VIII.—*On some Cornish Tin-Stones and Tin-Capels.*

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

Second Paper.

Wood Tin.

In my former paper (*Min. Mag.*, vol. IV, page 1) the different modes of occurrence of oxide of tin in Cornwall were briefly described, and the characters both macroscopic and microscopic of the ordinary tin-stones and tin-capels were illustrated in considerable detail. I have now to describe the peculiar varieties of "wood-tin" or Cornish tin-ore, which are certainly characteristic of many of the Cornish deposits, although their occurrence is not limited to Cornwall as was at one time supposed.*

The chemical composition of Cornish wood-tin differs very little from that of ordinary Cassiterite, as was shewn long ago by Klaproth. The following analyses were given in my Mineralogy of Cornwall and Devon, pt. 2, p. 24 :—

	a.	*b.*	*c.*	*d.*
Oxide of Tin	93·93	96·26	91·0	94·5
Peroxides of Iron and Manganese	0·32	3·40	9·0	1·5
Silica	0·75	0·75	—	1·0
Alumina	—	—	—	3·0
	100·00	100·41	100·0	100·0

a was a specimen from Altarnun, analysed by Klaproth, *b* was analysed by Thomson, *c* by Vauquelin (sp. gr. 6.45), and *d* by Johns.

The following percentages of metallic tin were obtained by means of a charcoal crucible and blast furnace, by Klaproth :—

Light-brown acicular crystals ..	75 per cent.
Grey crystals from St. Agnes ..	74 ,,
Wood Tin	73 ,,
Stream Tin from Ladock	76 ,,
Stream Tin, Altarnun	76 ,,

* Among foreign localities for wood-tin the detrital deposits of the Mexican uplands may be especially referred to. In these many nodular and concretionary masses of a yellowish or reddish-brown wood-tin occur—sometimes associated with the rare mineral Durangite. These, however, unlike most of the Cornish wood-tins, generally contain a very large proportion of oxide of iron.

The tin so obtained, however, would contain traces of the iron, manganese, and other metals contained in the ore. On the other hand there would be a certain loss of metal in the slag which would more than compensate for the increase from this source in such pure selected ores, so that the results obtained were on the whole remarkably near the theoretically possible quantity of 78·67 p.c. of metallic tin.

The following are analyses made by myself:—

	a.	*b.*	*c.*
Tin	77·80	72·50	74·6
Iron	·21	5·22	2·3
Manganese	traces	traces	1·2
Silica	traces	·31	·2
Oxygen (calculated) ..	21·20	21·86	21·7
Loss	·79	·11	—
	100·00	100·00	100·0

The general appearance of wood-tin has been already described*—the more important varieties are illustrated in the plates VII to XI, which accompany this paper.

The Garth Mine has already been referred to as a notable locality for wood-tin. Balleswidden Mine in St. Just has also been given as a locality.†

The following extracts from Mr. Carne's account of the Garth mine (*Trans. Roy. Geol. Soc. Cornwall*, IV, p. 99) will be found of considerable interest. The paper was read in October, 1830. "The Garth Mine, known also as East Wheal Cock, is situated on the side of a granite hill, about two miles from Penzance, on the Land's-end road. Eastward the lode is in granite, westward in killas, but the workings have all been in the granite portion." After adverting to the former history of the mine, Mr. Carne continues—"About three years ago the Garth was again set at work, with an engine worked by a water-wheel for draining the water: the present workmen, on exploring the lode immediately below the *old workings*, found it productive of tin, and it has continued so to the present depth of thirty fathoms, although scarcely rich enough to pay the expenses which attend the concern: the tin-ground in the lode is about six fathoms in length, and occurs directly westward of the intersection of the lode by a clay cross-course on which the adit was driven; the lode has not been explored east of the cross-course.....In all this space, wood-tin and

* *Min. Mag.*, vol. IV, p. 6.

Some beautiful coloured figures of wood-tin are given in plate 1, of the Catalogue of the Rashleigh collection, published in 1797. A good drawing of the "needle-tin" from Glasteining mine in St. Mewan (now I believe known as St. Austell Consols) is given in pl. 4. Some of these "needles" are extremely fine, but unlike the "fibres" of wood-tin which are nearly opaque, these are very transparent.

† *Rep. Roy. Inst. Corn.*, 1841, *p.* 38

toads'-eye tin have been plentifully found; tin in globular distinct concretions, from the size of a pin's head to that of a pea has occurred more sparingly; and of botryoidal-tin only a few specimens have been met with....Of the specimens which I have the pleasure to present to the Society,* Nos. 1-6, are of the lode itself: it has in general a very granitic appearance, but it is not granite, its constituent parts (except the metallic ores) appear to be quartz, felspar, and chlorite, coarsely mingled together; the two former highly crystalline. The only metallic ores which I have observed in it are the carbonate of iron and the oxide of tin; the tin is not generally scattered throughout the stone, but exists in singular forms, and in such modes as have been seldom if ever observed before. Where the felspar predominates the tin occurs in small separate layers between the crystalline masses of felspar, possessing the fibrous texture and brown colour peculiar to the wood-tin as in specimens 7-8. It occurs also in contemporaneous veins in the quartz as in No. 9, and in similar veins between the quartz and another constitutent part of the stone as in No. 10,and investing the sides and summits of the quartz crystals as in Nos.11, 12. No. 13 is a specimen of the globular distinct concretions; on breaking a stone these concretions are often found bedded in one part and capped by the other as in No. 14, when broken they commonly present the appearance of toad's-eye tin as in Nos. 15-16. In some of the specimens two or more of these varieties may be observed in the same stone, as in Nos. 17-18. No. 19 presents the wood-tin with a rough botryoidal surface." Several of the varieties referred to by Mr. Carne are described and figured in Plates VII and IX. The figures are however drawn from specimens in the Truro Museum.

Wood-tin, Garth Mine (Plate VII, fig. 1.) This specimen is in the Truro Museum. It consists essentially of a layer of dark brown wood-tin thinly coating the sides and summits of the large quartz crystals at *c*. This is succeeded by a series of bands of hair-brown wood-tin, grayish quartz, and pale pink felspar several times repeated. At *e* is a band of green chloritic substance which probably formed the wall of the lode from which the specimen was derived. What was the entire breadth of the lode in this part we have no means of knowing as the other side of the specimen is broken away.

