same inexorable destiny, when, after the passage of countless ages, his fires cease to burn, the mysterious fuel that now sustains them being exhausted.

We are indebted to *Nature* for our drawings.

Scientific Items.

ETCHING FILM FOR TRACING WITH A NEEDLE.

Mr. H. Trueman Wood, the Secretary of the Society of Arts, sends the following to the *Photographic News*;

There are many cases in photography for which an opaque film capable of being etched with a sharp point might be useful. Such a film can be obtained by use of the following formula; Negative collodion, one-half ounce; ether, 6 drachms; alcohol, 6 drachms; shellac, 30 grains; aurine, 2 grains; Judson's mauve die, 30 drops; water, 30 drops.

A collodion thus treated gives a film which is perfectly non-actinic, and which allows the finest tracery to be executed upon it without any tearing or chipping whatever. The film is the result of a good many experiments, and was devised by a friend of the writer for the purpose of reproducing tracings made by a geometric chuck in the lathe. As a general rule, these patterns, which form the delight of so many amateur turners, are either traced with a pencil suitably held, or by a glass pen charged with aniline ink, the latter being the more recent device which has superceded the old pencil. They are, of course, also cut on wood or metal with suitable tools. By the use of a plate covered with the film of the above described mixture, a steel point can be used. The glass plate is properly held in the chuck. and a steel point, which may be fitted with a spring, so as to prevent undue pressure or risk of breakage, is placed in the position, usually occupied by the pencil. The pattern is thus traced in perfectly clear glass, and from the negative—if the term may be used—thus produced, prints can be taken on ordinary albumenized paper. As the film itself transmits practically no actinic light, the printing can be carried to any extent, and a perfectly black print produced. The film may also be etched upon with an ordinary etching needle, or even with a common needle, and prints produced from the plate thus obtained.

Another use of the formula is for the preparation of lantern diagrams. Any diagram can be rapidly traced upon a coated plate, and the diagram can then be thrown on the screen in the ordinary manner, appearing, of course, in bright lines on a black ground. A diagram of this sort is quite as effective as, if not more effective than the ordinary black lines on the illuminated ground. as was shown by the very vivid way in which a negative diagram, recently employed by Mr. Bolas at one of his Cantor lectures, shone out across the screen. It would, of course, be easily possible to obtain a printing block by any of the ordinary methods from a plate etched in this manner.

The mixture requires some little care in its preparation and especially as regards the addition of water. It is better to add the water gradually, coating the plate occasionally after each addition of a few drops. The formula might doubtless be susceptible of considerable modification ; but the one given above has been proved to give the best results of any which have yet been tried.

THE PLETHYSMOGRAPH.

This is an apparatus for detecting the variations in the size or dilatation of a body. For example, by its use, the dilatation or contraction of the human hand, arm, or other organ can be ascertained. The hand or organ to be tested is placed in a vessel containing a liquid. Connected with the vessel is a test tube, a stylus, rotating cylinder, etc.

At a meeting of the Massachusetts Institute of Technology, Dr. Bowditch, proceeded to exhibit this use of the instrument.

For this purpose an assistant placed his arm in the apparatus, and the arm was then surrounded by water heated to a blood heat. The connections having been made, Dr. Bowditch waited until the style was describing a line nearly horizontal, and then directed the assistant to multiply twenty-three by seventeen in his head. As soon as he began to think this out, the style rose rapidly and remained up till he had finished the computation, when it fell thus showing that during this process a certain amount of blood rushed away from the arm. When the style began again, after a minute or two, to trace a line nearly horizontal, the assistant was directed to multiply thirteen by twelve. During this process the style rose, but not nearly as much as in the former case, showing that a smaller quantity of blood left the arm in this case than in the preceding.

Dr. Bowditch then related the story that a friend of Prof. Mosso, who claimed that he could read Greek as easily as he could Italian, had his arm placed in the apparatus by the professor, who presented him successively an Italian and a Greek book to read. While reading Greek the style rose very much more than while reading Italian, and thus the instrument demonstrated that the friend was mistaken in regard to his powers, and that it was much easier for him to read Italian than Greek.

In answer to a question as to whether it could be used to study the effect of digestion, Dr. Bowditch replied that it probably could, but that the fact that digestion is exceedingly slow might present a difficulty.

In answer to some other questions, Dr. Bowditch said that the results shown by the instrument in its present state of advancement are purely qualitative, and that no quantitative determinations have been made ; also, that, because we have a certain amount of blood leaving one arm during a mental process, it would not be safe to assume that the same amount left the other arm, or even to assume that the amounts of blood leaving one arm during certain mental processes were proportional leaving the whole body.

TELEGRAPHING FROM A MOVING TRAIN.

The Santa Barbara *Press*, of California, gives an account of a patent recently issued to a resident of that town for a method of telegraphing from a moving railroad car. The invention enables each freight or passenger train to have its own telegraph office. Two wires are required instead of one, and these are suspended directly over the track, and above the moving train. They are parallel, and about eighteen inches apart. One wire is connected with a battery at the station from which the train starts, and the other with a battery at the terminal station. They are so suspended, that, by a somewhat ingenious arrangement, light running wheels can move along them from one end of the road to the other. The wheels are insulated from each other, but are connected with wires which pass down through the roof of the car to the operating instrument, and through it complete the circuit. As the car moves, the wheels are drawn along on the wires just above it, and a constant current of electricity is maintained between the initial and terminal stations, through the moving car.

One great value of this invention, will be the saving of life and property by preventing collisions like the the terrible one which recently occurred at Spuyten Duyvil. A lightning express rushes over long stretches of road between stations, without knowing at what moment it may crash into an approaching train. Upon leaving a station all communication is cut off until the next station is reached. With offices upon each moving train, and constant uninterrupted communication, not only with the head office, but with all trains moving on the same track, collisions would be impossible, and the safety of passengers and freight would be enhanced five hundred per cent. over the present system.

INDIA RUBBER VARNISH.

Dr. Elder gives the following recipe for making India rubber varnish :

Inclose 30 grammes of finely cut caoutchouc in a capacious linen bag, and suspend this within a flask containing a liter of benzine, by means of a thread held fast by the stopper, so that the bag remains near the surface of the liquid. In the course of six or eight days, the soluble portion of the caoutchouc—about 40 to 60 per cent—will pass into the benzine, while the contents of the bag will expand enormously. The clear solution, which is quite viscous, and contains 1.2 to 1.5 per cent of caoutchouc, is then carefully separated. The swelled contents of the bag retain one-fourth to one-third of the benzine used, and may be utilized for the preparation of an inferior kind of varnish.

A solution of India rubber in benzine, kept in half-full bottles, is decomposed on exposure to light, which may be seen by the change in the solution from a viscous to a thin fluid condition. Even in the dark this change goes on, but it takes bout three times as long.

An Archæological Find.—Few of the busy men men who are constantly passing to and fro under the shadow of Old St. Paul's ever give a thought to the ancient people who once guarded their primitive fortress about this spot. Apart from the question as to the traditionary altar to Diana, no doubt has ever existed concerning the British earthwork that once occupied the place, similar to the one which is still carefully preserved in the centre of the handsome residences of Clifton. The mounds and earthworks of Britain are innumerable and scattered over all our hills. They are only now beginning to be systematically studied, and a member of one of our old City families and guilds, Dr. Phené, the founder in the City of London College of the prize for essays on Archæology, who has for nearly thirty years studied the subject not only in Great Britain but in many parts of Europe and Asia, has lately made a discovery which excites a good deal of interest in archæological circles. As Dr. Phené intends at the proper time, and in scientific form, to lay before the archæological world the facts of his discovery and his opinions thereupon, it would not fair to say more than the find is concerned with a "serpent" mound in Gala Park, near Galashiels, and with the remains therein of a supposed Pagan altar. The circumstances of the investigation were so thoroughly genuine, and it was through an induction of so legitimate and logical a nature, that Dr. Phené unearthed what will doubtless prove to be the veritable ashes of an old sacrificial fire, that all who are interested in a subject of wide and inexhaustible importance will await with curiosity the publication of his own report.—*City Press*.

From all accounts it appears that in Norway the telegraph lines exercise a peculiar influence on birds and the lower animals. In the pine forests the telegraph posts are often found to be entirely perforated by the woodpeckers. The resonance which is produced by the vibrations of the wires leads the bird to suppose that there are worms and insects in the interior, and holes are consequently made which are sometimes as large as a man's arm. They are usually found near the insulators. Bears are often attracted by the humming of the wires, which they imagine to be a swarm of bees. Thinking the hive is hidden under the heap of stones at the foot of the post, they scatter them in all directions. It is found that the telegraph wires drive away wolves from large regions. Wolves, however hungry they may be will never enter yards which are enclosed by simple cords stretched between posts.

Scientific.

SCALE FOR POLYGONS.

In the issue of the *Metal Worker* for February 18th there appeared a communication from J. R. describing some scales for polygons, by which the length of a side, the diameter across corners (that is the diameter of the circumscribing circle), and various other dimensions of regular polygons, may be obtained by use of a pair of dividers or a pocket rule. The diagrams illustrated are very good in their way, and I presume were of interest to many of your readers. I have been using for some time past a similar device, which I think has some advantages over that already published. I enclose a drawing of it herewith. It combines in one diagram what your correspondent obtains from two, and as it represents the full half of any given polygon, it admits of the length of a side being obtained by one operation. In the diagram already published only the half of a side is shown, requiring to be doubled for the full length.

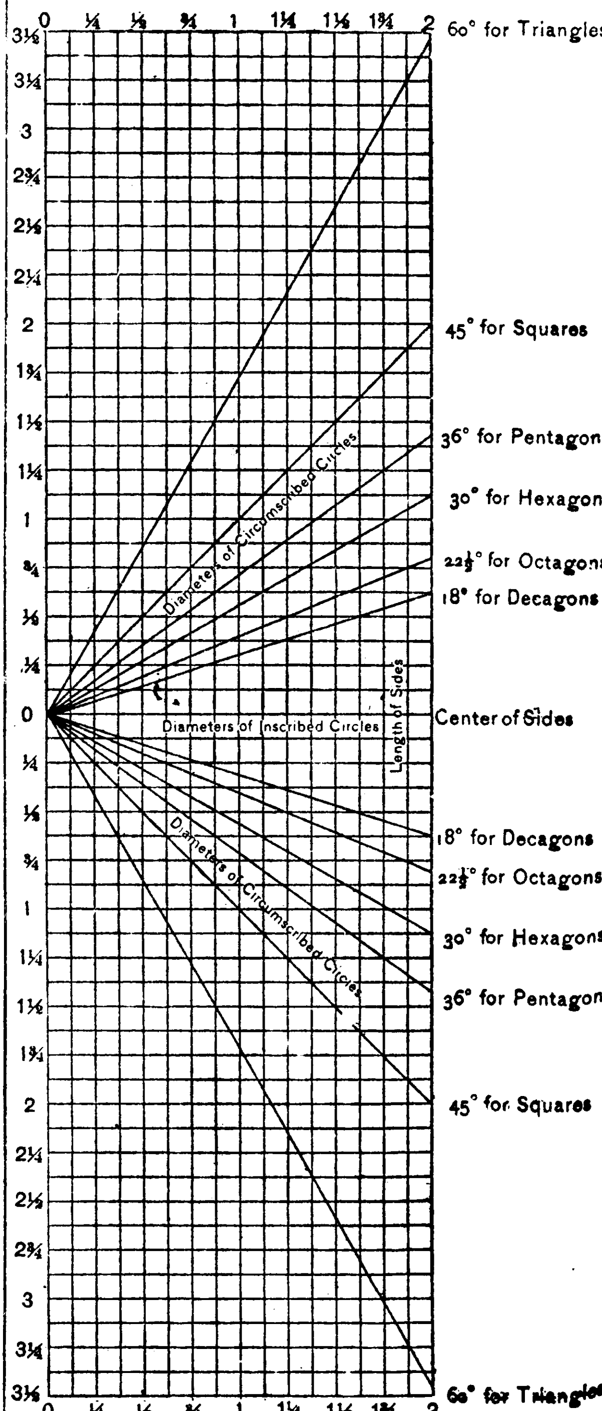
Referring to the drawing, a common centre line, extends horizontally across the scale, and is divided into eights of an inch. The vertical line bounding the scale at the left is similarly divided, and the spaces are numbered each way from the horizontal centre line. Through the dimensions in each of these, lines are drawn across the scale. From the assumed center O, radial lines are drawn at angles corresponding to the several polygons, dimensions of which are to be obtained by the scale. The horizontal centre line becomes the centre of the sides of the polygons, the lengths of which are shown by the distance between the proper radial lines.

The scale as shown may be used for actual measurement upon polygons up to and including 4 inches diameter of inscribed circle. Or it may be used for larger figures by reading an inch or 3 inches, or some other quantity, for the several spaces into which the lines are divided.

One or two simple examples will illustrate the applications that may be made of this scale. What is the length of the side of the hexagon, the inscribing circle of which is 3 inches in diameter? Look along the top of the diagram for 1½ inches which is one-half of the diameter, and follow down on this line until the radial line marked 30° is reached. From this point measure upon the same line to the corresponding radial line in the lower half of the diagram, which will be the length of the required side.

Let it be required to find the length of the side of the hexagon whose circumscribing circle is 3 inches. Place the rule upon the two radial lines marked 30° and locate points 1½ inches from the center O. Then the distance between these points will be the length of the required side.

