THE TRICKS OF THE ALCHEMISTS.

During the sixteenth and seventeenth centuries the practice of alchemy was held in the highest repute by men of learning, while princes and even kings were seized with the popular delusion. At the same time spurious alchemists infested the country, passing from town to town and by the most specious deceptions imposing upon the inhabitants. These practitioners with the greatest ease procured from their dupes necessary funds which they—as the pioneers in the cause of science and on the point of making the grandest discovery that had ever enriched the world—required to complete their costly experiments. The more readily to attain their ends the pretended alchemist would exhibit to the gaping multitude, sometimes an apparently rusty nail which he, with great gravity and muttering some cabalistic words, would plunge into the wonderful liquid of transmutation: after the lapse of a few moments the nail is shown with its lower portion turned into the precious metal. With such proof before their eyes the credulous audience could not withhold the small pittance, their insignificant offering on the shrine of science, which the learned operator needed to renew his wonderful liquor and the cunning pretender repaints his gilded nail, fills again his vial with pure water, and passes to the next village. Sometimes a lump of lead was exhibited into which a piece of gold had previously been introduced. On heating, the lead was gradually oxydized, leaving the precious metal behind: or a crucible, concealing beneath a false bottom a bead of silver, is exposed to the action of heat, some simple powder being now thrown in, the vessel is cooled, broken, and the silver is discovered. Even such a shallow deception as washing a coin with quicksilver, thus giving it a silvery appearance, proved sufficient to deceive the simple populace.

But while these impostors were thus successful, the study of alchemy was faithfully pursued by such scholars as Augurello, Cornelius Agrippa, and the unfortunate Bombastes Paracelsus. Hitherto the sole aim of these enthusiasts had been the transmutation of the base into the precious metals: but about this time a new object to be attained presented itself. The success which had attended the use of mercury, antimony and several chemical preparations in the treatment of certain diseases awakened, the hope that by diligent study the discovery would be made of some universal menicine which should heal all disorders, and prolong human life indefinitely. This new field was occupied by new zealots, and one of these was Paracelsus, who, maintaining that strong distilled alcohol was the desired elixir vitæ, fell a sacrifice to his enthusiasm by drinking too freely of this preventive of old age.

The decline of alchemy may be dated from the middle of the sixteenth century. Few writers of reputation after that time wrote professedly on this subject, though a kind of half belief in its truth was long after cherished by even the most eminent chemists, and occasionally individuals appeared boldly claiming success in the science: such men were Agricola, Denis Zachaire, Dr. Dee and his co-laborer Edward Kelly and, as the last of the alchemists, Helvetius, Jean Delisle, the Count de St. Germain and Cagliostro. Even so late as the year 1784 Dr. Price, F. R. S., publicly proclaimed his ability of creating gold at will, but an investigation into his process being determined upon by the Royal Society, finding detection inevitable, the would-be alchemist finished his course by committing suicide.

The poverty of the alchemists as a class became proverbial, thus though avowedly in possession of the art of making gold, they were at any time willing to divulge this secret merely for a small amount of what they pretended to produce in any quantity. Although it cannot be claimed that the researches of these philosophers were in the domains of true science, yet in their fruitless efforts for obtaining the philosopher's stone, or the elixir of life, the world acquired information of far more value than the possession of either would have conferred upon it, in the advancement made in the rudiments of what has since their day developed into the grand science of chemistry.

The Engineer's Alphabet.

First obtain a fair familiarity with the mode of working out all ordinary arithmetical questions, and also a knowledge of algebra as far as simple equations. Learn also the elementary problems in mensuration, and how to measure hights and distances, and how to level and survey land.

Next gain some general knowledge of the principles of chemistry and of geology, and of the qualities of stones and cements, the action of the tides, the force of the winds, and the amount of rainfall.

Next obtain a thorough familiarity with the strength of materials, and acquire a distinct apprehension of the laws of virtual velocities and of the conservation of force.

