$\omega \approx 1{\cdot}995$ and $\varepsilon \approx 2{\cdot}095$, and commonly twins on {011} to produce 'knee twins' (Deer *et al.*, 1963).

Cathodoluminescence is known to reveal a wealth of detail invisible in ordinary microscopy (e.g. Smith and Stenstrom, 1965). Fine banding seen in cassiterite is due to zonation of crystal defects or trace element impurities, or both (Rémond *et al.*, 1970).

The following sequence of events in the growth history of a cassiterite 'knee twin' has been established in the present study:

Nucleation of the cassiterite crystal.

Early nucleation of the 'knee twin'.

Growth of the twin into a macroscopic specimen. The two twin members grew at a similar rate. They had a definite crystallographic relationship to each other expressed by the {101} twin law along an irregular non-planar contact.

The irregular growth contact of the 'knee twin' was an unstable crystallographic contact, and a planar crystallographic contact formed close to the growth contact. The switching of crystallographic orientation produced a palimpsest in the part of the crystal between the growth contact and the new planar crystallographic contact. This involved kinking of growth zones along the new planar crystallographic contact. Kinking took place along one plane through part of the specimen and along three parallel planes through the rest of the specimen. Thus polished manufactured faces show either simple or repeated twinning.

Acknowledgements. Mr. E. H. Boult of the Electron Optical Unit, Newcastle upon Tyne University, kindly provided the cathodoluminescence photographs. The financial help of the Universities of Newcastle upon Tyne and Strathclyde is gratefully acknowledged.

REFERENCES

Deer (W. A.), Howie (R. A.), and Zussman (J.), 1962. *Rock-forming Minerals*, **5**, London.

Gehlen (K. von), 1960. Röntgenographische und optische Gefügeanalyse von Erzen. *Beitr. Mineral. Petrol.* **7**, 340–88.

Rémond (G.), Kimoto (S.), and Okuzumi (H.), 1970. Use of the SEM in cathodoluminescence observations in natural samples. *Scanning Electron Microscopy. Proceedings of the Third Annual Scanning Electron Microscope Symposium*, 35–40.

Smith (J. V.) and Stenstrom (R. C.), 1965. Electron-excited luminescence as a petrologic tool. *J. Geol.* **73**, 627–35.

[*Manuscript received 18 April 1977; revised 30 December 1977*]

Department of Applied Geology
University of Strathclyde

A. J. HALL

MINERALOGICAL MAGAZINE, JUNE 1978, VOL. 42, PP. 290–1

Occurrence of thaumasite in weathered furnace slag, Merthyr Tydfil

THAUMASITE, a hydrated calcium silicate with the general formula $[Ca_3Si(OH)_6(H_2O)_{12}](SO_4)(CO_3)$, has a structure consisting of columns of empirical composition $[CaSi(OH)_6(H_2O)_{12}]^{4+}$ aligned parallel to *c* with CO_3^{2-} and SO_4^{2-} groups located between them (Edge and Taylor, 1971). The most interesting structural feature is the six-fold coordination of silicon—an arrangement usually associated with formation at high temperatures and pressures, as in the SiO_2 polymorph stishovite. However, it seems certain that this is not the case with thaumasite. Most findings of the mineral are in altered basic igneous rocks (e.g. Medici, 1972; Brown, 1973; Paulitsch, 1973) or altered limestones (Carpenter, 1963; Stephens and Bray, 1973). To the writer's knowledge, the only reported occurrences of thaumasite in Britain are from a borehole in Co. Down, Northern Ireland, where it occurs coating fracture surfaces in a dolerite sill (Knill, 1960), and in a vein transecting a quartz-dolerite sill exposed in a quarry near Cockermouth, Cumberland (Embrey—see Knill, 1960).