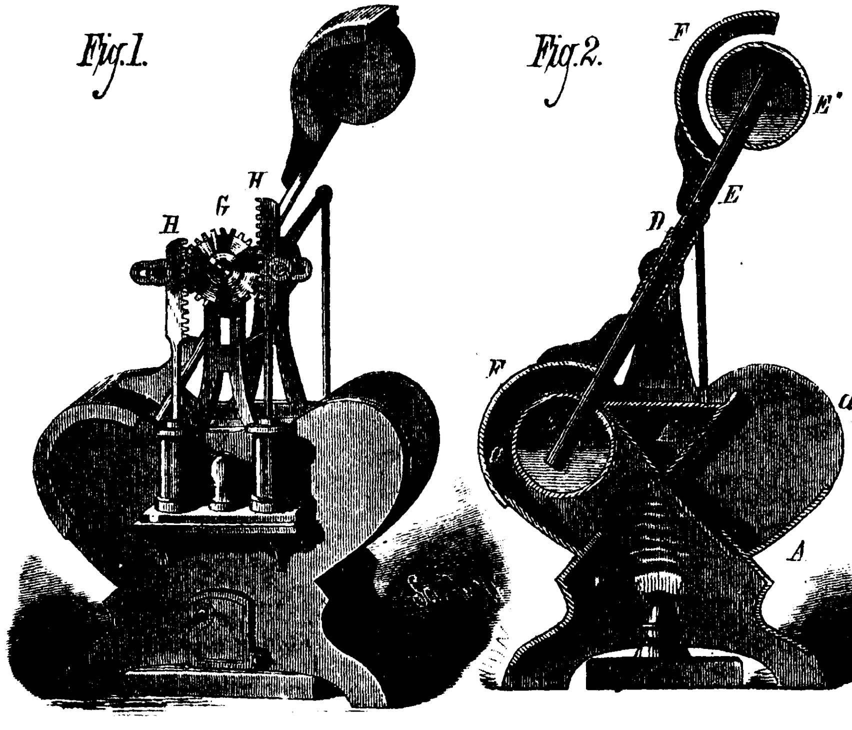
A diagram constructed upon the principle here shown, and drawn upon metal with a very fine point, might be used for the most accurate kind of work.—*Metal Worker.*



Scale for Polygons.

DANIEL DRAWBAUGH'S TELEPHONES.

The People's Telephone Company has obtained the testimony of about one hundred and thirty witnesses at Harrisburg, Pa., to show that Daniel Drawbaugh who resides in the adjoining country of Cumberland, invented the first magneto-telephone, and its side of the great case will soon close in this city with the examination of an expert electrician who has tested all of Drawbaugh's inventions. The testimony given thus far goes to show that Drawbaugh invented at least half a dozen speaking telephones before Bell conceived the idea that sound could be transmitted by electricity. Drawbaugh, according to this testimony, began thinking about sound transmission in 1861, and in 1867 invented a machine which carried sounds by means of a voltaic battery, In 1871 he made a magneto-electrical instrument which transmitted speech, and which is said to embody all the principles of the Bell telephone of to day. In 1874 and 1875, it is claimed he made marked improvements on this invention before Bell had any thought of telephonic communication. Since the Bell telephone went into operation Drawbaugh has invented a machine which he claims, according to tests made, will carry speech at least one thousand miles, and will not be affected by atmospheric influences. The same instrument, he thinks, can be made to transmit sound an indefinite distance. The American Bell Telephone Company, which is resisting the claims of the People's Company will begin taking testimony in a few weeks. In New York, next summer, it will be decided whether Bell or Drawbaugh invented the first magneto telephone.—*Operator.*



ISKE'S MOTOR.

NOVEL MOTOR.

The engraving represents a new motor which operates by the shifting of an inclosed volatile liquid in vacuo from one chamber to another and higher chamber. The casing forming the frame of the motor is open at the bottom and at each of its upper corners. A V-shaped partition converging downward from the top of the casing toward the lamp, divides the calorific chamber into two diverging passages or apartments, one extending from the lamp to entrance a, and the other to entrance a'. On the top of this casing are two standards, which afford bearings for a sleeve, D, rigidly secured on the middle part of a tube, E. This tube has at its end cylindrical receptacles, E' E^2, and the tube and receptacles are exhausted of air and supplied with some easily vaporizable liquid—for instance, alcohol—in sufficient quantities to partly fill them. Each end of the tube is also provided with a flanged cap, F, which extends over the adjacent receptacle and is adapted to fit about the entrance in the casing which receives the receptacle, E', descends into entrance a, as shown, its cap, F, entirely closes this entrance. The heat is thus prevented from escaping, and also is reflected upon the top of the receptacle.

Trunnion, c, carries in front of its standard, C, a gear wheel, G, which meshes with two racks, H H, formed on the upper ends of piston rods which operate the pumps. Of course any other form of mechanism may be operated instead of these pumps by said cog wheel and pinion, or by cranks or other suitable devices.

The other trunnion c', carries a crank arm, k, which is connected by a long rod or pitman to a crank arm l, on a rock shaft, L, journalled in the front and rear walls of the casing. This rock shaft carries a depending gate, M, which vibrates from side to side as the tube, E, oscillates on its trunnions or transverse shaft. When receptacle, E', is within the calorific chamber, and receptacle E^2, at its highest point, the gate, M, is in position to direct the entire body of heated air against the former receptacle. The liquid in this receptacle becomes partly vaporized; but, as the end of the tube, E, is extended nearly through this receptacle, the vaporized liquid drives by expansion the remainder of the liquid before it through the tube. This results in transferring bodily and almost instantly the whole supply of fluid from the lower receptacle to the upper one. The latter then preponderates, and therefore descends to become the lower in its turn. During this descent the trunnion cranks and connecting rod or pitman above described cause shaft, L, to rock in the opposite direction, so that the gate, M, cuts off the hot air from entrance a, and allows it to flow to entrance a'. The receptacle, E^2, is then brought under the influence of heat, when the operation just described is repeated. The inventors state that this machine is capable of operating very rapidly. Fig. 1 is a side elevation of the motor, and Fig. 2 is a vertical section. This device was recently patented by Messrs. Anthony and Albert Iske, of Lancaster, Pa.

Miscellaneous.

REGENERATIVE FIXTURES FOR BOILERS.

It is a fair question whether a part of one of the regenerative attachments of modern gas furnaces may not be introduced into the ordinary boiler furnace with advantage. This is the mass of open piled fire-brick out through which the waste furnace gas passes, and in through which afterward the combustible gas passes for the supply of the furnace. The boiler furnace has, it is true, no waste gas issuing from it which can be used for this purpose with the slightest advantage, for a good boiler will absorb all the heat from this outgoing gas save what is absolutely needed to maintain the draft in the chimney. The only way in which this fraction of the regenerative furnace fixtures can be used is by piling the brick on or close behind the usual bridge wall, so that the gas passing away from the fire shall strike them. The mass of brickwork will then become heated fully, and may be made to give out part of the heat thus absorbed from the strong flame to the colder gas which passes over the bridge just after fresh coal has been thrown upon the fire. It should never be forgotten that this mass of gas arising from a furnace fire needs to be kept hot long enough to become thoroughly mixed, one part with another, or else it cannot be made to burn completely. For this reason furnaces of ample dimensions invariably give the best results, so far as smoke prevention is concerned, so long as they are skillfully managed, for then, as a rule, the gas moves but slowly away from the close nearness to the fire, or not until the combustible elements have become fully ignited and consumed.

Sometimes this open body of brick may be thus made useful in maintaining a uniform temperature under the boiler, and it may also be made effective, if properly placed, in keeping up the needful agitation for insuring the most perfect absorption of the heat from the gas in its movement beneath or around the boiler. This whirling around one part of the current upon or against another, is a far more important element in the securing both of a prevention of smoke and in the best economy of working, than is generally believed. Some men consider that the smooth, unbroken flow of a mass of gas away from a boiler-grate is the thing to be aimed at, whereas the real fact is the exact opposite, and the more completely the gaseous flow is baffled or broken up the better, so long as it is done by some means that will throw the gas against or toward the boiler. It would almost seem as though some men aimed to burn the coal in the most perfect way, without any reference whatever to the heating of the water in the boiler, as though the object aimed at was the preventing of the absorption of the heat by the water.

It is quite obvious that if this service of breaking up or baffling of the gas currents can be done by some parts of the boiler itself, as, for example, the tubes of a well-designed water-tube boiler, then the absorption of the heat by the water within the tube will be of the most vigorous and effective kind; and it is equally obvious that the high rank held by the water-tube boiler may be most justly attributed to the persistent baffling action upon the flow of gas, combined with the strong sweeping circulation of the water within the tube.

There are some objections to the use of the regenerative element referred to under boilers which are obvious, and some may not be. It is clear that it will not do to obstruct too much the draft of a fire with any contrivance, however useful may be the purpose for which it is intended; but it is certain that very much more may be done, with useful results, in the breaking up of the undisturbed parallel flow of gas under a boiler which is so common—indeed, so universal. It is also clear that if a forced draft be used, then the way is much more fully open for the use of such contrivances, and the importance of their use becomes much more clearly marked. Another objection is the danger that the openings between the brick in this "checker-work" may become choked or filled with ashes, so that the draft may become unduly obstructed, or so that only a small fraction of heat could be given out from the brickwork when a flow of cooler gas is passing. It sometimes happens, too, that a coal is used which sends so large a proportion of ash over the bridge wall that it becomes quite needful to make a large pocket behind this wall to receive and to store it, until, at the end of the week's run, it can be shoveled out and removed.

In such a case the placing of anything like additional walls, or blocks of brickwork, under the boiler may be a disadvantage in causing the more speedy filling up of these dust pockets, and the consequent carrying along of the dust into the tubes, where its lodgment will be likely to cause a much greater obstruction to the absorption of the heat than could be offset by any regenerative effect to be derived from the walls beneath the boiler.

It remains, then, a fair question for every boiler user whether, in his case, something may not be gained by the use of this simple device of a mass of regenerative brickwork, which, though placed and used in an entirely different way, is the source of so tremendous a heating and melting power as that possessed by the best open-hearth steel furnaces.—*Mechanics.*

PROSPECTING FOR WATER.

The diamond drill is now one of the best and most useful tools used in our mines. All Pacific coasters will remember the howl that was raised when the diamond drill was first taken into the lower levels of the Comstock. Indeed, such a row was kicked up about it, that the drill was secretly taken into mines and was run on the sly. In those days the miners themselves (for reasons of their own) were not very friendly to the diamond drill. It was then thought to be a great thing for use in finding out ore bodies; but it was not long before not a few discovered to their cost that for such use the drill was very unreliable.

The great use of the diamond drill, says the Virginia *Enterprise*, is now acknowledged to be not in hunting for ore, but in guarding against water. When the drill has been run ahead and the ground to be passed through probed for a distance of 150 to 250 ft., the miners feel perfectly safe in banging right along on a drift.

In most of our leading mines, such great depth has been attained that it is very dangerous to push into unexplored ground with a drift. Bodies of water are liable to be reached that stand under such pressure that the whole face of a drift may be forced in and a torrent of scalding water poured out. In the event of such an accident occurring, the men could only run for their lives to the nearest shaft or winze. In not a few situations, loss of life would be almost inevitable. Suppose, for instance that the men drifting on the 2,700 level of the Ophir or Mexican should tap a flood of water, what would become of the men at the bottom of the winze on the 2,900 level? They would be scalded to death—cooked by the hot water and the steam—almost as soon as the flood began to tumble down into the winze.

But for the fact that they know that the ground into which drifts and crosscuts are being thundered with huge blasts of Giant powder have been thoroughly probed with the diamond drill, there are many places in all our mines into which it would be almost impossible to induce miners to go. When a man has descended a winze 200 or 300 ft., then has moved out in a drift from the bottom of said winze 500 to 700 ft., it is not pleasant for him to think that, by a blunder made on a level above, a small river of scalding water may suddenly be seen pouring down and cutting off his only means of escape.

It would be impossible to get along in our mines at the present depth without the diamond drill, as all mining men know. Miners know this as well as do superintendents, and feel just as friendly toward the diamond drill, once such a bugbear, and by so many considered a swindling tool invented by either Jim Fair or the devil.—*Mining and Scientific Press.*

AN ACCIDENT WITH HYDROFLUORIC ACID.

One of the Boston medical journals gives a statement of Mr Robbins, assistant in the laboratory of the Massachusetts Institute of Technology, respecting the dangerous severity of injuries to the skin by contact with hydrofluoric acid. As this acid is much used in the arts in etching glass, porcelain and the like, and often by persons who know little or nothing of its dangerous character, we think the record of Mr. Robbins' experience with it may serve a useful purpose in impressing the necessity of caution upon those who have occasion to use this energetic reagent:

Mr. Robbins having occasion to etch a hole through a piece of porcelain, made use of hydrofluoric acid, and to facilitate the process, used a piece of match that had been saturated with the acid. Noticing that his fingers were getting wet, he washed them and applied tallow. He held the match in his fingers the greater part of an hour and a half, and about the end of that period noticed a loss of sensitiveness in the end of the finger and thumb, and some pain. He again washed them, and applied dilute ammonia water; washed that off, and applied bicarbonate of soda. The pain increasing, he applied Carron liniment, the sensation being like that of a burn. This was about noon. The pain gradually increased, and in the evening he was obliged to consult a physician.

