CHEMISTRY OF IRON.

Number VI.

NATIVE LODESTONE.

In ancient Greece, among the shepherds who tended their flocks upon the sides of Mount Ida, was an observing man by the name of Magnes. He noticed that a certain black stone adhered to the iron of his crook, and making known his discovery the stone was called magnet, after the name of the discover, which was thus made immortal. The mineral has been called also the native lodestone, but it is known to modern chemistry as the magnetic oxide of iron.

We have described two oxides of iron. The atom of one is formed by the combination of one atom of iron (*ferrum*) with one atom of oxygen, Fe O ; this is the protoxide of iron. The other is formed by the combination of two atoms of iron with three of oxygen, Fe_2, O_3, and is called the sesquioxide of iron. The atom of the magnetic oxide of iron is formed by a combination of one atom of the protoxide with one atom of the sesquioxide, $Fe\,O + Fe_2\,O_3$, or it may be written $Fe_3\,O_4$. As the oxygen atom weighs 8 and the iron atom 28, the proportion of iron in pure magnetic oxide of iron would be 84 pounds of iron to 116 pounds of the ore.

The magnetic oxide is one of the best of the iron ores. The famous Swedish iron is made from this ore, and Iron Mountain in Missouri is formed of it. Those of our readers who are following Dr. Stevens in his exceedingly interesting history of the geology of this continent, will remember that magnetic iron ore is found only in the azoic rocks, those that existed before the creation of life upon the earth. As this ore will attract iron, while none of the other oxides of iron will, it is very easily distinguished; and it is very easy by its means to determine the age of the geological formation in which it is found. The scales which fly from wrought iron while it is being forged, are the magnetic oxide of iron.

HARDENING AND TEMPERING TOOLS AND METALS.

Number I.

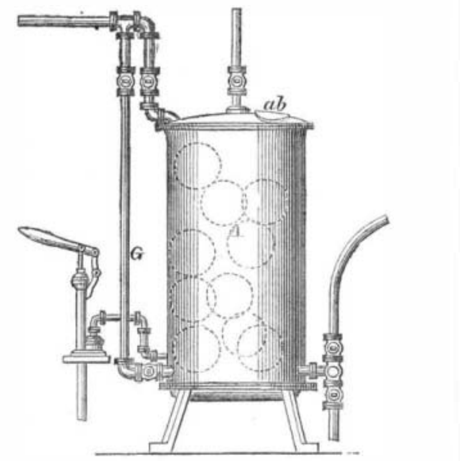
Steel possesses the property of becoming exceedingly hard by being highly heated, then suddenly cooled. The higher the temperature to which this metal is raised, and the colder the solution into which it is suddenly plunged, the harder it becomes. The temper of a tool or piece of steel means that degree of hardness and tenacity which it possesses. Steel is usually hardened by raising it to a red heat in a clear fire, or in molten metal, such as lead, then plunging it either into cold water, cold salt brine, or a cold oil bath. By this treatment it is not only made hard, but very brittle. Tempering consists in removing this brittleness and this process succeeds that of hardening. It is based upon another property which steel possesses, namely, becoming soft and tough again when subjected to heat. In proportion as the heat is gradually increased, the brittleness diminishes, and when it is reduced to the proper degree of hardness required for the instrument it is again cooled. The proper degree of hardness is ascertained by the color which the surface of the tool or metal assumes when being heated in the open atmosphere. When great elasticity is desired for steel, such as in springs for watches, locks, &c., it is cooled as soon as it has assumed a blue color. The following table gives the color and temperature required for the temper of different instruments and tools :—

1. Pale straw color, 430° Fah. for lancets (hard.)
2. Dark yellow, 450° Fah. for razors.
3. Dark straw, 470° Fah. for penknives.
4. Clay yellow, 490° Fah. for chisels and shears.
5. Brown yellow, 500° Fah. for axes and plane-irons
6. Very pale purple, 520° Fah. for table-knives.
7. Light purple, 530° Fah. for swords and watch-springs.
8. Dark purple, 550° Fah. for softer swords and watch-springs.
9. Dark blue, 570° Fah. for small fine saws.
10. Blue, 590° Fah. for large saws.
11. Pale Blue, 610° Fah. for saws, the teeth of which are set with pliers.
12. Greenish blue, 630° Fah. for very soft temper.

It is a remarkable fact that hammered iron does not become hard like steel by heating and cooling. Most of the metals and their alloys are unaffected by heating and cooling so far as they relate to hardness and temper. Steel alone possesses the hardening and tempering properties in an eminent degree. By hammering and rolling steel cold it increases in hardness and elasticity up to a certain point, but after this has been reached the action must be stopped or the metal will become very brittle. The hardening and rolling seem to produce the tempering effects by forcing the grains of the metal closer together. Some kinds of steel springs and saws are treated by the hammer-hardening process. A large circular steel saw being raised to a red heat is laid down upon a circular steel, faced anvil secured upon a solid bed of masonry, and a heavy hammer shaped like a cheese, weighing several tuns, is tripped and falls down upon it with a tremendous blow. The saw is kept under the weight until it cools. Large saws which are hardened by plunging them when red hot into a mixture of oil and resin, are generally tempered by subsequent hammering.

TESTING BOILER WATER GAGES.

