

Notes on the occurrence of Bertrandite at some new localities in Cornwall.

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IN 1904 Professor Bowman described the occurrence of bertrandite at the Cheesewring Quarry, Linkinhorne, Cornwall;¹ the mineral having been then recently discovered there by Mr. F. H. Butler. The following notes contain an account of the character and mode of occurrence of the same mineral at four additional localities in Cornwall.²

Gold-diggings Quarry,³ St. Cleer, Cornwall.

This quarry is situated about 900 yards west of the Cheesewring Quarry (Sheet XXVIII NW, Six-Inch Ordnance Map), the granite being of an almost precisely similar character at both places. Bertrandite was first found here by myself in 1904. It forms clusters of colourless crystals, which occasionally attain a length of 5 mm., but which are usually much smaller, and is associated with crystals of deep-violet fluor, quartz, slightly pinkish crystals of orthoclase of adularia habit, pyrite, and red blende, upon vertical joint-faces of the granite.

The crystals are usually rhombic in outline, and in habit exactly resemble those from the Cheesewring Quarry as described and shown in

¹ H. L. Bowman, 'On the occurrence of Bertrandite at the Cheesewring Quarry, near Liskeard, Cornwall,' *Mineralogical Magazine*, 1911, vol. xvi, pp. 47-50.

² Brief mention of the occurrence of bertrandite at the localities described in this paper has already been made by Mr. J. H. Collins in his 'List of Minerals found in Cornwall and Devon, with notes supplementary to the author's "handbook",' *Journ. Roy. Inst. Cornwall*, 1911, vol. xviii, pp. 425-461 (bertrandite on p. 431).

³ This quarry has recently for trade purposes been given the name 'Silver Grey': it is still, however, locally known by the old name of 'Gold-diggings'. The owner, J. Sweet, Esq., of Liskeard, has been most kind in affording me permission to examine it thoroughly on many occasions.

the first figure in Professor Bowman's paper. The forms present¹ are c {001} and m {110} prominent, with a {100}, f {130}, and b {010} small. One specimen was, however, found showing a totally different type of crystals. These are tabular parallel to c and rectangular in outline, the forms being a {100}, b {010}, and c {001}, sometimes with very narrow faces of m {110} and f {130}. They are twinned on ϵ {011}, the b -axes of the two individuals being inclined at an angle of about 60° . A smaller individual usually springs from near the middle of one side of a thicker and wider individual; and the basal plane on the side towards the twin-plane is always arched owing to an oscillation between the forms c {001}, and ϵ {011}, the basal plane on the opposite side being quite flat. In one instance there is a repeated twinning of three distinct individuals of graduated size, the largest measuring $1\frac{1}{4}$ mm. along the edge (fig. 1). These crystals occur in small cavities on one side of a mass of granite, the opposite side of which formed the wall of a large vug lined with yellowish-white Carlsbad-twins of orthoclase, tapering prismatic crystals of smoky quartz, fluor, and a few colourless crystals of apatite. Bertrandite is of much rarer occurrence here than at the Cheesewring Quarry.

Kit Hill Great Consols Mine, Stokeclimsland, Cornwall.

Bertrandite appears to be a rare mineral at this locality, inasmuch as successive searches have resulted in the finding of three specimens only; these I collected in 1905.

The crystals are small, the largest measuring about 1 mm. in length. They occupy the interstices of masses consisting principally of small, bright, cubes of pyrite, a {100}, o {111}, with some black tetrahedra of blende, and also a little pale-purple fluor, black, fibrous tourmaline, quartz, and a white, scaly, talcose mineral. The crystals for the most part exactly resemble those of rhombic habit from the Cheesewring and Gold-diggings Quarries, the forms being the same, c {001} and m {110} prominent, a {100} and b {010} small, and f {130} very small. A few, owing to the absence of b and f , are rhomb-shaped in outline, being bounded by an acute angle $mm' = 121^\circ 20'$, others again are six-sided in outline owing to a large development of b . Of the associated minerals bertrandite appears to have been the last formed, with the exception of fluor, which in one case is evidently of subsequent growth.

¹ The orientation and lettering are throughout as in Dana's 'System of Mineralogy,' sixth edition, 1892.

The specimens were collected from a heap of vein-stuff derived from an adit-level (No. 2 cross-cut)¹ then being driven into Kit Hill on the north side, a little to the N.W. of the granite quarry (Sheet XXIX NW, Six-Inch Ordnance Map). The lode ('Quarry Lode'), which is in granite, was at its intersection with a caunter lode very rich in tin and wolfram for a short distance, and from it were obtained many fine specimens of cassiterite in black and very rarely yellowish-red, translucent, twinned crystals. This lode also contained small quantities of chalcopyrite and mispickel.

Wheal Metal, Breage, Cornwall.

