The Burning of Iron and Steel.

Iron that has been raised to near its temperature of fusion and slowly cooled is designated as "burned" or overheated metal. It is both red short and cold short, and exhibits a coarse, crystalline structure and a bright glistening fracture. Such iron contains oxygen. But this oxygen is not, as is commonly believed, derived from without during the heating; but it was previously contained in the iron itself through the medium of the scoria or slag impurities mixed with it. When the iron is raised to the fusing heat, or near it, a chemical reaction takes place; the metallic iron reduces the sesquioxide to protoxide, which, by being dissolved in the iron, alters the properties of the latter. The coarsely crystalline quality of iron so treated is not due to the presence of the oxygen. The metal usually contains a notable quantity of phosphorus, which is well known to give a coarse grain accompanied by the quality described as cold short. The crystallization takes place during the slow cooling while at rest. The greater the proportion of phosphorus present, the lower is the temperature to which the iron may be raised without being burned. Pure iron should not take up more than 0·25 per cent of oxygen in solution. Though this substance does not greatly affect the ductility of the metal when cold, it acts like sulphur on its malleability.

The qualities of steel also undergo change when heated to a high temperature, or when subjected to a lower temperature for too long a time. The richer the steel is in carbon, the lower is the temperature at which the change takes place. Therefore, the harder the steel, the more carefully is it to be dealt with in the fire. Such overheated steel becomes coarse grained and brittle; that is, cold short. If the temperature be increased, showers of sparks are thrown off, and the steel is said to be "burned." The alteration brought about in this way has generally been attributed to a diminution in the proportion of the carbon constituent, though this assumption is not warranted by the results of analysis. The presence of manganese and silicon is of more weighty consequence. When steel containing these is heated it is not the carbon, but the manganese and silicon, that first becomes oxidized, and there results an important change in the properties of the steel. Later the carbon is oxidized; and while the oxide of carbon escapes, those of the manganese and silicon remain behind, and the whole molecular structure of the metal is altered. If the heating be carried still further, the iron will next be oxidized. A cast iron furnace door, exposed for several years to the flame of a coal fire, was found to contain 27·8 per cent of oxygen, in combination with iron, sulphur, nickel, copper, phosphorus, and arsenic. The cause of the sparks is not the combustion of the carbon, and the consequent generation of carbonic oxide gas, but the escape of gases imprisoned in the steel. Similar results may be brought about by exposing the steel to a lower temperature for a longer time; the oxidation of the constituents will, in this case, be effected in the order mentioned above, the only difference being in the slower action. Steel altered in this way is well described as "dead." A regeneration of the metal by mechanical treatment is hardly possible, since the original chemical composition cannot be restored by such means.—*Jahrbuch fur den Berg- und Huttenmann.*

An Interesting Relic.

A writer in the Panama *Star-Herald* says: Recently I had the pleasure of examining an old piece of Spanish ordnance. It is a brass breech-loading cannon, the property of our esteemed friend, the Bishop of Panama. The exact measurements of this shapely piece of artillery are as follows:

The diameter of the bore at the muzzle is three inches. Back of the muzzle band, on a raised square measuring two inches by two, is the letter R, for Rey. The circumference of the muzzle band is eighteen and a half inches. The circumference of the second band is thirteen inches. The extreme length of the piece is forty-four inches. The distance between the edges of the trunnions is nine and a half inches, their circumference is seven and a half inches, and their diameter two and one-eighth inches. The first part or swell of the breech, just back of the trunnions, measures twenty-one and a half inches. Circumference of the breech at its thickest part, twenty-one and a half inches. Thickness of its sides, one and a half inches. Internal diameter of the bore where breech block closed the gun, three inches and an eighth. In the upper posterior third of the breech, on both sides, are two slots, measuring two inches and a half horizontally by three-quarters of an inch wide. These undoubtedly were used for passing a transverse bar, that held the block in position during traveling and firing. In the under surface of the breech chamber there is an opening, square externally, measuring half an inch; it tapers off to a small round hole that enters the chamber about its center. One can hardly fancy that it was the firing hole. A careful examination leads one to suppose that as the block fitted with almost mathematical accuracy, this opening was probably left to allow air to escape in closing the breech, and permit rapid firing, etc. The measurements of the breech chambers are five and a half inches longitudinally by four and a half inches transversely.