At this time the ends of the fingers were white and very hard—so hard, indeed, as to dull the scalpel with which he endeavored to cut away some of the skin. The action was still going on; and as the depth to which it had penetrated could not be determined, a dressing of cold cream was applied, and later vaseline was used; but neither seemed to allay the steady increase of the pain, which now most nearly resembled the sensation of a burn when held to the fire. The only relief obtained was by the application of cold, and this was only partial; and the only variation in it was from bad to worse, and at last it became the most severe pain you can imagine. It was not until 4 o'clock the next morning, and with the aid of one hundred and ten drops of laudanum, that he was enabled to obtain sufficient relief for a broken nap. The next day the pain had subsided, and the acid had penetrated quite a distance below the skin, rendering the flesh totally insensible and hard, having abstracted all the water from it. The other fingers were only slightly swollen, and the swelling did not extend back as far as the hand, showing that the blood was not poisoned at all. His usual good health was only temporarily and slightly impaired by the laudanum, but no other medicine was given.

"The course of treatment was to remove the destroyed tissue. This it was thought best not to do with the knife, but poultices, alternating with frequent soakings in very hot water, were constantly employed, which proved effectual, although slow, in their operation, it being fully twenty days from the time of the injury till the slough was all removed. It was very dry and tough, and by no means inclined to separate from the surrounding tissues. In four weeks I abandoned all dressings to the fingers, and was enabled to use them a little. Only a small permanent loss of tissue had resulted, but now, after three months, the sears are tender and the sensation is perhaps permanently destroyed. This agrees with the action of this acid as stated by Wurtz, especially as regards the pain; but he does not mention the very important fact that no pain is felt for some time after contact with the acid, which in my case was between one and one and a half hours, and by this time the surface has become so hard that it is difficult, if not impossib le, to check the action underneath, so that the damage is for the most part done before one finds it out.

"The difficulty in healing appears to consist in removing the slough, as it heals very quickly when this is out of the way; and after the first siege of pain, which is a long and severe one, the sore is is no more painful than any other of equal size. I think that should I meet the same accident again, I should lose no time in washing it off as thoroughly as possible, and then apply water glass if this were accessible; if not I should use an alkali, and, if possible, soak the part in water as hot as could be borne, and apply cold cream or some other dressing which would keep the part soft, and also exclude the air."

MALARIAL GERMS.

M. A. Laveran has found in the blood of patients suffering from malarial poisoning, parasitic organisms, very definite in form and most remarkable in character; motionless, cylindrical curved bodies, transparent and of delicate outlines, curved at the extremities; transparent spherical forms provided with fine filaments in rapid movement, which he believes to be animalcules; and spherical or irregular bodies, which appeared to be the "cadaveric" stage of these, all marked with pigment granules. He has also detected peculiar conditions in the blood itself. During the year that has passed since he first discovered these elements, M. Laveran has examined the blood in 192 patients affected with various symptoms of malarial disease, and has the organisms in 180 of them, and he has convinced himself by numerous and repeated observations that they are not found in the blood of persons suffering from diseases that are not of malarial origin. In general the parasitic bodies were found in the blood only at certain times, a little before and at the moment of the accession of the fever; and they rapidly disappeared under the influence of a quinine treatment. The addition of a minute quantity of a dilute solution of sulphate of quinine to a drop of blood sufficed to destroy the organisms. M. Laveran believes that the absence of the organisms in most of the cases (only twelve in the whole 192) in which he failed to find them was due to the patients having undergone a course of treatment with quinine.

PRESERVING FENCE POSTS.

A correspondent at Benton Harbor, Mich., sends us the following statement by Parker Earle (a widely known horticulturist), in the Chicago *Times*, and requests our opinion of his mode for preserving fence posts. In answer it may be stated that no single experiment, or no single series of experiments under like circumstances, can be adopted as a rule for unlike conditions. Our own observations and experiments have led uniformly to the opinion that coal tar (applied warm to dry wood) is a good preservative for timber under ground, or exposed to wet and shade, but does more harm than good if exposed to the action of the sun and weather. But varying circumstances may vary the rule. The character of the soil may have a controlling influence, and experiments should be repeated in different places and on different kinds of wood.

The experiments of Mr. Earle are a valuable contribution to such a series of trials. For general application, we would recommend first impregnating the whole of the post with crude petroleum as a general preservative, and when dry apply hot tar to the portion going into the ground, but none above. The petroleum will penetrate the pores, and the tar coating will hold there, The following is Mr. Earle's statement:

In building a fence around our young orchard, several years ago, we tried many plans for preserving the posts. Having occasion to remove the fence this winter, we noted the condition of the post as follows: Those set with no preparation were decayed an inch or more in thickness; those coated with a thick wash of lime were better preserved, but were quite seriously attacked by worms; those posts coated with hot tar were perfectly sound as when first put in the ground; those painted with petroleum and kerosene were equally sound and as good as new. In future we shall treat all posts in the following manner before setting: Let the posts get thoroughly dry, and then, with a pan of cheap kerosene and a whitewash brush, give the lower third of the post, the part to go into the ground, two or three good applications of the oil, letting it soak in well each time. Posts so treated will not be troubled by worms or insects of any kind, but will resist decay to a remarkable degree. This we find to be the simplest, easiest, cheapest, and best method of preservation.—*Country Gentleman.*

PHTHISIS, THE CABINET MAKERS' DISEASE.

Dr. Stahn, in a discourse delivered before the Berlin Cabinet Makers' Guild, says: Among the diseases to which cabinet makers are liable, because of their profession, phthisis occupies the first rank. This arises from the constant inspiration of air charged with smoke, dust, coal gas, and small particles of wood, and because of the badly ventilated and overcrowded workshops and factories. Where air is so constantly filled with smoke and coal dust from fires, dust from sawing and planing, in connection with the poisonous colors used in staining furniture, and varnishes composed of materials detrimental to health, pure air is obtained only by perfect ventilation, and this, I regret to say, is hardly ever found. In the use of these poisonous dyes, etc., one cannot be too cautious, for they also occasion bowel complaints.

The unavoidable position assumed by the body while working, results in alterations in the foot tendons, producing parrot toes and the peculiar dragging gait which we often see.

Almost every cabinet maker is affected with a continual trembling of the right hand, a condition arising from the overuse of that member, while the left is never or very seldom used. It is therefore natural to recommend an equal use of both hands.

The unfavorable development of the cabinet maker's bodily constitution arises not rarely from the fact that young people commence to learn this trade at a period before the body has arrived at a proper state of development.

From the little that I have advanced, it is not surprising that, on account of the unhealthy effects of their profession, the duration of life among cabinet makers is to-day, deplorably short, especially when we take into consideration the present immense trade, and therefore the necessity for more work, and consequently the proportional increase in the number of hours devoted to labor.

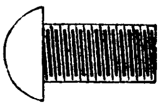
If new oak work is washed with a solution of bi-chromate of potass, and then oiled, it rapidly darkens. The bi-chromate is neither a stain or dye, and does not clog the grain of the wood.

Workshop Sketching.

BY JOSHUA ROSE, M. E.

V.

As an example in drawing a sketch, let it be required to draw a screw thread, as shown in Fig. 46. It is not necessary and therefore not usual in so small a screw to draw in the full lines representing a thread, but to draw in



WORKSHOP SKETCHING. FIG. 1.—MANNER OF INDICATING THE THREAD UPON A SMALL BOLT.

place thereof thick and thin lines, the thick ones representing the bottom and the thin ones the top of the thread. The pencil lines would be drawn in the order shown in Fig. 47. Line 1 is the centre line, and line 2 a line to represent the lower side of the head ; from the intersection of these two lines as a centre (as at *A*) short arcs 3 and 6, showing the diameter of the thread, are marked, and the arcs 5 and 6, representing the depth of the thread, are marked. The arc 7, representing the head,

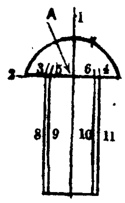


FIG. 2. 47.—ORDER IN WHICH THE LINES ARE DRAWN.

is not marked. The vertical lines 8, 9, 10 and 11 are then marked, and the outline of the screw is complete. The thick lines representing the bottom of the thread are next marked, in, as in Fig. 48, extending from line 9 to line 10. Midway between these lines fine ones are made for the tops of the thread. All the lines being penciled in, they may be inked in with the drawing instruments, taking care that they do not overrun one another. When the pencil lines are rubbed out, the sketch will appear as in Fig. 46.

For a bolt with a hexagon head the lines would be drawn in the order shown in Fig. 49. At a right angle to

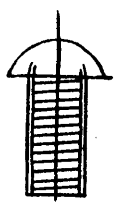


FIG. 3.—THE BOTTOM LINES OF THE THREAD IN PLACE.

centre line 1, line 2 is drawn. The compasses are then set to half the diameter of the bolt and from point *A* arcs 3 and 6 are penciled, thus showing the width of the front flat of the head, as well as the diameter of the stem. From the point where these arcs meet line 2, and with the same set of compasses, arcs 5 and 6 are marked, showing the widths of the other two flats of the head. The thickness of the head and the length of the bolt head may then be marked either by placing a rule on line 1 and marking the short lines (such as line 7) across line 1, or the compasses may be set to the rule and the lengths marked from

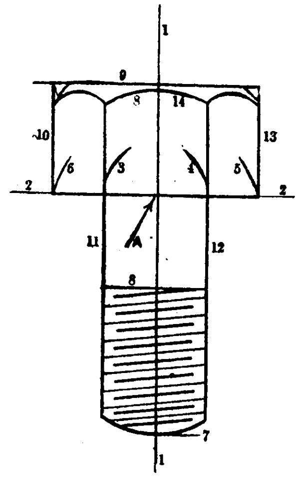


FIG. 4.—DRAWING A BOLT WITH HEXAGONAL HEAD.

point *A*. In the United States standard for bolt heads and nuts the thickness of the head is made equal to the diameter of the bolt. With the compasses set for the arcs 3 and 4, we may in two steps from *A* along the centre line mark off the thickness of the head without using the rule. But as the rule has to be applied along line 1 to mark line 7 for the length of the bolt, it is just as easy to mark the head thickness at the same time. The line 8 showing the length of the thread may be marked at the same time as the other lengths are marked, and the outlines 9, 10, 11, 12, 13 may be drawn in the order named. We have now to mark the arcs at the top of the flats of the head to show the chamfer. The middle flat is the one to have its chamfer marked. The set of the compasses to mark the chamfer will depend upon the amount of chamfer there is to be. As the chamfer, however, is simply used to remove the sharp corners, it is not an important point, and for convenience the compasses may be set to the point *A*, and arc 14 drawn, its distance from line 9 denoting the amount of chamfer. For the other two flats the compasses must be set to a radius that will cause them to mark an

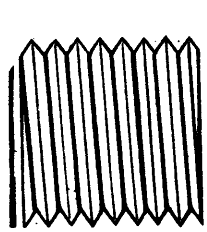


FIG. 5.—REPRESENTATION OF A COARSE V THREAD.

arc the same distance from line 9 that arc 14 is, and meeting that arc on the line representing the middle flat. This point was fully explained in Fig. 27, of these articles, and the remarks that accompanied it. The lines representing the thread are, in bolts of such small diameter, usually marked in as described for Fig. 46.

In threads of larger diameter it is usual to mark in the

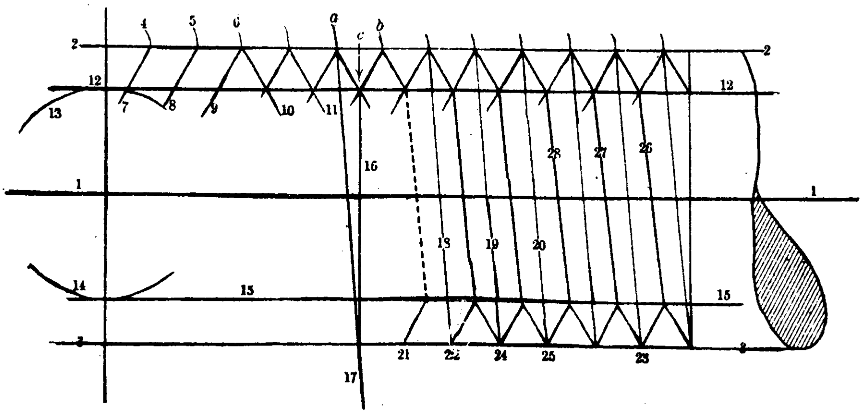


FIG. 6.—ORDER OF DRAWING THE LINES TO REPRESENT A V THREAD.

