# *On the occurrence of the rare mineral nadorite in Cornwall, and of beraunite in Co. Cork, Ireland.*

By Arthur Russell.

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## Nadorite.

[$PbClSbO_2$. Orthorhombic, $a:b:c = 0{\cdot}7490 : 1 : 1{\cdot}0310$.[1]]

THE rare mineral nadorite has hitherto been recorded from one locality only, namely, Jebel Nador in the province of Constantine, Algeria, where at one time it was found in considerable quantity associated with bindheimite, smithsonite, and galena in a deposit lying between lacustrine limestone and brown marl.

In the present notes I am able to record the occurrence of this mineral at the small antimony mine of Bodannon, St. Endellion, Cornwall, where I found a single specimen in 1907. Immediately after the reading of this paper, Professor A. Hutchinson of Cambridge most kindly sent me a specimen for examination which he had himself collected from the small dump at Bodannon in 1919, and this mineral, which had attracted his attention, also proved to be nadorite.

The Bodannon mine is situated about a mile south-east of Port Isaac in the fields on the left-hand side of the road a little east of Trewetha. The mine was opened in virgin ground in 1906 by the late Major J. Teague, to whom, and to Captain T. H. Oliver of St. Teath, I am indebted for the help they afforded me in the look-out for any minerals of interest. The workings were so limited in extent and the mine so short lived (on account of the ore met with being entirely jamesonite, and as such unsaleable) that much cannot be said respecting the deposit. There appeared to be two distinct antimony lodes, one of which is very probably a continuation of one of those worked long since in the adjoining mine of Wheal Boys or Old Trewetha, famous as the original locality of bournonite ('endellionite'). The antimony at Bodannon was entirely in the form of jamesonite and its alteration-product bindheimite; and of the

[1] G. Cesàro, Bull. Soc. Franç. Min., 1888, vol. 11, p. 44.

former I saw in an open-cut, only 6 feet from the surface, a nearly solid pocket 8 feet wide. The only other minerals observed, in addition to those mentioned, were anglesite as small greenish crystals in cavities in the jamesonite, some chalybite, and much limonite and quartz.

Specimen no. 1 collected by myself consists of a mass of bright fibrous jamesonite externally coated with yellow somewhat resinous-looking bindheimite. Well within the unaltered jamesonite is a cavity $2\frac{1}{2} \times 1\frac{1}{2}$ cm. almost entirely filled with nadorite, the surface of which is covered with very small, though well-defined, crystals of that mineral. Penetrating the mass of the nadorite are a few small needles of jamesonite and flakes of bindheimite, the remainder of the cavity being occupied by quartz and lemon-yellow bindheimite, on both of which minerals are scattered plates of nadorite. In a small adjoining cavity are minute colourless octahedra of senarmontite.

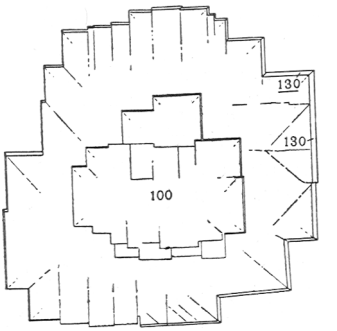


FIG. 1. Nadorite from Bodannon mine, St. Endellion, Cornwall. Aggregate of crystals twinned on (011).

The nadorite forms aggregates of more or less parallel, nearly square, exceedingly thin, transparent plates of a smoky brownish-yellow to reddish-brown colour with a bright adamantine somewhat resinous lustre. The largest aggregate of plates is about $1\frac{1}{2}$ mm. across and is represented in fig. 1. Under the microscope each individual plate is seen to consist of two or more crystals tabular parallel to $a(100)$ and twinned on $l(011)$. The calculated value $l$ to $l'$ being 91° 45′, the plates are therefore practically square in outline. A slight diagonal depression is often visible running across the plate from coign to coign. The crystals are bounded on two adjoining sides by narrow, though bright, faces of $r(130)$; these as well as $a(100)$ afford, however, banded or multiple images on the goniometer. The other two sides are seldom free, but when visible they taper away to edges and afford no evidence of definite forms. The measurements given below were obtained from four crystals from specimen no. 1, and two from no. 2.

| Angle. | Calculated. | Observed mean. | Limits. | No. of readings. |
|---|---|---|---|---|
| (100) : (130) ... | 66° 0½′ ... | 65° 5′ ... | 64° 10′ – 66° 24′ ... | 7 |
| (130) : ($\bar{1}$30) ... | 47 59 ... | 47 35 ... | 44 14 – 48° 48′ ... | 6 |

The orientation and axes adopted are those of Cesàro, the letters those of Dana (sixth edition).