The law of virtual velocities enables the strain placed upon any part of a machine or structure to be immediately computed when we know the weight or force applied to any other part, and by this expedient, joined to a previous knowledge of the strength of materials, it can easily be determined whether any machine or structure is strong enough. Thus in a crane, if the interposed gearing is such that the travel of the handle through 100 in. will cause a tooth of a certain wheel to move through 1 in. then we know that the strain upon that tooth will be 100 times greater than the force applied to the handle, and so in all other proportions. So, also, in a beam or girder of iron of which the top flange is incompressible, if we wish to determine the breaking strain acting upon the bottom flauge when the beam is loaded in the middle, we have only to suppose that the beam has been broken, and if we find that the broken edges separate only 1 in. while the weight falls through 6 in., then the strain at the edge of the beam seeking to sever it is six times greater than the weight.

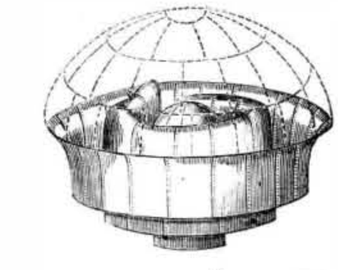
The law of the conservation of force teaches that a force once existing cannot disappear except in the creation of some equivalent force, and one corollary of this law is that no form of mechanism can create power. Hence in a steam engine, if the steam were to be condensed by a jet of cold water immediately as it issued from the boiler a certain volume of hot water would be produced. But if the same steam be allowed to flow through the engine, and be finally condensed in the condenser, the resulting volume of hot water will be less in the proportion of the power exerted by the engine. Heat being a form of power, it follows that if a certain portion of it goes to generate mechanical power in the engine, there is less to expend in raising the temperature of the water by which the steam is condensed.—*Engineering.*

STEAM BOILERS--THEIR FORM, CONSTRUCTION, AND MATERIAL.

[NUMBER TWO.]

The balloon or haystack boiler, two engravings of which appeared in our article of April 27th, was attempted to be im-

1.



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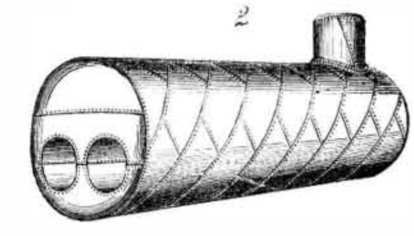
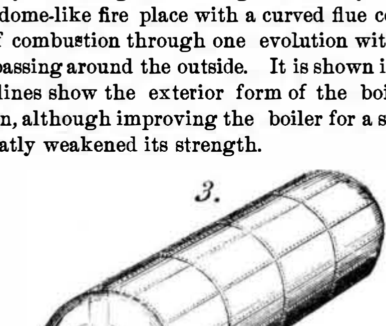


proved by increasing its heating surface by constructing a central dome-like fire place with a curved flue conducting the gases of combustion through one evolution within the boiler before passing around the outside. It is shown in No. 1. The dotted lines show the exterior form of the boiler. Its construction, although improving the boiler for a steam generator, greatly weakened its strength.

3.



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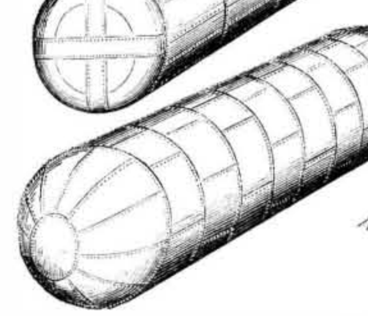
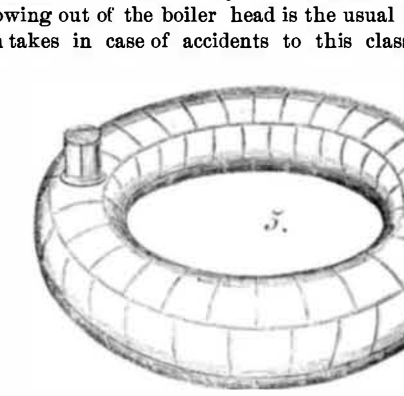