V outline of the threads, as in Fig. 50. The method of doing this is shown in Fig. 51. The centre line 1 and lines 2 and 3 for the full diameter of the thread being drawn, set the compasses to the required pitch of the thread, and stepping along line 2 mark the arcs 3, 4, 5, 6, 7, etc., for the full length the thread is to be marked. With the triangle resting against the T-square, the lines 7, 8, 9, etc. (for the full length of the thread), are drawn from the points 3, 4, 5, 6, on line 1, These give one side of the

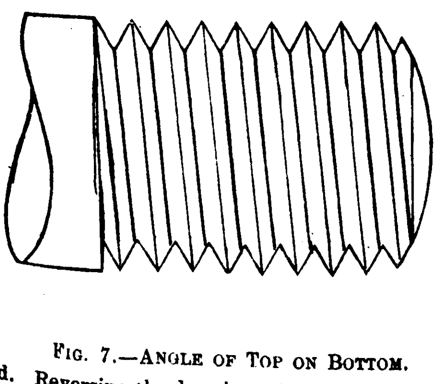


FIG. 7.—ANGLE OF TOP ON BOTTOM.

thread. Reversing the drawing triangle, angles 10, 11, 12, etc., are then drawn, which will complete the outline of the thread at the top of the bolt. We may now mark the depth of the thread by drawing line 13, and with the compasses set on the centre line transfer this depth to the other side of the bolt, as denoted by the arcs 14 and 15. Touching line 15 we mark line 16 for the thread depth on that side. We have now to get the slant of the thread across the bolt. It is obvious that in passing once around the bolt the thread advances to the amount of the pitch

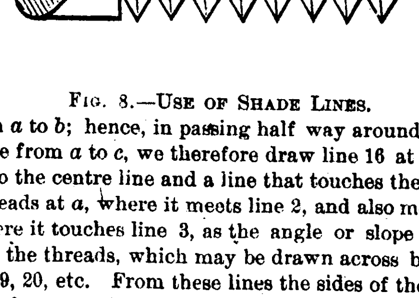


FIG. 8.—USE OF SHADE LINES.

as from *a* to *b*; hence, in passing half way around, it will advance from *a* to *c*, we therefore draw line 16 at a right angle to the centre line and a line that touches the top of the threads at *a*, where it meets line 2, and also meets line 16, where it touches line 3, as the angle or slope for the tops of the threads, which may be drawn across by lines, as 18, 19, 20, etc. From these lines the sides of the thread may be drawn at the bottom of the bolt, marking first the angle on one side, as by lines 21, 22, 23, etc., and then the angles on the other, as by lines 24, 25, etc.

There now remains the bottoms of the thread to draw and this is done by drawing lines from the bottom of the thread on one side of the bolt to the bottom on the other as shown in the cut by a dotted line, hence we may set a square blade to that angle, and mark in these lines, as 26, 27, 28, etc., and the thread is penciled in complete.

CARE AND MANAGEMENT OF A BOILER.

BY WM. M. BARR.

It is not enough that a boiler be of approved design, made of the best materials, and put together in the best manner; that it have the best furnace and the most approved feed and safety apparatus. These are all desirable and are to be commended, but cleanliness and careful management are quite as essential to getting high results.

Special attention should be given at all times to the feed and safety apparatus; the pumps should always be in good working order. It is preferable that they be independent steam pumps rather than pumps driven by the engine or by a belt. They should be kept well packed and the valves in good condition.

Kindle a fire and raise steam slowly; never force a fire so long as the water in the boiler is below the boiling point: The fire should be of an even height, and of such a thickness as will be found best for the particular fuel to be burned, but should be no thicker than is actually necessary. In regard to the size of coal used, that will depend upon circumstances. If anthracite coal is used, it should not, for stationary boilers, be larger than ordinary stove coal. For bituminous coal, which is always shipped in lumps as large as can be conveniently handled, the size will vary somewhat in breaking, but it may in general be used in larger lumps than the anthracite.

If the coal is likely to cake in burning, the fire should be broken up quite frequently with a splice bar, or it will fuse into a larger mass in the centre of the furnace and lower the rate of combustion. If the coal is likely to form a considerable quantity of clinker, or enough to become troublesome, it may be advantageous to increase the grate area, and thus lower the rate of combustion per square foot of grate and have a fire of less intensity. The fire should be kept free from ashes, and the ash pit should be kept clean.

Whenever the fire-door of a steam boiler furnace is opened, the damper should be closed to prevent the sudden reduction of temperature underneath, which is likely to injure the boiler contraction, and thus render it likely to spring a leak around the riveted joints. Some firemen are very careless in this respect, and there is little doubt that many a disagreeable job of repairing a leaky seam might be prevented by this simple precaution.

Gauge cocks should be kept free from any accumulation of sediment. It is a very common practice to rely wholly on the indications of the glass water gauge for the water level in the boiler, This is all wrong and should be discontinued if once begun. The glass water gauge serves a very useful purpose, but it should not be wholly relied on in practice. In using the ordinary gauge cocks, the ear, more than the eye, detects the water level, and thus acts as a check on the indications given by the glass gauge.

Water gauges should be tested several times during the day to see that they are clear, and to keep them free from any sediment likely to form around the lower openings to the water in the boiler. If this is not attended to, the water gauge is likely to indicate a wrong water level, and a serious accident may be the result.

Steam or pressure gauges are likely to become set after long use and should be tested at least once, or better still, twice a year, by a standard gauge known to be correct. They should also be tested every few days if the boilers are constantly under steam by turning off the steam and allowing the pointer to run back to zero.

Blow-off cocks or valves should be examined frequently and should never be allowed to leak. In general, a cock is to be preferred to a valve, but if the latter is selected it should be some one of the various "straight-way" valves of which there are a number in the market. If the cock is a large one, and especially if it has either a cast iron shell or plug, it should be taken apart after each blowing out of the boilers, examined, greased with tallow, and returned.

Boilers should be blown out at least once a month, except in very rare instances in which water is used that will not form scale, The boiler should not be blown out until the furnace is quite cold, as the heat retained in the walls is likely to injure an empty boiler directly by overheating the plates, and indirectly by hardening the scale within the boiler. Bad effects are likely to follow when a boiler is emptied of its water before the side walls have become cool; but greater injury is likely to result when cold water is pumped into an empty boiler heated in this manner. The unequal contraction of the boiler is likely to produce seams in the shell and to loosen the tubes and stays. It is a better plan to allow the boiler to remain empty until it is quite cold or sufficiently reduced in temperature to permit its being filled without injury. Many boilers of good material and workmanship have been ruined by the neglect of this simple precaution.

Fusible plugs should be carefully examined whenever the water is blown out of the boiler, as scale is likely to form over the portion projecting into the water space. It is only a question of time when this scale would form over the end of the plug thick enough to withstand the pressure of steam, and thus fail in the accomplishment of the very object for which it was introduced. This applies especially to the fusible plugs inserted in the crown-sheet of portable engine boilers.

The tube should be cleaned every day if bituminous coal is used. A portable steam jet will be found an extremely useful contrivance which will keep them reasonably clean by blowing out the loose soot and ashes deposited in the tubes. Every two or three days, or at least once a week, a tube scraper or stiff brush should be used to take out all the ashes or soot adhering to the tubes, and which cannot be blown out with the jet. Flues may be cleaned the same way.

If from any cause the water gets low in the boiler, bank the fires with ashes or with fresh coal as quickly as possible, shut the damper and ash-pit doors, and leave the fire doors wide open; do not disturb the running of the engine, but allow it to use all the steam the boiler is making; do not under any circumstances attempt to force water into the boiler. After the steam is all used and the boiler cooled sufficiently to be safe, the water may be admitted and brought up to the regular working height, the damper opened and the fires allowed to burn, and steam raised as usual.

Foaming or priming is always troublesome, and often dangerous. Some boilers foam almost constantly because of their bad proportions and will require the constant care of the person in charge, especially at such times as the engine may be using the steam up to the full capacity of the boiler. In a case of this kind, an increase of pressure will often check but will not entirely prevent it. Nothing short of an increase of water surface, or a better circulation of water, or a larger steam room, will afford a complete remedy. If the foaming or priming is due to the sudden liberation of steam, or on account of impure feed-water it may be checked by closing the throttle-valve to the engine and opening the fire door for a few minutes. The surface blow may be used to advantage at this time, by blowing off the impurities collected on the surface of the water. The feed pump may be used if necessary, but care should be exercised that too much cold water be not forced into the boiler, and thus lose time by having to wait for the accumalation of the regular steam pressure required for the engine.

The dangers attending foaming or priming are: The laying bare of heating surfaces in the boiler, and of breaking down the engine by working water into the cylinder. The commonest damage to the engine is apt to be either the breaking of a cylinder head, or the cross-head, or of the piston.

When boilers are new and set to work for the first time, priming is a very frequent occurrence; in fact, it may be said that for the first few days there is always more or less of it. All that is needed during this time is a little care on the part of the attendant to see that the water is kept up to the required level in the boiler. It is also recommended that the throttle-valve to the engine be partially closed to prevent any great variation of pressure in the boiler, and thus prevent water passing over with the steam in such quantities as to become dangerous. If a boiler continues to prime after it has had a few weeks' work and then thoroughly cleaned, the causes are to be attributed to other than the grease and dirt in it, which are inseparable from the manufacture.

As already said, priming may be caused by a sudden reduction of pressure; that is, a boiler may be working smoothly and well with say 80 pounds pressure; if an increase of load be suddenly applied to the engine so as to reduce the pressure to 70 or 60 pounds, this sudden reduction of pressure will almost always cause priming. The less the steam space in the boiler, the greater the tendency to prime, and the greater the difficulty in checking it.

The only permanent cure for this is more boiler power. As a temporary expedient the engine should be throttled sufficiently to make the drain upon the boiler constant instead of intermittent. If the duty required of an engine is irregular, the steam pressure should be carried higher; in any case similar to the above, it is recommended that the pressure be increased to 90 or 100 pounds, the throttling to begin with the increased drain upon the boiler.

Mining and Metallurgy.

THE METALLURGY OF COPPER.

BY JEFFREY H. BURLAND.

II.

Continental Method.—MANSFELD PROCESS.— The extraction of copper as practised at Mansfeld will serve as an example of the Continental methods.

The ore which is found and so extensively worked at Mansfeld is principally copper pyrites with Malachite or Native copper, Blend Galena, etc. occuring in a bituminous shale, this tends to save fuel, the consumption of fuel being only ⅓ that used at Swansea.

The ore here treated contains from four to five per cent. of copper and about 25 per cent. of silver, and there are not less than nine operations in connection with the extraction of the copper and silver, the following are the processes:

1. *Burning* in heaps to drive off water and bituminous matter.
2. *Smelting* in furnace for coarse metal.
3. *Roasting* coarse metal in stalls to drive off sulphur and oxidize iron.
4. *Fusion* for fine metal products copper 65 per cent with silver also, rich slag going to No. 2.
5. *Grinding* or granulation of fine metal.
6. *Roasting* ground fine metal to transform copper into cuprous oxide and silver into a sulphate.
7. *Solution* of silver sulphate in warm water and precipitation of silver with metallic copper.
8. *Smelting* residue in Cupelo furnace to produce blister copper or rich matt and poor slag.
9. *Refining* black copper either in a reverberatory furnace or in a German hearth.

I. *Burning.* The burning takes place in the open air upon a platform of stone from 200 to 300 ft. long, by 30 to 40 ft. wide. This is covered with faggots leaving air passages; the ore being piled on top and the wood ignited. Although the time necessary to complete this operation is from two to four months from 300 to 900 tons of ore are roasted, thus more work is done in two to four months than one ore furnace at Swansea could complete in a year.

Another consideration is that not more than ten pounds of fuel is used per ton of ore.

II. *Fusion* The charge of roasted ore is fused with fluorspar and carbonate lime to slag of the oxide of iron, etc., and with oxide of copper to decompose the sulphide of iron and remove it in the slag. This operation was carried out until recently in a shaft furnace (Fig. V and VI), from 15 to 20 feet high and three to four feet in diameter, furnished with a pair of tuyers placed about two feet from the bottom to supply the hot blast heated to a temperature of 280° Fah. The fluid slag and regulus are run into basins C C1 lined with charcoal and clay through the channels O O1. The fuel employed is charcoal, or a mixture of charcoal with gas coke, and is charged in alternate layers with the ore as in iron smelting. The chemical reactions which take places resemble that of the Welsh method No. 2; the liquid matter in the basins divides into two layers, slag at the top and copper and iron sulphides at the bottom. The slag is removed by ladles into moulds to be subsequently used for building purposes and the regulus removed in crusts as it solidifies.

The furnace used at present is a blast furnace 25 to 30 feet high, and six feet in diameter, lined with fire brick and supported by an ir n collar on eight iron pillars. It has eight tuyers which conduct the hot blast under a pressure of two pounds per square inch to the furnace, the fuel used is coke and the slag runs continually off at one side into moulds, while the regulus is drawn off at the other side into water for granulation. This furnace will smelt a charge of 13 to 15 tons of calcined ore in 24 hours with 25 to 30 tons of fuel, the resulting product being coarse metal or "Rohstein" containg 30 to 40 per cent of copper.

III. *Roasting* in stalls (Stadelm.) The stalls are six in number built with a flue running up the back (Fig. VII.) to contain 200 to 300 cubic feet of coarse metal with fuel. The floor of these stalls are first covered with wood, then the coarse metal is introduced which after ignition of the fuel remains 10 to 12 days before the completion of the operation losing meanwhile from 15 to 20 per cent. by weight.

The ore is next placed in vats where the sulphate of copper formed by oxidation of the sulphide, is dissolved out in water. The sulphate of copper thus obtained by evaporation is sent into commerce whilst the dried matt is again roasted.

IV. *Fusion* of roasted coarse metal.

The matt from last process containing oxide of iron and sulphide of copper is treated as in Welsh method for the removal of iron by fusion with silica and production of fine metal.

The charge is:

Roasting coarse metal	200 Cwt.
Slag from No. 2 and silicious sand . .	2½ "

These fusions are made in reverberatory furnaces; until recently, however, shaft furnaces were employed. The matt is tapped into water for subsequent treatment.