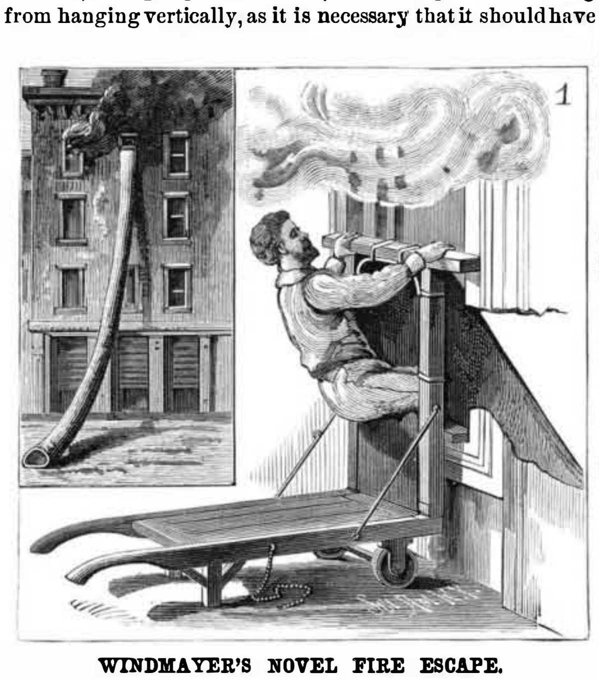
The gun evidently was designed and cast upon well known scientific principles, such as are recognized to this day. The upper part of the breech lock, fitted under a strongly cast shoulder of brass, in the thickest part of the side of the bore, just inside the trunnions. As stated, the diameter of the bore anteriorly is three inches; posteriorly, three inches and an eighth. Did the early Spanish artillerists cover their shot with lead to secure accuracy of aim, and prevent the loss of the gases generated by the explosion of the powder?

The weight of this very interesting relic of the Spanish Main of "ye olden days" is probably 125 pounds. In view of its antiquity, the symmetrical proportions are excellent. While Lieut. Napoleon Bonaparte Wyse's expedition was in the Darien, three guns of this type were discovered and brought to Panama. The gun under consideration was presented to Bishop Paul, and the others are in the Paris Museum.

A NOVEL FIRE ESCAPE.

A bag or chute made of canvas or other suitable material, and open at both ends, is folded regularly and placed upon a truck provided with wheels and handles. One end of the bag is secured firmly to a frame hinged to the truck in such a way that when raised to a vertical position its lower ends will rest on the ends of the side bars of the truck frame. At the hinged end of the frame is arranged a cushion that can be placed over the window sill. The end of the bag is secured to the frame in such a manner that it can be entered through the frame. The frame is held in a vertical position by hinged side braces, and the top cross bar is of such length as to extend beyond the side bars of the window frame. The lower end of the bag is provided with handles.

To use the fire escape the truck is rolled to a window, the frame is swung to a vertical position, and the bag is dropped out of the window. The weight of the chute presses the top cross piece of the frame against the uprights of the window frame. The cushion is placed over the sill, and the lower end of the bag is held by a few powerful men, who grasp the handles, and thus prevent the bag from hanging vertically, as it is necessary that it should have



WINDMAYER'S NOVEL FIRE ESCAPE.

a certain inclination to prevent the persons from sliding down too rapidly. The people to be rescued step through the frame into the chute and slide down, the speed of the descent being checked by pressing the knees and elbows against the bag.

Further particulars regarding this fire escape can be obtained by addressing the inventor, Mr. A. J. Windmayer, of Fort Madison, Iowa.

Dispatch in the Machine Shop.

The importance of a reputation for promptness in the fulfillment of engagements, and the execution of orders on the very day they are promised, is well illustrated by an incident related in a contemporary, *The Industrial World.*

A short time since a party who contemplated having some expensive machinery made was inquiring where he had best send his order. A friend suggested the name of a well known machinist near at hand. The reply to this suggestion was: "While I know A to be one of the best machinists in the town, yet he is so proverbially slow that there is no telling when he would complete the work. I cannot afford to take the chances of his delays." A did not get the job; it was given to a firm who had a superior reputation for getting out work in a satisfactory manner with great dispatch.

This order was the beginning of a very large business, and it is safe to say that A's reputation for negligence lost him business the profits on which would, in a short time, have amounted to no less than ten thousand dollars. How many similar customers A has lost on account of his lax methods, no one knows. It is probable that his losses in this respect amount to many thousands of dollars, for he is only doing a limited business, notwithstanding his reputation for good workmanship is second to none, he being capable of successfully completing all sorts of the finer and more intricate mechanical work.

There is nothing that can be seemingly more vexatious than the customary delays in perfecting machine work. While it may be true that in this kind of employment there are numerous unexpected occurrences tending constantly to defeat the prompt dispatch of work, yet these difficulties are such as can be overcome by the display of extraordinary exertion and by paying a due regard to the minute details of the business. Machinists have frequently a fault of accepting orders for more business than they can do within the time stipulated. In their endeavors to fill their shops with work, they book more orders than they can take care of, and hence let their engagements get ahead of them, resulting too often in delaying important jobs, and in keeping everybody connected with the business in a bad temper.