In 1909 I found three somewhat remarkable specimens of bertrandite. Two of these are in a small collection consisting principally of Cornish minerals, formed by the late Sir Clement Le Neve Foster, and presented by him to the Royal School of Mines, South Kensington, and the third is in Mr. W. Semmons's collection. All three specimens are exactly similar in character and were labelled 'Blende from Wheal Vor, Breage, Cornwall.' They show sharp, black tetrahedra of blende, measuring up to 9 mm. along the edge, with o {111} large and bright, and o' {111} small and dull. These blende crystals are attached to a mass consisting principally of yellowish-white, soft, and partially kaolinized orthoclase, dark-green, scaly and nodular chlorite, and a little quartz. Implanted directly on the blende crystals, and occupying cavities in the orthoclase mass are numerous, colourless, platy crystals of bertrandite, elongated in the direction of the a -axis, and showing the forms a {100}, b {010}, c {001}, f {130}, m {110} (fig. 2). The crystals are mostly intergrown and are flattened, effecting lamellar groupings more or less parallel to c , which face possesses the characteristic pearly lustre. There are three distinct cleavages parallel to c {001}, b {010}, and m {110}. Some of the crystals attain a diameter of 5 mm. and have a thickness of 0.7 mm. One of the largest plates has a number of small irregularly placed rectangular pits on the c face, suggesting impressions due to some mineral no longer present. The specific gravity of the crystals is about 2.59.

Thinking there might be other Cornish examples of bertrandite, I looked carefully through the various minerals labelled Wheal Vor,

¹ This and two other adit-levels, one above, and one below, although situated on the north side of Kit Hill were during the recent working designated East Kit Hill Mine; the company making use of an engine which was standing on the old East Kit Hill Mine for the purpose of driving their dressing plant. The workings were abandoned in 1909. They are included in the group of mines on Kit Hill known as Kit Hill Great Consols Mine.

preserved in the British Museum (Natural History) and also in my own collection, and was rewarded by finding three additional specimens. Of the two in the British Museum, one (reg. no. 61384) was purchased in 1886, and the dealer's label describes it as 'Orthoclase and Blende from Trevaunance Mine, St. Agnes, Cornwall.' This locality is, however, obviously wrong, and should be Wheal Metal, Breage, Cornwall, the specimens being practically identical in character with those described above. It shows numerous large, though mostly broken, plates of bertrandite resting on black tetrahedra of blende, with chlorite, and cream-coloured crystals of orthoclase of adularia habit.

The other British Museum specimen is especially interesting and has been referred to by Mr. J. H. Collins in his 'Handbook to the Mineralogy of Cornwall and Devon' (Truro, 1871, part ii, p. 2). Of it he says: 'An interesting specimen of albite, in very peculiar colourless transparent

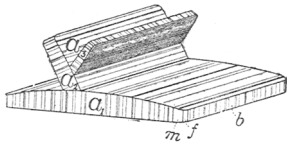


FIG. 1.—Twinned crystal (triplet) of Bertrandite from Gold-diggings Quarry, Cornwall.

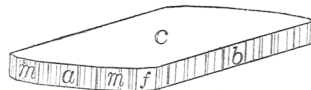


FIG. 2.—Crystal of Bertrandite from Wheal Metal, Cornwall.

twinned crystals, was recently found at Huel Metal, in Breage, in the 135 fathom level, by Capt. G. M. Henty. It is now in the British Museum.' This specimen was presented to the Museum by Captain Henty (an agent at Wheal Metal) in 1870, and was registered at the time as albite; the date of its presentation being ten years previous to Bertrand's original announcement of bertrandite as a new species. I am indebted to Mr. L. J. Spencer for supplying me with the following description of this specimen:

'The small specimen (reg. no. 43938), of less than a cubic inch volume, consists of a matrix of quartz and a black, compact aggregate of fine tourmaline needles. On the free surface are prisms of quartz, small, nodular masses of dark-green chlorite, and a yellowish, clayey material. The bertrandite crystals encrust the quartz crystals, and also form a hollow crust suggesting a pseudomorph after an octahedron possibly of fluor. The order of deposition appears to be tourmaline, quartz, chlorite, bertrandite, chlorite, clay.

The crystals of bertrandite are white to colourless and transparent, the smaller ones being perfectly water-clear. The forms determined by measurement on the goniometer are: a {100}, b {010}, c {001}, f {130}, m {110}, ϵ {011}. The faces $afmb$ are striated parallel to their zone-axis, the striations on a being a prominent feature on the twinned crystals. The faces of ϵ are striated parallel to their intersection with b , and c is smooth with a somewhat pearly lustre. The crystals are elongated in the direction of the a -axis, and they range from a fraction of a millimetre to 4 mm. in length in this direction. Simple, twinned, and triplet crystals¹ are present (figs. 3-5), the twin-plane being ϵ (011). The form ϵ was noted only on the twinned crystals, and these are relatively thicker (in the direction perpendicular to the base) than the simple crystals. The angle $\epsilon\hat{b}$ between the faces of adjacent twinned portions was measured as $2^\circ 42'$, $2^\circ 38'$ (calculated $2^\circ 33'$) and the re-entrant angle $\epsilon\epsilon$ as $56^\circ 33'$ (calculated $56^\circ 36'$).

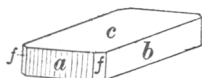


FIG. 3.—Simple crystal.