Wood-tin Garth Mine. (Plate VII, fig. 2.) This very peculiar figure is also drawn from a specimen in the Truro Museum. It consists mainly of crystals of pink felspar which are just in contact with each other—so as to leave numerous angular interspaces. These are all

* The Royal Geological Society of Cornwall. The specimens are preserved in the Museum at Penzance in wall-case No. 11.

filled with very compact dark-brown wood-tin, as indicated in the figure. There is scarcely any quartz in this stone.

Wood-tin, Garth Mine. (Plate IX.) This is another figure drawn from a specimen in the Truro Museum. It consists of fine alternating layers of quartz, pink-felspar, and wood-tin, part of a thick band from a granite "country." This is an exceedingly beautiful specimen, but not so rich in tin as the last described.

Wood-tin, Tregoss Moor. (Plate VIII.) This magnificent specimen was found in the slightly water-worn detrital deposits of Tregoss Moor, and is now in the Truro Museum. It has evidently at one time formed part of the filling of a fissure, but the original locality is not known. At *b* the stone consists of a peculiar pale brownish-gray quartz, a *melange* apparently of small irregularly formed crystals. At *c.c.* is a band of moderately large prisms and pyramids of quartz, pointing no doubt as is usual towards the interior of the fissure. Upon and between these crystals is a series of layers of wood-tin, varying in tint from a very pale hair-brown to a very dark chocolate tint, many of the layers being less than one-hundreth of an inch in thickness. Then upon this we have the main mass of confusedly crystalline quartz enclosing smaller patches of wood-tin, and, at the farthest edge a semicircular mass which is no doubt part of a band corresponding to that first mentioned. All the wood-tin here is most perfectly concentric, and also radiated in structure.

How wide the original fissure was cannot be determined, as not the slightest appearance of a wall or selvage is to be seen; but it must have been considerable in the part from which this specimen was derived, even though there had been only these two layers facing each other, i.e. that there was no re-opening and re-filling of the fissure. Its total breadth could not have been less than 6 inches, and may have been as much as 9 or 10 inches. Such a lode would be capable of yielding in each fathom of length and depth nearly two tons of tin-ore. Of course there may have been several such layers in the same fissure, forming a gigantic specimen of "banded" or "combed" structure.

Shot-tin (Pl. X., figs. 1 and 2). This very remarkable form of wood-tin was first noticed by Klaproth—and it is the rarest of all the forms. Its general appearance is very remarkable, that of a number of small brown shot, varying in size from a pin's head to the 16th of an inch, embedded in and cemented together with a greyish-brown cement. In fig 1 a section is drawn as seen with the $\frac{1}{2}$-in. objective ($\times\frac{66}{1}$). The greyish circles are sections of spheres, generally more or less broken or incomplete—sometimes hollow, sometimes containing a kernel of nearly opaque wood-tin. The spheres themselves do not appear to be composed of

cassiterite, but I am not at present able to say of what material they consist, as I have but a very small fragment of the stone at my disposal. They are surrounded on all sides by distinctly radiated wood-tin, as shewn in the sketch. The matrix encloses a number of prisms which appear to be quartz; similar crystals are embedded in some of the spheres. In fig 2 the same section is shewn as seen with the 2-in. power ($\times\frac{16}{1}$). The specimen from which the sketches are drawn is said to be "from near Penzance," but the exact locality is not known. It is, however, probably from the Garth Mine.

Carvear, St. Austell.—In this specimen the wood-tin occurs in little botryoidal layers and groups of spherules enclosed in nearly white quartz. As in every other case, the spherules exhibit the radiated and concentric structure.

Wood-tin, Prideaux Wood Mine (Plate XI, fig. 1.) This is an illustration of the very remarkable brecciated stanniferous deposit already referred to.* Referring to one of the finest masses discovered, my friend Capt. John Simmonds, of Liskeard, writes me as follows:—"The wood-tin found at Prideaux Wood was discovered in a lode of copper-ore; it was a large kidney-shaped specimen, but, unfortunately the men broke it up to see what it contained, supposing it to be iron. No one knew what it was until I brought it up from underground, and had it bruised down and calcined, when it shewed a splendid "vau" of tin. I have a part of the stone (also some small fragments) which in appearance closely resembles a specimen of wood-iron alongside of it." Some fragments of the included radiated masses (for which I am indebted to my friend Dr. C. Le Neve Foster) are drawn as seen under the microscope in Plate XII.† The appearance to the unaided eye is beautifully represented in the Rashleigh catalogue already referred to. The concentric bands are alternately light and dark-brown, some few being very nearly black.

Wood Tin, Roche—Specimens of wood-tin associated with tourmaline-schist and quartz were presented to the Truro Museum many years since by Mr. W. Mansell Tweedy. One of the specimens, besides the usual narrow bands and botryoidal or mammillary crusts, has a fine circular radiated mass of wood-tin about one inch in diameter. Mr. Tweedy remarks of the wood-tin from this locality, "The specimens were of unusual beauty, one which I obtained for Mr. Williams had the radii at least an inch in length. The specimen I have the pleasure to exhibit will illustrate the character of the larger specimens: it is of a light hair-brown colour internally, darker externally, sprinkled with minute crystals of white quartz, in nodular concretions in a dark, nearly black and

* First Paper, p. 7.

† On analysis this wood-tin yielded 25 p.c. only of peroxide of iron.

schorlaceous rock. In other specimens the wood-tin in radiating fibrous masses with darker concentric bands, is intermixed with the schorl rock." Some of the specimens exhibit a brecciated structure; the tin mixed with schorl apparently serving partly as a cement. Some of the wood-tin masses are coated with minute nearly black crystals of cassiterite.*

Wood-tin, Gavrigan Mine—A specimen in the Truro Museum marked as above, consists of dark-brown irregular masses of wood-tin, coated with brilliant black crystals of cassiterite, resting upon and occupying fissures in tourmaline schist. It does not essentially differ from the specimens above described as from Roche, and may probably be from the same locality.