V. *Grinding.* The matt containing 67½ copper and 35 per cent silver is ground between granite mill-stones.

VI. *Roasting* ground matt. The ground matt from No. V is roasted in a double bedded furnace 18ft. + 8ft. to oxidize copper and convert sulphide of silver into sulphate.

VII. *Solution of Silver.* In this process the sulphate of silver is dissolved out from the matt in large vats with water and subsequently precipitated with metallic copper.

VIII. *Fusion* The matt from No. VII. is mixed with a sufficient quantity (eight per cent.) of clay to enable its formation into balls about 4" in diameter; these are placed in a blast furnace with 10 per of cent. of sand, 5 per cent sulphide of iron or gypsum, 10 to 15 per cent. slag, and from 1 to 2 per cent regulus from same operation. The resulting product is Black or blister copper containing 65 to 66 per cent. of copper.

IX. *Refining.* The Blister Copper is refined in a reverberatory furnace (Fig. VIII and IX) the hearth of which is lined with charcoal and clay upon which the copper is fused by the flame of a wood fire in the grate F and air is thrown upon the surface from two tuyers T T removing the sulphur as sulphurous anhydride and the foreign metals as oxides. When the refining is complete, as ascertained by testing a sample, the copper is run into the basins B B and removed in rosettes by throwing water upon the surface and removing the crusts formed.

The rosettes contain a large quantity of cuprous oxide which has to be removed by treatment in a German furnace (Fig. XXI.) consisting of a basin C 16" wide, lined with fire clay and charcoal and furnished with a blast pipe.

The copper is placed on glowing charcoal in the basin, covered with charcoal and fused by the hot blast and kept in a state of fusion until it is tough pitch owing to reduction of the oxyde of copper, when the reduction is complete the refined metal is ladled into ingot moulds.

Wet Process is divided into three parts as follows:—

1st. *Extraction* of copper from solution in mine and other waters.

2nd. Solution of ores with acids (sometimes after roasting), and precipitation of copper with iron.

3rd. Wet and dry combined.

I. This process is carried out by allowing the water containing copper in solution to pass through tanks containing scrap iron which causes the copper to be precipitated in a metallic state.

II. As an example of this process the German hydrochlorine acid process is taken. It is worked in "twist" in Waldic and consists in the treatment of sandstones impregnated with carbonate of copper, containing 1 to 1½ per cent. of copper, with dilute hydrochloric acid. The solution for precipitation is pumped into vats containing scrap iron where the copper is precipitated in an insoluble gangue.

III. Dry and wet process.

There are many processes under this heading including those of Longmaid, Bankart, Birkmyre, Henderson, Hunt and Douglas.

The latter is considered one of the best, and will, therefore, be used as an example of the wet and dry methods.

The Hunt and Douglass process is for the extraction of copper from oxidized compounds whether they are natural or obtained by roasting sulphuretted ores.

The oxidized ores are acted upon by an aqueous neutral solution of ferrous chloride and zodic chloride whereby the oxides of copper are converted into cuprous and cupric chlorides while iron separates in form of hydrated peroxide. The presence of

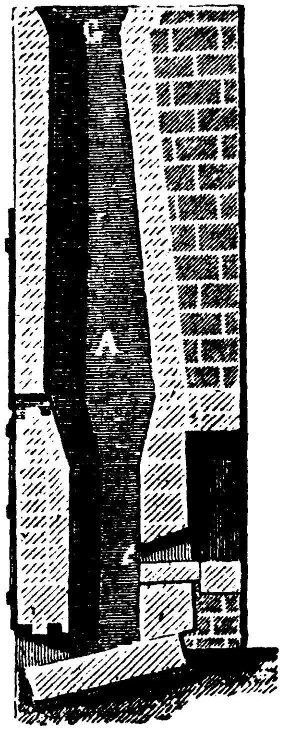


FIG. V.—Blast-furnace.

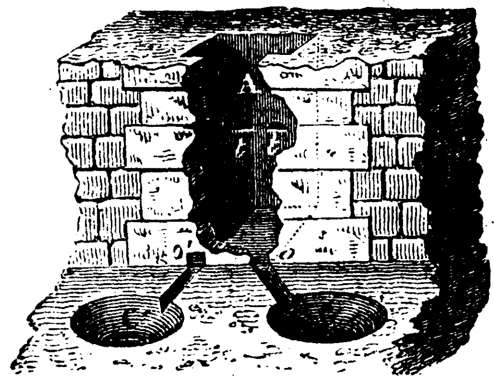


FIG. VI.—Hearth of Blast-furnace.

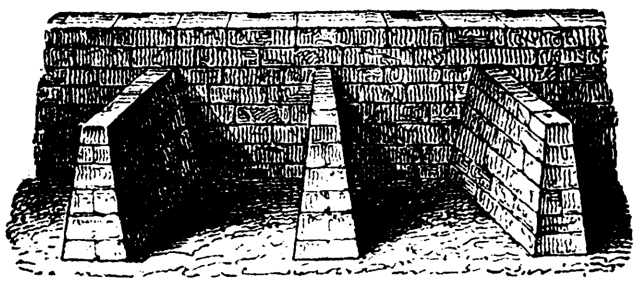


FIG. VII.—Roasting-stalls employed at Mansfeld.

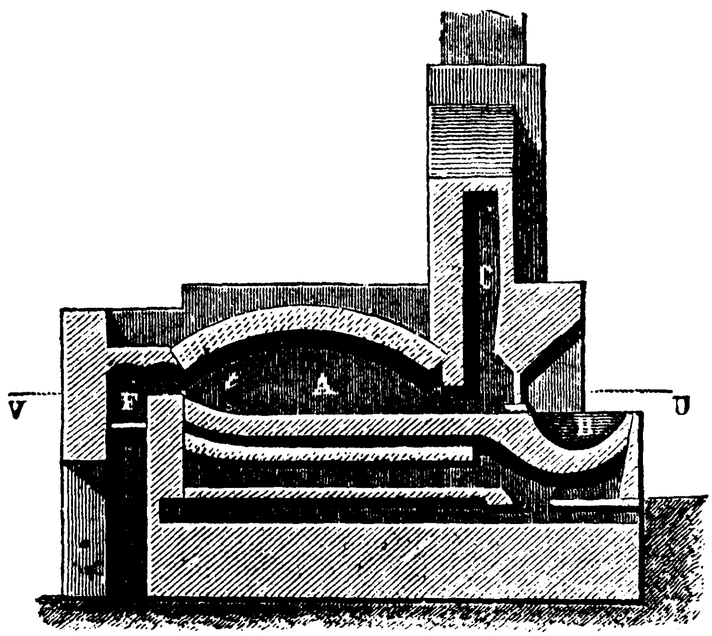


FIG. VIII.—Section of Furnace for refining Black Copper, at Mansfeld, made at the line x of the plan, Fig. IX.

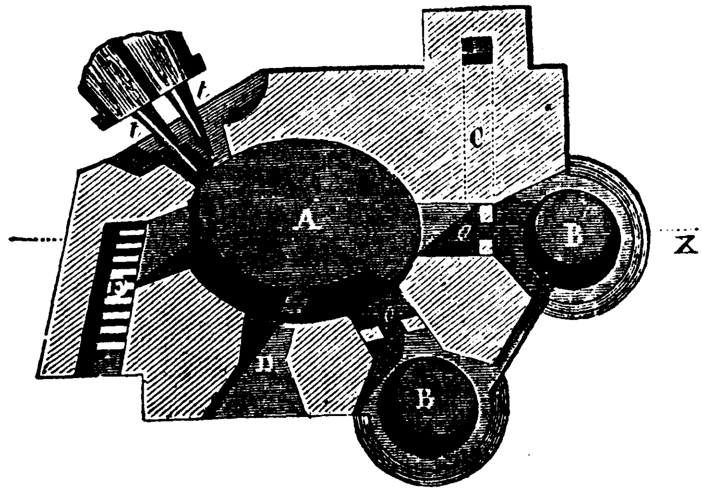


FIG. IX.—Plan of Furnace for refining Black Copper, at Mansfeld, made at the line V U of the section, Fig. VIII.

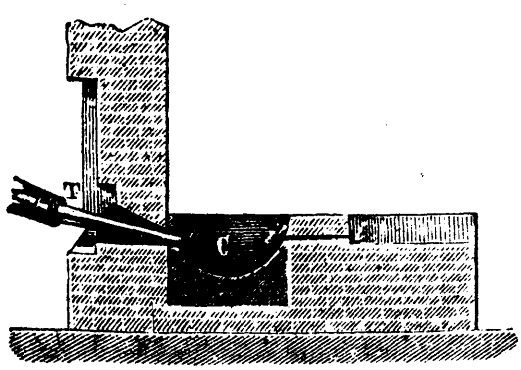


FIG. X.

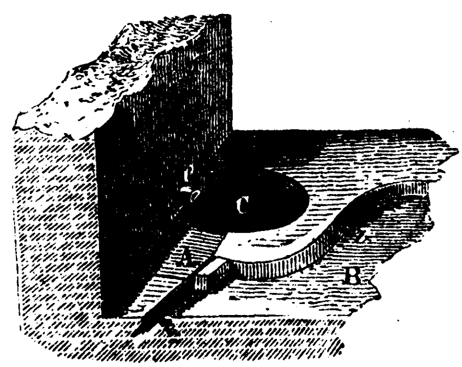


FIG. XI.

German Hearth used for refining Rosette Copper, at Mansfeld.

zodic chloride is necessary as cuprous chloride is otherwise insoluble; the copper is precipitated with iron which restores the solutions to its original strength for further use. If cuprous oxide is present the reaction will be as follows:

$3\,Cu\,O + 2\,Fe\,Cl_2 = Fe_2\,O_3 + Cu_2\,Cl_2 + Cu\,Cl_2$. Cuprous oxides being present it would be

$3\,Cu_2\,O + 2\,Fe\,Cl_2 = Fe_2\,O_3 + Cu_2\,Cl_2 + 2\,Cu_2$. This metallic copper reacts with Cu Cl forming $Cu_2\,Cl_2$.

The copper is precipitated with metallic iron and according to the equation $\frac{2}{3}$ of the copper present has been converted into $Cu_2\,Cl_2$ which gives for a known quantity of iron just twice as much copper as $Cu\,Cl_2$.

$$Cu_2\,Cl_2 + Fe = Fe\,Cl_2 + Cu_2$$
$$Cu\,Cl_2 + Fe = Fe\,Cl_2^2 + Cu$$

The above process is not applicable to ores containing silver but the following process by the same inventors is now used for the extraction of copper and silver from argentiferous copper ores.

The process is based on the reactions between sulphurous anhydride acid and cupric chloride.

$$2\,Cu\,Cl_2 + S\,O_2\;2\,H_2\,O = Cu_2\,Cl_2 + 2\,H.C.L. + H_2\,S\,O_4$$

The ore is roasted until about $\frac{1}{3}$ of the copper has been converted into a sulphate and the balance oxidized and then leached out with water containing a small quantity of sodic chloride which precipitates the silver as argentic chloride sulphurous acid is then passed through the solution when the following reaction takes place:

$$2\,Cu\,SO_4 + 2\,Na\,Cl + SO_2 + H_2O = Cu_2\,Cl_2 + Na_2\,SO_4 + 2\,H_2\,SO_4.$$

The oxides from the roasting may be treated with sodic chloride and residue from the last part of the process and sulphurous acid thus:

$Cu\,O + 2\,Na\,Cl + H_2\,S\,O_4 = Cu\,Cl_2 + Na_2\,S\,O_4 + H_2\,O$, pass sulphurous acid through the solution and $Cu_2\,Cl_2$ will be formed.

In this process the silver is precipitated by Na Cl as chloride and the copper reduced to cuprous chloride, which is involuble by the sulphurous anhydride.

Home Industries.

A LESSON IN FILING.

By J. H. Evans.

To use a file is one thing, but to file with the same is quite a different matter, and I think a few hints upon this most important branch of mechanics will be found of much service to many of our readers.

To file properly, then, must be the aim of all who undertake to do it at all, and until a flat surface can be filed with a certain amount of ease, it cannot be said that the workman, whoever he is, can file; therefore, before going on to different things, let the beginner settle down to his work with the determination to overcome the difficulty of filing a flat surface. I say the difficulty, because it is a matter that will take some practice, and now I will endeavor to show the best means of setting about such a job.

