6. *TIN and TOURMALINE.* By DONALD A. MACALISTER, Esq., F.G.S.
(Read November 19th, 1902.)

[Abstract.]

CASSITERITE hardly ever occurs without tourmaline, although the latter is found without the former; hence it appears that tourmaline-producing constituents and influences are of wider range than are those of cassiterite. Boron-trioxide is an extremely common accompaniment of volcanic action, and there can be no doubt that it has acted powerfully in changing such original minerals as the micaceous and felspathic ingredients of crystalline rocks. From a comparison of formulæ representing tourmaline and feldspar, it is evident that the act of tourmalinization has been accompanied by a loss of soda (which alone is capable of action on tin). The excess of boric acid (which is over and above that required for tourmalinization) will combine with this soda, forming metaborate and pyroborate of soda. The former, acting on disseminated tin-ore, might result in the production of sodium-metastannate and borax. The soluble metastannate is capable of being leached out of the magma, and, by a new reaction, tin-oxide may be precipitated and concentrated, sodium-metaborate being liberated. According to the principle underlying the cooling-curves of solutions, in all probability deposition of cassiterite would take place more rapidly at a certain stage in the process of cooling than at others.

DISCUSSION.

Mr. J. H. COLLINS remarked that the Author did not refer to the somewhat extensive literature of the subject, and especially to the writings of Von Buch (1824), Daubrée, Foster, and others, which, as well as Daubrée's experiments, went to show that fluorine had played a great part in the production of schorl, as also in the origin of cassiterite and of kaolin, in Saxony, Cornwall, and other countries; so that while there was in these countries schorl without cassiterite and kaolin, there was not cassiterite or kaolin without schorl. A due consideration of these facts might perhaps lend support to the Author's hypothesis, at any rate as to the secondary deposition of cassiterite. Some attention should, however, be given to the fact that in Tuscany and in the Malay Peninsula cassiterite did undoubtedly occur in limestone unaccompanied by schorl, as also in the hornblende-rocks of Pitkäranta in Finland, and in connexion with the andesites of Bolivia.

Prof. SOLLAS thought this an interesting speculation and very suggestive for future investigation, which he hoped the Author would pursue both by experiment and observation.

Mr. T. H. HOLLAND agreed with the previous speaker in welcoming a paper which, not claiming to explain every case, or to be a complete discussion of the well-known work of Élie de Beaumont,

Boase, Le Neve Foster, and others, was suggestive in offering another possible chemical explanation of the reactions by which tin-dioxide could be separated from solution in magmas containing alkaline borates. Although the deposition of tin is frequently an accompaniment of kaolinization, where fluorine has been active, kaolinization is not essential, as cassiterite occurs in perfectly fresh acidic pegmatites. But the consolidation of a pegmatite results in the exclusion of water to the final stages to such a degree that the last deposition of mineral matter may imitate the 'comby' structures of ordinary mineral veins; while the vapours set free begin to attack the crystals of early consolidation, and to produce results akin to secondary alteration. At some stages in this process the Author's supposed chemical reactions may occur, and the granting of one process for the separation of cassiterite does not exclude others that are chemically possible under changed physical conditions.