Wood-tin, St. Agnes—A specimen exhibited at the annual meeting of the Royal Institution of Cornwall in 1841, was thus described by Mr. W. M. Tweedy, "The specimen from St. Agnes is a fragment showing a portion of the lode and both walls, with some of the *country* on each side, which is a very hard siliceous killas. The fibrous wood-tin is principally at the sides of the lode, which assumes in the centre a more uniform structure, and incloses fluor spar, quartz, and some mundic."†

Toad's-eye tin, Polberrow Consols—This occurs in minute light and dark brown spherules and mammillary coatings. Many of the spherules are not more than one-sixteenth of an inch diameter, and very few are more than one-tenth of an inch. However minute the spherules, they all exhibit the characteristic concentric and radiated structure. Some of the spots have a dark centre, surrounded with a lighter band, a dark margin beyond presenting a very considerable resemblance to a toad's-eye. Unlike the toad's-eye tin (described on p. 14 of my former paper) from Penhalls, these from Polberrow contain no crystals of cassiterite in their interior and no quartz.

Wood-tin, Penhalls Mine. For this very beautiful specimen I am indebted to Dr. Foster. It is of a general dark gray colour, banded with narrow curved lines of white quartz, alternating with others of grayish and brownish wood-tin. The whole has been at some time broken across and re-cemented with white crystalline quartz. The separate layers of tin oxide and quartz in this specimen are almost inconceivably fine, dozens may be counted in the space of an eighth of an inch in some places (Plate XI, fig. 4.)

This mine is situated on the edge of the cliff on the east side of Trevaunance Cove. Its singular "heaves" were described by the late Mr. John Pike‡ and some of the more remarkable features of the mineral deposits were detailed by my friend Dr. C. Le Neve Foster.§

* *Rep. Roy. Inst. Corn.* 1841, p. 38.
† *Rep. Roy. Inst. Corn.*, 1841, *p.* 38.
‡ *Quart. Jour. Geol. Soc.*, XXII, p. 535.
§ *Trans. Roy. Geol. Soc. Corn.*. IX, pp. 206-9.

Capt. S. Bennetts, the manager of the mine, describes the occurrence of the wood-tin here and at the neighbouring mine of Blue Hills in the following terms:—"The wood-tin obtained in those mines has principally been found near the various intersections of the tin-lode by the so-called "gossans" (parallel veins having opposite underlie and faulting the tin-lodes.) It is found too in greater quantities near those faults on the borders of good deposits of cassiterite. On one occasion in the western part of the mine, under these conditions large lumps several pounds weight were found of solid massive wood-tin. It is often found in small rounded concretions, occasionally covered with a coating of a friable oxide of tin, (just exactly like putty powder, both in colour and appearance) as fine as the finest slime, and as easily washed off; and again this in some cases is hard as flint, of a pale-straw colour and without any granular structure so far as I can magnify it. I have generally considered this to be a *silicate* of tin. As to the *quantity* of the wood-tin found in this and the Blue Hills Mines from time to time, it is difficult to estimate; but from its being so often met with, and sometimes by no means small in quantity; I should think some tons of it had been met with since I have been connected with the mines."*

Capel, Brookwood (Pl. X., figs 3 and 4). This is a dark granitic capel which was not known to contain tin till it was examined in thin sections under the microscope. It consists of a series of dark-brown and nearly opaque patches, which appear to be composed of oxide of iron and amorphous tourmaline, occupying cavities in what was originally a vesicular rock. Around these, as seen in section, we have a narrow band of quartz crystals with their principal axes radiating from the dark centre. The summits of these are coated with an extremely thin layer (sometimes two or three distinct layers) of wood-tin. The interspaces are filled up with hyaline quartz. The quantity of metallic tin contained in the specimen here illustrated did not exceed 4 lbs. per ton, or less than ¼ per cent. Fig. 3 shews the section as seen under the 2-in. power ($\times\frac{16}{1}$), fig. 4 with ½ in. power ($\times\frac{66}{1}$).

Blue Hills, St. Agnes, (Pl. X., fig. 5). This is very similar to the specimen from Brookwood, but the layers of wood-tin are somewhat thicker, and the quartz crystals radiating from the dark patches are also separated from each other more or less completely by layers of wood-tin, in other words the faces of the prisms as well as those of the pyramids are coated with wood-tin.

Wood-Tin, Wheal Vor (Pl. XII, fig. 1.) The stone here illustrated is from a deposit which occurred near that described by Mr. G. M. Henty, and already referred to in my former paper.†

* Private communication, August 12th, 1880.

† First paper p. 7.

The mode of occurrence of this deposit is thus described by my friend Mr. Argall in the Journal of the Royal Institution of Cornwall.* "The ancient and well known mine of *Wheal Vor*, situate on an elevated plain of chloritic slate immediately East of Tregoning Hill, an isolated body of granite, has, perhaps, afforded more tin ore than any other land of equal extent in Cornwall.

The *Wheal Metal Lode* bears 10°-15° N. of E—S. of W., and like most of the other *lodes* in *Wheal Vor*—dips some 65°-80° N.

Some six or seven years since, traces of *wood-tin* were discovered about 180 fathoms from the surface, west of the *Metal* shaft; and, within a few months, ore of much the same character has been found at some 200 fathoms deep, 80 fathoms further east in the same *lode*, which maintains for some considerable extent an average width of about two feet. Almost suddenly however it attains a breadth of about six feet, and the vein-stone, at the same time, becomes less quartzose, more chloritic, and contains a larger proportion of crystalline tin of the ordinary character. These are sometimes separately aggregated, though frequently they are more or less mixed; but whether the ingredients are earthy or metallic, the *wood-tin* occurs either in scattered grains, in small isolated masses, or in veins of unequal yet always of inconsiderable width; and these—even when no thicker than paper, display the most capricious and complicated flexures, and still preserve a fibrous structure. Both in the broader parts of these narrow veins, and in the small bodies of ore, whether imbedded in ordinary cassiterite, or in earthy ingredients, radiated crystalline, as well as a concentric lamellar structure prevails, the successive rings or cylinders of ore being alternately of clove-brown and of brownish-yellow hue. These aggregations of divergent crystals sometimes enclose kernels of ordinary tin-ore; but now and then they radiate from minute cavities *(vughs)*, which, in such cases are lined with microscopic pyramids of cassiterite.

As wood-tin has been so rarely found in *lodes*, and in no instance yet recorded from so great a depth as in *Wheal Vor*, I venture to hope that the foregoing description of the conditions under which it occurred may not be uninteresting."

