Mineralogy—No. III.

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Having become somewhat familiar with iron pyrites last month, it will be interesting to trace it through changes which lead to other and more valuable minerals. Iron and steel are obtained from magnetite, hematite, limonite, siderite and bog-iron ore. A study of these minerals and their origin, therefore, will be profitable not only for the present interest and pleasure of the pupil, but for the commercial value of such knowledge to the boys who are to be our future captains of industry. I am well aware that the few notes one may give in an article so limited as this will never make successful miners, prospectors or manufacturers of our school boys; but they may serve as an introduction to the subject, from which some boy will go on to further study, and attain success in the industrial world. Even if such an end be not accomplished, the awakening of the boy's interest to the details of the mineral world will make a more intelligent man of him.

The origin of beds of iron ore may be briefly given as follows: We may, for convenience, take iron pyrites as the starting point; though it itself doubtless came from pre-existing compounds. The pyrites, which we learned was iron sulphide (Fe Ss), readily oxidizes to iron sulphate ($FeSO_4$), which through chemical agencies turns to iron oxide (Fe_2O_3). This is the common form of iron which gives nearly all soils and rocks their red or rusty color.

In this state the iron is insoluble in pure water, but is soluble in water containing carbonic acid. One readily sees, therefore, that water containing decomposed vegetable matter, which supplies the carbonic acid, would, when percolating through the soil, or sandstone formed from soil, dissolve out much of the iron oxide and carry it away as iron carbonate. Now if this carbonate collect in a bog where there is an abundance of organic matter, it remains as carbonate; and, hence, we have beds of *Siderite* ($FeCO_3$). When iron is found associated with coal, it is nearly always in this form. (Why?) If, on the other hand, the carbonate be deposited so as to be exposed to air, it re-oxidizes to iron oxide (Fe_2O_3). This, when in cellular or earthy masses, and united with water, constitutes *bog-iron ore*. When changed to more compact form, but still retaining water, it is *limonite*. After the water has been driven off by physical agencies the mineral becomes *hematite* or *magnetite*. Have you not seen rusty ponds or pools where every blade of grass had adhering to it a spongy mass of iron rust? Can you not see how it got there, and, in imagination, see it at some future time buried beneath sand and clay, which themselves will become rock with a layer of iron ore beneath them? In the same way thick beds may accumulate, and, by successive filling with sediment, followed by periods of rest, successive beds of iron may occur alternating with beds of sandstone or other rock.

Thus all iron ore beds may be traced back to the disseminated iron particles in soils or sandstones, which in turn may be traced to iron pyrites. It has often been observed that in the vicinity of iron beds, sandstone is usually white or gray, showing that the iron has leached out of it; while in the vicinity of red sandstone extensive iron beds seldom exist. We are all familiar, too, with the fact that soil round the roots of trees is decolorized, showing that the vegetable matter has rendered the red iron soluble, so that it could wash away. Perhaps some one can tell us why soil under a black mud bog is usually white. Can you also tell why blue clay will make a red brick?

Now let us look at the distinguishing features of these minerals. Bog iron and limonite have the same composition ($Fe_2O_3+3H_2O$). They differ only in their texture: bog ore being more or less earthy or porous. Limonite is usually brown; often radiating or fibrous in structure. It is always distinguished by its brownish yellow streak. The earthy form is yellow ochre, so well known as a paint. If this ochre be heated, water escapes, and red ochre is left. Natural red ochre is the powder of hematite—a mineral easily recognized by this red streak and by its becoming magnetic when heated. In mass the mineral is red, or steel gray, or black. The black variety is specular iron, and looks much like magnetite,, but its red streak distinguishes it. A finer powder of hematite than red ochre is red chalk—common in red pencils. Hematite has the same composition as limonite, *minus* water. We saw above that heat drives off water from limonite, leaving hematite. It gets its name from the Greek word for blood, owing to its red powder. Is it harder than limonite?

Magnetite (Fe_3O_4) is black, heavy and magnetic, and has a black streak. It is the "loadstone" of the ancients, and gets its name from Magnesia, where it was found many centuries ago. All iron