REMARKS ON TIN ORE DEPOSITS AT MOUNT BISCHOFF, TASMANIA.

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The Royal Academy of Mines at Clausthal was some time ago placed in possession of a very fine collection of Australian ores. That collection was presented to our Academy by M. Wagenknecht, of Aachen (a Fellow of the Royal Society of Tasmania).

Amongst the samples were found a number of specimens of Tin Ore, together with the rocks and the minerals said to be associated with same, from Mt. Bischoff, Tasmania. The series interested me, particularly on account of a piece of supposed Quartz-Porphyry, which rock, it was represented, is associated (according to the description of S. H. Wintle* and Geo. H. F. Ulrich†) with those Tin Ores, and also because of some peculiar, dense, greyish-blue coloured masses of mineral‡ which most frequently are found to enclose those Tin Ores.

The chemical and microscopical tests gave the unexpected and interesting result, proving this Quartz-Porphyry to be a kind of *Topaz* rock of porphyritic structure, the white or light-coloured portions of same consisting of dense Topaz, whilst the greyish-blue were principally formed of dense Tourmalines.

As this appears to be—so far as I am aware—a totally unknown occurrence of Topazes with Tourmalines carrying Tin Ores, a description of same may be, under the circumstances, justified. As to the value of this discovery, from a geological point of view, I am not able to form an opinion, and such can be only ascertained properly after a careful

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* S. H. Wintle; Stanniferous Deposits of Tasmania. Trans. Royal Society of New South Wales, 1875, vol. ix., page 87.

† Geo. H. F. Ulrich. Written communication; New York Book for Mineralogy, etc., 1877, page 494.

‡ These dense masses of minerals at first led to the belief, from the peculiar structure of same, that they were the results of transmuted Quartz-Porphyries. An analogy certainly exists in the well-known transmutation of Granites, carrying Tin Ores, into "Greisen" or a felspar—less rock. These possibilities gave rise to the now detailed researches; and this paper was read by me at a meeting of the German Geological Society at Hanover in September, 1884. At that time I was not aware of the real character of the supposed Quartz-Porphyry. The special examinations of same were initiated in October of the same year.—V.G.

examination of the several features observable in the respective localities. To initiate and induce such examinations the following may deserve attention:—

1. Porphyritic Topaz Rock from Mount Bischoff.

This resembles, to a considerable degree, the Quartz-Porphyries, whether such is examined by the naked or unarmed eye or by means of powerful lenses. It consists of a light grey-coloured, dense, hornstone-like base, in which numerous transparent Quartz-crystals can be observed up to 3 mm. in size. One imagines, likewise, of being able to distinguish, in the white coloured cross fractures of this rock, crystals of felspar. It carries also Iron Pyrites in both large and small crystal or in crystalline aggregations.

A preliminary chemical examination showed that, after the removal of the metalliferous ores, the pulverised rock would completely fuse with soda, but that hydro-chloric acid had no effect except the deposition of a white precipitate, composed of Silicious Acid and Alumina. Distinct Fluor reactions were observed with traces of Lime and Magnesia, but alkalis were not present.

The special chemical analysis of this sample of rock, freed from iron pyrites through nitric acid, as carried out by Dr. Sommerlad in the Royal Academy's Laboratories, gave the following results:—

Silicious Acid	76·68
Lime	1·19
Fluor	6·48
Alumina	19·99
Magnesia	Traces
Phosphoric Acid	Traces
Total	104·34
Specific Gravity	3·014

Two separate tests were made, according to Rose's method, for ascertaining the percentage of Fluor. The high percentage of Fluor, and the total absence of alkalis, are therefore convincing proofs of this rock not belonging to the Quartz-Porphyries, and that it can now be stated that it consists of, in round numbers, 35 per cent. of Topaz and 65 per cent. of Quartz. To what form the 1·19 per cent. of Lime in this rock can be assigned is not quite clear; but it is quite possible that some very minute crystals of "Titanite"—to be described lower down—contain this Lime. In the same manner, it is doubtful also how the Phosphoric Acid occurs, except with "Apatite." The solution which was obtained by treating the ores with Nitric Acid in order to secure their extraction was found to contain a considerable percentage of

Lime, owing to some Calcites which the microscope had previously discovered.