The object of increasing the strength of boilers by diminishing their diameter led to the construction of boilers of a cylindrical form. They, however, had flat ends generally of cast iron, as are hundreds still in use in this country. The flat surface has much less resisting power than a convex surface, and as cast iron will not yield much without breaking, the blowing out of the boiler head is the usual form the explosion takes in case of accidents to this class of boilers.

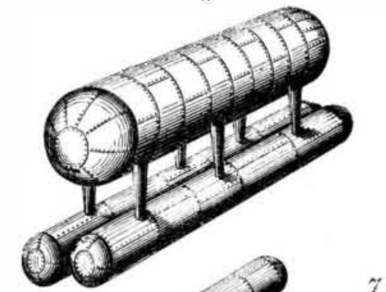


5.

Long stays running from end to end are employed to keep these heads rigidly in place; in flue boilers the flues themselves are the stays. This tendency to cracking of the cast iron head suggested the wrought iron head, seen in Nos. 2 and 3, and in some cases the employment of bands crossing at right angles as in No. 3. To further strengthen the shell of the boiler the seams of the plates were sometimes made to run diagonally, as in No, 2.

No 4 shows an improved form of cylindrical boiler in which the ends are hemispherical. This form is now so extensively used in England that boilers of this shape greatly outnumber those of all others. This shape renders them very strong, as the whole body of the boiler is in simple tension and internal pressure has no tendency to alter the form. Plain cylindrical boilers externally fired have the advantage of being easily cleaned internally and are accessible to necessary repairs; but that part upon which the flame impinges is liable to be weakened by the action of the heat, especially when the boiler is of great length, as seventy or eighty feet, not—an uncommon length—and the heat has to act upon a large body of water at one point or on a circumscribed and limited area. Mr. Marten, from whom we largely quote, says he has seen a modification or rather extension of the cylinder boiler where great surface was obtained and extreme length avoided by curving the shell until both ends met, making an annular or ring boiler, seen in No. 5. It had a diameter of five feet for the cylinder with an external diameter for the ring of twenty-five feet, giving a total length of about sixty-three feet. It has worked for years well although exposed to the heat of six puddling furnaces.

6



7

As large diameter for boilers is a source of weakness, and the immense body of water just over the fire is a hindrance to the rapid generation of steam, the elephant boiler or as commonly known, the French boiler, so called from its general use in France, has been designed. It is seen in No. 6 and is merely a combination of small cylinders connected by upright conical tubes. The large upper cylinder is the steam chamber. The disadvantages of these boilers are difficulty in cleaning or examining internally, and the exit for the steam from the generator to the steam cylinder being cramped, tending to priming and hindering the free generation of steam. The same objections apply to the retort boiler No. 7, although both of them expose a large surface to the action of the heat, and consequently are better generators than the plain cylindrical boiler.

GLEANINGS FROM THE POLYTECHNIC ASSOCIATION.

The regular meeting of this branch of the American Institute, was held on Thursday evening, April 11th, Prof. Tillman presiding.

MISCELLANEOUS PROCEEDINGS.

The chairman read a collection of scientific items, after which a long discussion arose respecting the merits of corrugated iron in the construction of boilers. Dr. Bradley followed, explaining a plan for preventing incrustation of boilers, which was simply passing a continuous current of free electricity through the iron. After some further transactions the society listened to a paper from Mr. H. F. Walling advancing a new hypothesis relating to

MOLECULAR MOTIONS.