Take a piece of wrought-iron about 2in. square, and with a 10in. file, bastard cut, make a commencement. The vice should be so fixed that it is a convenient height, and that ought to be about the level of the right elbow, or a little below, if anything. The point of the file should be held in the lefthand and the handle grasped with the right, so that the thumb is uppermost. To one who has not filed before it will feel very awkward at first. The left knee should be slightly bent, and the body must move in conjunction with the knee; by doing this the weight of former is thrown on to the file, and a pressure created, which will compel the file to cut the material. The right foot ought to be about 2ft. 6in. from the left; but here a great deal must be left to the operators, and it will be found that the most convenient pose is always the best; the elbow, should be kept well into the sides, as nothing looks worse than to see a man at work who requires the room of two or three for his arms. However, as I say, it must rest in a great measure with the person about to learn. Having, then, obtained to a certain extent an insight as to how the file should be held, and the best position to stand in, fix the piece of iron as level as possible in the vice, and shoot the file forward, bearing upon it at the same time When the whole of the cutting-part has gone over the surface bring the file back, but without the slightest pressure upon it: otherwise all the teeth will soon be taken off, and the file become useless. There not the least doubt that much dissatisfaction will be felt at the first few attempts, but that must not be allowed to interfere with the determination to succeed. There is no necessity to grasp the file in the right hand, as if it were going to run away, but just sufficiently tight to prevent its moving where it is not wanted. Having filed away at the iron for some time, upon examination it will be found to be anything but a flat surface; but this cannot be helped. After a little practice it will be a good reward to find that great improvement is visible; and when this is the case, fresh interest will be instilled into the one who is learning, and such anxiety to accomplish what he has set about that a little more practice and the difficulty will be overcome. As we proceed, the file may be used from the left to right, or *vice versa*. I dare say, in the course of using a bastard file on a piece of wrought iron, it will be found to, what we term, pin—that is, small pieces of the material will become wedged in the teeth, and the effect of this will be to tear the work. By rubbing a little chalk on the file a deal of this may be prevented; but the pins, when once in, must be removed, and a piece of brass, pointed, will be the best to do this with. The files must always be kept clean by what we term a file-card. This is simply a piece of old cardingwire, nailed to a piece of wood about 2in. by 4in. And now, by the time half the substance of the metal being worked is disposed of, some advance ought to have been made; and assuming that it is so, a second-cut file may take the place of the bastard. This is much finer in the cut, and, before being used, should have some chalk also, or a little oil, rubbed in the teeth, as this is more likely of the two to get full of pins. The same position, the same action—in fact, the same process entirely—has to be gone through with this as with the other; and one of the principal things to attend to is to let the movement of the elbow be simultaneous with that of the left knee.

Having, then, had a certain amount of practice on a piece of iron, as described, and become somewhat efficient, it will be time to alter the style of work, in which there will be a deal of sameness; and I should advise the tyro to try and file all the edges square to the face. To begin this, it must, of course, be reversed in the vice, with the edge to be filed fixed at the most convenient height. Now the same process will again be necessary, and extra care exercised in order not to break all the teeth out of the file. A first-class vice-man ought to be able to file up anything of this kind without much reference to the square; but this latter tool is an absolute nceessity to the vice, and should be what we call a back square, which means that that part usually placed on the work is broader than the blade. By applying this to the work, it will show where it is out of square, and to get it true it must be filed on the highest part only; and here I may say plainly that nothing but practice will perfect anyone in this particular art. So far, then, we see what the position is that is required, how to hold the file, and to test what is being operated upon. I will leave this part and proceed to explain a few of the uses of different cut and shape files for shaping up work of various forms.

I dare say, in these enlightened days, when so much work is done by machinery of different kinds, that many may look upon these few remarks as worth very little; but to whatever extent machinery is eventually brought into use, we shall not be able to dispense with the file. It is a well-known fact that first-class vicemen are at a premium, and the only reason I can assign for it is that so many youths are now brought up to simply watch machinery at work and grind tools, without any idea of ever using their hands at all; this, however, is not my business.

To shape up curves, either convex or concave, will be found on the whole a more easy matter than a flat surface, and only requires practice and a variety of different shaped files, such as pillar, crossing, round, and half-round. These are almost as many varieties as will be required for general purposes, and in using a crossing or half-round file, the movement of the wrist will be found to follow almost the curve of the work naturally. That is to say, no one desirous of following a curved line would drive the file straight across. Here, again, is scope for determination and practice. I have filed the teeth in a number of different circular cutters in my time; but this I may say is obsolete now, as such things are now all cut with a cutter. It afforded, however, good experience in the use of files, and was most useful at the time.

Another important part will be to get out mortise-holes; for instance, the receptacle in a spindle to hold vertical cutters. To get such a hole out quite square on the flat and ends is no easy matter, and the first thing to do will be set out the lines to the size the hole is required, and to get an entrance for a file. First, then, drill a series of round holes as closely together as possible, then plug each one up, and drill each one again, and when the plugs, or, rather, what remains of them, are removed, a small pillar file will enter; if there is any part of the steel left between the holes that will impede the progress of the file, it can be removed by aid of a small round file; but as files of this shape and size are delicate and likely to break, great care must be exercised. As soon as the pillar file will pass through the space, the hole may be roughed into shape by resting the round part of the spindle on the vice, holding the work in the left hand and usingthe file with the right; the vice should be slightly opened, and the work allowed to move with the action of the file; this is an assistance in making the hole quite flat. Another very good way to effect the same purpose is to place the work between the centres of a lathe, in which both hands are at liberty for the file. In getting out a hole or mortise slot of this character, it is most important, in good work, to have the ends flat and square. It is true, if not absolutely so, it would hold the cutter; but that is not the thing in high-class work.

We now are advancing to a very great extent, and when a flat surface, a square edge, and a good clean hole can be filed, the workman may begin to think he is arriving at a certain stage of perfection. In filing up, say, a square stem for an eccentric cutting frame, or any similar piece of work, before finishing, the flats should be made smooth by what is termed drawfiling, that is, the file placed across the work, and instead of shooting the file as before shown, it must be drawn up and down the work while it lies on it at a right angle. Here care and practice will show that it is not an easy matter to keep the cut of the file straight; it is, however, only a question of holding it in the proper position, which will soon show itself, and the result will be satisfactory.

In proceeding with work of various kinds, a workman is almost sure to require a square hole for some purposes or another, and a few hints on this will help. Suppose, then, such is needed, whatever size the hole is across the flats, a round hole should be drilled through a little under the size of hole; then open out the corners with a square file. Now to get out a square hole is a troublesome job; but no great difficulty should present itself to an experienced fitter. But as there is a means of assisting in the progress of it, it is as well to know all about it; therefore, I should advise anybody doing such a thing to file up a square drift. This must be made of steel, cut across at the bottom where it enters the hole, and then hardened and tempered. In making a hole in steel, the drift must be used very carefully, and not driven down with much force, or the steel will split across the corners; but for brass or gun-metal, after the corners are cleared, the drift may be driven through, and a square hole flat and sharp will be the result; drifts of any shape may be made for this purpose, such as hexagon, octagon, &c., and to get out a clean hole, that which is drilled first must, of course, be under the size of the flats. In finishing up all good work, the best file is a Lancashire superfine smooth file, and when this is properly applied having on it a little oil, very little emery-paper will be required, and the less of the latter that is used the better; the best way of applying it at all is to have, in the first place, the highest quality paper to be obtained, and make one fold of it round a file, so that the paper is as flat as the file itself. I have often noticed in different factories the men with a whole sheet of emery-cloth round a file. This, it will be seen, must render the surface anything but flat. Cloth should be avoided in all cases, and in my opinion emery-cloth is only fit for housemaids to polish fenders, &c. I am anxious to explain to others how to produce equally good work, as may be done in a factory where nothing, but the best is produced, and as it is only by using the same means and ways that this is to be done, I cheerfully endeavor to tell what I know, in the hope that it may help, at all events, the tyro in the art of using the file.

There are so many things at the present time done by machinery that it is a difficult matter to name any single article that would most likely require to be filed; therefore it is necessary to be able to do any and everything.

A few words as to the use of what are termed saw-files. These are a triangle shape, and cut on each flat, the edges being used for setting the teeth of a frame or bow saw. As there are various kinds of blades to these saws, and some much harder than others, great care must be used when sharpening one that is hard, and the files must be used slowly, or the teeth will not last to set one blade; there are, of course, many other purposes to which a saw-file may be devoted, and they should never be discarded, for when absolutely used up as a file, they make the best triangular tools for turning iron and steel.

While I am on the subject, I will just remark upon the best kind of handle. I know many amateurs who have tools of all kinds fitted with hard wood handles. Now, this is essentially bad, as they never hold in; and when using a 12in. file, should it come out of the handle, it would probably do a deal of damage. I have seen it occur, and the tang of the file I have in one instance, known to enter the foot of the workman. The best handles are those of soft wood, common and cheap, to be had at all tool-shops at a trifling cost. I merely mention these points, as it may help anyone who may desire to become an efficient viceman; and I should recommend those who desire to become good workman in general, not to lose a single opportunity of learning the art of filing.—*English Mechanic.*

REMOVING MILLSTONE GLAZE.

The Fry process for taking off the glaze of millstones, which was so much talked of a few years ago was as follows: first, the buhrs must be put in perfect face, well dressed, out of wind, and in the best possible condition for grinding. They are then run a couple of hours until they become warm, taken up and washed with aqua ammonia in the following manner: Take four ounces of aqua ammonia (spirits of hartshorn) and thoroughly saturate the stones with a good sponge, and let them stand over night. By doing this once a week, or oftener if necessary, the glaze will be kept off. His second method was to take two ounces each of borax, washed soda and muriate of ammonia, and dissolve them in a quart of warm water; then add cider vinegar. Now cover the stone with sand, and apply the solution with a sponge. Leave it on ten minutes and then dry the stones thoroughly. This is said to harden the buhrs so that nothing, not even garlic, can glaze them, and they will retain their natural temper and grit for weeks, and will not glaze.—*St. Louis Miller.*

Fifty-one candidates names are "up" for election into the Royal Society. The council during next month will select fifteen, who will no doubt be elected in June.

Carvers' and Gilders' Work.

LESSONS IN WOOD-CARVING.

There has been of late years a most noticeable and gratifying interest shown in the introduction of the artistic element into the industries, as a consequence of the more general appreciation among our people of the beautiful in union with the useful. This is shown not only in the superior artistic quality visible in the products of most of our manufactories, notably in those branches that relate specially to household decoration, but also in the establishment in our manufacturing centres of schools of industrial art.

One of the many evidences of this strong development of artistic perception, is the interest which is shown in the elegant and useful art of wood carving. There is, it is safe to say, as much native artistic talent in this country as in any other, but it is undeveloped for the want of the spur to force it to activity. The art of wood-carving is not difficult to acquire, though, of course, elaborate work is not easily done. As the traditional Yankee, howavor, is invariably represented with his jack-knife in hand, one would think that in the land of whittlers wood-carving should take rank among the most widely practised of the elegant arts. Though this is far from being the case, for want hitherto most provably of the guides and facilities for giving proper artistic direction to the crude and undeveloped artistic talents of our people, this state of things bids fair soon to disappear before the rapid multiplication of schools of art and the rapid growth of opportunities everywhere for the cultivation of the artistic element.

These comments have been induced chiefly by the inspection of an admirable little manual devoted to the artistic treatment of wood, giving, among other interesting lessons, plain instructions in the rudiments of wood-carving. This manual is issued by A. H. Shipman, of Rochester, N. Y., and we deem this portion of its contents of sufficient interest to reproduce certain parts of it for the instruction of many of our readers, especially the younger ones among them, who may find the subject specially attractive.

Carving is only a higher grade of whittling, in which the jack-knife gives place to the chisel and the gouge; and it would astonish most people to be shown what may be done with these simple tools. Not only may such elegant trifles as brackets, book-rests, paper-knives, picture frames, etc., be made by the home carver, but chairs, tables, sideboards, bedsteads, and other domestic articles may be ornamented in this way. A degree of skill that will enable the worker to produce fairly good and satisfactory results, may readily be acquired with a little patience, and any boy or girl with ordinary mechanical ability has in his or her power to soon learn the art of carving many articles of utility, and thus, by adding to the artistic decoration of home, to have acquired a never failing source of gratification, if not indeed a pleasant means of acquiring a livelihood.

To such as may feel a desire to learn the rudiments of wood-carving, the following lessons will be found useful: The first lesson of the amateur is to learn the use of the three principal tools—the flat chisel, gouge and veining tool (Nos 2, 3 and 4) shown in Fig. 1. For this lesson, take a block of white wood 6 inches long by 2 or three wide, and 1½ inches thick; secure it firmly to a bench, then with the flat chisel carve the bevelled edges and make the miters perfect; now take the veining tool No. 3, which cuts a V-shaped groove, and carve out the design as seen in Fig. 2.

In using this tool, hold it in the right hand and in a slanting direction. The left hand should be hollowed and placed on the tool, the wrist and tips of the fingers resting upon the work. This steadies the right hand and prevents the tool from slipping forward. Now use the gouge, and carve out the circular depression which may be seen in the design. This lesson should be passed until the design can be carved accurately. Fig. 3 shows a slip of Arkansas stone for sharpening the veining tool No. 3 and the gouges.

After mastering these tools so as to use them with ease, try carving a wall pocket, Fig. 4. The wood to be carved should be black walnut, 12 by 14 and one-half inch thick. It must be well seasoned, straight grained and free from knots. First give the outline shape of the design, as seen in Fig. 5, which may be done with an ordinary fret saw; then sketch the pattern upon the wood. A knowledge of drawing will greatly aid the carver, yet in many cases the drawing can be easily made by means of impression paper. Place the wood upon a table or bench, and secure it firmly with a clamp or screws. With the parting tool, No. 3, cut the V-shaped groove for the parting of the design. Having finished the grooving, use next some of the carving punches. First use the punch *c* for making the three circular impressions in each corner; then with punch *b* go over

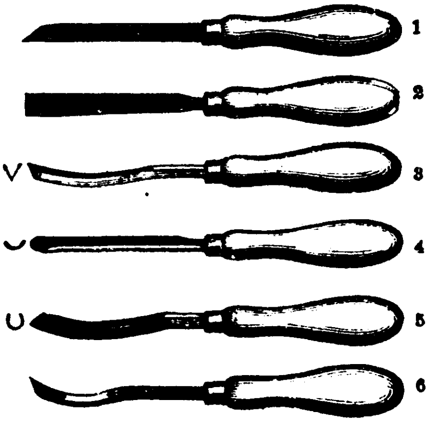


FIG. 1.

the design as in Fig. 4. The cross-shaped punch *d* can be used to ornament the outer rim. Very handsome ornamental work can be done with only the punch *b*, and for this design it can be used to good effect without the aid of the other punches. In using the punch hold it perpendicularly in the left hand, and with a mallet give it a sharp, quick blow. Furniture ornamented in this style looks remarkably well, and the work is easily executed.

