DESCRIPTIVE METALLURGY OF IRON AND STEEL.

BY THE EDITOR.

II.

ORES IN NATURE.

It is a remarkable fact, that in nature, things which are of vital importance to the existence and evolution of man are universal—either in adaptability or diffusion. For example, wheat, "the staff of life," is the only cereal which can be grown in every clime. Iron, "the king of metals," is found in every part of the globe.

Universal Diffusion.

As W. Mattieu Williams has said, we cannot dig up a spadeful of earth without finding oxide of iron. No geological formation is free from it. It is found in the ocean, in mineral springs, in the red blood, in the atmosphere, in the very heavens above. So rarely is it absent from the soil that a bed of sand free from it is as valuable as a gold mine. Glass-workers have no little difficulty in getting such supplies. Clay free from iron oxide is of great value to the potter. The prevailing reddish brown color of the earth is due to iron. Snow is looked upon as an emblem of purity, and yet within the Arctic Circle one cannot evaporate a handful of snow without leaving behind a sediment containing darkish particles which jump to a magnet.

It does not need high powers of inductive reasoning to perceive in this phenomenon of the universal diffusion of iron, a wonderful example of design in nature. Without metals man would have remained a savage. Louis Figuier has luminously enforced this view in his "Primitive Man:"—

> There can be no doubt that the free use of or privation from metals is a question of life and death for any nation. When we take into account the important part that is played by metals in all modern communities, we cannot fail to be convinced that without metals civilization would have been impossible. That astonishing scientific and industrial movement which this nineteenth century (1876) presents to us in its most remarkable form—the material comfort which existing generations are enjoying—all our mechanical appliances, manufactures of such diverse kinds, books and arts—not one of all these benefits for man, in the absence of metals, could ever have come into existence. Without the help of metal, man would have been condemned to live in great discomfort; but, aided by this irresistible lever, his powers have been increased a hundredfold, and man's empire has been gradually extended over the whole of nature.

Origin of Iron Ores in Nature.

The popular scientific theory is, that in the beginning the matter which constitutes the round globe upon which we live, existed as a fiery mist floating in space. In some way—we call it *gravitation*—the particles of incandescent gaseous star dust (by mutual attraction) ran together, and condensed into a globular mass, which gradually cooled, forming a solid crust, enveloped by dense seething metallic vapors, holding in suspension carbonic acid, oxide of iron, siliceous sand, aluminous clay, magnesia, phosphates, sulphate of lime, etc. At first, the metallic rain which poured down boiled off again on approaching the heated surface. After a time, however, this metallic rain ceased to rise again, and remained part of the solidifying earth. Then came the birth of vegetable life, colossal palms and immense ferns. It is well-known that plants, under the action of light on their green cells, decompose carbonic acid, and liberate oxygen. Now the earth's atmosphere at this stage—known as the Carboniferous Period of Geology, was densely laden with carbonic acid; but in time this was abstracted and absorbed by the great forests and swamps with their rank vegetable growths, thus clearing the atmosphere and making the earth's surface habitable for animal life. As the broad forests and widespread swamps became submerged, either by the action of glaciers or subsidence of the earth, the buried organic matter, consisting largely of carbon, taken from the atmosphere, was petrified into *coal*; while the immense areas exposed to the oxygenated atmosphere gradually died, decomposed and decayed, evolving in the process carbonic acid, which attracted to itself the surrounding oxide of iron, silica, alumina, magnesia, sulphates, phosphates, etc., and gradually solidified into beds of iron ore, even 100 feet thick, as in Lake Superior, U. S. A. (Fig. 3), and in India. The various depths and angles at which these layers or strata are found being mainly due to volcanic eruption and upheaval of the earth's crust.

Having glanced at the Nebular Hypothesis of La Place, as the best scientific explanation of the origin of iron ore in nature, let us now follow this up by one or two illustrative proofs furnished by modern research.

Aerolites.

Native iron in a metallic state is very rare. It is one of the pet schemes of the metallurgical chemist to form pure iron in the laboratory; but even then it has to be kept hermetically sealed, otherwise it is attacked by the oxygen in the atmosphere and quickly transformed into oxide of iron. If exposed long enough it will crumble into dust. Nearly all iron found in a metallic condition is of terrestrial origin, and is never pure, for in the aërolitic form it is invariably alloyed with other metals, such as nickel, cobalt, manganese, etc. The use of aërolites in iron working is as old as history. Amerigo

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Fig. 1.—Largest Aerolite Known to be in Existence.

Vespucci, after whom the North American continent is named, tells us that in the fifteenth century the Indians at the mouth of the La Plata River made their arrow heads of iron extracted from aërolites. Certain Siberian tribes are known to make their knives from this source, and a like practice exists among the Laplanders. Indeed some writers have set up the fanciful theory that the working of iron began with the use of these metallic stones dropped from the skies. It is true these stones of terrestrial origin are found in all parts of the earth, varying in size from mere dust grains to masses weighing tons.

Fig. 1 is a photographic picture of "Ahnighito," the largest meteoric mass of native iron ore known to be in existence in the world. It was discovered by Com. Robt. E. Peary, U. S. navy, at Cape York, Greenland, in 1894, and is now in the American Museum of Natural History, New York. It is 11 feet long, 7½ feet thick, and weighs 37 tons. The mass of metallic iron is alloyed with 8 per cent. nickel and a little cobalt.

In Fig. 2 is shown a diagramatic section of the Egremont Mine on the north-west coast of England, illustrating the remarkable manner in which strata of red haematite ore are sometimes found imbedded in thick layers of limestone. As the waters, heavily laden with vegetable matter in process of decomposition and hence highly carbonized, flowed through the limestone, it dissolved out large quantities of the