It is very dark-brown, has a sp. gr. of 6·32, and contains 1·95 p.c. of oxide of iron. Under the microscope with the 2-in. power, it has the appearance represented in fig. 1, pl. XII, the fibres or needles of cassiterite being intermixed with a little quartz, so as to exhibit the most brilliant colours with crossed prisms. A little colour, no doubt due to interference, is visible without using polarized light at all. The mineral is only translucent

* Vol. IV. p. 255, 1873.

even in very thin sections. The thin vein and branch shewn represent what looks like an alteration of the brown fibrous wood-tin to ordinary translucent crystallized tin along a narrow fissure. In parts only of these fissures do we see any quartz in particles of distinct size, but minute granules appear to be present throughout the mass.

All the specimens of wood-tin which have come under my notice, including those above described and figured, agree in being nearly opaque, even the light-coloured varieties being much more so than the blackest crystals of tin-oxide. A fibrous-concentric structure is always visible, and, owing to the little adhesion existing between the separate layers and fibres, the mineral is very brittle when cut into thin slices, although it may be tough in mass. The sp. gr. is usually about 6·1 to 6·45, or somewhat lower than in crystallized cassiterite, and it is much more readily acted on by a mixture of sulphuric and hydrochloric acids, as first noticed by Klaproth. Some remarks on its probable mode of origin will be made in a future paper.

Wood-tin of comparatively recent formation.—In the year 1871, an anciently smelted ingot of tin from Tremethack Moor in the parish of Madron, was purchased for the Royal Institution of Cornwall. This block was partially covered with a hard and brittle coating, in some places as much as ¼ in. thick. The brown colour was not evenly distributed, some parts being darker than others, and under the microscope a few shining particles of metallic tin were visible. The specific gravity of the crust was 5·64. I found its composition to be as follows:—

Moisture evolved at 120° C.	6·25 p.c.
Metallic Tin	·43
Chloride of Tin	1·66
Peroxide of Tin	90·62
Peroxide of Iron..	1·04
Silica	·41
	100·41

In describing this crust to the Royal Institution, I said "The crust therefore appears to be composed chiefly of peroxide of tin, somewhat resembling that native variety of Cassiterite called "wood-tin," but neither so hard nor so heavy. It has no doubt been formed by the slow oxidation of the outer surface of the block of metallic tin The slowness of the change is, perhaps, indicated by the dense condition of the incrustation.* A similar sample was submitted about the same time to Mr

* *Journ. Roy. Inst. Corn.*, XIII, 84, 1871.

Jas. Napier, F.C.S., who wrote of it as follows: "The incrustation which invests the mass of *Jews'-house tin* from Tremethack Moor is a pure peroxide of tin, with a mere trace of iron; in short, the metal has been reconverted into *tin-stone*. This is of exceeding interest, as it shews how pure the metal must have been."*

Similar tin-crusts have since then been placed in my hands from several different localities.

In comparing the crust to wood-tin, I had in view the hardness, specific gravity, and brown colour of the specimen. I have lately, however, cut some microscopic sections from the fragments of the crust still in my possession, and I find the characteristic radiated-concentric structure with a tendency to assume botryoidal forms, in fact the most precise agreement in the appearances presented under the microscope to those presented by ordinary wood-tin.

PSEUDOMORPHOUS TIN.

Reference has already been made to certain pseudomorphous occurrences of cassiterite in Cornwall.† The most important of these may be here described as follows:—

a. Oxide of tin, pseudo. after felspar.

This is the best known of the Cornish pseudomorphs. Its occurrence in considerable abundance at Wheal Coates in the parish of St. Agnes in the year 1828, was thus described by Mr. Stephen Davey.‡ "Huel Coates is an ancient tin-mine, situated about three hundred fathoms north-west of St. Agnes Beacon. The adit level is about fifty-five fathoms below the surface, and five fathoms above high-water mark. The mine has never been worked more than a few feet below this level.

The crystals in question were discovered in a small vein (composed principally of light-red sand) whose usual width is not more than three inches; but just at this spot it becomes enlarged to twelve inches: they were first discovered about three fathoms above the adit, and continued in the vein to the height of six fathoms, and for two or three fathoms in length; here the small vein was intersected by a large one, about three feet wide (composed of ore-stone and sand, underlying northward about three feet in a fathom) which *heaved* it; and as the mine has not since been much explored, the vein containing the tin crystals has not been discovered on the other side of the larger vein.

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* Ibid.

† First Paper, p. 8.

‡ *Trans. Roy. Geol. Soc. of Corn.*, IV, p. 484. See also Dr. Boase, p. 291, and Mr. Hawkins, p. 140.

"The crystals have generally the usual form of felspar crystals; the most common is that of a flattened rhomboid with the angles deeply replaced; they frequently cross and overlap each other. The quantity of oxide of tin contained in them varies greatly, some containing only ten and others as much as seventy-five per cent. Many appear as if they had been broken, and the pieces afterwards cemented together by minute crystals of tin. The crystals first found were small and imperfect; but they increased in size, and became better defined as they approached the centre of the bunch; but from this point a gradual decline took place until they nearly corresponded with those first discovered."

"The veins or lodes in Huel Coates are in soft or decomposed granite or elvan. In this substance similar crystals of a kind of sandstone have been found containing no tin; these occurred on the north of the small vein for the space of two feet in width and fifty fathoms in length."

Referring to some of these crystals Mr. Tweedy says*: "The specimens on the table will exhibit the process of change in various stages, but I would particularly direct your attention to some in which the infused portion of tin-stone has not sufficed to fill the cavity left by the felspar, in which case crystallization has taken place, and the tin-stone has assumed its ordinary form."

The crystals are really twins of the Carlsbad type—some very simple, others highly complex, of four, eight, or even twelve individuals. Some of the more elaborate forms are figured in Groth's *Zeitschrift*† When viewed in thin sections under the microscope the tin is seen in dark-brown opaque masses, usually more thickly aggregated around the borders of the section than elsewhere, but in some occupying the whole of the section, except that there are usually some cavities visible—both angular and irregular. In these, occasionally, distinct though minute crystals of cassiterite are observable.

With the $\frac{1}{4}$-inch power ($\times \frac{150}{1}$) most of the tin still remains opaque and formless but a few crystalline grains are usually visible. The crystals containing only a little tin are seen to be very unlike ordinary felspar (orthoclase). They consist of irregularly aggregated bundles of minute fibres, just like the substance of the elvan from Trelaver Downs‡ described and figured by me a few years since. The tin begins to shew itself on the edges of the sections as a brown opaque cloud entangled among the fibres, and from this small beginning it can be traced up to crystals in which very little beside tin is visible.