Relief Carving.—Our next lesson will be to carve a book rack with the grape leaf pattern in relief, Fig. 6. The wood, either walnut, oak or mahogany, should be half an inch thick and 6 inches wide; but the proportions and sizes may vary to suit the wishes of the carver. Having sketched the design

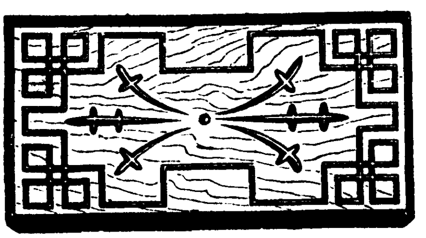


FIG. 2.

upon the wood, "stab out the work." This is accomplished by holding the chisel No. 2 upright on the line and pressing it downward to the depth of about one-sixteenth of an inch. It is better not to cut exactly in the line, but keep just outside.

When the "stabbing" has been done, hold the chisel slantingly, and cut towards the pattern, thereby removing the wood near it and leaving it quite free. Then with tools Nos.

FIG. 3.

4 and 6 clear away the "dead" wood in the intermediate space, leaving the design standing up in relief. Notice carefully the grain of the wood. If the grain runs downward, turn the wood around and work the reverse way, or sideways. It will readily be apprehended that the whole of the branches and leaves which form the pattern should not lie on one dead level. The thickest portion of the stems, leaves and grapes should be the highest; the rest of the design must be harmoniously lowered. At this stage remove those parts which the design indicates to lie very low. Be careful while working to "stab out" the line again, so that you may keep accurately to the copy. Next, you must "stab out" the whole design again, and deepen the ground until it is about a quarter of an inch lower than the upper surface, then carve the leaves, stalk and grapes, copying nature as far as possible. In doing this there will be ample occasion to exercise individual judgement and taste.

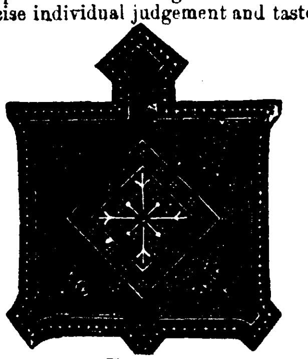


FIG. 4.

Carved Fret Work.—Another popular style of carving is "carved fret work." For this lesson we will take a carved paper-knife, Fig. 8. Take a good piece of black walnut, ten inches long, and one and a half inches wide, and one quarter of an inch thick. On this trace the design seen in the cut. With the fret saw cut out the pattern, as is done in ordinary fret sawing. Now, with the tools carve the design to imitate as closely as possible the natural leaf, flower and stalk. This being done, with sand paper and a knife bevel the edges and shape the handle.

Rim of Bread Platter, Ornamented with "Relief Carving."

FIG. 5.

Fig. 7 shows a specimen of fret carving. The dark portion of the bracket shows it simply sawed out with the bracket saw. The other side has been carved.

All tools used in wood-carving should have sharp, keen edges. Do not try to carve with dull tools.

When the beginner has so far mastered the rudiments of the art as to be able to carve these designs with ease and accuracy, he will have acquired such manipulative skill in the use of the tools as to be able to rapidly perfect himself in the more difficult features of the art.

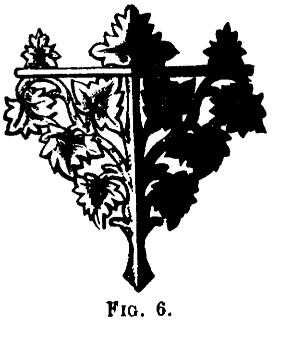


FIG. 6.

FIG. 7.

FIG. 8.

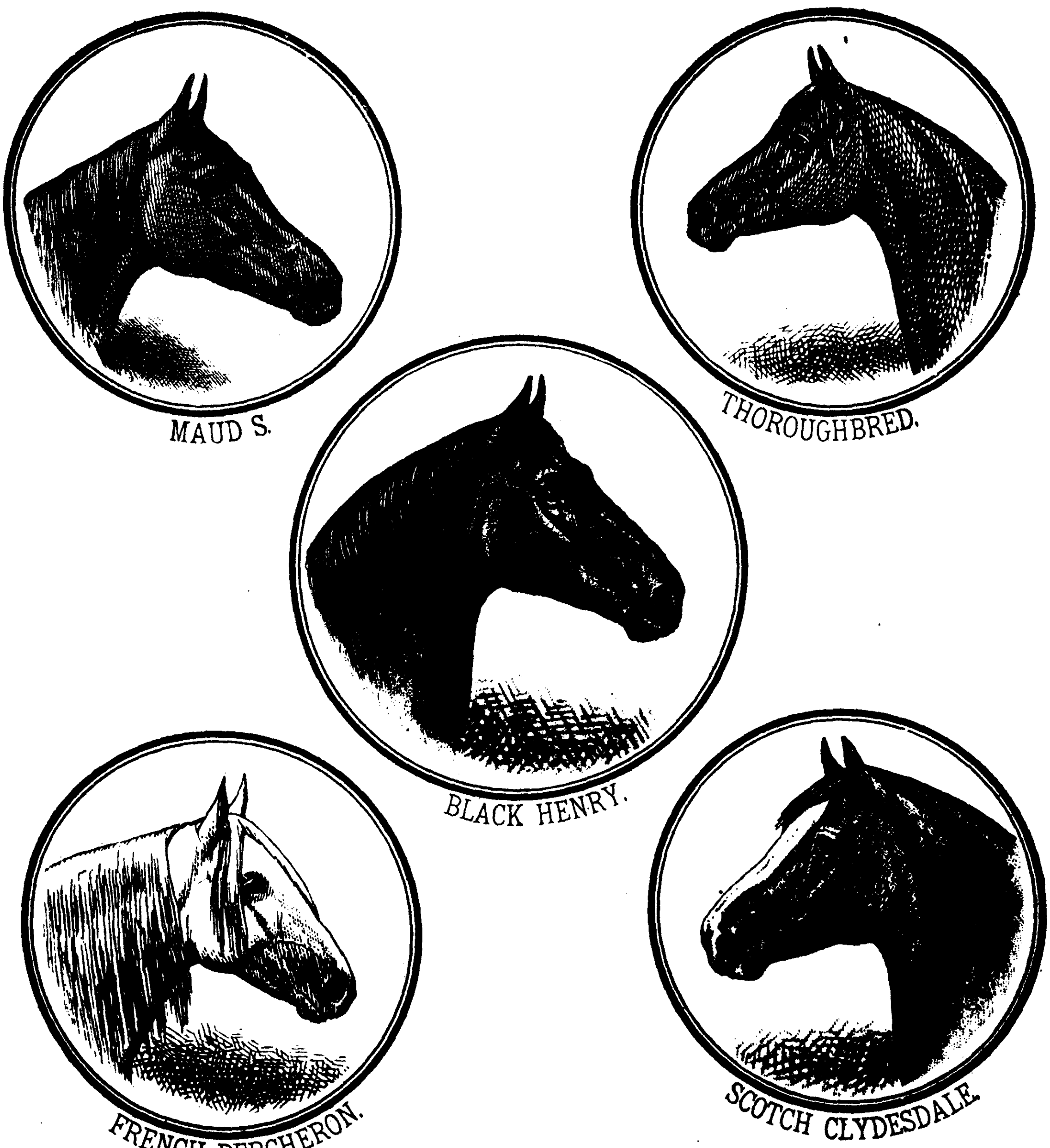


FIG. 6.—HEAD OF A HORSE OF TRACTABLE DISPOSITION, AND THAT CAN BE TAUGHT ALMOST ANY THING.

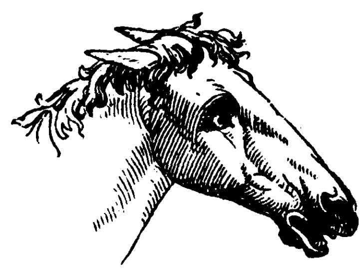


FIG. 7.—A HORSE OF THE LOWEST GRADE OF INTELLIGENCE, WHICH KNOWS SCARCELY MORE THAN SELF PRESERVATION.

HORSE CHARACTER—A GROUP OF PORTRAITS OF NOTABLE AND TYPICAL HORSES.

Natural History.

HORSE CHARACTER.

A correspondent some time since inquired if we would not publish a description of the horse's head pointing out his phrenological development and the signs which indicated his position and character. Believing the subject fo be of general interest to our readers, we have given it careful attention and present herewith a number of illustrations, two which have been selected in order to illustrate the following remarks that are from the pen of Prof. Nelson Sizer, of the American Institute of Phrenology, 753 Broadway, New York :

"The horse is at once the noblest and among the most intelligent of the animal kingdom. Like the dog, he becomes fond of man, and "shares with his lord the pleasure and pride" of companionship and achievement. Like men, horses are of various dispositions. One exhibits pride and dignity ; another is dull, tame and inefficient. One is savage ; another is kind. One is quick to understand, while another is stupid. One has courage ; another is shy and timid, and therefore unreliable. There are differences in the form and expressiou of the face of the horse, especially in the structure and form of the head. Characteristics of this kind may be profitably studied by horsemen. In Fig. 8 of the engravings it will be noticed there is a great width between and prominence of the eyes, which indicates a teachable and tractable horse. The width between the ears indicates courage, nobleness and strength of character. Roundness and elevation between the eyes is a sign of mildness of disposition, and desire to be caressed and to reciprocace kindness. A timid horse is narrow between the ears, like the deer, sheep and rabbit. Such an one lacks courage, and is always unreliable. A dull, unteachable horse is narrow between the eyes, and flat and contracted above and back of them. A horse of the general characteristics indicated in Fig. 3 can be taught almost anything. Such an one trusts and loves man.

"The sketch exhibited in Fig. 9 shows in all respects a marked contrast, comparing with the figure just referred to. The intelligence of the horse represented in this figure is of the lowest sort, and is confined to self-preservation. Such a horse is comparatively destitute of kindness and tractability. He will bite, kick, shy, run away or balk, if irritated and worried. Be lacks every element of nobleness and amiability. He is fit only for a mill or horse-boat. In monotonous lines of drudgery he map be worth keeping, but for general use he should be shunned.

"Some horses from defective vision shy at shadows or anything not dangerous. When this is the case gentleness and patience may tend to cure the habit. No horse should be whipped for stumbling and falling, or for being afraid, unless one would make the matter ten times worse."

Horse phrenology is a subject which has not received sufficient attention to warrant definite conclusions with reference to an animal's character, or to enable us to talk advisedly about the traits of horses simply from their portraits. The group of heads presented upon another page will be of interest to our readers in a general way, even though we are not able to draw those specific lessons that may seem desirable. In this group are shown a number of famous horses, concerning whose history our readers doubtless are already familiar. Different types of horses are presented, and the heads being actual portraits, become interesting subjects of study.

Maud S., whose record is 2:10¾, is too well known among horse fanciers to need a lengthy description. She was originally owned by Capt. Stone of Cincinnati, and was named by him. At present she is the property of Mr. William H. Vanderbilt, of New York.

The thoroughbred shown in our second illustration is simply a typical head. The general features presented will be recognized by our readers as those very generally met with among thoroughbred horses.

Daniel Lambert the subject of our third sketch, is the descendant of a certain line of horses formerly called Morgan horses. In color he is light chestnut, in general appearance quite stylish, and through his progeny has become well known throughout the country.

Hambletonian, the subject of our fourth sketch, is the well-known sire of Volunteer, and of many of the best trotting horses of the present day. More of the descendants of Hambletonian are in the 2:30 list than of any other horse in existence.

The typical French Percheron, which we show in Fig. 5, was drawn from a photograph. The original of this picture has been in active service in a Paris omnibus company for a number of years. While this style of horse is not favorably considered as a draft horse in this country, the head becomes an interesting object of study in the general connection in which we present it.

A typical Scotch Clydesdale is shown in our sixth sketch. This is a favorite draft horse, heavier in weight than the French Percheron and quite largely imported into this country for breeding purposes and for crossing in breeding with the view of obtaining desirable draft horses.

Black Henry, the central figure of the page, is of the Clay breed. He is a son of the well-known stallion Henry Clay. The Clay horses are well-known among breeders and turf men, and many of our readers no doubt hade had practical experience in driving and or shoeing them.

In this group we have seen seven typical heads. Most of the horses represented are so well known that there will be no difficulty in making a comparison of character between them, and by such a study our readers cannot feil to profit.

NOTES ABOUT SNAKES.

