The Melting Point.

The theory that iron in a cupola is melted all up through the stock is wrong, for every cupola has a certain point at which the iron is melted, and there is not a pound of iron melted in any cupola until it comes down to the melting point. The melting point in a cupola is generally from six to eighteen inches above the tuyeres, but it may be raised or lowered a little by increasing or diminishing the amount of fuel in the bed: but if we get the bed too high it throws the melting point too high, and the result will be slow melting. If we get the bed too low, it will allow the iron to get below the melting point, and the result will be dull iron; and in order to do good melting in any cupola, it is very essential that the melter should know the melting point of his particular cupola. The melting point of a cupola is the point at which the most intense heat is created by the action of the blast upon the fuel. This intense heat at the melting point will cut the lining more than at any other place in the cupola, and the lining will generally be found to be cut out more just above the tuyeres than at any other point, which indicates the melting point of the cupola. If tuyeres are put in so as to distribute the blast evenly through the stock, and the charges of iron and fuel are put in evenly, and every charge leveled up properly, the heat will be even all through the cupola, and the lining will be cut out in a regular belt at the melting point all around the cupola. On the other hand, if the tuyeres are not put in so as to distribute the blast evenly through the stock, or the charges of iron and fuel are not put in even and level, or if the fire is all on one side of the cupola, the heat will not be even through the cupola, and the lining will not be cut out in a regular belt at the melting point, but will be cut full of holes, which shows that the cupola is not melting all around, but is only melting in spots. By this irregular charging and melting in spots, the cupola may be reduced to half its meltingcapacity, which accounts for a cupolameltingfast on one day and slow on another day. As before intimated, the melting point in a cupola is the point at which most intense heat is created by the action of the blast upon the fuel. When the blast enters the cupola it is cold, and as it passes through the heated fuel it becomes hot, and as it becomes hot it creates heat by combination with the fuel, and makes an intense heat. If we have a very strong blast it will travel fast and will pass through the fuel rapidly, and it will have to pass through more fuel before it becomes heated sufficiently to make an intense heat by combination with the fuel. On the other hand, if we have a mild blast, the blast will pass through the heated fuel slowly, and is more heated, so that it does not have to pass through so much fuel before it becomes sufficiently heated to make an intense heat by combination with the fuel; so that when we have a strong blast the melting point of a cupola is higher than when we have a mild or weak blast; and the bed has to be put in higher in a cupola with a high melting point than in a cupola with a low melting point, which accounts for one cupola requiring more fuel in the bed than another cupola does. When the cupola is in blast, the bed or fuel in the bottom of the cupola is constantly burning up, and the unmelted iron will get down below the melting point. To prevent this, the melter has recourse to charges of fuel between the charges of iron, and as the charges of iron are melted and drawn out at the tap hole, the charges of fuel come down and replenish the bed and again raise the melting point; the next charge of iron comes down and is melted and drawn out; the bed is reduced and is again replenished by the next charge of fuel, and so on through the whole heat. If we supply too much or too little fuel between the charges of iron, the melting point will be raised too high or reduced too low, or in other words, if we have a melting point of ten or twelve inches in height in our cupola, and we supply twenty or twenty-five inches of fuel, this extra fuel must all be burnt up before the iron can come down to the melting point; and we will not have a continuous melting, but will have a delay between each charge of iron. If, on the other hand, we have only five or six inches of fuel between the charges of iron, when we should have ten or twelve inches, this small amount will not more than half replenish the bed, and the unmelted iron will get down too low and will not make hot iron, and the iron may not be melted at all; and in order to do either fast or economical melting, we must not use either too much or too little fuel, and we must have the fuel distributed so as to suit the particular cupola in which it is used; for, as before explained, there are scarcely two cupolas that will melt exactly alike on account of the melting point being higher or lower, which is caused by a stronger or weaker blast, or by more or less draught; and in order to do good melting, the melter should not charge his cupola just the same as some other cupola of the same size is charged because that cupola does good melting charged in that way; but he should vary the height of the bed and the amount of fuel between the charges of iron, and the amount of iron on the bed and on each charge of fuel, until he finds the exact proportions that will do the best melting in that particular cupola.