It can readily be conceived that when a man orders a machine completed on a particular day, and has made his arrangements in accordance with a belief that the machinist will live up to his engagement, the disappointment in the event of a non-fulfillment must be very great, as in not a few cases is also the loss.

All that some people care for is to get the orders on their books, and little regard is paid to the time when they are filled. This is a wrong which will operate seriously to the discredit of the offending machinist.

If there were no loss of trade, no decline of reputation, or other ill-effects of the inexcusable course, a due regard for doing what is just and right should inspire the machinist to do his work promptly and in the best manner.

When a man leaves an order and agrees to pay a price for work done for him, there is an obligation on the workman's part to perform it in manner and form as agreed. Nothing avoidable should be allowed to prevent the honest consummation of this agreement.

There are occasionally valid excuses for the non-fulfillment of an agreement to get out machinery at a specified time. In such instances no blame can attach to the machinist, but it is safe to say that ninety per cent of the customary delays in machine shop practice might be prevented by intelligent forethought or by extra exertion.

Gumbo.

On the Canadian Pacific Railway, west of Winnipeg, it is noticeable that all the prairie land is free from stones. For great distances along the line, one bushel of stones could not be gathered in fifty miles. In the neighborhood of Brandon the soil is gravelly, and there are some large bowlders, which are striated in the east and west direction; these are the only bowlders to be met with for 400 miles from Winnipeg.

The absence of earth-worms and slugs is a marked feature of this soil. When dry, it is hard to work; during the summer it can scarcely be plowed; when wet, it adheres so hard to carriage wheels and boots, that it can only be removed by being scraped off. A very little moisture produces this state. It is very difficult to work in this condition, as it can scarcely be cast off the shovel or the scraper; with 20 per cent. moisture it somewhat resembles half-set mastic or glue. The most adhesive qualities of this soil are termed "gumbo." When "gumbo" dries, it bakes too hard to be plowed; on several occasions it was taken out with picks, in large blocks, and laid by hand in the dump. In its worst condition of moisture it will hold the hoofs of horses working in it and pull their shoes off; this has occurred repeatedly, and within one hour of their having been set. The authors kiln-dried and soaked some of it, and found it would absorb 72 per cent. of moisture before becoming "slurry."

The frost penetrates the ground to a considerable depth. In the excavations for the main sewer in Winnipeg some years ago, a layer of frozen clay, 12 inches thick, was found 8 feet below the surface in the month of August. The presence of frost in the lower layers of the subsoil is not prejudicial to the growth of the crop. The soil does not heave when the frost leaves it in spring, which is a marked difference to the clay subsoils of the eastern provinces. Houses can be built on sills laid on the surface of the ground; foundation walls or piles have to be carried down 8 feet. Frost has a beneficial effect on the earthworks, crumbling down the "gumbo" and causing it to fall like fine garden soil. It also consolidates the embankments.

Robert Henry Sabine.

This eminent electrician, who is well known for a variety of useful works, died in London on the 24th of October. Sabine was born at Dorchester on November 6, 1837, but subsequently lived at Bristol with his father, Mr. H. S. Sabine, a solicitor. Educated at Bristol, he entered his father's office at the age of seventeen; but manifesting a preference for engineering studies, he was sent to Manchester to enter an engineering firm, and there met the late Sir William Siemens, who engaged him as an assistant. In 1859 he went to the Mediterranean on H.M.S. Firebrand to test the Siemens deep sea thermometer, and afterward was transferred to the Berlin works of Siemens & Halske. He subsequently engaged in cable work abroad, and finally left Siemens, Halske & Co. to become a consulting engineer in 1867. In 1871 he became associated with Sir Charles Wheatstone in a private factory, which afterward developed into the British Telegraph Manufactory. Here the first Gramme machines were made, and many interesting experiments in electric lighting carried on. Sabine was married to Sir Charles Wheatstone's second daughter. For some years he was in partnership with Sir Samuel Canning. His best known works are the "Electrical Tables and Formulæ," which he prepared with Mr. Latimer Clark, and his "History and Progress of the Electric Telegraph," which, although overweighted with the productions of Messrs. Siemens Brothers to the exclusion of other inventors, is nevertheless a clear and correct work. His best known research is on a "Method of Measuring the Contour of Electric Waves passing through Telegraph Lines," and his most original invention is perhaps the "wedge and diaphragm photometer."