A serpent's first instinctive impulse of self-preservation, like that of every other animal, lies in escape ; probably a more nervous creature does not exist. If surprised, suddenly or brought to bay at close quarters, it may be too terror-stricken to attempt flight ; then it *bites*, following a curious general rule which seems to obtain throughout nearly the whole animal world, from a passionate child downward, no matter what the natural weapons of offense may be. Young *Felidæ* will keep their talons sheathed until they have exerted all possible force with their soft milk-teeth, and a lizard will seize the hand which restrains it with its insignificant little jaws, when its tail or claws might inflict far more injury. The *Boidæ* never use their constrictive powers in self-defense (unless they are griped), and it seems probable that if a venomous snake's fangs lay in its tail, it would use its teeth *first* when attacked, before bringing them into play. Indeed, it must be remembered that very few animals are provided with exclusively defensive weapons, and that the python's enormous strength in constriction, the viper's poison apparatus, the lion's teeth and claws, and the electric discharge of the gymnotus are given them primarily for the purpose of securing their food.

A snake *runs*, walking along on the points of its numerous ribs with a rapidity which can only be appreciated by those who have seen a long one—*Herpetodryas*, for instance—escaping in the open field or over the bushes when alarmed, its speed being further increased by the body being drawn up at intervals into folds, which, being extended, shoot the head forward This is the swiftest mode of progression of which a snake is capable, and is, as I have said, difficult to be realized from the spectacle of these reptiles in cages ; the Brazilian neck-marked snake (*Geoptyas collaris*), at the Zoological Gardens, will perhaps convey some idea of it, being certainly the most agile denizen of the Reptile House. But this movement is only an increase of the same action which is observed in one creeping slowly along, displayed to best advantage when it is gliding from a plane to a raised surface.

When a snake is in imminent danger, however, it adopts a remarkable motion for the purpose of eluding injury or capture, which motion, though it may be termed, *par excellence*, "serpentine," has singularly enough, been very little commented upon by ophiologists.

The body is thrown laterally into a series of deep curves, which alternate so quickly from convexity to concavity that it is extremely difficult to touch or aim a blow with precision at any part of it, the lateral movements covering a square of ground, the side of which would be represented by at least two-thirds of the snake's length. This motion is clearly protective in its object, and is only exhibited when the straight onward movement is felt to be insufficient to avoid peril, since the reptiles speed in travelling is greatly retarded by it—necessarily so, as the head turns alternately from side to side at an angle of fully a hundred and twenty degrees to the line of its course, thus describing the major part of the circumference of a series of circles which the body and tail follow. Even a small one on a table will not be picked up without two or three ineffectual efforts, when it wriggles in this way, and I have seen a tiny *Oxyrhopus doliatus* defend itself so for some moments against the lightning "dabs" of a serpentivorous bird ; while a lively whip snake, which was cruelly thrown to a peccary in my presence, actually twined away among the hog's feet and escaped into the jungle, in spite of the hungry and active animal's attempts to secure it. I was walking in the Botanical gardens of Rio de Janeiro some time ago, when a lady called my attention to something going away among the ferns. Not being able to see it from where I stood I jumped down the bank, and found myself literally upon an immense green tree snake, at least nine or ten feet long; I was almost treading on it, but notwithstanding my most energetic efforts to catch such a magnificent specimen with my hands, feet, and the crooked handle of an umbrella, it succeeded in crossing an open space two yards wide and disappeared into a clump of bamboo, solely by virtue of this lateral movement. I noticed that the intensity of the curvatures caused the ventral plates to be exposed, so that the yellowish under color was visible at each contortion; owing no doubt to the interlocking of the vertebræ, and consequent expenditure of the excess action in rolling.

This serpent, of course, was harmless, so that there would have been no danger in grasping it; but it emitted a curious sound in its terror, such as I never heard before or since. It *screamed*, and so loudly, that some people near who saw nothing of what was going on, thought they heard a child cry. A snake's hissing, the only vocal expression of which the *Ophidia* are naturally capable, is produced simply by the rush of air through the narrow chink by which the trachea communicates with the pharynx, without any complex vibratory apparatus such as exists in mammals, though this may be prolonged for a considerable time on account of the enormous capacity of its single lung. I infer, therefore, that this one had just swallowed something, and that either its windpipe was not properly retracted to its normal position, or that the glottis was partially occluded by a pellet of mucus or (more probably) a filament of some extraneous material, which thus converted the hiss into a sort of whistle—just as boys produce a hideous screech by blowing forcibly on a blade of grass held edgewise between the applied knuckles of their two thumbs. Serpents make all sorts of noises besides hissing, according to their different kinds; Crotali spring their rattles; the carpet viper (*Echis carinata*) rubs the imbricated scales of its adjacent coils together; the fer-de-lance (*Trigonocephalus lanceolatus*) is said in St. Lucia to give out a series of little taps with its horny extremity; and many others—such as the rat snake (*Spilotes variabilis*) of South America—certainly indicate their presence when angry by quivering their tails against the ground; but a crying snake would have been a decided novelty in one's collection.—ARTHUR STRADLING, in *Nature*.

HOW SCREWS ARE MADE.

The process of making screws is very interesting. The rough, large wire in big coils is, by drawing through a hole smaller than itself, made the size needed. Then it is put into sawdust and rattled and thus brightened. Then the head is shaped down smoothly to the proper size, and the nick put in at the same time. After "rattling" again in sawdust, the thread is cut by another machine, and after another rattling and thorough drying, the screws are assorted by hand (the fingers of those who do this move almost literally like lightning), grossed by weight and packed for shipping. That which renders it possible for machines to do is done by a little thing that looks like and opens and shuts like a goose's bill, which picks up a single screw at a time, carries it where needed, holds it till grasped by something else, and returns for another. This is about the most wonderful piece of automatic skill and usefulness to be seen, and it has done distinctive work at the rate of thirty-one screws a minute, although this rate is only experimental as yet; ninety-three gross per day, however, has been the regular work of the machine.

WATER-TIGHT BRICK WALLS.—Brick walls may be made water-tight by using two washes or solutions. The first is composed of three-quarters of a pound of castile soap dissolved in one gallon of water, laid on at boiling heat with a flat brush. When this has dried, twenty-four hours later apply in like manner the second wash, composed of half a pound of alum dissolved in four gallons of water. The temperature of this when applied should be 60 to 75 degrees Fah. After twenty-four hours apply another soap wash, and so on alternately until four coats of each have been put on. Experiments show that this is sufficient to make a wall practically water-tight.

AGRICULTURAL TRAMWAYS.

The Western grain producing sections would seem to present good fields for trying the "agricultural tramways," which are about to be experimented with by the Great Eastern Railway of England. The plan proposed in England is, to build cheap tramways as feeders out out into different producing sections which the main line does not reach, using in many cases the ordinary wagon road for its course. The plan would doubtless prove a decidedly beneficial one in some cases in our Western country, where the question of distance from the railroad is the all important one affecting land values and the return of agricultural work. Feeders of this kind, provided in some practical and economical manner, which deserved encouragement from the land-owners, or towns and counties directly benefitted, would tend to greatly equalize settlement and give value to lands now considered nearly worthless, because not touched by the railroad. They would act like a net work of veins distributing the business life and enterprise which the railroad creates and naturally deserves to locations along its route.—*American Railroad Journal.*

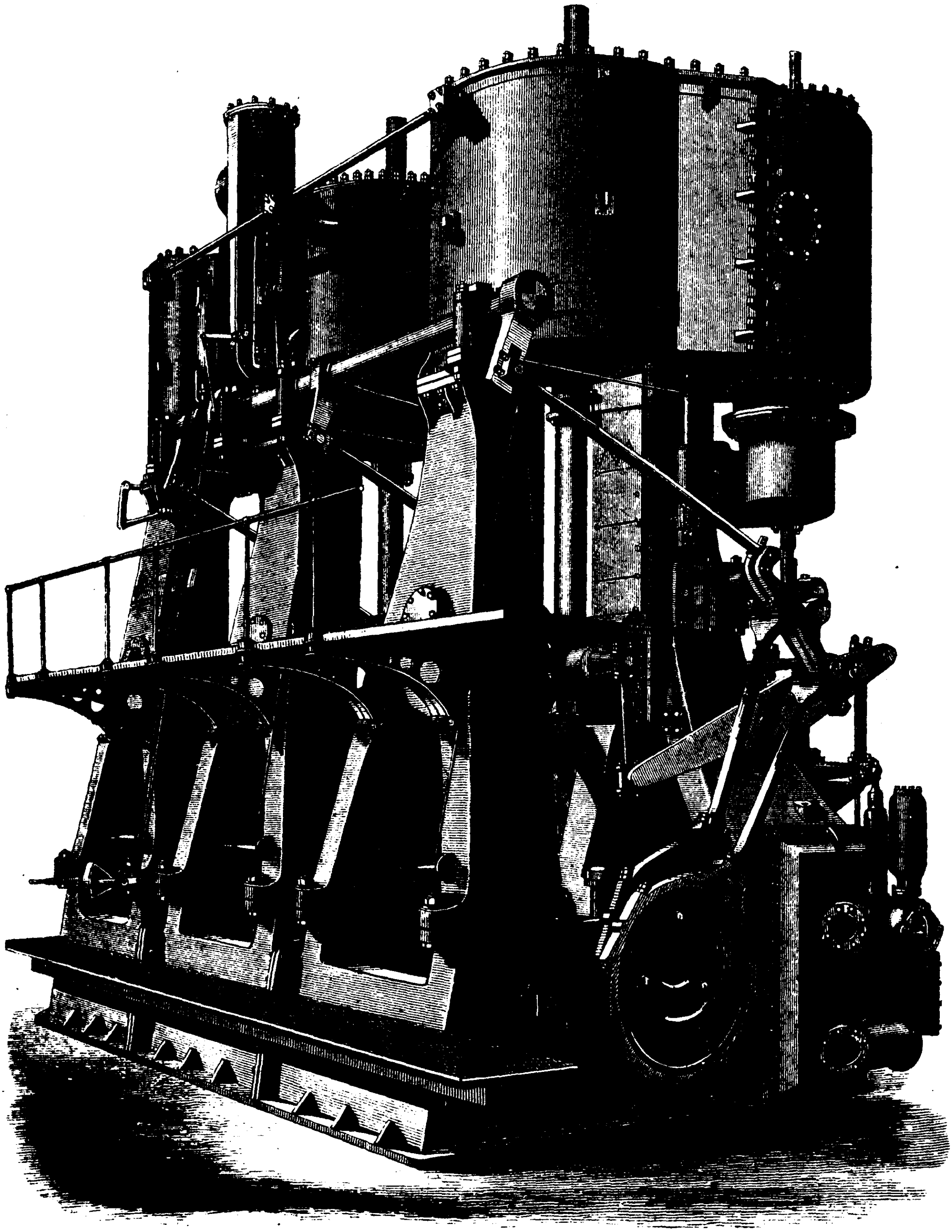
PAPIER-MACHE FLOOR COVERING.

A new and desirable papier-maché process for covering floors, is described as follows: "The floor is thoroughly cleaned. The holes and cracks are then filled with "paper putty," made by soaking newspaper in a paste made of wheat flour, water and ground alum as follows: To one pound of wheat-flour add three quarts of water and a tablespoonful of ground alum, and mix thoroughly. The floor is then coated with this paste, and then a thickness of manila or hardware paper is put on. If two layers are desired, a second covering of paste is put on the first layer of manila paper, and then the second thickness of manila paper is put on. This is allowed to dry thoroughly. The manila paper is then covered with paste, and a layer of wall paper of any style or design desired is put on. After allowing this to thoroughly dry, it is covered with two or more coats of sizing made by dissolving one-half pound of white glue in two quarts of hot water. After allowing this to dry the surface is given one coat of "hard oil-finish varnish," which comes and is bought already prepared. This is allowed to dry thoroughly, when the floor is ready for use." The process is represented to be durable and cheap, and besides taking the place of matting, carpet, oil-cloths or other like coverings, makes the floors air-tight, and can be washed or scrubbed.

A NEW KIND OF STREET CAR.

The Accommodation Car Co. has begun operation in Chicago, with a capital stock of $1,000,000, divided between the patentee, T. T. Prosser, and F. F. Cole, a real estate man. The object of the company is to build and equip a thousand cars and put them upon the streets of Chicago. The car is the patent of Mr. Prosser, and as regards present appearance is a queer, oglesome-looking craft, which carries its track along with it, and to all intents and purposes is designed to traverse any and all lines of street. The car, which is of the ordinary kind, is mounted, in the middle, upon a trunk which sits upon four wheels, each about one foot in diameter. These wheels run around inside of two steel tires, each ten feet in diameter, and which rest upon the ground and are held only to the car by a set of wheel-clamps. The car is designed to hold fifty people, and the owners claim that the more it carries the easier it runs. It will be stopped in the usual manner, and two horses will be required to pull it. The owners say that they intend putting the cars on the principal streets of the city, and placing the cash fare at four cents, and selling thirty ides for $1.00.—*Elevated Railroad Journal.*

PETROLEUM FOR FUEL.—Petroleum is more extensively used in Russia for fuel than in this country. Upon some of the railways the locomotives are fired with crude petroleum, which is introduced into the tender as it comes from the wells, and so far it is claimed, no accidents have resulted from its use. All the ships upon the Caspian sea use petroleum exclusively for heating purposes, the cost being only half that of coal. The use of petroleum, with injectors for introducing it into furnaces, is found to be very convenient. The combustion is easily regulated, and the absence of sulphur causes the furnaces to last longer. Cinders, smoke and sparks are also done away with, and the work of the stokers is much simplified.



COMPOUND "TANDEM" ENGINES OF STEAMSHIP PARISIAN.—(SEE EDITORIAL.)