NOTES ON A FOSSIL WOOD FROM COX'S BIGHT.

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There being, so far as I can ascertain, no description or notes in the Papers and Proceedings of the Royal Society of Tasmania on replacement fossils of wood by iron pyrites, it seems to me not out of place to record some observations on an interesting specimen of this nature from the locality of Cox's Bight, and kindly placed at my disposal by Mr. Alex. Morton.

This specimen was discovered in the tin deposits at Cox's Bight.

In appearance it is rather deceptive, and at first sight its upper half seems like graphite, being of a dull greyish-black colour. The streak also would be apt to deceive, being somewhat like that of graphite. The extension of the upper half is smooth, showing a slight longitudinal graining, whilst on the ends traces of the original fibres of the wood may be seen. The upper half is united to the lower in a very distinct manner, just as if the two pieces had been cemented together. The lower and larger half is of an entirely different nature in certain respects to the upper. Its surface, though in a certain degree rounded, is rough, and has the appearance of a fragment of a holocrystalline rock of medium texture which has been subjected to friction in the bed of a river. Embedded in it can be seen by the naked eye small grains of quartz of a subangular and rounded nature. On fracture the two halves exhibit striking differences. In the upper half it may, perhaps, be best described as like that of a piece of charcoal wood, and being at right angles to the grain of the specimen, though of a slightly rough and uneven character, and the fresh face is of a metallic-grey colour. The lower half, on the other hand, presents a coarse hackly fracture like that of cast iron, and shows small embedded grains of quartz of a subangular nature. The colour of the fresh face is like that of the upper half, being a metallic-grey.

The total length of the specimen is about three inches, the width about three-quarters of an inch, the depth about one inch, the lower portion being larger than the upper.

The hardness of the upper half was rather difficult to obtain; the outer surface can be pared away with a knife like a piece of graphite, on account of the finely-divided state of the iron pyrites, but on fracture both the upper and lower portions have a hardness approximating that of iron pyrites (6 to 6·5)

The specific gravity of the upper portion when taken by weighing in air and in water is low, being 3·5 instead of 4·5,

but on grinding to fine powder, and using the specific gravity bottle method, it is considerably higher. This difference seems to be due to the physical structure, and not to the chemical composition, which shows the upper half to be almost pure iron pyrites ($Fe. S._2$), and can no doubt be accounted for by the slightly porous nature of the mass, resulting from the original wood tissue being entirely replaced by sulphide of iron. The specific gravity of the lower portion is also slightly low, due to the inclusion of quartz particles.

The results of two analyses show the upper half to be almost pure $Fe. S._2$, with traces of $Si. O._2$, metals of the copper group, and, perhaps, some carbon, which latter were not determined, owing to insufficient material to operate on. The lower half gave 26 per cent. $Si. O._2$ and 73 per cent. $Fe. S._2$, with traces of the copper group. No assay of gold and silver was made on account of the smallness of the specimen, though it is probable that traces of these metals would be found.

The microscopic examination of this specimen is most interesting and instructive, and shows very clearly the exact nature and derivation, and throws light on the striking physical differences between the upper and lower portions. Using reflected light and a two-inch objective, the fibrous nature of the upper portion is clearly seen, and on the longitudinal surface these fibres, replaced by iron pyrites, appear closely packed together, and retaining remarkably well their original structure. The iron pyrites on the outer portion shows little signs of crystallisation, but towards the centre of the upper portion becomes more dense and semi-crystalline. On a freshly fractured cross section the structure of the upper half is seen in an even more striking manner than in longitudinal section. The ends of the fibres give circular cross sections and appear as a mass of very minute little rings closely packed together. These longitudinal and cross sections show conclusively the origin of the specimen, though I am unable to give the exact genus and species of the original wood, but perhaps some of the botanically-inclined members of the Society may be able to clear up this point. The lower portion exhibits none of these peculiarities either in longitudinal or cross section, and merely presents the ordinary appearance of massive iron pyrites with embedded grains of quartz of a subangular form, and is apparently purely a mineral deposit, though the adjacent organic matter probably had some part to play in its deposition from solution.