Mr. Walling proposed to refer all the forces of nature to one simple or universal force. Gravitation, he considered to be the resultant of equal infinite and opposite forces, intercepted by matter, thereby causing a diminution of the two opposing forces between the atoms, and a preponderance of the external force; thereby impelling the atoms toward each other. All molecular attractions are the results of gravitation in atoms, repulsion being due to the excess of momentum over gravitation. Heat, the great repulsive force of nature, is simply the momentum or centrifugal force of atoms.

In the molecular hypotheses advanced by Boscovich, Mossotti, and Prof. Norton, the conditions of solidity and fluidity are explained by supposing the ultimate atoms to be solid and encompassed by an elastic etherial atmosphere, but the inquiry suggests itself, whence is derived the atomic solidity and fluidity? In this hypothesis, the only properties attributed to ultimate matter are position, and inertia, or the capacity for associating with force and acquiring motion. Repulsions, attractions, impenetrability, elasticity, etc., are the manifestation of this associated force, and are not the inherent properties of matter. Atoms, the speaker supposed, actually moved around each other in pairs, describing in three intersecting planes, circular or elliptical orbits upon the surface of imaginary spheroids. The intersections of these orbits form six poles, each a central point in a face of an imaginary circumscribing prism. Since heat is momentum, uniform temperature is maintained in atoms of different weights, when the products of mass into velocity are equal. It follows that pairs of heavy atoms move slower than pairs of lighter ones. This explains the spheroidal forms of certain molecules, from which all forms of crystaline structure arise. Solidity and liquidity are due to the interlinking of the orbits of adjacent molecules at the six poles, a single interlinking producing liquidity, a double one solidity. The rigidity of solids is the result of this polar attractive force. The conversion of solids into liquids and liquids into gases by increasing temperature, is caused by accelerated momentum of the atoms overcoming the interlinking or polar force. A reverse action takes place when heat is diminished. In gases the centrifugal force predominates and there is a constant tendency of the atoms to separate.

Mr. Walling exhibited drawings and models, and gave a mathematical demonstration of the stability of a system made up of atoms moving as described, and proposes to pursue further the investigation of the subject.

[For the Scientific American.]

BREAKAGE OF CAR WHEELS--THE CAUSES AND REMEDIES.

The subject of car wheels has not had the attention its importance demands, and so important is it to the public that many have thought a Government Inspector should be appointed to inspect every wheel before it is put in use. The lives of millions of our citizens are constantly in jeopardy while traveling over our railroads, and what may insure greater safety should receive the earnest attention of the National Government. If the inspection of boilers on steamboats is necessary, surely the same precaution is desirable in railroad trains.

Cast-iron wheels are so fully established in this country, that it is scarce worth while to attempt the introduction of wrought iron or any other kind of wheel, but what may improve the quality of wheels is worthy the attention of all railroad managers, car and locomotive builders. A proper chill on poor iron may insure a wheel under favorable circumstances to wear as long as a wheel made from iron of a better quality. If, however, any unusual strain comes on the wheel, the poorer iron may fail in the time of need, when the better iron would have withstood the shock. Cheap wheels seem to be more sought after than those of a better quality costing more. The best charcoal iron, remelted in a cupola, always deteriorates in quality. It becomes anthracite iron and assumes all the qualities of anthracite iron, and will rarely show a tenacity of over eighteen to twenty thousand pounds to the square inch. High tenacity, when the proper degree of mottle is maintained, will always produce the best wheel, as it not only has tensile strength but a greater degree of toughness. This has been fully demonstrated by General Rodman in the manufacture of his incomparable guns, which are unequalled by any other made in any part of the world.

To insure good wheels the tenacity should never be less than thirty thousand pounds to the square inch, and this without the iron being too high, so as to endanger brittleness. If an inspector would require this tenacity we would seldom hear of broken wheels. Car wheels, like carriage wheels, will wear out, and good wheels, if replaced in time, will generally insure against accidents. The same may be said of car axles. Hammered axles are better than rolled axles, and yet rolled axles are coming into general use because they can be made cheaper. Let us have Government Inspectors for each, and greater safety will be the result.

