CHEMISTRY OF IRON.

Number V.

IRON AND OXYGEN.

Iron has a very strong affinity for oxygen, so strong that if perfectly pure iron in powder is exposed to the air it combines with the oxygen of the atmosphere so rapidly as to become red hot; in other words, it burns spontaneously. Iron combines with oxygen in four different proportions, but there are only two of these which are of any interest, and which it is desirable to understand. These are the protoxide and the sesquioxide, the simplest being the protoxide, which is formed by the combination of one atom of iron with one atom of oxygen, Fe O. Whenever any element combines with oxygen in several different proportions, the one containing the least oxygen, if not an acid, is called the protoxide. This word is from the Greek *protos*, first, and is intended to signify the first step in oxydation. The protoxide of iron has so strong an affinity for oxygen, that if exposed to the air it immediately combines with more oxygen to form the sesquioxide. The Latin word *sesqui* means one and a half, and it is used in chemical nomenclature to express a combination between two substances in the *proportion* of one atom of one substance to one and a half atoms of the other. This is the *proportion*, but as there is no such thing as half an atom, the real combination is of two atoms of one substance with three of the other. The atom of the sesquioxide of iron is composed of two atoms of iron combined with three atoms of oxygen, $Fe_2 O_3$. It would be represented in our engravings thus :—

This combination is also called the peroxide of iron. *Per* is a Latin prefix signifying through, or to the end, and in chemical nomenclature peroxide implies that the substance has received all of the oxygen that it will take; that it is as highly oxidized as it can be. If, however, oxygen in combining with an element, forms an acid, the substance is named an acid instead of an oxide. One of the proportions in which oxygen combines with iron is that of one atom of iron to three atoms of oxygen, $Fe O_3$; and as this combination produces a substance with acid properties it is called ferric acid, from the Latin name of iron, *ferrum*.

Sesquioxide of iron is the most abundant of the iron ores. Red hematite is the sesquioxide; and brown hematite is a hydrated sesquioxide; that is to say it has water chemically combined with it. The atom of brown hematite is formed by combining two atoms of sesquioxide of iron with three atoms of water. The formula is, therefore, $2\ Fe_2 O_3 + 3\ HO$. It will be remembered that HO in chemical formulæ means one atom of water; the atom of water being composed of one atom of hydrogen and one of oxygen. As the oxygen atom weighs eight times more than the atom of hydrogen, there are eight pounds of oxygen and one pound of hydrogen in nine pounds of water.

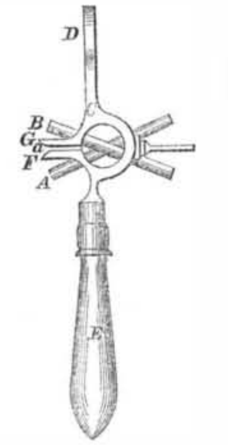
Common red-iron rust is the sesquioxide of iron. The brown freestones, so much used in the buildings of New York, the red sandstones of New Jersey, and all rocks of a reddish-brown color owe their hue to the sesquioxide of iron which they contain.

The only combinations of iron that are of any particular interest are the protoxide, Fe O, the sesquioxide, Fe_2O_3, and a certain combination of these two, of which we shall give a full description in our next article.

THE NEW METALS RUBIDIUM AND CÆSIUM.—M. Bunsen, in the *Annal der Physik und Chem*, states that the equivalent of rubidium is 85.36 (H = 1), which is more than double that of potassium. It is more electro-positive than potassium, and it decomposes cold water. Cæsium is named from cæsius (sky blue) on account of the ray which it produces in the spectrum. Its equivalent is 128.4, ranking by the side of that of iodine and gold, and is one of the very highest. This metal is less abundant than rubidium, but it is generally found along with it; the richest source of it yet known is the mineral waters of Durkheim. Bunsen states that probably all the saline mineral waters contain rubidium, in the condition of a chloride. No useful application has yet been made of these metals.

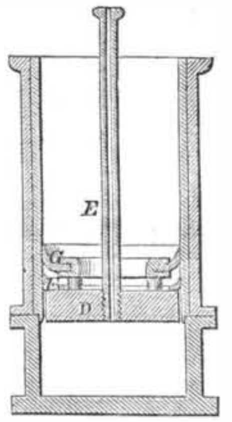
NOVEL KNIFE SHARPENER.

The old fashioned "steel" consisting of a long, tapering cone of steel roughened on the surface, seems to have had its days as a knife sharpener, judging from the innovations made upon its use, lately, by what are called "angular knife sharpeners" composed of hard blades of steel between which the blade of the knife is inserted and drawn. The accompanying figure represents a new and more highly developed knife sharpener. It has two rounded file bars, A B, confined in the holder, C, in which they are clamped. F G are guide bars open at *a* for the reception of the knife, which is guided by them to be acted upon by the angulated file sharpeners. D is a rest for the instrument, and E is its handle. The knife sharpener can be held very firmly with one hand, on account of its having the rest; and with the other hand the knife can be applied properly to the files, A B. Patented March 6, 1860; patentees, S. C. and B. S. Stokes of Manchester, New Hampshire.



Black Washing Molds for Castings.