The present note records the occurrence of thaumasite in abundant quantity in weathered furnace slag heaps derived from the now disused Dowlais and Cyfartha Iron Works in the vicinity of Merthyr Tydfil, South Wales. The Dowlais slag heap forms a conspicuous feature, locally known as the 'White Tip', and the thaumasitic slag was collected on the north side of the A4060 road between Pentrebach and Dowlais Top, about 600 m

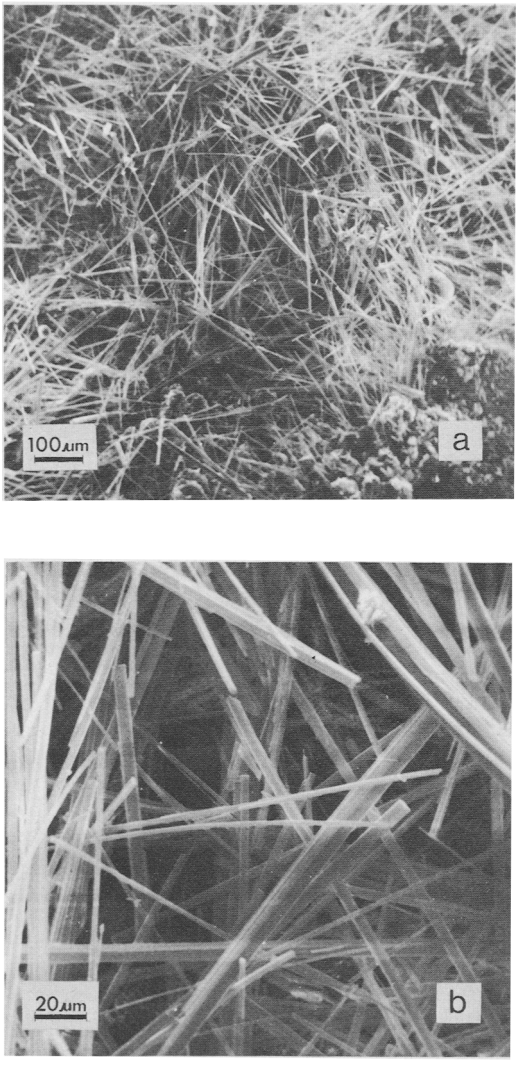

FIG. 1. *a*, scanning electron micrograph of fibrous thaumasite on Cyfartha slag, associated with calcite. *b*, scanning electron micrograph showing acicular or lath-like form of thaumasite.

NNE. of the Farmers Arms (SO/067070). The Cyfartha slag heap occurs immediately to the south of the Heolgerrig road about 400 m N. of the Merthyr Rugby Club (SO/043064). In both instances the thaumasite occurs as white, vesicular infillings and encrustations with a fluffy or felted texture. The mineral possesses a finely fibrous morphology, individual fibres being from 5 to 10 μm wide, and up to about 500 μm long, with an acicular or lath-like form (fig. 1*a*, *b*). A resin-impregnated thin section shows that vesicular thaumasite has a cross-cutting mesh (sometimes radial) structure and is often associated with calcite. X-ray powder photographs of hand-picked fibrous material, using a Philips 11·46 cm diameter camera with Fe-filtered Co-$K\alpha$ radiation, show a pattern almost identical with that on ASTM card no. 13-156, having strong lines at 9·66, 5·54, 4·58, 3·79, and 2·49 Å. The DTA curve and the infra-red absorption spectrum are similar to those shown by Font-Altaba (1960) and Kirov and Poulieff (1968), respectively. The slag itself is composed primarily of euhedral, rectangular melilite—showing a typical 'peg structure'—surrounded by fine-grained, pale-brown material. It seems likely that the mineral forms during the weathering of the slag, which contains considerable amounts of sulphur; crystallization must have been relatively rapid since most of the slag is less than 150 years old.

REFERENCES

Brown (P. R. L.), 1973. *Antarctic J.* **8,** 159-60.
Carpenter (A. B.), 1963. *Am. Mineral.* **48,** 1394-6.
Edge (R. A.) and Taylor (H. F. W.), 1971. *Acta Crystallogr.* **B27,** 594-601.
Font-Altaba (M.), 1960. *Mineral. Mag.* **32,** 567-72.
Kirov (G. N.) and Poulieff (C. N.), 1968. Ibid. **36,** 1003-11.
Knill (D. C.), 1960. Ibid. **32,** 416-18.
Medici (J. C.), 1972. *Mineral Record.* **3,** 173-9.
Paulitsch (P.), 1973. *Der Aufschluss.* **24,** 266-8.
Stephens (J. D.) and Bray (E.), 1973. *Mineral. Record.* **4,** 67-72.

[*Manuscript received 8 December 1977*]

The Macaulay Institute for Soil Research
Craigebuckler, Aberdeen AB9 2QJ

M. J. WILSON