Melters, in changing from one cupola to another, will generally have trouble in making hot iron, and they will often make a complete failure of melting in a strange cupola. This is simply because they undertake to charge that cupola the same as some other cupola that they have been melting in, and they never pay any attention to the draught, blast, or the melting point of the cupola, which is the cause of their failure in melting in a strange cupola. When a melter takes charge of a strange cupola, his first object should be to study the draught of the cupola, the nature of the blast, and to ascertain the melting point of the cupola. He can generally tell where the melting point is by noticing where the lining is cut out the most, and he can tell whether the cupola is melting evenly, or is only melting in spots, by noticing whether the lining is cut out in a regular belt all around the cupola, or is only cut out in holes, as before explained. He can tell whether the bed is too high or too low by noticing how the cupola melts. He can tell whether he is using too much fuel between the charges of iron, or if he is putting in the charges of iron too heavy, by noticing whether the cupola melts regularly or not, and by noticing if it makes regular iron; for if the iron is very hot in one part of the heat and dull in another part, it is a sure indication that the fuel is not properly distributed through the iron, and it should be remedied by increasing or diminishing the weight of the charges of fuel or iron.

In melting with coke, the melter cannot put in his iron in as large charges as he can with coal, because the coke is more bulky than coal, and he has more bulk in the same weight, and if he puts the same weight of coke between the charges of iron as he does of coal, the bulk of the coke will raise the iron above the melting point, and the iron cannot be melted until part of the coke is burnt up so as to allow the iron to come down to the melting point, and the result is that he does not have continuous melting, but he has a delay between each charge of iron, and theiron will probably be dull in the latter part of each charge; but the melter can do equally as regular melting, and can do faster melting with coke than he can with coal, by putting in the coke and iron in smaller charges, and more of them, which proves conclusively that good melting can be done with almost any fuel and in any cupola, if the melter understands his business; but he may not be able to do as economical melting in a poor cupola as he can in a good one.—*From "Founding of Iron," by Edward Kirk.*

Iron-Steel.

MM. Asbeck, Osthaus, and Eicken, of Hagen, Westphalia, says the *Revue Industrielle*, have recently manufactured a metal composed partially of steel and partly of iron to which they give the name of iron-steel. The novelty of the combination consists in the introduction of a thin sheet of iron between the surfaces to be welded. A cast iron mold is divided into two compartments by means of a transverse plate or of a tube placed in the interior and the two metals are poured into the respective compartments. Before fusion both metals are submitted to complete refining which removes all matters which hinder welding. They are then turned into the mold, the sheet iron partition in which serves to prevent their mingling and to facilitate welding by being itself brought into a state of fusion. The success of the operation depends considerably on the preparation of the metals, on their readiness to weld, and on the thickness of the partition. The last is determined experimentally and the dimensions differ according to those of the ingots to be produced. The metal thus prepared is said to be adapted for the fabrication of rails, anchors, and armor plates, etc., where the hardness of the steel diminishes the wear and increases the resistance of the masses. In the construction of safes, plates of this combination are said to be proof against attempts to break or drill through them. In all portions of machines or for tools which support or transmit heavy pressure or undergo instantaneous and powerful stress, as in rolls or axles the metal is claimed to possess very superior advantages.

Gas Main Leakage.