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* *Rep. Roy. Inst. Corn.*, 1841, p. 39.

† *Zeit. f. Kryst. u. Min.* 1, plates VII and XVII.

‡ See "On the Trelissick elvan and on a proposed classification of the Cornish Elvans."—*Trans. Roy. Geol. Soc. Corn.*, IX, p. 221.

In a few cases nearly the whole of the tin replacing the felspar is in a crystalline condition, and then the resulting mass precisely resembles the patches of tin filling cavities after felspar in the Terras elvan already referred to.

The following additional particulars relating to this peculiar mode of occurrence of tin-ore were communicated to the Royal Institution of Cornwall by Mr. Tweedy in the year 1845 :—"The direction of the great lode is nearly east and west. In it scarcely any tin is found, but it carries a good deal of iron and some manganese. The lode in which the pseudomorphous crystals have been found carries its head about 16° south of east, and from its containing a large quantity of sand is called the sand-lode. In fact for a distance of about 25 or 30 fathoms on each side of the point at which it intersects (is intersected by, see Mr. Davey's detailed account *supra*) the great lode, it is filled with a light-coloured sand, containing a large proportion of tin disseminated through it. This sand is commonly aggregated into large nodules or balls, in which the tin crystals are found.....The sand lode also contained numerous fine strings of rich tin-ore running through the sand. The lode had its regular walls, and was at the intersection and for some distance on each side about three feet big, which gradually decreased to about 5 or 6 inches, and as the lode became smaller, instead of sand it was composed of schorl rock with a felspathic base of a light colour containing a good deal of talc (Gilbertite) and a considerable proportion of tin ; as the distance from the great lode increased the sandy character of the schorl rock changed, it became more compact and contained less tin."

"The tin-crystals....occurred principally between 55 and 75 fathoms from surface....In the sand lode and in a parallel lode to the north of it masses of botryoidal and stalactitic siliceous black iron-ore containing a very large proportion of manganese with some tin also occurred....in the cavities of these masses, pseudo-crystals of tin occur, which appear as if they had been entangled in the mass of silex and iron....The most remarkable crystals are two in my own collection—one of sandstone, the other of tin, which have been traversed by a vein of iron which has shifted the parts of the crystal on each side of it, in the case of the tin crystal as much as 3-20ths of an inch—the heave appears to have been an oblique one. I have also several of sandstone traversed by minute veins of iron apparently filling up fractures in the crystals."*

The more recent workings at Wheal Coates, on Towanrath lode, have been described by Dr. C. le Neve Foster,† and he states that most of

* *Rep. Roy. Inst. Corn.*, 1845, p. 20.

† *Trans. Roy. Geol. Soc. Corn.* IX p. 211.

the tin "is derived from the killas on the hanging-wall side. The enclosing rock or *country* is here full of little veins of white clay (*prians*) and cassiterite. Many of the little strings are not thicker than a knife-edge, others ⅛-in. or even 1-in. wide . . . . . the killas is traversed in all sorts of ways by these tinny branches, which extend from two to four fathoms south of the lode. The killas, on the foot-wall side is either destitute of tinny veins or contains very few."

Pseudomorphs of tin after felspar, precisely similar to those from Wheal Coates have been also observed at Carn Brecon* and at Balleswidden mine, near St. Just. †

Felspar cavities filled or partially filled with crystallized cassiterite, or with a mixture of cassiterite and schorl are common in the Terras Elvan already referred to, (see Plate XI) in the felspathic elvans at Belowda Hill (Plate III. fig. 3) and Castle-an-dinas; and in the schorl-rock of Rock-Hill, near St. Austell;‡ as well as in many other parts of Cornwall.

b. Oxide of tin pseudo. after Quartz?

The so-called "Silicate of tin" from Wheal Primrose has been thought to be pseudomorphous after quartz, but the microscope shows it to be of quite a different nature. The crystals are of a grey colour—generally they are groups of rough hexagonal prisms with broken or irregular terminations as shewn in Plate XI. In thin sections the quartz is seen to be filled with minute botryoidal groupings of tin particles, nearly or quite opaque and of a brownish colour. They are in fact enclosed in the quartz, just as we often see chlorite, oxide of iron and other minerals enclosed in quartz. I have only been able to get one specimen of the supposed quartz pseudomorph, but I have little doubt that they are all the same, and that there is no such thing as a pseudomorph of tin oxide after quartz—except of course the well-known natural moulds already referred to as being formed by the deposit of a layer of tin oxide on a quartz crystal. It is indeed probable that any solution which could dissolve and carry away quartz would also carry away cassiterite.

c. Oxide of tin pseudo. after organic forms.

In the British Museum, and in the Museum of the Royal Geological Society of Cornwall, at Penzance, are several fragments of deer's horn containing oxide of tin. A great many of these are said to have been found formerly in the tin stream-works in the Carnon and Pentewan

* T. M. Hall; *Mineralogists' Directory*, p. 131.

† R. Pearce, *Rep. Roy. Inst. Corn.* 1861, and 1863.

‡ "On the occurrence of Achroite at Rock Hill." Min. Mag. 1. p. 55.

Valleys, and to have been sold to the smelters. The specimens in the British Museum appear to contain a large quantity of tin, but I have not been able as yet to learn what is their specific gravity. In some parts the original horn structure seems to be almost entirely reproduced or preserved in oxide of tin. The specimen belonging to the Penzance Museum has been very kindly placed in my hands by the council for examination, both chemical and microscopical. It is represented on plate XI drawn one half its natural size.

The specific gravity of the whole fragment, and also of a small piece cut from it is 2·7.* Its analysis is as follows:

Calcium Phosphate	80·04
,, Carbonate	2·24
,, Fluoride	·50
Ferrous Disulphide	1·66
Ferric Oxide	·62
Stannic Oxide	2·60
Silica	·22
Organic matter and loss..	12·12
	100·00

It will be seen that in this specimen the amount of tin is somewhat small. It is still however an important constituent of the mass.

The microscopic appearance of the horn as seen in thin sections is represented in plate XII.† The oxides of tin and iron, and the iron pyrites, have found their way to the interior of the bone and are visible throughout the structure, although somewhat more abundant near the periphery than in the interior.

d. Oxide of tin pseudo. after Wood.

Pieces of wood impregnated with oxide of tin are said by many tin-streamers to have been found in the tin-gravels. No such specimens have come under my notice, but I see no reason to doubt their occurrence. I should much like to examine such a stanniferous wood, and perhaps the mention of my desire here may lead to its gratification.