On placing the pulverised rock into a "Thoulet's" solution of 3·202 specific gravity, the ore was gradually precipitated, and on analysis of that precipitate, the presence of Iron Pyrites was detected with slight traces of Antimony, Copper, and Zinc. The chemical and microscopical examinations which followed established the composition of the rock as follows:—Quartz, Topaz, Iron Pyrites, Calcite, Titanites, and Apatite (?) of which the first two form the leading, and the remainder the less important constituents. The base of the Topaz, as ascertained by analysis, appears, in the microscopic slides under their proper magnifier, as an aggregation of colourless and irregularly formed crystalline grains not above 0·02 min. measurement. Every now and then—especially in the vicinity of the crystals of iron pyrites, the basic Topaz partakes of a more fibrous texture, gaining thereby an appearance which very closely assimilates with the denser whitish Topaz referred to below. The very small crystals, already alluded to, as having been observed in the fractures of the rock itself, sometimes enclose such fibrous Topaz, and they are frequently coated by a whitish mineral, which on account of its granular composition renders the inner or enclosed crystals necessarily less clear, but opaque. It has been impossible for me, at present, to classify these small crystals under any distinct system. It is likewise not possible to declare same as "*pseudo-morphic*" as there are no grounds for such an assumption. On the other hand, they may be accepted as imperfectly formed, minimised crystals of Topaz —*microscopic Pycnite (?)*—as composed of very minute fibrous crystals, and that their want of clearness is due to those incrustations. It remains now only to be observed, that within those minute crystals, grains or specks occur, which exhibit vividly coloured polarising colours (also of Topaz) as well as irregularly formed particles of iron pyrites.

The Quartz occurs in the basic mass of the rock in the form of crystalline grains or aggregations from 0·06 to several mins. in measurement. To judge from the very regularly developed form—six sided—of some of these crystals, and their behaviour, when crossing each other's positions, the well-known Dihexadron would most likely be their form under that system, if accompanied by the narrow column sides which are so frequently observed when embedded in Quartz-Porphyries. On magnifying these transparent and polarising crystalline aggregations 400 times their original size, they exhibit frequently those well-known vesicular openings filled with fluids. Fluids, because, they do not appear to consist of carbonic acid, as is sometimes the case,

on account of their immobility and I have not, so far, been able to observe any really distinct changes in their position. Various granular and crystalline-foliated minerals could not likewise be defined to satisfaction. Very fine, needle-like crystals occasionally occur, and they may, in all probability, hereafter be recognised as *Apatite*, which would explain the presence of phosphoric acid as shown by the analysis, which acid has not been found in any other form in the rock. The aggregations of iron-pyrites exhibit in the thicker slides under the microscope some very interesting features, as one is enabled to recognise cubes from 0·05 to 0.15 min. in length, edgewise. These crystals are sometimes enclosed for over half their length in quartz crystals, the remaining half being embedded in the basic Topaz. Other very peculiar features are also observable with some very long fibrous forms, measuring from to 0·1 mm. in width by 0.3 to 0.7 m.m. in length, also partly or wholly encrusted by a very thin coating of Calcite. These are very probably lengthened cubes, which have, by some occult means or another, developed in one direction more than in another. These cubes are irregularly formed crystals of iron pyrites, Besides these, there also occur rectangular, nearly cubical, but otherwise irregular crystals of iron pyrites, measuring from 0·35 to 2 mm. in size; impregnated as they are sometimes by crystals of quartz and Calcites; these latter predominate sometimes to such a degree over those sulphurets, which however retain their crystalline form, as to make same quite subordinate so far as proportions or percentage are concerned.

The Calcites occupy various forms and positions within these iron pyrites, and they are confined sometimes by peculiar minute botryoidal and oblong crystals, brownish red in colour, which, from their general appearance, their distinct pleochroism, and the absence of the former fibrous forms, and being accompanied by a very vivid rainbow-like polarism, cannot be mistaken for any other but "*Titanite.*"

The Calcites of this rock, so easily distinguished by their vivid iridescent properties, occur most frequently in the form of impregnations of the iron sulphides, also in distinct, but smaller particles. These crystals of quartz and iron pyrites are evidently of a remoter origin than the basic mass of Topaz. Could it be assumed, for instance, that the latter consisted, whilst in the course of formation, or partook of the gelatinous compound?

2. Dense White Topaz of Mt. Bischoff.

This rock exhibits in its peculiar uneven and splintery fractures a trace crystalline.

When heated, in a solution of Cobalt, it turns blue, and gives distinct reactions with Fluor. After roasting, the fact of Hydrofluoric, or Muriatic acids, having no effect is a distinguishing feature.

Dr. Sommerlad's analysis gave the following results :—

Silicious Acid	33·34
Aluminous Acid	37·02
Lime	0·83
Fluor	17·64
Total	108·73
Specific Gravity...	3·456

The alterations from the normal composition of Topaz (5 Al Si O5 + Al Si Fl10) are very insignificant, indeed, and they may be attributed to these impurities, the existence of which have been demonstrated wheu under the microscope, but the percentage of Lime is very remarkable as such cannot belong to the Topaz proper, but is due to other minerals interspersed through the rock. The "slides" of this dense white Topaz exhibit an aggregate of irregularly deposited streaky or oblong groups of needle-like prisms from 0·01 to 0·05 min. in width, to 0·04 to 0·3 min. in length, showing also, across their diameter vivid rainbow-like colours, which, however, disappear entirely with their longer axis. Only very rarely—as quite natural—are the rhombic cross-sections observable in the directions just alluded to. The terminal apices of these prisms resemble those, with crystallized Topaz, customary pyramidal and domatic points.*

To judge from the specimens now before me, dense Topaz, intermixed with dense greyish blue Tourmaline, can easily be discerned with the naked eye, though the latter occurs in forms unlike its usual character, maintaining, however, the ordinary fibrous forms.

