

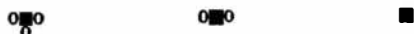
CHEMISTRY OF IRON.

Number IV.

IRON AND SULPHUR.

We very frequently receive from correspondents scattered over the country, some little yellow crystals looking very much like gold, with the inquiry of how much they are worth. These are simply a combination of sulphur and iron, the sulphuret of iron it was formerly called, but now generally written the sulphide. The termination *uret* is now obsolete, having been superseded in all cases, by *ide*, or, as some write it *id*. The crystals spoken of are usually the bisulphide of iron, the atom of which is composed of one atom of iron combined with two atoms of sulphur, FeS_2 . This substance is also called iron pyrites. There are other combinations of iron and sulphur which bear the same name, iron pyrites; but the bisulphide is the most common.

As many who may read these articles will neglect to make the balls to represent the atoms, we will represent them as well as we can by engravings. Let O represent the atom of hydrogen, and o the atom of oxygen. Then the atom of water will be represented by the two combined together, Oo, the symbol of which is H O. If we represent the atom of sulphur, S, by the black square at the left



hand, then the middle figure will represent the atom of sulphurous acid, $S O_2$, and the right hand figure the atom of sulphuric acid, $S O_3$. We will use a cross, X, for the atom of iron, Fe, and the atom of the bisulphide of iron, $Fe S_2$, will be formed thus.

■ X ■

These figures do not make the matter so plain as the balls do, but they are the best substitute that we can devise.

The bisulphide of iron, iron pyrites, may be found in almost every neighborhood, and examined by our readers. Its properties will be found to be entirely different from those of either sulphur or iron, the two substances of which it is composed. If pounded with a hammer, it is not beaten out into a thin sheet, like iron, but it crumbles into powder. It is not malleable, but it is pulverizable. Neither has it the properties of sulphur. It is harder than either iron or sulphur. It will scratch glass. This is a simple test by which iron pyrites may be distinguished from copper pyrites; and it is well worth knowing, as copper pyrites is very valuable, while iron pyrites has no commercial value. One of the most wonderful things in nature is the entire change which is wrought in the properties of substances by their chemical combination.

The combination of sulphur and iron may be broken up by simply heating the pyrites red hot. The sulphur goes off, and as it leaves the iron it combines with the oxygen of the air, forming sulphurous acid, $S O_2$. By a certain treatment another atom of oxygen may be induced to unite with each atom of sulphurous acid, and sulphuric acid is produced, $S O_3$ becoming $S O_3$. Iron pyrites has come into extensive use within a few years for making sulphuric acid, in place of brimstone which was formerly employed. So far as we know, this is the only industrial use which is made of the bisulphide of iron.

The Cavendish Society.

There is in England an association called the Cavendish Society, of which many men of science in the United States are members. It was formed after the death of Henry Cavendish, the famous chemist and philosopher, who died in London on the 24th of February, 1810. He was a very rich old bachelor, and devoted his life to science from the pure love of the study, having no desire for fame. It is said that several of his discoveries perished with him, and are lost. He, however, published some of the more important in papers read before the Royal Society. He discovered the composition of water and of nitric acid, and proved that the electric spark will cause the oxygen and nitrogen, which are mechanically mixed in the air, to combine chemically and form nitric acid.

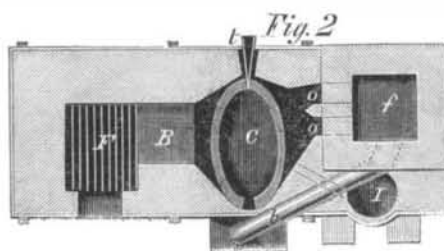
After the death of Cavendish, a society was formed

to publish his writings, and it has been continued for the purpose of publishing works valuable to the world, but of which the circulation would be too limited to render the publication remunerative. The society is now publishing an English translation of Gmelin's work on chemistry, in seventeen large volumes, by far the greatest work that has ever been written on any department of science. The terms of subscription to the Cavendish Society are five dollars a year, and the publications are distributed among the subscribers.

LEAD MINES — PROCESS OF SMELTING.

[Concluded from our last Number.]

In our last we illustrated the common reverberatory used in England for smelting galena; we now present two other furnaces, Fig. 2 being a plan view of the refinery for treating argentiferous lead to obtain its silver.



F is the fire box, B is the fire bridge, and C is the cupel. The flame passes directly over the surface of the cupel, thence by a split passage, o o, into the flue, f, which is connected to the chimney. The cupel is an oval iron frame; its greatest diameter is 4 feet, its lesser $2\frac{1}{2}$ feet, and it is surrounded with a ring, 4 inches deep, strengthened by cross-bars. It is filled with powdered bone ash, moistened slightly with a weak solution of pearl ash. This gives it consistency. The bone ash is beaten down, and when the ring has been well filled, the centre is scooped out with a small trowel, which leaves a raised border of the ash, as represented in the Figs. The width of the border is about five inches, and a hole is cut in it for the escape of the scum which is litharge. The cupel is prepared outside of the furnace, then lifted into it and wedged in its place. The charge to be operated upon consists of lead containing a certain amount of silver. The chemistry of the operation consists in exposing the lead when highly heated to the action of air in the furnace. In this state the oxygen of the air readily unites with the lead forming litharge, but it does not unite with the silver. By constantly removing the litharge (brown oxide of lead) as it is formed, and exposing fresh surfaces of the melted metal to the heated air, the whole of the lead is ultimately converted into litharge leaving the silver in the bottom of the cupel.