Appended are three water-colour drawings, No. 1 being that of the specimen as seen by the naked eye, a portion having been broken off for analysis; No. 2 a longitudinal view under reflected light with a two-inch objective; and No. 3 a cross section under the same power and light, both of the upper portion.

Fig. 1.

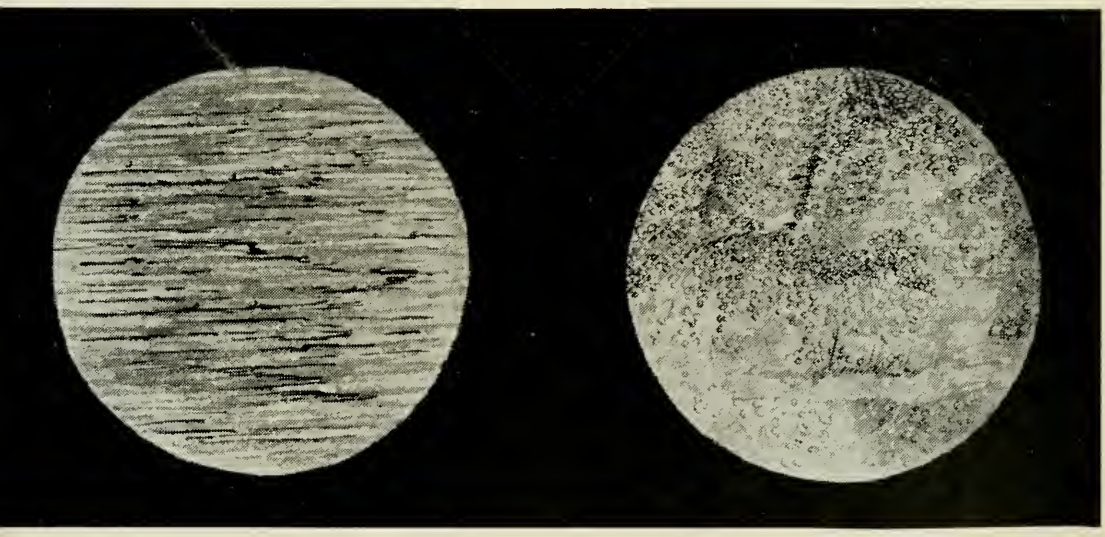

Fig. 2.

Fig. 3.

The history and chemical changes involved present a most interesting study. Neglecting all the complicate processes resulting in the formation of wood from the ingredients of the soil and air, the most important question that presents itself is: "How has a piece of wood become almost totally changed into iron pyrites, that is, a compound consisting of iron and sulphur, in the proportion of one atom of iron to two atom of sulphur?"

It is a well-known fact that iron pyrites can be precipitated from a solution of sulphate of iron by organic matter, and also from the higher sulphate of iron by carbonates, and it is most probably by the former reaction that this specimen was replaced. The wood, being organic matter, would be the precipitating agent, but there remains the presence of the lower sulphate of iron to be accounted for. This substance is often formed by the reverse process of that above described, that is, when iron pyrites is exposed to the action of air it becomes oxidised into ferrous sulphate, the conditions here being purely oxidising, and in the former case reducing. In many mining districts the waters are largely charged with this sulphate, and frequently large stalactitic crystals are obtained from the roofs of workings and drives. Some such occurrence probably caused the water percolating through the drift in which the piece of wood had become embedded to become charged with sulphate of iron which, on coming in contact with the wood, was reduced and iron pyrites was formed, which gradually took the place of the organic matter consumed in the reduction process. From the strong contrast between the upper and lower portions and from the sharp divisional line, it would appear that the wood had been lying loosely on a deposit of drift containing fine quartz, grains of subangular character, and that the lower half had been precipitated owing to the presence beneath the wood of perhaps decaying organic matter, and so had enclosed particles of the drift on which it was formed.

After these changes were completed, the specimen was altered in shape by physical agencies, as is evinced by the rounded water-worn character of the lower and upper portions. The original drift was probably cut into, and to a greater or less extent removed by the agency of water, and the accompanying attrition rounded off any sharp corners, giving a smooth, round aspect to the specimen, and finally the specimen was deposited in the locality where it was discovered.

It must be remembered that this short historical sketch only presents what seems the most plausible theory which has been presented by chemists and geologists to explain such occurrences.