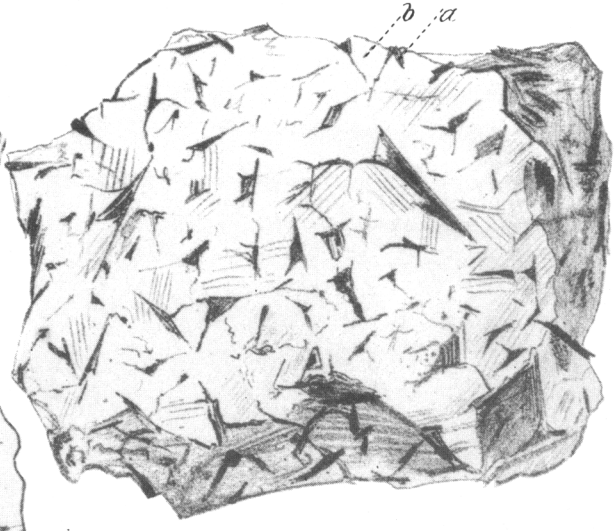
* The sp. gr. of unaltered (recent) deer's horn (fallow deer) I find to be 1·26, and the organic matter 62 p.c.

† This plate will appear in the next number of the Mineralogical Magazine.

CORNISH TIN STONES.

a = WOOD TIN.
b = ALMOST AMORPHOUS QUARTZ.
c = LARGE CRYSTALS OF QUARTZ.
d = PALE PINK FELSPAR.
e = CHLORITE.

WOOD TIN IN QUARTZ.



BROWN WOOD TIN IN PINK FELSPAR. NAT. SIZE.

a = WOOD TIN.
b = FELSPAR.

J.H.C. Del.

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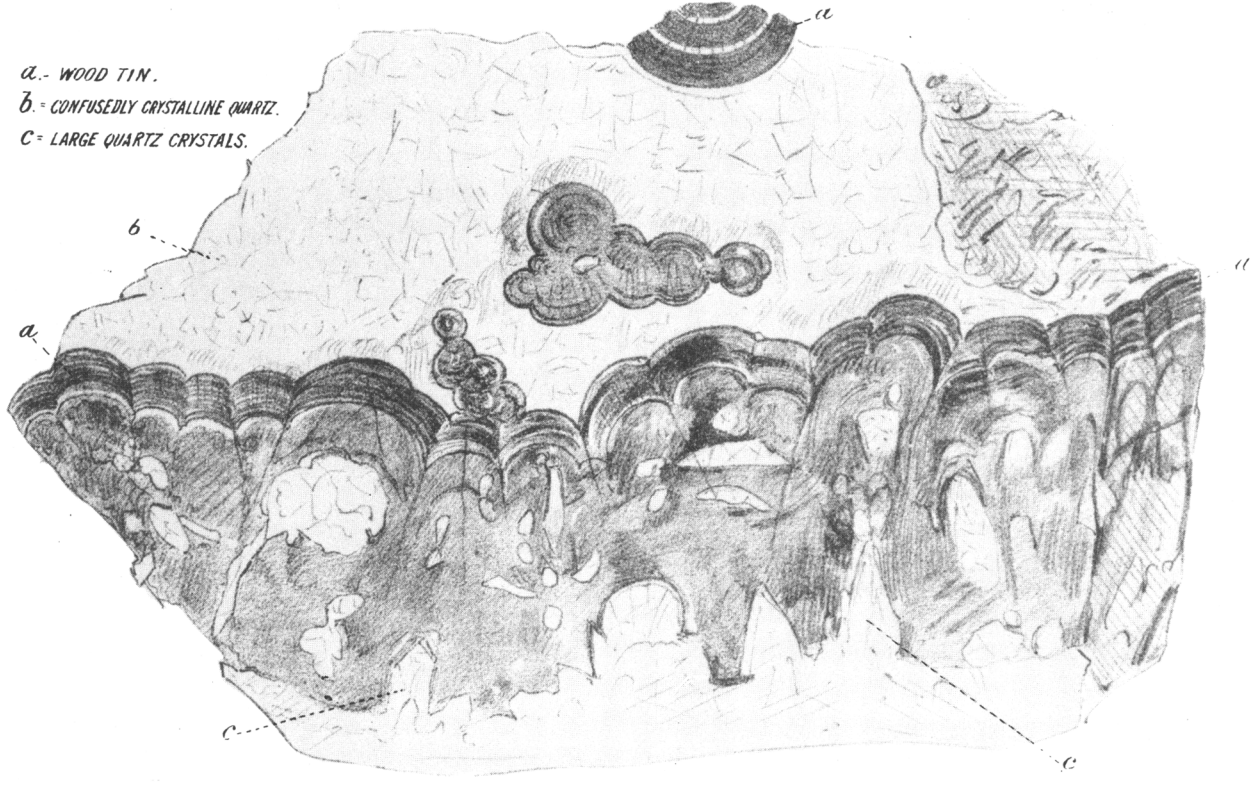
CORNISH TIN STONES.



