

To Dr. Stutzer and other advocates of a magmatic origin for these and similar deposits I would point out that the magnetite which is contained in the accompanying crystalline rocks is invariably titaniferous, as Dr. Stutzer himself records in so many of his observations, and as the iron sands resulting from the disintegration of such rocks are always found to be. The analysis of the Kiruna syenite given in Dr. Stutzer's paper on p. 113 shows that the magnetite yielded by segregation from such rock would contain 20 per cent. of titaniferous acid, while the Kiruna ore contains but traces of this substance. As Dr. Stutzer admits or claims a contemporary origin for the syenites and the ore bodies they enclose, I shall be interested to learn how he reconciles these facts with a magmatic origin for the ore. Had Dr. Stutzer checked his observations more frequently by chemical analysis, he would, I think, have avoided many pitfalls and arrived at a different conclusion.

In supporting the theory of a sedimentary origin for these Lapland ores, I would draw attention to the fact that similar iron ore deposition is now going on in the same district, and probably under very similar conditions to those prevailing when these great deposits were laid down.

Dr. Stutzer notices the occurrence on pp. 108 and 111 of his paper without apparently appreciating the relevance of the matter to the subject he was studying. He says: "In the numerous peat-bogs the iron of the more ferriferous rocks has been largely changed by reduction to an organic ferrous salt, which, when removed in solution in running water, is re-oxidized to ferric hydrate, furnishing material for lake and bog ore deposits." And again he says: "The innumerable peat-bogs of Lapland have a powerful solvent effect on the more ferriferous rocks, the dark red porphyries being soon bleached white; the iron-laden bog waters collecting and stagnating (?) in ponds deposit their contents as a dark brown ferric hydrate."

Here Dr. Stutzer has accurately noticed and recorded natural processes of iron ore deposition going on, which we have every reason to believe have gone on through all the cycles of the geological ages. These processes, which modern science enables us to trace to organic agency, furnish, I submit, a simple and natural explanation of the origin of these deposits more probable and more convincing than those requiring us to accept them as deep-seated magmatic segregations, subsequently injected to their present positions, or as of "pneumatolytic hydatogene" origin, "derived from gases in solution in the magma or contact deposits." That they are of sedimentary origin, however, is, I think, rapidly becoming the accepted belief, and in claiming, as I do, that their metamorphosis has been caused by heat generated in the constant shrinkage of the earth's crust, always steadily going on, with the consequent folding and compression which is every where apparent where igneous and eruptive manifestations are found, I am again looking to a simple and natural agency to explain their present condition.

In support of my views I would point out that—

(1) The general alignment of the magnetite outcrops, and the continuity of the deposits in length and in depth where worked or tested, correspond in every way with the extensive areas generally covered by sedimentary iron ore deposits.

(2) The average phosphorus contents of these deposits (the magnetites) is everywhere from 1 to 2 per cent., agreeing in this important respect with sedimentary deposits of similar geological age.

(3) In the Annapolis-Torbrook district of Nova Scotia the metamorphosis of a sedimentary hæmatite into a phosphoric magnetite can be definitely traced.

(4) Mr. L. Cayeux has shown that the magnetite ore of Dielette, France, is a metamorphosed sedimentary ore, as it still preserves a typical oolitic structure.

In conclusion, I may note that a consideration of the organic origin of certain ores of iron has incidentally brought to notice the fact that manganese ores may be similarly formed.

It throws more light on the close and constant association of the ores of the two metals in nature, and suggests that organic agency may have been responsible, at least in part, for the great sedimentary ore beds of the Caucasus and South Russia which frequently show an oolitic structure, and other manganese deposits elsewhere whose sedimentary origin has been lost or obscured by subsequent metamorphism. With respect to the connection which I have endeavoured to show between the phosphoric magnetites and the sedimentary ores of iron, it is evident that the acceptance of my views would recognize, in the metamorphic action, a natural refining process which has thrown out the earthy constituents of the sedimentary ores and raised the metallic contents of the metamorphosed product to a high degree of concentration.

If this be so, then the same refining and enriching process may be expected to be met with elsewhere wherever sedimentary ore beds have been subject to disturbance by earth movements from their original horizontal position, the degree of enrichment being proportionate to the dynamic force developed and the thermal equivalent resulting therefrom.

In preparing this paper, I have to thank Dr. David Ellis, of the Technical College, Glasgow, for much valuable information respecting the iron bacteria, of which, as is well known, he has made a special study.

Methods of Removing Slag at Granby Company's Smeltery, B.C.

The Granby Consolidated Mining, Smelting, and Power Company, Limited, is preparing to dispose of the slag from the blast furnaces at its copper smeltery at Grand Forks, Boundary district of British Columbia, by a different system to that in use there, which latter has been for years the hauling from the furnaces to the dump, of the slag while hot in cars by steam locomotives.

The extent of the smelting operations of this company, the smeltery of which is stated to be the largest copper reduction works in the British Empire, and among the biggest in the world (second only to the great Washee works at Anaconda, Montana) is indicated in the following brief outline of the smeltery plant and equipment in use at Grand Forks. At this smeltery there are eight rectangular, water-jacketed, blast furnaces—six 44 by 266 inch, and two 48 by 260 inch, at tuyères, depth 15 feet 8 inches—having a total capacity of 4,000 to 4,500 tons of ore per diem; 12 Connersville blowers, with a total air capacity of 239,000 cubic feet; specially designed mechanical furnace-charging system; hot slag haulage, by 14-ton steam locomotives in 44-cubic ft. slag cars; three converter stands, 84 by 126 inches, operated by electricity, and