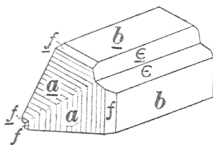


FIG. 4.—Twinned on ϵ (011).

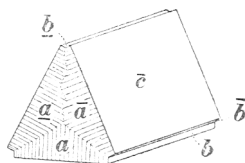


FIG. 5.—Triplet twinned on (011) and (01̄1).

Bertrandite from Wheal Metal, Breage, Cornwall.

'A negative biaxial figure was seen through the face a , the plane of the optic axes being parallel to b (010), that is, parallel to the striations on a . The optic axial angle in oil (of refractive index 1.505) is $2H_a = 90^\circ$ about. The angle between the optic axial planes in adjacent twinned portions is 118° . Specific gravity about 2.59.'

The specimen in my own collection is also from Wheal Metal and was acquired from Mr. F. H. Butler about 13 years ago. It consists of a mamillated mass of cassiterite (wood-tin) measuring about 8×6 cm., and is built up of brown, concentric layers which have a fibrous structure, becoming black and distinctly crystallized towards the exterior. The outer surface of the mass is more or less coated with small, nodular aggregates of greenish-grey gilbertite, upon which on one part of the specimen are thickly clustered numerous small crystals of bertrandite,

¹ Very similar twin-crystals of bertrandite from Pisek, Bohemia, have been described by C. Vrba, Zeits. Kryst. Min., 1894, vol. xxiv, p. 112.

and also two colourless prismatic crystals of apatite (one of these was measured and shows the following forms c {0001}, m {1010}, a {1120}, r {1012}, x {1011}, y {2021}, s {1121}), white crystals of orthoclase of adularia habit, and a little, dark-green chlorite.

These bertrandite crystals attain a length of 2.5 mm. and are whitish to colourless, and nearly transparent. The forms determined by measurement are: a {100}, b {010}, c {001}, m {110}, f {130}, and ϵ {011}, both m and f being well developed. The crystals are elongated in the direction of the a -axis and are all twinned on ϵ , most of them showing the thicker of the two individuals extending beyond each side of its fellow, and are thus exactly similar to the twin-crystals from Gold-diggings Quarry described above; others are similar to that shown in fig. 4 of Mr. Spencer's description of the preceding specimen.

Cassiterite in the form of wood-tin was found in considerable abundance, in the year 1866, in the 162 fathom level on Wheal Metal lode west of the Metal Engine Shaft, and its occurrence was described by Captain G. M. Henty.¹ It was associated with ordinary crystallized cassiterite, quartz, chlorite, chalcedony, dolomite, orthoclase, and pyrite. In 1873 the same mineral was found in even larger quantities, in the same lode about 80 fathoms farther east, and at a depth of about 200 fathoms.² The Metal lode was entirely in killas and was extraordinarily rich in cassiterite; it also contained small quantities of chalcopyrite and blende.

There can, I think, be no doubt that the above-mentioned specimens of bertrandite with blende labelled Wheal Vor really came from Wheal Metal, the exact locality being confused by the two distinct mines being once included under the same name. Without entering into the history of Wheal Vor and Wheal Metal, it may be pointed out that Wheal Metal, although really a distinct mine worked on lodes to the south and parallel to those of Wheal Vor, formed at one time (1855 to 1877) part of a sett known as Great Wheal Vor. Wheal Vor proper was abandoned about 1848, while Wheal Metal continued working down to 1877.

In conclusion I may say that a careful search on the old burrows of Wheal Metal and Wheal Vor has failed to produce any further specimens.

¹ G. M. Henty, 'On the Occurrence of Wood Tin at the Great Wheal Vor Mines,' Rep. Miners' Assoc. Cornwall and Devon, 1867, p. 55.

² W. H. Argall, 'On the Occurrence of Wood-tin in the Wheal Metal Lode at Wheal Vor,' Journ. Roy. Inst. Cornwall, 1873, vol. iv, p. 255.

Mean Quarry,¹ Constantine, Cornwall.

Since writing the above notes, I have quite recently, in 1913, found a single small specimen of bertrandite in this granite quarry. The crystals are tabular parallel to $c(001)$, and are very nearly square in outline. They show a tendency to parallel grouping, being piled one on another on the basal planes. They attain a length of $2\frac{1}{2}$ mm. in the slightly longer direction of the a -axis. The forms present are $a\{100\}$, $b\{010\}$, $c\{001\}$, with very narrow faces of $m\{110\}$. An interesting feature in connexion with this bertrandite occurrence is that the crystals partially invest long hexagonal crystals of pale-violet apatite, and are therefore of more recent formation than the latter mineral. The other associated minerals are large white crystals of albite, quartz, small hexagonal plates of muscovite, earthy green chlorite, tourmaline, and orthoclase, the whole occupying a cavity in a coarse pegmatite granite.

¹ This quarry is situated a few yards to the west of the houses shown on the maps as Mean Pern (Sheet LXXI SW, Six-Inch Ordnance Map). The spelling 'Mean Quarry' is that given on the Ordnance Maps; in the Home Office List of Quarries, however, it is spelt 'Maen'.