There appears to be a good opportunity for some one to invent a cheap method of rendering the pipes and mains which conduct illuminating gas under city streets thoroughly tight. At the present time there is always leakage, and when the earth is broken to reach water pipes, etc., in our thoroughfares, the overpowering stench shows the ground air to be thoroughly permeated with gas. Even if this, as Dr. Chandler says, is not directly detrimental to health is at least exceedingly disagreeable, and without doubt it exhales from the ground in sufficient amounts to add its quota to the combined odors of garbage and refuse which pervade the densely populated districts of the city. The principal parties affected by leaky gas mains are the gas companies, and we are informed that the yearly loss from this cause reaches considerable figures. Gas pipes are tested by closing the ends, plunging them in water and pumping in air, the escape of which indicates the existence of flaws. If these are large the pipe is rejected, if small they are closed by hammering; but that this system does not entirely guard against leakage, is, as already stated, evident. Coal tar has been used as a varnish for outsides of pipes with fair results; but cannot the metal of the pipe itself be so mechanically treated, by compression or rolling either outside or inside, that it shall be wholly impervious to gas?

Self-Vivisection.

It is not often that an inventor has such an implicit faith in his invention, or the nerve to demonstrate the fact as Dr. Waters, of Salem, recently showed before the Massachusetts Dental Society. He stated that bicarbonate of soda, such as used for cooking purposes, or any other alkali in neutral form, would afford instantaneous cessation of pain from the severest burns and scalds, and would cure such injuries in a few hours. Deliberately dipping a sponge into boiling water, the Doctor squeezed it over his right wrist, producing a severe scald around his arm and some two inches in width. Then, despite the suffering occasioned, he applied the scalding water to his wrist for half a minute. Bicarbonate of soda was at once dusted over the surface, a wet cloth applied, and the pain, the experimenter stated, was almost instantly deadened. Although the flesh on the wrist was literally cooked down to the sweatglands, and the wound was of a nature to be open and painful for a considerable time, on the day following the single application of the soda, the less injured portion was practically healed, only a slight discoloration of the flesh being perceptible. The severer wound in a few days, with no other treatment than a wet cloth kept over it, showed every sign of rapid healing.

Purification of Bismuth.

Bismuth has been purified by Mr. E. Smith in this way: To every sixteen parts of bismuth, kept in a fluid state, at the lowest point of its fusing temperature, he added one part of a mixture composed of three parts of flowers of sulphur and eight parts of cyanide of potassium. The bismuth was kept melted for fifteen minutes after the mixture was introduced, and then allowed to cool.

NEW BOOKS AND PUBLICATIONS.

STRENGTH AND DETERMINATION OF THE DIMENSIONS OF STRUCTURES OF IRON AND STEEL. By Dr. J. J. Weyrauch. Translated by A. Jay DuBois, Ph.D. New York: John Wiley & Sons, 15 Astor Place.

Dr. Dubois' translation of Dr. Weyrauchs' work will especially commend itself to engineers as being prepared at the especial request of the author, and as it consequently is the only one vouched forby Dr. Weyrauch, its accuracy and authenticity need no better recommendation. As to the value of the book, it will be sufficient to say that its object is to substitute the legitimate deductions of varied and careful experiment for abstract and purely theoretical assumption; to furnish in lieu of arbitrary rules accurate and reliable formulæ involving all the necessary data for a simple and rational method of dimensioning in a systematic manner covering all cases. "What has for the last hundred years justified the assumption that a piece which has once successfully resisted a certain stress, must necessarily resist equally well an independent number of repetitions of that stress? How can it be held that it is a matter of indifference whether a piece is subjected always to the same constant load, oris alternately loaded and then unloaded, or is evensubjected to alternate strains of tension and compression. * * * By assuming the strength which is *not* constant, as nevertheless constant for every member of a construction, the degree of safety of the different members varies. The least safety of any place in the structure is however the measure of the security of the whole. If one member gives way, it is a matter of little moment whether in falling, the other members hang together or not." This extract from the translator's preface will give the key to the tendency of the work. In order to determine the required area of cross section of a part to safely resist a given stress the practice has been to divide the greatest stress by the assumed allowable stress per unit of area and the resulting general value is taken as invariable no matter whether the stress be occasioned by dead load or whether it undergoes sudden changes. After a long series of experiments Wohler reached the conclusion that "rupture may be caused not only by a steady load which exceeds the carrying strength, but also by the repeated application of stresses none of which are equal to this carrying strength. The differences of these stresses are measures of the disturbance of the continuity, in so far as by their increase the minimum stress which is still necessary for rupture diminishes." Starting from Wohler's law which does not cover all cases, Dr. Weyrauch reviews and adopts Launhardt's formula which he shows to be applicable when a piece is always extended or always compressed or generally submitted to stress of a single kind. In the succeeding chapter (chap. IV) the author himself deduces a forformula, instances of pieces subjected to alternate tension and compression. The subject matter of the remainder of the volume is of a directly practical nature. Chapter V deals with carrying strength for compression and tension, and embodies the results of a host of valuable experiments. Then follow sections on transgression of elastic limit, annealing, tempering, influence of form, constituents of steel and iron, influence of temperature, estimation of material, allowable stress per square centimeter, method of determining dimensions, shearing strength and rivetting, the last very fully discussed. The book ends with an appendix in which other methods are considered, and Professor Thurston adds his excellent papers on strain diagrams with which our readers are already in some measure familiar. There are several good illustrative plates, some valuable reduction tables, and in general as the translator claims the subject is capitally set forth "in a shape to meet the daily wants of the practising engineer and constructor."

