SUPPLEMENTARY NOTE ON LIMURITE IN TASMANIA.

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Since we contributed a notice* of the remarkable "limurite" rock occurring on the property of the Colebrook Prospecting Association, N.E. Dundas, and more recently discovered to extend in a more or less broken sequence as far north as the Southern bank of the Pieman River, mining operations have been carried on there continuously, and have invested the occurrence with additional interest from that point of view. Renewed examination of the rock under the microscope, as well as in the field, has resulted in further conclusions along the line of our previous enquiries, and these we now submit.

The mine has been made easily accessible from both Ringville and Rosebery, being situate between those townships. The rock occupies the saddle of a hill about 1500 feet above sea level, has approximately a strike of N.E.–S.W., and has been proved to be metalliferous for at least 100 yards in width. The contained metals are magnetic pyrites, arsenical iron pyrites, copper pyrites, and a small amount of bismuth oxide, the copper combined with small gold and silver contents, giving the occurrence its chief economic value. The published assays of the mixed stuff state the copper contents at from 1 % to 2 %. The Government Analyst is said to have also ascertained the presence of 1 % of nickel and cobalt in the pyrrhotite examined by him.

Geologically, the rock is a dyke or intrusive mass, apparently developed between slates on the eastern side and serpentine on the west. The intrusion has evidently taken place along or near this line of contact, though it would appear to have come up at the top of the ridge through the slates in several branches or bodies, as horses of hard metamorphic slate have been left standing in it, to the annoyance of the miners. A clean contact is formed, near which

* Proc. Roy. Soc., Tasmania, 1897, pp. 1-6.

the slate, a quartzo-felspathic variety, is micaceous, with chlorite and actinolite. Leaving the metals out of consideration, the dyke is composed of monoclinic pyroxene (largely altered to uralite and actinolite) axinite, calcite, datholite, danburite, with a little secondary quartz (?) chlorite and granular sphene, and a little talc in the rock occurring further north on the Clifton property. We are disposed to consider the presence of original hornblende not established. The axinite is in veins and massive patches, and is intergrown with datholite, danburite, and the other minerals of the rock mass. Professor A. Lacroix, in his memoir on the limurite of the Pyrenees, is of opinion that the rock does not belong to a definite petrographical type, as it is variable in structure, and its mineralogical composition differs in different parts of the same mass. This remark applies with unabated force to the Colebrook intrusion, so far as the dyke as a unit is concerned. Looking at it in this way, it is essentially a pyroxenite, which here and there receives the addition of axinite and other boric minerals. Where these minerals are developed the rock becomes locally limurite, a composite rock containing pyroxene and axinite. It is agreed that the axinite resulted from boric emanations, but how these were introduced is matter for speculation. Was the magmatic reservoir below an independent unit in course of differentiation into basic and acid layers at the time of intrusion? Or was this spot on the confines of two reservoirs, and were the boric vapours, which were carried up in the pyroxenic material, escapes, so to speak, from the neighbouring acid basin? Axinite veins are often found elsewhere injected into rocks already consolidated, but in this case it seems clear that the two elements crystallised synchronously. Even in those parts which are veined by axinite we do not think that the veining was later than the consolidation of the mass as a whole, nor that the rock as a whole had emerged from the phase to which both pyroxene and boron vapours alike belonged. One part of the intrusion may very well have advanced a little further in the crystallising process while other parts lagged behind; and one result of this would be the somewhat heterogeneous character of the dyke as a whole, which, in fact, we observe.

That there was a granite reservoir not far off is shown by the tourmaline-quartz porphyry to the west at the South Renison Bell mine, between which and the Colebrook is another occurrence of axinite, in the form of

axinite quartz veins, on the West Coast P.A. sections, close to the granite. A slide prepared from this vein rock shows axinite, quartz, and an abundance of leucoxene. It is noteworthy that the axinite is confined to the vein stuff, as in Cornwall, but there is no occurrence of limurite.

Boron vapours, existing in the magma, and evolved during crystallisation, undoubtedly play a part in producing both tourmaline and axinite. In Cornwall both tourmaline and axinite are found in the granite contact zone, while other rocks, sometimes basic igneous ones, have been acted upon by granite with the same results. In the Hartz axinite and tourmaline occur at the contact of granite and diabase, and this led Lossen to correlate these two minerals.* In view of these facts, it seems to us very likely that the Western granite or its elvans and the Colebrook pyroxinite consolidated contemporaneously. Plutonic solfataric processes, which were plainly in operation in the granite area, as shown by the tourmaline and axinite just referred to, may very well have liberated the boron vapours, which, travelling eastwards by easily imaginable channels, arrived at and were entangled in the moving mass which cooled as the axinitic pyroxenite at the Colebrook. The whole question of this occurrence of axinite possesses a special interest for all occupied with the problems connected with the origin of igneous rocks.

Microscopical inspection of the tourmaline-quartz-porphyry at the South Renison Bell mine discloses a groundmass existing as a Mosaic of quartz and tourmaline, which contains porphyritic crystals of quartz and nests of large tourmaline and quartz crystals. There is no doubt as to the tourmaline. Its colour is brownish yellow and blue, often in one and the same crystal, strongly dichroic $O > E$, axis of maximum elasticity $\parallel c$. The tourmaline often enwraps grains of quartz. The quartz contains vacuum bubbles in fluid inclusions in considerable quantity.

Last year a note on datholite as occurring in the Colebrook limurite was submitted by one of us to the society, (†) and we have since taken occasion to examine this mineral microscopically. In thin section it is colourless, but in polarised light the interference colours are high, comprising the tints of the second and third orders of Newton's scale. The double refraction is slightly under that of augite. In

* Massige Gesteine. H. Rosenbusch, 1896, p. 103.

† Notes on some recently discovered and other minerals occurring in Tasmania. W. F. Petterd, Proc. Roy. Soc. Tasm. 1897, p. 63.

the only direction in which the 001 imperfect cleavage lines appeared the extinction was straight. No pleochroism is perceptible. The mineral contains microscopical fluid inclusions with moving bubbles, some of which are easily visible with a half-inch objective, other bubbles are stationary.

Another new mineral, which may be added to the list of components of this singular rock, is the boro-calcium silicate danburite, famous for its crystallographic resemblance to topaz. It is disseminated through the stone and abundant on fissure planes in glistening irregular crystal aggregates, looking like quartz ; but with a hackly kind of fracture. It is colourless to pale yellow. Under the microscope the relief in Canada balsam is weak, a little less than that of quartz. It gives allotriomorphic interlocking granular sections like grains of a quartzite, and is of startling limpidity. Its interference colour is low, not above the yellow of the first order. Its only inclusions appear to be needles of actinolite.

On one of our slides we notice in the clear substance of the axinite some pale green sub-spheroidal and polygonal translucent crystals generally made up of rods or fibres somewhat curved, proceeding from the periphery to the interior. These remind one of the decomposition products of borocite called "parasite" by Volger (*), a hydrous magnesian borate. The wavy fibres are suggestive of some of the forms met with in precipitations from a saturated solution, and the phenomena seem to point to the existence of an excess of boric acid in the rock magma.

As the serpentinous and gabbroid rocks at and to the west of the Colebrook must be more ancient than the Colebrook dyke, and if our interpretation be correct, also older than the phrase of activity in the granite basin, it follows that we have here some light thrown upon the question of the age of the granite of the West Coast. We do not now formulate a theory of its age, but simply observe that the limurite rock will probably be found to constitute one of the factors to be reckoned with in settling that question.

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* Zirkel, Mik Besch, min und Gesteine 1873, p. 226.