where it occurred as large masses apparently formed by oxidation of rhodonite and tephroite, both of which commonly occur as unaltered cores in the pyrolusite (Russell, 1946). In describing the large variety of manganese and other minerals at this locality Russell (*op. cit.*, p. 225) commented that some of the pyrolusite occurred in a black shining form. It is likely that at least some of this material may be the mineral now identified as birnessite.

There is no doubt that the birnessite at Treburland occurs as an oxidation product of the primary manganese silicates. Birnessite has previously been described as an early oxidation product of manganese carbonates at Janggun Mine, Korea (Kim, 1974) and as an alteration product of rhodochrosite and rhodonite in quartz veins at Gouax de Larboust Hautes Pyrenées, Hautes Garonne, and Ariege, France (Perseil *et al.*, 1974).

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KEYWORDS: birnessite, Treburland, Altarnun, Cornwall, England.

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A note on occurrence and optical orientation of brewsterite

GREG and Lettsom (1858) note that brewsterite occurs in cavities of amygdaloidal rocks at the Giant's Causeway but it has not been found by any subsequent workers. A search of the Ulster Museum mineral collection revealed the following five specimens which, on the basis of their morphology, could be the brewsterites of N.E. Ireland.

1 'Brewsterite', Mourne Mtns, I1574
2 'Thomsonite', Moneymore, I8662
3 'Crystallized zeolithe', Giant's Causeway, I3179
4 'Epistilbite with aluminite', Co. Antrim, I1524
5 'Primitive stilbite', Giant's Causeway, I1520

The first specimen is a gneissose granitic rock, 7 × 5 × 4 cm in size. It is covered with stumpy prisms of a pale citrine-coloured mineral which matches the description of the Strontian brewsterite and without doubt is wrongly labelled. The rest of the specimens have a basaltic matrix and there is no reason to doubt that they are Irish. Optical examination revealed that these specimens contain thomsonite (no. 2) and stellerite (nos. 3, 4, 5). Stellerite has flat terminations, compared with the pyramidal appearance of stilbite. The two minerals can be differentiated by single crystal X-ray diffraction and chemical analysis, but optical distinction is not so easy, as both minerals are biaxial (−) and length-fast with X: a = 0–5°. Epistilbite is also supposed to be biaxial (−) but is length-slow. Thomsonite and brewsterite are biaxial (+) but brewsterite differs from it in having inclined extinction. It is concluded therefore that the occurrence of brewsterite

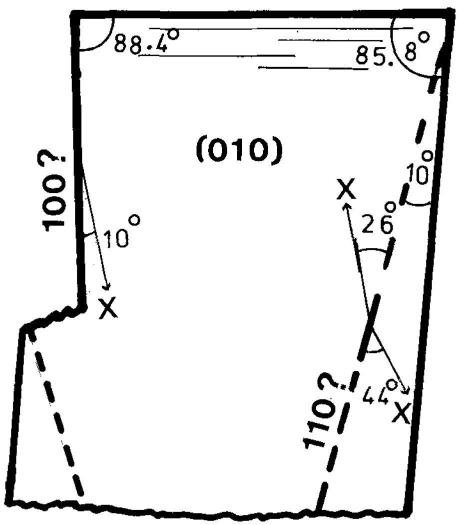

FIG. 1. Optical relations in growth sectors of brewsterite as seen in its (010) cleavage flakes. The trace of the optic plane and the fast vibration direction are shown by arrows. Growth zonation marks are indicated by horizontal lines and sector boundaries (twin planes?) by dashed lines.

(and of epistilbite) in N.E. Ireland remains unproven and doubtful.

This opportunity, however, is taken to record afresh the properties of the Strontian brewsterite to settle the doubts raised by Gottardi and Galli (1985) as to whether the morphology and optical orientation of Dana (1892) or that of Khomyakov *et al.* (1970) is correct. The examination given below is in favour of the former version.

The brewsterite crystals are generally elongated in the *c*-direction, being between 1 and 3 mm in the longest dimension. They are (110) prisms somewhat flattened parallel to (100). On (001) they are either equant or elongated along *b* and show re-entrant angles indicative of twinning on a plane in the prism zone. On (010) they are elongated along *c* and on (100) they are equant or elongated either along *b* or along *c*. They cleave easily parallel to (010) which has a pearly lustre. The terminal ends are zoned and gently curved similar to those of thomsonite and stellerite. There is a poor cleavage nearly parallel to (100) in the cleaved sections which show three wedge-shaped sectors; the central, largest one, is sandwiched between the two smaller ones with their thin-edges reducing to nothering near the terminus of the crystals as shown in Fig. 1. The sectors show a biaxial (+) figure. The optic plane of the largest sectors makes an angle of 26° with the {110} twin plane (?) and that of the smaller sectors 44°. A strong dispersion is noticed and the 2V is higher than 45°.

The orientation X: $c = 26°$ assumes that *c* is the direction of growth and elongation as implicit in Dana's diagram and as shown in Gottardi and Galli (1985). This compares favourably with the X: $c = 22°$ of Dana (1892) but differs radically from X: $a = 28°$ of Khomyakov *et al.* (1970).

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