The heat is applied very slowly at first in refining for silver, otherwise the cupel, C, would crack. The temperature is gradually raised to a cherry red, and the charge of lead previously fused in the cast-iron vessel, I, (which has a small fire under it) is introduced in the cupel by a spout. A blower is always necessary for refining, and the blast is introduced into the cupel by the tuyere, t. It blows off the litharge as it forms on the surface of the charge, and drives it over the cupel head on the other side into an iron vessel below. As the lead wastes away by the litharge scum forming on the top of the charge, and being blown off, more molten lead is occasionally added from the iron smelting vessel, I. The operation is continued until about five tons of lead have been operated upon. The remainder is then withdrawn and tested, and it generally undergoes another refining operation before the silver is obtained pure. Pure lead, containing only three ounces of silver to the ton, may be advantageously treated for its silver, by what is called the Pattison process which is now followed in the lead mining districts of England. This process is founded upon the principle that when lead containing silver is melted and allowed to cool in the same vessel, crystals of lead will first form from the surface downward, while the silver remaining longer fluid sinks toward the bottom. Argentiferous lead when thus treated deposits all its silver in the bottom of the vessel, but combined with such a small quantity of lead that it can be coupled at a

very moderate cost, in comparison with the old method of coupling a great quantity of lead to obtain a small quantity of silver.

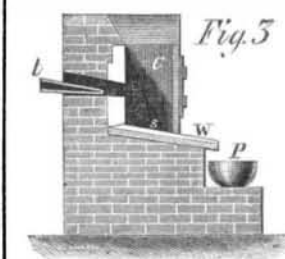


Fig. 3 is a very simple furnace employed for smelting the lead ore of the north of England and at the Scotch mines. C is a cavity of masonry lined with cast iron. The sole plate, s, is also cast iron, its back and sides are upright cast-iron ledges, and W is a cast-iron plate in front, called the work-stone. It has a rim at each side; it slopes forward and has a hind ledge rising about $4\frac{1}{2}$ inches above the hearth. The back ledge of the sole, s, is surmounted with a piece of cast iron called the back-stone, on which the tuyere, t, is placed. As the ore is smelted, the fluid lead which is separated flows out by two gutters in the plate, W, and into the receiving pan, P. The bottom of the hearth, s, is usually rammed with a mixture of bone ash and galena. The front of the furnace is open for about twelve inches from the lower part of the front cross piece, to the upper part of the plate, W, and the smelter operates upon the charge through this opening. The escape of the sulphurous fumes into the smelting house, is prevented by enclosing the entire hearth in a hood of arched brick work. It will be understood that all these smelting furnaces are reverberatory; the fuel is not mixed with the ore. The fire is separated, as shown in Fig. 1. The furnace, Fig. 3, requires the galena to be first roasted on a low flat hearth, covered by a low arch, and heated by a fire place at one end. The temperature of this roasting bed is kept below the melting point of galena. The object of this operation is to drive off the sulphur. Copious fumes of sulphurous acid always escape from the surface. In all smelting establishments there is difficulty in preventing a considerable portion of lead from being carried off in the form of fume, because lead sublimes at a high temperature. This occasions loss to the smelter in metal and these fumes are injurious to vegetation in the surrounding country, especially when the ores contain some arsenic. To prevent this, the flues of the chimney communicate with large chambers in which a shower of cold water is introduced, and the sulphurous fumes condensed. It may be stated in a general way, that the process of smelting galena consists simply in burning out the sulphur after the ore is properly prepared. The galena is kept at a temperature below that required for its fusion, and air is freely admitted into the furnace. The sulphur being driven off, the lead is left pure excepting that which is formed into an oxide and passes into the slag, which is afterwards reduced with charcoal dust, and lime. The use of the hot blast in lead smelting reduces the ore in a much less space of time than the cold blast. In Germany and France, small reverberatory lead furnaces are employed, and about 28 per cent of old iron is thrown into the melted ore. This iron absorbs the sulphur, and the lead flows into the bottom of the basin, such as that represented in Fig. 1. This system involves the total loss of the iron, but it is quicker than the English mode.

Natural Spring of Carbonic Acid.

At Piermont, in Germany, there is a natural spring or well of carbonic acid gas. The sides of it have been walled, and steps have been laid for entering it. The well is shallow, and the gas fills it to a depth of about four feet, so that the gas rises about to the middle of a person standing in the well. Carbonic acid, in contact with the skin, produces a peculiar prickling sensation, and people visit Piermont for the purpose of taking a carbonic acid bath. The keeper makes a practice of blowing soap bubbles, which fall through the air, but which rest upon the surface of the heavier gas, and dance up and down as the gas is agitated.

ALL kinds of soft porous stone become hard by whitewashing them with fresh slacked lime. The lime absorbs carbonic acid from the atmosphere, and is converted into carbonate of lime. A portion of this remains in the pores of the stone, and ultimately becomes marble.