limited by the supply of material—that is, ferruginous and phosphoric solutions available.

As regards the phosphoric contents of the sedimentary ores of iron and its relationship to their organic origin, the association of phosphorus with living matter is of ancient date, and it is well known that phosphorus in a soluble form must be supplied to all land, growing crops. Tests recently carried out by me show the presence of 5.28 per cent. of phosphorus in the ash of the "dry rot" fungus already mentioned, while in the ash of ordinary mushrooms I found as much as 6.85 per cent. In a sample of seaweed I found 1.86 per cent. phosphorus in the ash, equal to 0.104 per cent. in the plant itself. The highly phosphoric contents of bog iron ores which are shown to be composed of bacteria remains, confirms the phosphoric character of those organisms also.

The very considerable variations of the phosphorus contents in the different sedimentary ores may be assumed to be due to the different organisms concerned in their deposition, and possibly also to the varying degree in which the matter of the organisms itself may have become incorporated in the ore deposits.

Though the phosphorus present in iron ores is invariably of organic origin, it does not always indicate an organic origin of the ore itself. Some fifteen or twenty years ago some shipments of Elba iron ore sent to this country were found on analysis to be higher in phosphorus than usual, parts showing as much as 1.5 per cent. phosphorus. As the Elba ore had hitherto been one of the purest of our ore supplies, this caused some consternation to the parties interested, and I was sent out to the island to investigate the matter. I was able to trace the phosphoric ore to the summit of a hill not far from the coast, and came to the conclusion that the excessive phosphorus contents of that part were due to it having at some remote period been the haunt of sea fowl, the guano deposit of which had in the course of time become incorporated with the surface layers of the iron ore masses at that point.

My explanation, I remember, was ridiculed at the time by one of our leading luminaries, but has since been amply confirmed by similar experiences in insular positions elsewhere.

On the connection of the oolitic structure with the organic origin I do not dwell, as at present I have no evidence to offer.

I propose now to deal with the phosphoric magnetites, especially those of Swedish Lapland, my remarks being suggested by a recent purusal of the Carnegie Research Report, by Dr. O. Stutzer, on the "Geology and Origin of the Lapland Iron Ores," published in No. II. of the Journal of the Institute for 1907. Dr. Stutzer appears to have made a very careful examination of these ore fields, and reviews impartially the various theories regarding their origin, and the evidence by which they are supported, his own conclusion, however, invariably being that they are magmatic segregations in depth, which, with their enclosing crystalline rocks, have been injected to their present position.

I find myself entirely at variance with Dr. Stutzer in his conclusions, which, in my opinion, are also contrary to the mass of evidence he adduces to support them, and as the problem of the Lapland ores has, since my own brief visit, appeared to me a simple one, I propose to submit my views for criticism and comparison with those of Dr. Stutzer and others, set out in the paper referred to.

My opinion is that the Kiruna and other phosphoric magnetites of Sweden are sedimentary ores of organic origin of Cambro-Silurian age, similar to and probably contemporary in deposition with the Wabana ore beds of Newfoundland. These Swedish deposits, together with their containing rocks, have been metamorphosed by heat of dynamic origin, due to compression caused by the shrinkage of the earth's crust, to which force all volcanic activity is probably due. The evidence of this action is the tilted position of the ore bodies; the ore was brought to a state of fusion, or an equivalent physical condition at the great depth at which this action took place, and the peroxide particles have been converted into magnetite, which appears to be the ultimate product of thermal metamorphism. The particles of this magnetite have segregated into the dense form in which it now exists —the silica, alumina, and lime of the sedimentary ore passing into the composition of the containing clays, shales, etc., which now, by semi or complete fusion, are transformed into the gneisses, porphyries, and syenites associated with the present ore masses.

In the Kiruna district the ore and rocks have been subjected to a higher temperature than at Gellivara, where the granular structure of much of the ore probably represents the remains of its original oolitic structure, and the gneisses the incomplete fusion of the shales which contained the original ore beds.

That the width of the ore body at Kiruna is greatly in excess of any known sedimentary iron ore bed is explained by presuming the segregation of several ore beds into one body, their partings naturally uniting by fusion with the adjacent rocks, while some further thickening would probably occur by the action of gravity on the tilted ore mass; it is notable that the greatest thickening occurs at Kiruna, where there is also evidence that the highest temperature and consequent greatest approach to fluidity prevailed.

From Dr. Stutzer's paper I find that a sedimentary origin for the Lapland deposits is advocated by Sjogren, Hamberg, and De Launay, though none of these authorities appears to offer any definite explanation of the subsequent metamorphosis.

That the ore beds form part of a regular sedimentary series is shown by the section given on p. 117 of Dr. Stutzer's report, and is confirmed by all the evidence he has collected.

When the series became heated by the pressure which brought about the metamorphosis of the ore into magnetite, the highly alkaline fucoid clays enclosing the ore beds would naturally be the first to soften and fuse, while the more acid members would be metamorphosed without fusion, or the loss of their sedimentary identity to the schists and quartzites as they now exist. The specular ore deposits of the quartzites frequently referred to by Dr. Stutzer are of quite different origin, being non-phosphoric impregnations of the original sandstones, which have been segregated and metamorphosed during the period of high temperature into their present specular condition. They are of the same class and type as those found throughout the northern parts of the Scandinavian Peninsula constituting the ores of Dunderland and Sydvaranger. The ore is frequently mixed specular hæmatite and magnetite, showing an incomplete stage of metamorphism due to thermo-physical causes respecting which we are at present imperfectly informed. The complete transformation of peroxide ores into magnetite is apparently only brought about when actual fusion results.