The cleavage is perfect parallel to $a(100)$, and the streak pale yellowish. The crystals are optically positive and show strong birefringence. The optic axial plane is parallel to $b(010)$, and the obtuse negative bisectrix perpendicular to $a(100)$. For the determination of the optical characters I am indebted to Mr. W. Campbell Smith.

In the closed tube the mineral gives a white sublimate of lead chloride. Before the blowpipe on charcoal it yields a globule of lead and a white coating of antimony oxide.

Specimen no. 2, collected by Prof. A. Hutchinson, shows an aggregate 1 cm. across of tabular nadorite crystals, the largest of which measures about $1\frac{1}{2}$ mm. in diameter, occupying a cavity in quartz and jamesonite. Adjoining cavities contain minute greenish crystals of anglesite, octahedra of senarmontite, and a little bindheimite. The nadorite crystals on this specimen are much thicker than those on no. 1, are dark reddish-brown and translucent, and both crystals and broken surfaces possess a slightly iridescent tarnish. The habit also differs somewhat from the preceding in that these crystals do not appear to be twinned, and they are six-sided rather than square in outline. In no case are more than three bounding edges exposed, while the faces of $a(100)$ and $r(130)$ are the only ones which afford reflections. The crystals further have a tendency to grouping in more or less parallel position. The faces of (130) are well developed and usually uppermost; the faces forming the remaining edges are rounded and afford no reflections, the angle between them over the edge (130) ($\bar{1}30$) determined by the maximum illumination being approximately 119° 54′.

Although the crystals of nadorite on these two Cornish specimens are insignificant in size compared to those from Algeria, the occurrence forms an interesting addition to the species known to Britain.

## Beraunite.

[Hydrated ferric phosphate. Monoclinic.]

A single specimen of this mineral was found by myself in 1918 on the old dumps at the small iron and manganese mine of Roury Glen, situated between Glandore and Ross Carbery, Co. Cork. The lode here appears to be a continuation of that on which the Glandore iron and manganese mine was worked, two miles to the west. It has an east and west direction, and traverses brown micaceous sandstones and very pale, often

almost white, talc-schists of Devonian age. The vein-filling consists principally of limonite and shattered quartz, much of the former being botryoidal and beautifully iridescent; psilomelane and pyrolusite are also present in smaller quantity. The mine was worked on a small scale apparently at the same time as, and in conjunction with, that of Glandore between the years 1843 and 1854, while about 1906 it was partially re-prospected.

The specimen in question consists of a small mass $4\frac{1}{2} \times 3\frac{1}{2}$ cm. of diverging fibrous crystals of a reddish-brown colour, the fibres extending from walls of pitchy black limonite and meeting in the centre, a certain amount of limonite being also present between the fibres. The fibres attain a length of 1 cm., are readily divisible, and many of them when viewed singly under a lens are seen to be transparent, and of a beautiful dark hyacinth-red colour. The mineral exactly resembles, though on a larger scale, certain radiated specimens of the variety of beraunite from the Rothläufchen mine, Waldgirmes, Hesse, Germany, to which the name eleonorite has been given. The fibres are elongated in the direction of the *b*-axis, and are strongly pleochroic, red-brown for vibrations parallel to *b*, and yellow in the transverse direction. The refractive index is 1·78, and the specific gravity 2·99. The mineral is soluble in hydrochloric acid. Before the blowpipe it fuses easily to a crystalline black metallic-looking bead. A qualitative analysis gave ferric iron, phosphoric acid, and water.

Beraunite was mentioned from Wheal Jane, Kenwyn, Cornwall, by R. P. Greg[1] in 1860; the mineral, which accompanied vivianite, was later, however, analysed by A. H. Church,[2] and shown to be a variety of hisingerite. It is therefore satisfactory to be able to re-establish this species as occurring in the British Isles.

[1] R. P. Greg, Phil. Mag., 1860, ser. 4, vol. 19, p. 14.

[2] A. H. Church, Journ. Chem. Soc. London, 1870, vol. 23, p. 3. In Dana's System of Mineralogy, 6th edit., 1892, p. 703, the locality is incorrectly given as Lostwithiel.