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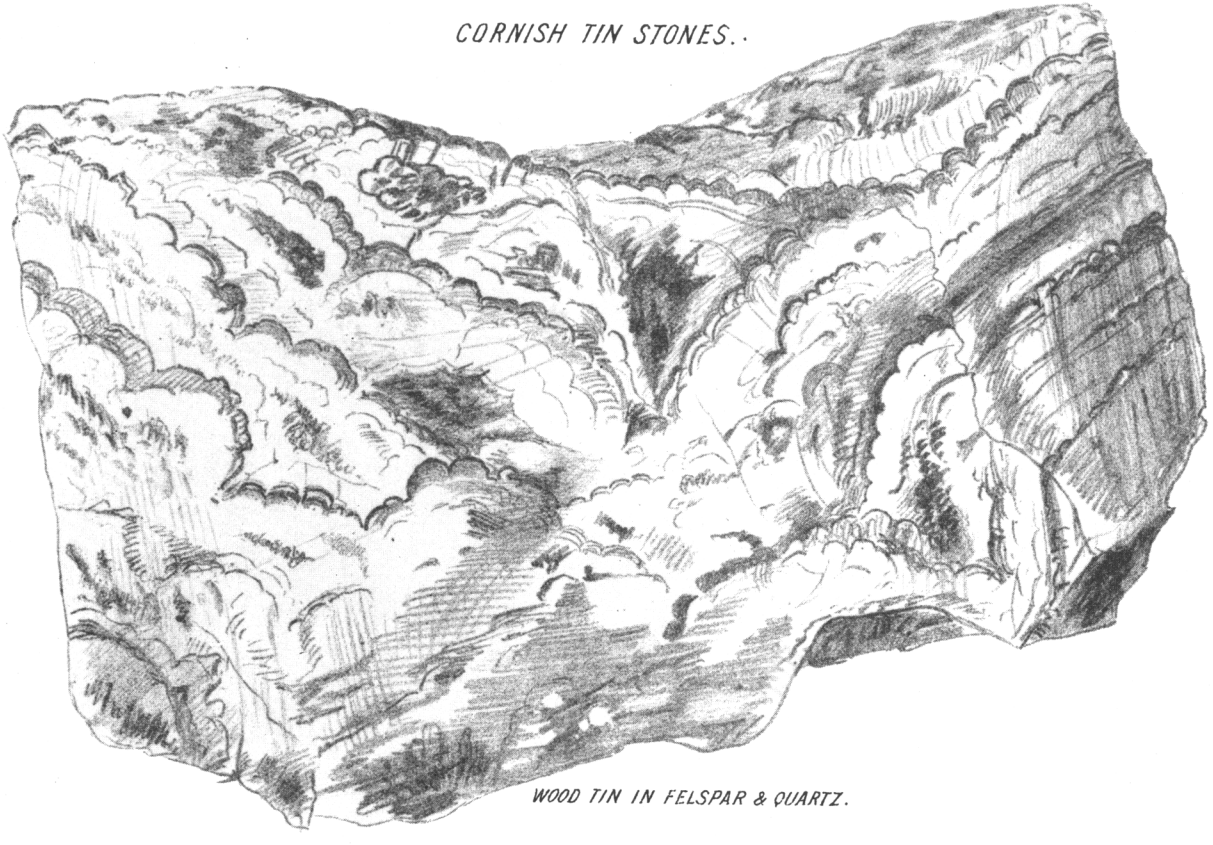
CORNISH TIN STONES.



WOOD TIN IN FELSPAR & QUARTZ.

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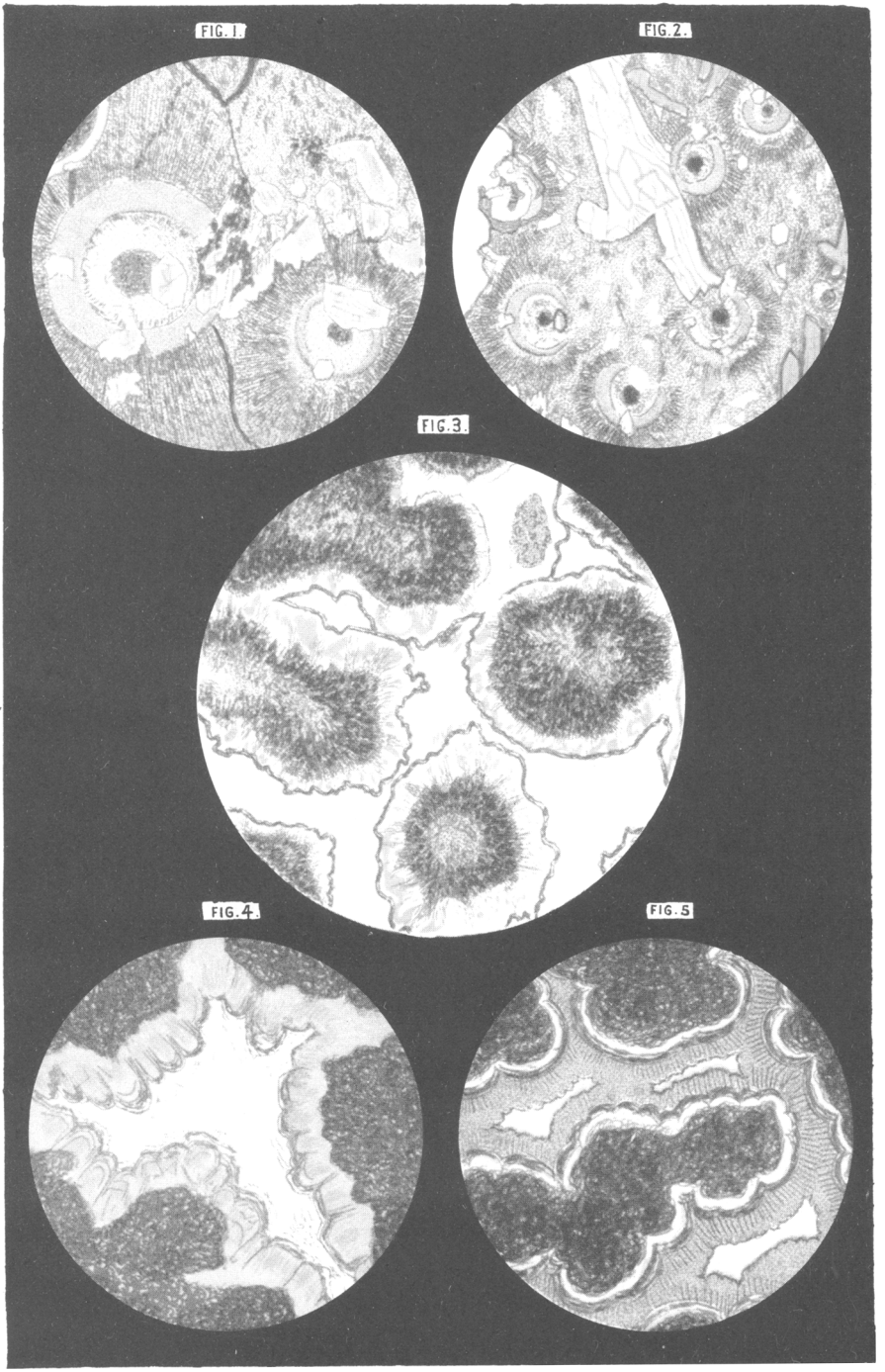

