The crystal-structure of violarite.

By F. A. Bannister, M.A.

Deputy Keeper, Mineral Department of the British Museum.

[Read November 7, 1940.]

WALDEMAR LINDGREN[1] described in 1924 a mineral present in nickel ores from southern Nevada which in colour, hardness, and stability differs from polydymite from Grüneau mine at Schutzbach, between Betzdorf and Daaden in Rhenish Prussia, and yet matches so-called ferriferous polydymite from Vermilion mine, Sudbury, Ontario. He proposed the name violarite both for the mineral from Nevada and for the 'polydymite' from Ontario on account of the violet-grey colour of the mineral on polished sections. Lindgren assumed that the iron found in the first analysis of 'polydymite' from Ontario was due to admixture with pentlandite and thence deduced nickel disulphide as the possible composition of violarite. In the light of subsequent results it is relevant to mention that Lindgren and Davy's work was based upon the study of polished ore sections but not in polarized light.

The more powerful method of studying polished sections in polarized light was applied to a large number of Sudbury ore specimens by M. N. Short and E. V. Shannon[2] in 1930. They concluded that although pentlandite is of common occurrence it never occurs associated with violarite in the same specimen. Violarite is intimately intergrown with chalcopyrite and the areas of violarite in a polished section are rimmed with pale-yellow millerite. The latter mineral had been mistaken by previous workers for pentlandite. Polished sections of both millerite and pentlandite have the same colour and only in polarized light can they be readily distinguished, millerite being strongly anisotropic and pentlandite isotropic. These and other observations led Short and Shannon to disagree with Lindgren and Davy on the paragenesis of violarite. Lindgren and Davy supposed violarite to be supergene replacing pentlandite, whereas Short and Shannon considered violarite to be hypogene and millerite to be supergene.

---

[1] W. Lindgren and W. M. Davy, Econ. Geol., 1924, vol. 19, p. 309. [M.A. 2–338.]

[2] M. N. Short and E. V. Shannon, Amer. Min., 1930, vol. 15, p. 1. [M.A. 4–335.]

Since violarite is isotropic and the closely associated chalcopyrite and millerite anisotropic, Short and Shannon were able to detach sufficient of the first mineral with a needle for chemical analysis. Their results yielded the formula $(Ni,Fe)_3S_4$ and they concluded that violarite belongs to the linnaeite group. F. W. Clarke and C. Catlett's[1] analysis of Ontario 'polydymite' showed less iron content, probably owing to admixed millerite. They were, however, correct in supposing that the essential constituent of the ore they analysed was a nickel iron sulphide.

Thus far the evidence taken in some detail from previous work suggests that violarite has a linnaeite rather than a pyrite type of chemical formula. Its isotropy in polarized light would, of course, fit either conclusion. My recent paper on bravoite from Derbyshire[2] draws attention to an upper limit to the nickel content of naturally occurring bravoite at 25 %. It is of interest to make quite certain whether violarite is a member of the pyrite-bravoite or of the linnaeite group. This can best be done by X-ray methods.

Through the kindness of Dr. A. L. Parsons the Mineral Department of the British Museum has recently received from Mr. E. A. Collins of the International Nickel Company of Canada, Ltd., a polished specimen of violarite detached from a mass collected by Dr. A. P. Coleman from the Vermilion mine. This specimen fits Short and Shannon's description exactly. A small fragment of the violarite was detached free from any adherent chalcopyrite or millerite. An X-ray photograph of the fragment revealed the lines corresponding to those of a face-centred cubic structure with edge 9·51 Å. X-ray photographs of linnaeite from Müsen, Westphalia, and of true polydymite from Grüneau mine show similar patterns both with smaller cell-edges, 9·40 and 9·47 Å respectively. These last two results are in fair agreement with those of G. Menzer[3] and those of W. F. de Jong and H. W. V. Willems.[4] Violarite, therefore, like linnaeite and polydymite, possesses the spinel type of crystal-structure with formula $(Ni,Fe)_3S_4$. This result confirms the optical and chemical work of Short and Shannon and refutes Lindgren's view.

Several specimens of so-called polydymite from Ontario which have been in the British Museum collections for some years have also been studied. Polished sections resemble exactly the above-mentioned violarite specimen and they all yield the same X-ray pattern. They are

---

[1] F. W. Clarke and C. Catlett, Amer. Journ. Sci., 1889, ser. 3, vol. 37, p. 372.

[2] F. A. Bannister, Min. Mag., 1940, vol. 25, p. 609.

[3] G. Menzer, Fortschr. Min. Krist. Petr., 1927, vol. 11, p. 315. [M.A. 3–339.]

[4] W. F. de Jong and H. W. V. Willems, Zeits. Anorg. Chem., 1927, vol. 161, p. 311.

undoubtedly violarite. It is a fortunate coincidence that the name polydymite can be retained only for the rarer mineral from Grüneau mine which exhibits well-developed octahedral, polysynthetic twin-crystals. Violarite shows no twin-lamellae on polished sections and the synonym ferriferous polydymite is therefore a less appropriate name.