Additional notes on Wood-tin.

(*With Plates I and II.*)

By J. H. Collins, F.G.S.

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In my previous papers[1] I described and illustrated several examples of the concentrically banded and radiated varieties of cassiterite known as 'wood-tin', and stated that one very constant character of this variety was its rather remarkable opacity as compared with ordinary cassiterite, which is indeed somewhat exceptionally transparent considering its (often) deep coloration. I also noted the frequent occurrence of specimens of wood-tin encrusted with more or less distinct crystals of cassiterite, or traversed by fissures filled with such crystals, as indicating successive formation.

In such cases the sequence of events seems to be: (*a*) the deposition in successive layers of amorphous, perhaps colloidal cassiterite, which is usually very ferruginous; (*b*) the gradual development of a radial crystalline structure; (*c*) the formation of distinct crystals of cassiterite, quartz, tourmaline, chlorite, and other minerals in the shrinkage cracks or cavities which result from the lesser space occupied by the crystalline as compared with the colloidal cassiterite, these latter minerals being formed by the re-solution and crystallization of the originally impure tin deposit, and of materials dissolved from the surrounding rock or vein substance. These conclusions will, I think, be supported by the further illustrations which I now present in the form of photographs.[2]

1. Wood-tin from Goss Moor, St. Dennis, Cornwall (Plate I, figs. 1 and 2, Plate II, figs. 5 and 6).—This is obviously a fragment of vein-stone resembling in some respects those already figured in Plates VII to IX of my previous papers. Here are innumerable alternating layers of light-

[1] J. H. Collins, 'On some Cornish tin-stones and tin-capels,' Mineralogical Magazine, 1880, vol. iv, pp. 1–20, 103–116, with 12 plates; 1883, vol. v, pp. 121–130. Reprinted, 54 pp., with 12 plates, Truro, 1888.

[2] For these photographs I am indebted to my friend Mr. Jos. M. Coon of St. Austell.

and dark-coloured cassiterite and of quartz, in some cases moulded on pre-existing quartz crystals, in others forming finely banded linings to cavities ('eyes') as shown in Plate I, fig. 2, and Plate II, figs. 5 and 6.

2. Wood-tin (shot-tin) from the Burthy china-clay works, St. Enoder, Cornwall (Plate I, fig. 3, and Plate II, figs. 7, 8, and 9, which may be compared with figs. 1 and 2 of Plate X in my former papers).—The 'eyes', or 'shots', vary in size from $\frac{1}{10}$ to $\frac{1}{30}$ of an inch diameter, and they appear to have been originally developed as globules in a siliceous matrix. Fig. 7 shows one of the 'shots' surrounded by distinctly crystalline cassiterite, the product, as I think, of its gradual destruction. This section is not very accurately through the centre of the 'shot', consequently the concentric structure is not very well marked. In fig. 8 the section is very nearly central, and many of the concentric 'shells' of which it is composed are plainly visible. The centre of this particular body, when examined under a higher power, is seen to consist of a group of quartz crystals, together with some tourmaline needles and a small quantity of opaque brown matter, probably oxide of iron, the whole being surrounded by an irregular aureole of similar substance. There is then an interspace occupied by quartz, which is succeeded by the first of a series of dark rings, and from which project inwardly many minute acicular crystals of cassiterite. Then follow many alternations of darker and lighter bands, with at least one distinctly quartz-filled interspace, the whole being crossed by fine radiations. Outside all is distinctly crystallized cassiterite in long prisms (fig. 9), which finally meet similar projections from other 'shots', leaving irregular interspaces, as seen in Plate I, fig. 3; also in Plate X, fig. 4, of my former papers.

3. Wood-tin (shot-tin) from Wheal Kitty, St. Agnes, Cornwall (Plate II, fig. 14).—In this section the original spherules are broken up, probably by subsequent stresses, partial solution, and re-crystallization. The specimens from Wheal Kitty and other St. Agnes localities recently examined by Messrs. Flett and Scrivenor afforded similar evidence: 'In some slides the felted masses of brown tourmaline are seen to be traversed by veinules of quartz bearing blue tourmaline. . . . In the specimen from Wheal Kitty dense masses of very minute and pale blue tourmaline prisms were found mingled with minute flakes of chlorite. . . . There can be no doubt that part of the blue tourmaline crystallized before the cassiterite'[1] (p. 77). It is in such complex crystallizations

[1] J. S. Flett and J. B. Scrivenor, Mem. Geol. Survey, 'Geology of Newquay,' 1906, pp. 76, 77.

that we often find traces of 'shots' of tin-ore, which have evidently been broken up and transformed as described above.

4. Wood-tin from Mexico (Plate II, figs. 10 to 13).—This is a remarkably opaque, reddish-brown substance. The specimen described was one of many rounded alluvial grains, probably from Durango; while Plate I, fig. 4, is a photograph in natural size of a quite similar substance from a vein, showing distinct globular masses, which have a structure precisely similar to that now to be described. In the lower part of fig. 10 the finely banded concentric structure of the interior of the rounded masses is seen, and near the top another series of bands. Between these the almost opaque mass is seen full of radial fissures,—shrinkage-cracks, apparently—which do not traverse the fine alternating bands. In figs. 11 and 12 some of the lighter bands are seen to be composed of bundles of acicular crystals, while fig. 13 shows the more minute 'vandyked' structure visible under a comparatively high power (magnified 110 diameters). The lack of transparency makes it difficult to apply still higher powers with advantage, and it must be admitted that the final 'resolution' of this peculiar structure has not yet been reached.