A PRACTICAL TREATISE ON LIGHTNING PROTECTION. By Henry W. Spang. With Illustrations. Philadelphia: Claxton, Remsen, & Haffelfinger, 1877.

This little treatise contains quite an amount of interesting practical information on the subject of lightning and the means to be employed for securing immmunity against its effects. Its main object seems to be however to introduce to public notice a new mode of obtaining a proper ground connection, which if capable of performing all that it is claimed for it can hardly fail to meet with extended favor. It strongly recommends the old but excellent idea of making all large masses of metal about a building, such as metallic roofs, rain and gas pipes, etc., serve as lightning conductors, and shows that they will afford absolute protection if connected properly with the earth. Explicit directions are given for ensuring the safety of structures of all kinds, also of ships, oil tanks, telegraph poles, wooden bridges, steam boilers, etc. The work will be found useful in many respects and will no doubt be fully appreciated by all who may have occasion to consult it.

THE FOUNDING OF METALS. A Practical Treatise on the on the Melting of Iron. By Edward Kirk. Price $2. Published by the Author, Albany, N. Y.

A capital little work written by one, who as every page indicates, is practically familiar with the subjects treated. The volume contains numberless suggestions of a type not found in ordinary treatises on metallurgy, and in brief it belongs to that class of books which intelligent workmen might often prepare regarding their trades, and of which there can never be a superabundance. The work is comprised under the three general heads; iron, founding of alloys and minerals, and gases, and each topic is fully discussed in a series of short pointed chapters. The author writes in a pleasantly readable way, altogether different from the style of the ordinary technical treatise. We can commend the book, as well worth careful perusal by both employers and workmen in the metal industries.

NARRATIVE OF THE POLARIS EXPEDITION. Edited by Rear Admiral C. H., Davis, U. S. N. Washington, Government Printing Office.

As its title indicates this large and finely illustrated volume gives a complete history of the North Polar Expedition which set out in 1871 in the steamer Polaris under command of Captain Charles F. Hall, and which virtually terminated or rather failed with the death of that brave explorer. The voyage of a portion of the survivors of the crew, detached from their vessel and afloat on an ice floe has already passed into history as one of the most wonderful of escapes from apparently certain destruction. The late Admiral Davis entered enthusiastically into the labor of condensing all the journals, reports and narratives of the officers and crew of the Polaris into one connected recital of events. This has been produced in a manner which merits the highest praise. Admirably and graphically written, lavishly embellished with illustrations from photographs. the volume is one which, unlike most emanations of the Government press may be read with profit and interest from beginning to end.