A hollow float, such as a thin copper globe placed in a steam boiler and connected with a lever to a steam valve, makes a safety water gage. The hollow

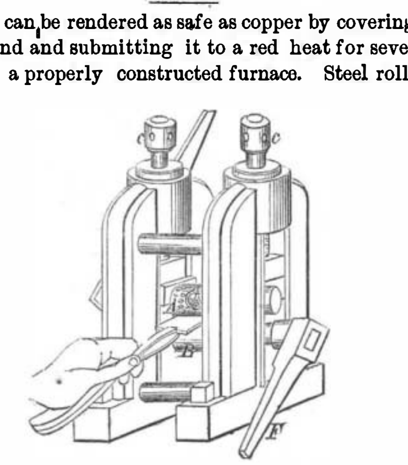


sphere rises and falls with the water, and when it drops below the fire-line, the lever opens the safety-valve and gives the alarm. The globe may also be connected with the valve of a water reservoir, which may be made to operate as a self-acting boiler feeder. It has been difficult to obtain reliable floats of this character—such as would stand the heat and pressure of a boiler—hence they have been used to a very limited extent. The accompanying figure represents a method of testing such hollow spheres to ascertain which are reliable, so that such alone may be employed. A is a close strong cylinder having a number of spheres in it to be tested.

It has a pipe, G, connected with a steam boiler ; also an exit pipe, and there is a Bramah pump situated at one side. In this manner the hollow spheres can be submitted to any degree of steam heat and water pressure. The spheres are put in and taken out at *a b*. Patented by G. W. Lane, Boston, Mass., March 13, 1860.

EMBOSSING DESIGNS ON METALS.

Steel can be rendered as safe as copper by covering it with sand and submitting it to a red heat for several days in a properly constructed furnace. Steel rollers



for embossing are thus treated, then they are engraved, and afterward hardened. They are then capable of impressing the design that is engraved upon them, upon all softer metals and it is thus they are employed as represented by the accompanying figure. A is a steel roller with the design engraved upon it, and B is the under roller with the lever F, for pressing the article to be embossed against the design. A strip of gold intended for a bracelet is shown as being placed under the design roller, and by bringing the two in contact under great pressure with the lever, the design is transferred in the reverse upon the sheet of gold. It is thus that an endless variety of beautiful designs can be quickly impressed upon such articles by this simple operation. The screws, *c c*, are for the purpose of regulating the pressure. The art of manufacturing such rollers has been carried to great perfection by our mechanicians. A Waterbury manufacturer has recently furnished such rollers to the banks of France and England. Our engraving represents a plan patented by W. Riker, of Newark, N. J., on the March 13, 1860.

Colored Liquids.

Solutions of some salts and metals in hydrochloric acid give colors of very great intensity and beauty. Thus, a yellow liquid is obtained by dissolving 3 parts of perchloride of iron, or hydrated peroxide in 100 of hydrochloric acid : the color may be hightened by adding some hydrated oxide. Various colors are produced with the solution of protocarbonate of cobalt in hydrochloric acid. The salt of cobalt used, must be chemically pure, especially free from iron or nickel, which would prevent or neutralize the formation of the blue and red shade. The green cobalt color is obtained by dissolving three parts of the protocarbonate in 100 parts of the acid, and filtering. By the addition of a few drops of the above yellow liquid, the color is deepened, and loses its bluish tinge. A blue color is prepared by dissolving 6 parts of the protocarbonate of cobalt in 100 parts of the acid and boiling for about two minutes to remove the carbonic acid or chlorine held in solution. Neither of the above two colors should be diluted with water, as this would change them to red. The violet color is obtained by dissolving 34 parts of the protocarbonate of cobalt in 100 parts of the acid, mixed with 5 of water, and boiling up before filtering. A very fine red liquid is obtained by dissolving 45 parts of the protocarbonate of cobalt to 100 parts of acid, diluting with 45 parts of water, and boiling. All the cobalt colors change by heating the solutions, which gives them more or less a blue tinge ; a solution of carbonate of chromium in hydrochloric acid (chloride of chromium), evaporated until it becomes hard on cooling, and dissolved in alcohol (90 per cent) in the proportion of 25 parts of the salt and 100 of the spirit (to which are added 5 parts of acid), furnishes a fine deep green. Four parts of crystallized acetate of copper dissolved in a mixture of 50 parts of aqua ammonia and 50 of 90 per cent alcohol, give a durable blue.

Gold for Jewelry.

Pure gold is not used for jewelry ; but is usually alloyed by introducing a small quantity of silver or copper. Silver renders it lighter in color, and copper gives it a deeper shade, inclining it to a reddish hue. The jeweller of the present day relies in a great measure on dies for the forms he gives the articles that come from his hand. These he has cut in steel with care, and many of them are beautiful, and often very intricate. The gold is rolled out into strips, and what is beheld is all that it professes to be—pure gold ; but the proportion of the metal to the whole is very small. A strip of gold, not thicker than a silver dollar, is secured to a bar of brass of corresponding size, but much thicker in proportion. A flux is applied, to unite the two, and the mass is subjected to the action of the fire. At the proper moment it is withdrawn, and when cool the two metals are found firmly united. The bar is then rolled out between steel rollers till the metal in the form of a long ribbon, is not thicker than letter paper. It is then cut into small pieces of the size required, and the artizan so places them in succession that the die falls upon each in turn, giving it the required form.

Sir Howard Douglass.—This military author died in London, on the 8th ult. He was an officer in the British army, and a member of Parliament, but it is as a writer on military subjects that he is best known. His treatise on naval gunnery is allowed to be a standard work, and he is quoted as good authority by all military men in questions relating to military engineering.