Pyrophanite from the Benallt mine, Rhiw, Carnarvonshire.

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PYROPHANITE was recorded by one of us in a recent paper[1] as one of the minerals occurring at the Benallt manganese mine in the vein from which material for the chemical analyses of the new manganese-rich chlorite, pennantite, was separated. As this was only the third record of pyrophanite in the world it seems necessary to give, very briefly, the evidence for its identification.

The original description of pyrophanite is that by A. Hamberg[2] (1890), who described the mineral, discovered by himself and G. Flink, as forming thin, deep-red plates, only about 0·15 mm. thick in drusy cavities in manganese ore at the Harstig mine, Pajsberg, near Persberg, Wermland, Sweden. The mineral is there associated with ganophyllite, garnet, 'manganophyll', and later-deposited calcite.

The only other record of the mineral is from the Piquery mine of the Queluz district, Minas Geraes, Brazil. Here O. A. Derby[3] found transparent red grains in carbonate-rich manganese ore 'composed of a carbonate (rhodocrosite?), an olivine-like silicate (tephroite) and spessartite'. They had the appearance of rutile, but gave strong characteristic reactions for both titanium and manganese.

During the examination of thin sections of the vein carrying pennantite, referred to above, a few small orange-yellow crystals were observed. They were remarkable for their very high birefringence and high refractive index. In the course of the separation of the pennantite for analysis a few of these crystals were found in the fraction of the powdered vein-material which sank in undiluted methylene iodide.

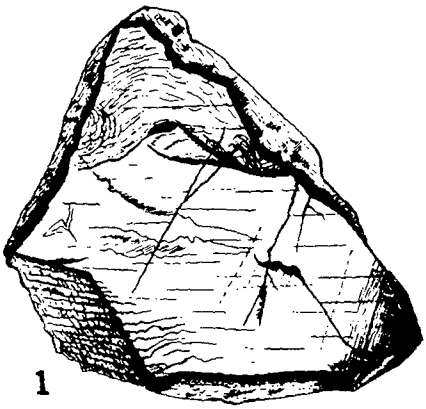
These crystals are very small, none exceeding 0·25 mm. in diameter, or 0·15 mm. in thickness. The habit is tabular with striations or traces

[1] W. Campbell Smith, Min. Mag., 1946, vol. 27, p. 218.

[2] A. Hamberg, Geol. För. Förh. Stockholm, 1890, vol. 12, p. 598.

[3] O. A. Derby, Amer. Journ. Sci., 1901, ser. 4, vol. 12, p. 21; 1908, ser. 4, vol. 25, p. 215.

of cleavage intersecting at 60° (figs. 1 and 2). Some show a trigonal outline. They are uniaxial, negative, with refractive index higher than 1·84 and very high birefringence. The optic axis is perpendicular to the crystal plates. No measurements could be obtained on two minute faces



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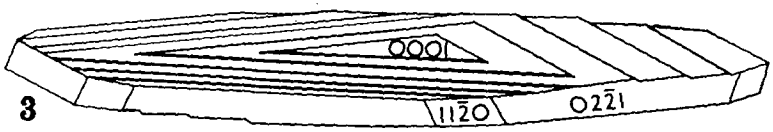

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FIGS. 1 and 2. Pyrophanite from *Benallt mine*, Rhiw, Wales. Drawings of crystals showing indications of faces and, on the (0001) face, striations or traces of cleavage intersecting at 60°. Fig. 1. Camera lucida drawing, ×270. Fig. 2. Drawn over a photomicrograph, ×270.

FIG. 3. Enlarged reproduction of A. Hamberg's figure of pyrophanite from Harstig mine, Pajsberg, Sweden. (Geol. För. Förh. Stockholm, 1890, vol. 12, pl. 13, fig. 10.)

or cleavage surfaces on the edges of the plates, but the triangular striations and outlines suggested rhombohedral (or hexagonal) symmetry. No pleochroism was observed either in the isolated crystals or in the thin sections. The colour of a crystal 0·13 mm. thick is ochraceous-orange.

These characters suggested that the crystals might possibly be pyrophanite. Microchemical tests made by Dr. M. H. Hey on a single crystal, which was all that could be spared at that time, indicated the presence of manganese, but failed to give a definite reaction for titanium. A

later test, using several crystals of the mineral, gave distinct reactions for both manganese and titanium. The identification was definitely confirmed by X-ray photographs taken with unfiltered iron radiation; and, incidentally, additional confirmation of the presence of manganese was given by the absence of β-reflections on these photographs. The best photograph was obtained from six crystals (0·13–0·26 mm. in diameter) mounted in random orientation. A rotation photograph of these grains gave a powder diagram typical of an ilmenite-type structure. Direct comparison with an ilmenite photograph taken in the same camera showed that all the spacings for the mineral under examination were slightly larger. Measurements taken on the photograph of the Benallt mineral are in good agreement with the spacing and intensity data given by E. Posnjak and T. F. W. Barth[1] for artificial manganese titanate, $MnTiO_3$.

[1] Zeits. Krist., 1934, vol. 88, pp. 276–278. [M.A. **6**–45.]