Tourmaline is seen distinctly in the "slides," in the form of botryoidal nests and as filling cavities of the Topaz rock.

3. Tourmaline from Mt. Bischoff.

This occurs also in the Carbonates of Iron as needles measuring 0·25 mm. thick, to 1 m. in length, from dark green to blackish colours. "Slides" exhibit the same likewise, as a dirty violet nucleus, which is enveloped by a greenish coating. Their pleochroism is very strongly marked, and the colouring partakes of lighter and stronger tints, according to the manner and position in which the crystals

* G. vom Rath has already described Topaz crystals from the Waratah Mine, Mount Bischoff, as from ¼ to ½ min. in size. These crystals formed fine crystalline aggregations in which crystals of Cassiterite were embedded. Also the occurrence of nests of radiating crystals of *Pycnite*. Bonn, 1879.

are being held by the observer. These proportionally larger crystals of Tourmaline are gradually developed from a granular and indistinctly radiated mass which appears under the microscope as finely radiated or irregularly fibrous. The mineral in question fuses, under the blow-pipe, with but little effect at the edges and it gives distinct reactions of Boron, and very little of Fluorine.*

Dr. Sommerlad has undoubtedly proved, from decimal analysis, that these light greyish blue masses of minerals are Tourmalines.

Silicious Acid	36·86
Aluminous Acid	36·72
Boracic Acid	10·56
Peroxyde of Iron	5·66
Peroxyde of Manganese	0·66
Lime	0·34
Magnesia	3·92
Kali (Potassium)	1·11
Natrium	3·57
Water	1·16
Fluor	0·61
Total	101·17
Specific Gravity ...	3·042.

Closing Remarks.

According to the descriptions given by Messrs. Wintle and Geo. H. F. Ulrich of Mt. Bischoff, it would appear that, on the top of that mountain, there occurs a bold stockwerk-like mass of porphyry which has penetrated a non-fossiliferous, and very probably, very old formation of slate, sandstone and quartzite. These latter exhibit, in the immediate neighbourhood, or, within the contact planes of the porphyries, great irregularities and considerable contortions in the bedding of the strata.

Wintle speaks of tinlodes in this porphyry; according to Ulrich, however, the tin ores occur as impregnations of the porphyry only, and principally so within the planes of contact with the schists. Ulrich reports also that the Waratah Company at the south-eastern flanks of the mountain is engaged in the exploitation of a lode (?) of Quartz-Porphyry carrying tin ore, which intersects independently the adjacent schistose (blue) formation.

It is quite evident, from these descriptions, that the

* These coarse needle-like aggregations of Tourmaline from Mt. Bischoff have that peculiar appearance, and remind strongly of those of *Zeuxite*.

Quartz-Porphyries at Mt. Bischoff must be considered the "carriers" of tin ores.

The specimen, I have been presented with, and which I have described as closely resembling Quartz-Porphyry, had therefore to be recognised as representing the occurrence of tin ore at that mountain, and therefore as occupying a very important position.

If, however, it has now been unmistakably proved that that specimen is actually not Quartz-Porphyry, but, a *porphyritic Topaz Rock*, then the question arises, whether any such Quartz-Porphyry occurs at Mt. Bischoff *at all*, and whether the whole formation, assumed to be such rock, is very probably a Topaz Rock, and in what manner, and under what conditions the latter occurs contiguously to the real Quartz-Porphyry.

The Topaz Rock, as described, is certainly a very remarkable formation in its character, and it is to my knowledge exceptional in its kind. I have named it Topaz Rock, because of its composition—like the well-known *so-called* Topaz Rock, near Auerbach, in Saxony—of Quartz and Topaz, though there it exhibits not the slightest resemblance in its mode of occurrence to that of Mt. Bischoff.

A probably not unimportant fact, which tends to connect both of these occurrences, otherwise so widely apart, should not, at this stage, be omitted to be mentioned. M. Breithaujet,* it should be borne in mind, has already proved that the Topaz Rock of Auerbach forms, at the surface, a huge well-like mass, which in itself contains or forms an immense lode of Tin Ore.

Topaz, it is well known, is a very frequently and widely disseminated mineral in close conjunction with Tin Ore deposits; but, to our knowledge, such an extraordinarily developed formation as that at Mt. Bischoff in Tasmania is not known to exist elsewhere. The occurrence of Tourmaline there is also very different from any other known in connection with Tin Ore deposits. These two minerals—viz., Topaz and Tourmaline (which are, however, not even mentioned in Messrs. Wintle and Ulrich's descriptions)—in their *dense* forms appear to play a very important and prominent part in the celebrated Tasmanian Tin Ore deposit. It might prove, in all probability, very interesting and valuable to ascertain whether or not such dense—and therefore easily passed over—masses of Tourmaline occur also with other Tin Ore deposits.

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* New Year Book for Mineralogy, 1885, page 788.