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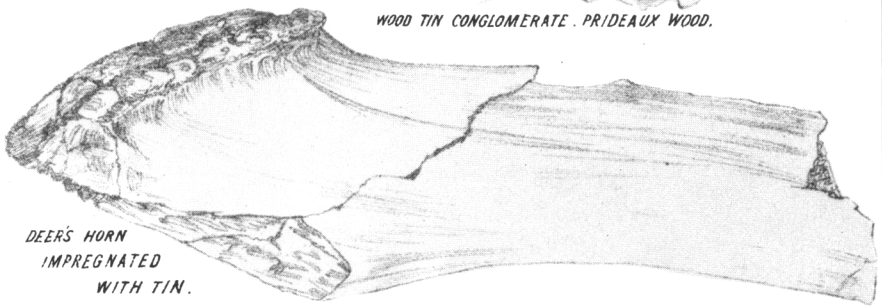
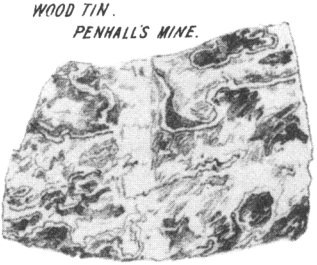
WOOD TIN CONGLOMERATE. PRIDEAUX WOOD.

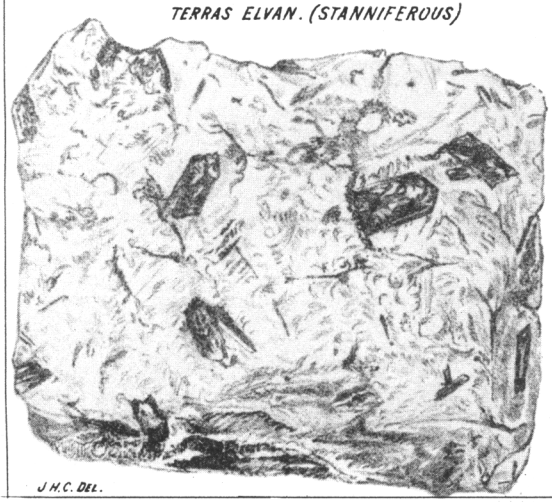


DEER'S HORN IMPREGNATED WITH TIN.

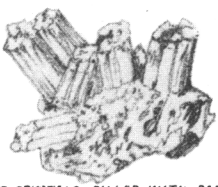
WOOD TIN. PENHALL'S MINE.



TERRAS ELVAN. (STANNIFEROUS)

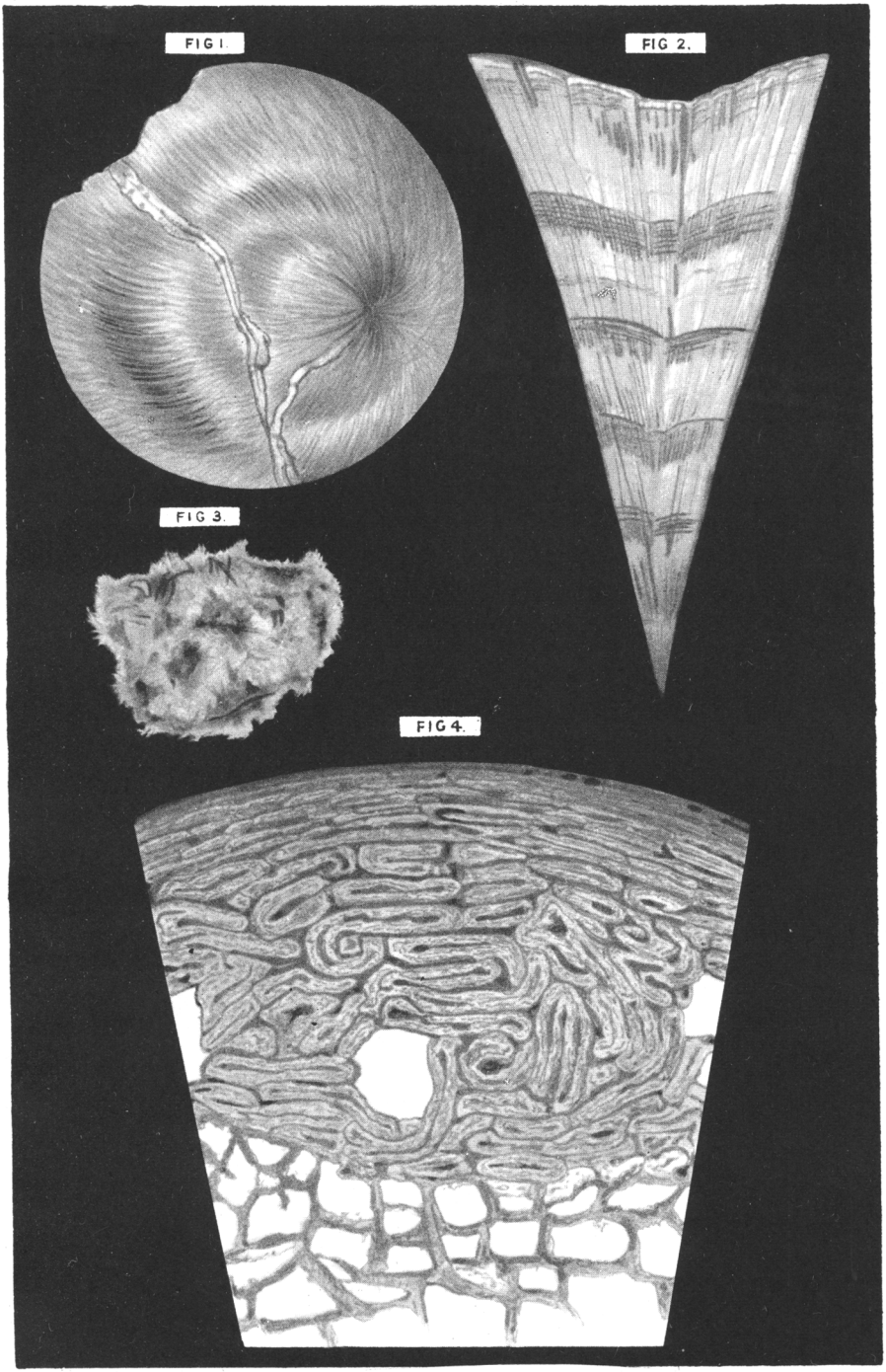


J.H.C. DEL.



QUARTZ CRYSTALS FILLED WITH PARTICLES OF OXIDE OF TIN.

WHEAL PRIMROSE.



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