Cold-blast charcoal iron is best for both car wheels and axles, and yet but little is used by the manufacturers of car wheels. Many of the manufacturers of wheels are interested in furnaces which are hot blast because the yield is greater with hot than with cold blast.

Charcoal iron remelted in reverberatory furnaces, if not permitted to become too high, will not deteriorate in quality, but Nos. 1 and 2 pig will improve in strength till it reaches No. 3, after which it deteriorates.

Some car-wheel manufacturers mix anthracite iron with charcoal iron in their wheels. Anthracite iron is usually much poorer in quality, and never uniform, and the practice should be discountenanced and condemned.

Castings from reverberatory furnaces are always superior in strength and toughness to those made from cupolas, and machinery castings, chilled or sand rolls, and car, wheels, should only be made from iron remelted in reverberatory furnaces. MULHOLLAN.

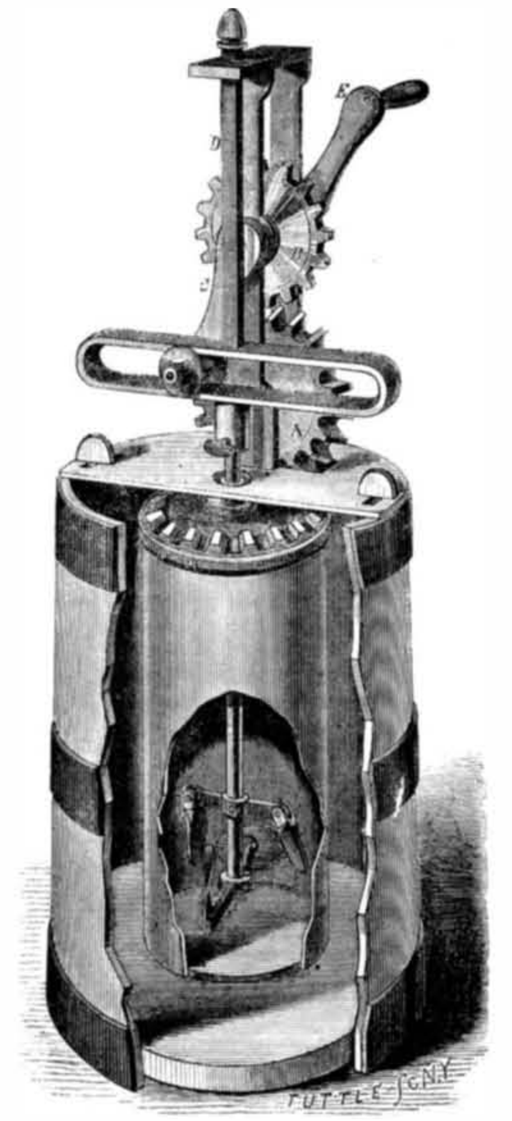
[Mr. H. C. Luce, of Jersey City, N. J., has addressed to *Engineering* a temperate, matter-of-fact statement of the case of the American car wheel, neither claiming nor admitting more than is reasonable. He says that the best American wheels sometimes break, and sometimes wear out in a few months; and yet, if made from good iron and treated properly, are the best wheels in use. He puts down the average wear under large business, at two years in passenger traffic and from three to seven years in freight. It is estimated that 25 per cent of the best wheels will fail in the first year in one way or another: the remainder will run for very various periods beyond the above average; sometimes as high as fifteen years. —EDS.

Proscription of Merit.

