# *On an occurrence of native Copper with tin-ore in the Federated Malay States.*

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

Geologist to the F.M.S. Government and formerly of H.M. Geological Survey of the United Kingdom.

[Read November 16, 1909.]

EARLY in 1909 a small quantity of fine sand was brought to the writer from a big Chinese-owned mine at Rotan Dahan, in the district of Kinta, the leading tin-producing district of Perak and, indeed, of any of the Federated States. The sand was a concentrate, and had been obtained in the final washing of the rough tin-ore concentrates, whereby the heavier impurities, generally referred to locally as 'amang', are separated from the cassiterite. In this case, however, the Chinese miner found that there was a reddish mineral present which he could not separate from the cassiterite. This proved to be native copper, and the mode of occurrence is of sufficient interest to warrant a brief description of this and other samples of ore from the same mine and an adjoining mine working on the same deposit.

The tin-ore is being won from a mass of partially decomposed, soft schists *in situ*, overlying limestone. The working face is about 80 feet high, and small patches of iron-pyrites in minute crystals are of frequent occurrence in the clayey mass. The clay is cut by hand and puddled, a sand rich in cassiterite being obtained as a result. This is concentrated into a marketable product in native-made sluice-boxes, or 'lanchuts,' and by a final washing by skilled workmen in fine-meshed sieves. The undersized material that falls through the sieves is generally washed again, and a low-assay, fine tin-ore obtained from it. It was in this undersize that the native copper was first found.

The whole of the sample submitted to the writer passed through a wire sieve of ninety meshes to the inch, with the exception of a few pieces of cassiterite. On treating portions of the sand with nitric acid, 72 per cent. dissolved with the separation of a very little sulphur. The remaining 28 per cent. assayed 71·5 per cent. tin, and was found to consist of cassiterite with some zircon. Microscopic examination of the

original sand also showed that the soluble portion consisted of native copper and a trace of iron-pyrites. No chalcopyrite was detected. But the most remarkable point about the concentrate was that the copper occurred for the most part in beautifully sharp crystals, varying considerably in form, and sometimes twinned. Roughly spherical masses occur too, but the minute crystals predominate, as can be seen when the material is mounted on microscopic-slides.[1]

Later in the year the writer heard that the same miner had been unable to sell two parcels of ore owing to the amount of copper in them. Samples of these were obtained, one being coarse, medium, and fine ore mixed, the other medium and fine ore only.

On grading the first sample it was found that the oversize in a $\frac{1}{30}$ inch mesh sieve contained only a trace of copper, but that the amount increased greatly with the fineness of the grade. Iron-pyrites also was abundant in the finer grades, but negligible in the $\frac{1}{30}$ inch mesh oversize.

Grading the second sample showed that such treatment was incapable of freeing any portion of the ore from copper. All the grades contained a high percentage of copper and of iron-pyrites.

In both the above cases the copper is present as shapeless grains, partially oxidized on the surface. No crystals were found, nor was chalcopyrite detected with certainty. Arsenopyrite, however, and some zircon were found.

Another concentrate containing native copper was obtained from the adjoining mine. The oversize of a $\frac{1}{30}$ inch mesh sieve contains arborescent growths of copper crystals, while the lower grades contain shapeless and considerably oxidized grains. Fresh and oxidized iron-pyrites is abundant, and some small, dull black, non-magnetic crystals were seen that could not be identified, but that might be oxidized crystals of copper. The remainder of the concentrate consisted of cassiterite, with occasional grains of zircon, tourmaline, and monazite.

On the whole of the working faces of these two mines the writer has not detected any trace of copper salts, but the extraordinary sharpness of the crystals in the first concentrate shows that they are very probably the result of reduction *in situ* of a copper salt held in solution by water

[1] Three of these slides have been presented to the Mineral Collection of the British Museum (Natural History). They were prepared after the concentrate had been in the writer's possession for some time, and the sand was treated with weak hydrochloric acid to remove the tarnish. When the concentrate was fresh, the crystals of copper showed brilliant metallic surfaces.

percolating through the schists from above, which also probably brought down the zircon crystals, found with the cassiterite, from alluvial deposits.

It is hoped that sufficient material will be found available to render practicable the removal of the copper by an oil-flotation process or by acids, thereby obtaining two marketable products. At present an interesting mineral occurrence of a valuable metal seriously threatens the prospects of two mines.