Notes on Cassiterite in the Malay Peninsula.

By J. B. Scrivenor, M.A., F.G.S.

Geologist to the Federated Malay States Government.

[Read March 21, 1911.]

THE following notes on some peculiar forms of cassiterite found in the Malay Peninsula will, it is hoped, prove of interest and an addition to our knowledge of the mineral.

Magnetic Cassiterite.

It is now well known that the most effective method of separating wolframite from cassiterite on a commercial scale is the electromagnetic process, which, in theory, lifts all the wolframite from the ore and leaves a concentrate of cassiterite. In practice, however, the separation is rarely, if ever, perfect; and it has been possible for the writer to obtain some interesting information bearing on the point, the most valuable being the discovery of a few specimens of cassiterite that may be termed magnetic in that it can be lifted by an electromagnet.

The mineral in question was found on the land of the Kinta Tin Mines, Ltd., at Gopeng, Perak, occurring as small boulders of cassiterite and quartz in stiff clays believed to be of Permian age. The specimens had attracted notice on account of their peculiar appearance, and the presence of tin had been recognized by Mr. F. Douglas Osborne and Mr. Master, of whom the latter gentleman submitted material to the writer for examination.

The mineral is almost black, having but an obscure tinge of brown, and it shows no crystal outline in the hand-specimens. The streak is dark brown, and a thin section under the microscope shows a mass of minute zoned crystals of cassiterite, the zones being opaque and vandyke-brown. In the translucent zones a pleochroism from vandyke-brown to deeper vandyke-brown is pronounced.

Some of the cassiterite was carefully freed from quartz and analysed. The percentage of tin was only 68, a very low figure for cassiterite, and it was established that iron was the chief impurity. A trace of titanium

was suspected, and subsequently confirmed by Dr. G. T. Prior. The specific gravity is 6·781, as determined by Mr. W. Campbell Smith.

The abundance of iron in this mineral doubtless explains its most interesting feature, which is that fragments greater than 60 linear mesh to the inch and less than 30 linear mesh were lifted by a small electromagnet using $2\frac{1}{2}$ amperes.

It has been the writer's custom for some time to clean samples of detrital tin-ore by means of the electromagnet, and he has noticed that it is not uncommon for occasional grains of cassiterite to be lifted together with the magnetic mineral impurities. It is possible, of course, that some of these grains, like the Gopeng mineral, are lifted because of a high percentage of iron present in chemical combination, but in the majority of cases the behaviour and appearance of the grains make it plain that they are attracted because of enclosed iron oxide or ilmenite. The amount of cassiterite lifted by an electromagnet is, in the writer's experience, very small in proportion to that which is not attracted, and of no importance as far as the economics of tin-ore are concerned, but as an abnormal form of cassiterite, this Gopeng mineral is of some interest. Specimens have been presented to the British Museum of Natural History.

Replacement-pseudomorph of cassiterite and tourmaline after an hexagonal mineral.

In January, 1911, the writer and Mr. W. M. Currie, General Manager of the Pusing group of mines, in the Kinta district, Perak, happened to pass a spot on the Pusing Bharu mine where one or two coolies are generally at work picking out lumps of tin-ore from the worthless stone coming from the puddlers, and Mr. Currie fortunately noticed a heavy brownish mass with a distinct hexagonal form, measuring about $2\frac{1}{2}$ inches in length and $1\frac{3}{4}$ inches in breadth. The writer examined the specimen later, and found that it consisted of a slightly porous mass of greyish-brown granular material that yielded metallic tin on fusion with potassium cyanide. The hexagonal mass was cut in half and the cut surfaces ground smooth, when it was seen that the granular material showed lines suggesting layers of deposition, and crossed by other lines suggesting veins. A small portion of the specimen, powdered and examined under the microscope, showed that the seemingly granular material consisted of very minute grains of cassiterite together with abundant minute prisms with the characteristic strong absorption of tourmaline and terminations recalling the rhombohedral terminations of the same mineral.

As all the ore at Pusing Bharu is won from beds of clay above the Kinta limestone, none having been found as yet actually in the limestone, one is led to conclude that in all probability this is an example of cassiterite and tourmaline, rapidly deposited from vapour and solution, replacing a crystal of quartz, but no trace of the pyramid-faces are preserved. The prism-faces show striations, but these are oblique and caused by the lines of growth seen in the section.

This specimen, which Mr. Currie has presented to the British Museum of Natural History, may be regarded as analogous to the well-known replacement pseudomorphs of cassiterite after orthoclase, found in Cornwall. It does not resemble the so-called 'silicate of tin' or oxide of tin pseudomorphous after quartz described by Mr. J. H. Collins.[1]

Finely granular tin-ore from Siputeh, Kinta, Perak.

In 1910 Mr. W. M. Currie submitted to the writer some pieces of light-brown stone, found in the mine of the Siputeh Tin Mining Co., Ltd., that would have been thrown away as worthless had they not attracted attention by reason of their weight. They were irregular in shape, and contained, in some cases, particles of quartz. The specific gravity of two specimens without quartz was found to be 5·195 and 5·226 respectively. One specimen weighed about 30 grams. A thin section under the microscope showed that the stone consisted of a mass of very minute granules and prisms which under a $\frac{1}{12}$-inch objective were found to be optically positive and to have straight extinction. A specimen of known cassiterite ground to the same fineness exhibited similar interference-colours, and this, combined with the fact that the stone when fused with potassium cyanide yielded metallic tin, leaves little doubt that the mineral consisted of extremely minute prisms and grains of cassiterite, much smaller than any of the fibres from 'wood-tin' that have come under the writer's notice.

Subsequently, Mr. Currie found specimens in which this finely granular ore could be seen passing into easily recognizable crystalline tin dioxide, and it would seem that the minute structure of the mineral is due to rapid deposition from vapour or solution.

Specimens of this Siputeh ore have been presented to the British Museum of Natural History, and Dr. Prior informs the writer that the specimens in the collection most resembling it are those of 'wood-tin' from Mexico and Bolivia.

[1] J. H. Collins, Mineralogical Magazine, 1880, vol. iv, p. 115.