The only point upon which the English railway managers stood out against the demands of their locomotive hands, appears to have been that of uniformity of wages and uniformity of promotion. The motive to this demand is obvious. The meritorious hands to whom more than average wages or promotion had been accorded were of course a minority. The others could conceive of no reason but favoritism for any one being preferred above themselves, and being the majority were able to vote as the sense of the Union that all discriminations would be in practice controlled by favoritism, and ought to be abolished; so that long and faithful service, skill, care and courage should be qualities henceforth of no use to the possessor, but a free gift to the employers and the public. The obvious interest of the payers of wages would be potent enough to secure a valuable equivalent for extra pay in general, although favoritism might sometimes succeed in defeating that object; and a system of merit records to determine promotion and exclude favoritism might easily be arranged if the argument were sincere. But so long as excellence *is* excellence—*i. e.*, the exception and not the rule—for first-rate men in any craft to submit themselves to the dictation of a majority in trade matters, is equivalent to surrendering their well-earned rank and its just rewards to the envy of their inferiors. Wherever merit "wont pay," universal deterioration and loss of prosperity must follow, and the last state of that craft will be worse than the first. It ought to be a fundamental and unalterable part of the constitution of every trade association, for their own permanent advantage, that no check shall be imposed upon individual promotion or pay.

LIPP'S ICE CREAM FREEZER.

The process of procuring that delicious compound for summer weather, known so favorably as ice cream, is sufficiently familiar to all. It is merely the thorough and even freezing of eggs, milk, and sugar, so that the mass shall be of the same consistency, without lumps and perfectly homogeneous. On the even freezing of the mixture much of the delicacy of flavor and satisfactory results depend. We have known good ice cream produced by simply turning an ordinary covered



tin pail filled with the sweetened compound in a freezing mixture of ice and salt in a common tub, but it was a labor requiring time, elbow grease, and patience. We give an engraving of a machine intended to shorten the time, reduce the amount of labor, and secure superior results.

In this machine the ordinary shaped ice receptacle is used, inside of which is a can which rests and turns upon a stud and step, one on the can bottom and the other on the ice tank. By means of a bevel gear which forms the top of the cream can, to which it is secured by a simple clamp, the can is rotated by a crank on the horizontal shaft which carries the gear, A, that meshes into that on the top of the can. The upper gear, B, also engages with A and gives motion, when so engaged, to the crank, C, and by a roll sliding in the horizontal loop, to the dasher shaft, by means of the guide, D, in a reciprocating, vertical movement. This dasher shaft has two arms, the lower one carrying a fixed curved scraper and a curved disk pivoted to the cross bar, while the upper one has two spoon shaped scrapers which assist in removing the frozen cream from the inner circumference of the can and throwing it toward the center. The times of motion between the revolving cream can and the upward and downward movement of the dasher shaft with its appendages are so arranged that they are not in unison, and consequently the contents of the cream receptacle will be removed from the sides as fast as frozen and sent to the center, while that in the center, not exposed to the freezing mixture, will be thrown by the centrifugal force of the revolutions of the can to the outside. The crank, E, can be placed on either shaft to revolve the can alone, or to give the vertical reciprocating motion to the dasher shaft. For this purpose the gear, B, is made to be shifted from a feather or fixed key on its shaft to a smooth place where the turning of the shaft will not affect it. It may therefore be used to raise and lower the dasher shaft or not, as may be required, or slipped into and out of gear to suit the progress of the work.

This improvement was patented through the Scientific American Patent Agency, February 26, 1867, by Lewis A. Lipp, whom address at Coatesville, Pa.

MAGNESIUM LIGHT is introduced into the human mouth in dentistry with great advantage, enabling operations to be performed at all hours, better than by the light of day.

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents.

The Philosophy of the Cracking of a Whip.

MESSRS. EDITORS:—In No. 16, Vol. XVI., April 20th, E. L. B. of N. Y. inquires "What is the explanation of the sound produced by the cracking of a whip." You reply, "The concussion of the lash with the air and the concussion of the air in closing up the vacuum left in the path of the lash. The sound produced by the concussion of air with air is illustrated by the whistling of a bullet."

Not so clear. Why is the report occasioned by the lash louder than the whistling of the bullet? The bullet is larger than the *end* of the lash—which produces the report. Is the vacuum or concussion less? A lash without a "cracker" *will not* make a loud report. A whipstock without a lash will produce a whistling sound.