The interior of molds requires to be coated on the surface with blackwash of coal dust, to prevent the adherence of the sand. This is usually a very troublesome operation for the molds of pipes. The accompanying figure is an interior section of a convenient mode for effecting this object. D represents a piston having a hollow rod, E. The edges F, are provided with a piece of felt cloth, and G is a brush. The blackwash is supplied through the hollow piston rod, and the brush and piece of felt cloth distribute it very evenly upon the inner surface of the pipe mold, and the piston at same time smooths it. In the same manner iron pipes, designed to be laid underground may be coated inside with asphalt or other adhesive solution to prevent them from rusting. Patented, March 13, 1860; patentees, W. and D. Ferguson, New York.



A New Metallic Alloy.

We owe to the process of alloying or mixing metals some of the most serviceable metallic substances employed in the mechanic arts. The modern discoveries in this branch of chemistry, however, have scarcely kept pace with those in other departments of the science. Two, at least, of the more important alloys are of great antiquity. Brass, we are told in the Bible, was manufactured by the antedeluvians, and bronze of a quality that has never been surpassed was in general use among the ancient Greeks and Phœnicians. When the art of working iron became understood that mineral took the place of the old alloys, as also of the softer metals, as a material for a large proportion of the implements of peace and war, and with the application of steel to its present uses the triumphs of iron may be said to have culminated.

Strange to say, few successful attempts have been made to blend other metals with steel. It seems to have been taken for granted that the article could not be so alloyed as to extend or increase its utility. American ingenuity and skill, however, are likely to disabuse the world of this error, by introducing into the arts a composite with steel for its basis, which cannot fail to be regarded, in an economic point of view, as of great importance.

To Messrs. Brown & White, of this city, belongs the credit of having discovered this new alloy. It is composed of steel, zinc, tin and manganese, and bids fair to work a revolution in some kinds of manufactures. The proportions of the ingredients we are not at liberty to state, as a patent has not yet been secured. The density of the alloy is greater than the mean density of its constituents; it presents a beautiful white and lustrous appearance, and is adapted, we are assured, to the manufacture of many articles in universal demand, such as axes, cutlery, &c. At present the discoverers are employing it extensively in the manufacture of bells for churches, factories, ferries, fire towers, &c., which are claimed to be equal to any made of the ordinary bell metal, while the price is two-thirds less.

Rigid economy in expenditures is a necessity with many churches, and of course no church, rich or poor, would desire to pay 30 cents a pound for a bell when it could obtain an equally good one at a little more than one-third that rate. If the only result of the discovery was to place a good bell within the reach of every church, however moderate its means, it would merit a favorable notice at our hands; but we are informed that the new alloy has a wider application, and we shall watch with interest the effect of its introduction in other branches of the arts.

Bells cast from the new alloy were exhibited at the late State fair, held at Watertown, N. Y., and the committee, after testing their qualities, awarded the exhibitors a premium.

What Becomes of the Silver?

Europe and America have been drained of silver to supply the demand of the British East India Company, who, since 1830, have required their revenues to be paid in silver. In this country, the intrinsic worth of silver has been reduced about 7 per cent in order to keep it here. The drain from Europe still continues. The gold that is brought into England is sent to the Continent, exchanged for silver, which finds its way to India, and there disappears. During the last twenty-five years, the shipments of silver to India have reached the enormous sum of $550,000,000, of which $92,000,000 have been re-exported, leaving $450,000,000 unaccounted for. And these shipments have lately been on the increase. For the first five years of the term named, the shipments were $45,000,000, showing an average of only $9,000,000 per annum, while for the last five, the shipments have been $215,000,000, or $43,000,000 annually, and the current is not yet checked. The movements of specie in all other lands can be distinctly traced, but here the keenest sagacity is at fault.

With the shipments to India there has ever been an insoluble mystery. It is like a stream emptying into a bottomless gulf, with a returnless flow. Some have conjectured that the silver thus sent to India is used up for ornaments; but this would account for only a small portion of the immense total. We should not be surprised if the secret of this flow of treasure in one direction was found altogether in the methods taken for its preservation in that distracted country, by burying it in the ground.

Cochineal in India.

An Indian correspondent of the London *Globe*, has recently pointed out that the cochineal insect—the dye of which is at present, with the exception of a small quantity imported from Madeira, entirely derived from South America—is found over a vast tract of country in British India. It was introduced in 1801, when the lac insect was unknown, and cochineal was worth $7 a pound, by a gentleman of the name of Dawson, tempted by a prize offered by the East India Company. The cactus, on which alone the insect flourishes, grows profusely throughout the south-western provinces of the Indian peninsula. Within a very short time, the cochineal extended over 800 miles of country; but, as no persons who understood how to prepare the article for market had been introduced with the cochineal insect, the commercial speculation completely failed. In the course of time, the cochineal insect extended from Fort St. George, where it was landed, 4,000 miles inland. Here it is now found in a wild state, but the natives have not yet learned how to use it for coloring silk and wool.

H. EDWARDS, London, has applied for a patent for making horse shoes of combined iron and steel, in bars. The iron and steel are rolled together in a bar, so as to leave the steel on the wearing face when forged into shoes.