5. Wood-tin from Mina del Diablo, Durango, Mexico (Plate II, fig. 15).—The close association of cassiterite and haematite in some of the tin-stone from this locality was long ago noted and described by L. V. Pirsson.[1] His conclusion was thus stated: 'It would seem as if the two minerals had been formed simultaneously and the hematite having a greater tendency to crystallize than the cassiterite had assumed its crystal boundaries without regard to the latter.' This was probably the true explanation of the origin of the compound and well-formed hexagonal crystals figured by him. But in the same stones there are many minute, translucent, red or brown, mamillary globules of wood-tin showing concentric banding and slight radial structure, which have evidently been deposited upon nearly or quite opaque haematite crystals; the whole being surrounded by a quartz matrix showing traces of striped felspars. One of these radiated and concentric groups of peculiar form is shown in fig. 15.

It seems likely enough that the original deposit was a gelatinous mass of mingled oxides of tin and iron, and also that there was some simultaneous crystallization, as suggested by Pirsson. Yet it would seem that even after much of the tin and perhaps all the iron had crystallized, enough tin oxide remained to furnish numerous new globular deposits.

[1] L. V. Pirsson, Amer. Journ. Sci., 1891, ser. 3, vol. xlii, p. 407. See also F. A. Genth, Proc. Amer. Phil. Soc., 1887, vol. xxiv, p. 23.

The marked tendency of oxide of tin to form botryoidal or globular aggregates is evident in the fine specimen from Tregoss Moor which is figured in Plate VIII of my former papers, and is now in the Truro Museum. It is also evident in two specimens in my possession from Wheal Metal, Breage, Cornwall, and still more strikingly in the Mexican[1] specimen figured here in Plate I, fig. 4.

These botryoidal forms of a mineral usually occurring in a highly crystallized condition should be considered in connexion with botryoidal or stalactitic forms of silica, phosphate of lime, pyrites, blende, galena, chalcopyrite, &c.[2] I would suggest that all have somewhat the same relation to the corresponding crystalline forms as chalcedony (and perhaps opal, except as regards its contained water) has to rock-crystal. I am also disposed to believe that all have been deposited somewhat rapidly from hot and often impure solutions at moderate depths and under little pressure. Whether such rapidly deposited colloidal forms are finally changed into crystalline forms depends no doubt upon their subsequent experiences, of varying pressure, the operation of circulating solutions, and the like. But such evidence as I have so far been able to acquire by the use of the microscope leads me to think that they are—and in particular that wood-tin was originally (and is still largely)—non-crystalline. Furthermore, I think this conclusion receives some support from the fact that wood-tin is sometimes soluble to a remarkable degree in hydrochloric acid.[3]

In conclusion, let me offer these beautiful figures and somewhat crude suggestions for the consideration of those more competent than myself to investigate chemically and optically the problems here indicated.

[1] A very fine specimen of dark colour, probably from Mexico, has recently been acquired by the British Museum as a bequest from the late Mr. F. Tendron, and there is a very similar specimen in the Ludlam collection at the Museum of Practical Geology in Jermyn Street, London.

[2] Botryoidal or stalactitic forms of all these substances were exhibited by the author in illustration of his paper.

[3] See J. H. Collins, 'On the assay of tin and on the solubility of cassiterite,' Trans. Inst. Mining and Metall., 1903-4, vol. xiii, pp. 485-486.

[*Explanation of Plates*, p. 34.]

Explanation of Plates.

Plate I.

Fig. 1. Wood-tin from Goss Moor, St. Dennis, Cornwall (slightly enlarged).
,, 2. Part of fig. 1 (×2).
,, 3. Wood-tin (shot-tin) from the Burthy china-clay works, St. Enoder, Cornwall (×5).
,, 4. Botryoidal wood-tin from Mexico, probably Durango (actual size).

Plate II.

Fig. 5. Part of fig. 1 (×7).
,, 6. Another portion of same (×7).
,, 7. Wood-tin from the Burthy china-clay works, St. Enoder, Cornwall (×7).
,, 8. ,, ,, ,, (×9).
,, 9. ,, ,, ,, (×40).
,, 10. Wood-tin from Mexico, probably Durango (×9).
,, 11. ,, ,, (×9).
,, 12. ,, ,, (×33).
,, 13. ,, ,, (×110).
,, 14. Wood-tin (shot-tin) from Wheal Kitty, St. Agnes, Cornwall. Here the spherules are much broken up (×28).
,, 15. Wood-tin from Mina del Diablo, Durango, Mexico (×50).

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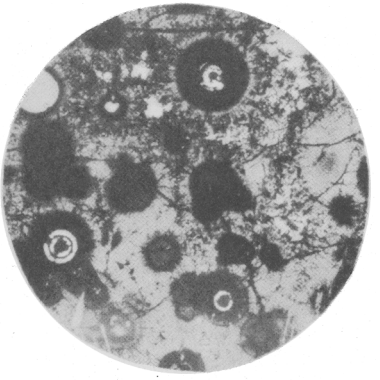

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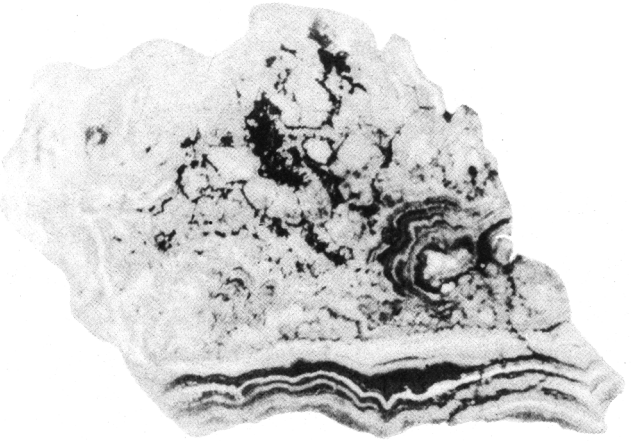

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