Again, why the well known difference, if the lash has a silk thread instead of tow-string or other cracker? If the report is due solely to concussion and displacement of air, why the difference in sound produced by a lash tipped with metal and one tipped with silk thread? The metal as in the case of the bullet will make some sort of whistling sound. The cracker will make a loud report.

If you are cornered please "face the music" and let us have more light, for that is what we expect to get out of the SCIENTIFIC AMERICAN. T. M.

Allegheny City, Pa.

[The ordinary sensation of sound is dependent upon rapid movements or vibrations of the air. This motion of the air is always the result of impact or collision, either of air with air, or air with another substance. The striking of solid and liquid substances should only be considered an indirect cause of sound; for the immediate antecedent to the movement of the air is not the striking but the movement of the substances which results from it, and which movement by collision is directly communicated to the air. The ringing of a bell, therefore, may be looked on as a case of collision of a solid with air. If the cracking of a whip is not included in this theory, which is simply another way of stating our answer—we are cornered and will face the music. It may be complained by some who accept the theory that it does not sufficiently take account of the details of the case of the cracker. For such we add further explanation. The sharpness and loudness of the crack depend on the suddenness of the impact and the size of the cracker. A metal cracker, on account of its inertia, would interfere with the suddenness of the impact; its weight would act to stretch the elastic lash and so to ease off the motion. A silk cracker on the other hand has little inertia and is brought up suddenly at the greatest extension of the lash; moreover its greater bulk compared with metal or tow gives a greater volume of impact, and consequently of sound. A cracker for a given lash may be too heavy or too light, too large or two small, and for a given cracker a lash may be too long or too short, or too light or too heavy. There is a chance on this subject for a mathematician to write a book.—EDS.

A Correction.

MESSRS. EDITORS:—I have subscribed to your paper for many years, and seldom read a number without getting some new ideas to store away for future use. But do you not think you are getting careless in your replies to your correspondents, many of whom—mere tyros—esteem every opinion and rule of yours as an axiom and indisputable? In your last number you tell T. A. M., of N. J., to multiply the hight of a tank by the area, and divide by 144 when you mean 1728. Again, you tell him the area of a circle is its diameter multiplied by 3·1416 when you know that it is the "square of the radius," multiplied by that number, or more simply the square of the diameter by the fraction of 0.7854, which is the same thing. It would be absurd to accuse you of ignorance on such elementary matters, but very much harm may be done, as you well may conceive by this carelessness, especially when you take into consideration the class of your enquirers who have had little or no education.

[Our correspondent is somewhat severe, but he is perfectly correct. We do not pretend to infallibility, but we desire to be right in our replies to inquiries. In this case two answers became unaccountably and inextricably "mixed."—EDS.

Testing of Boilers.

A section of the new water tube boiler invented by Mr. J. Howard, the agricultural machine maker, of Bedford, Eng. was lately tested with a hydraulic pressure of 1200 pounds to the square inch. Every joint remained absolutely tight; yet one of the tubes was afterward disconnected and taken out in five minutes, and not over ten minutes were required for replacing it as before. *The Engineer* makes this incident the text for a discussion of the question of over-testing. It would seem that if anything could spoil a good boiler and prepare it for mischief, it might be this excessive test. It is a little like the old-fashioned hydraulic test for witches: if they floated they must be burned, if they sunk they must of course be drowned. Our contemporary opposes the usual plan of taking as a basis the maximum working pressure demanded, and calculating the proper test by multiplying it. It is recommended on the contrary, to take the calculated strength of the structure, and apply a test equal to say one third of what it ought by analogy to bear. The theoretical strength of the boiler is thus tested practically to one third of its extent: if not started by this, there is a margin of twice as much probable strength to resist any injury from the strain. Assuming the test point therefore as a safe point, the proper working pressure may be taken from that datum with any proper margin for further security.