Notes on a Recent Discovery of "Connellite."

By W. Semmons.

[Read March 10th, 1885.]

THE gradual decline in the production of copper from the mines of Cornwall and the consequent diminution of their number renders any discovery of a rare copper mineral an object of interest to all mineralogists.

Owing to the exhaustion of all the upper deposits, those products of decomposition—the beautiful arseniates and phosphates, &c. which adorn the cases of our national collection and those of private collections—are getting more and more scarce, and perhaps in the near future, so far as Cornwall is concerned, we shall have to rely for illustrations entirely on its past productions.

Probably one of the most beautiful of these minerals was the rare species "Connellite," a sulphato-chloride of copper found in small crystals of a deep blue colour, in copper veins traversing clay slate at Huel Providence and Huel Unity, also in a vein at Huel Damsel traversing granite. Huel Unity was a perfect storehouse of copper minerals, no less than fourteen combinations of that metal being found there, some of them being crystallised better than in any other mine; so that we might naturally look for good illustrations of Connellite here if any where.

Rashleigh in 1802 seems to have noticed the mineral from Wheal Providence, as a copper ore of an azure-blue colour composed of needle crystals.

Phillips in his 1823 edition does not, however, notice it.

Connel (Report British Association, 1847) gives an interesting account of its composition; while Dana, 1850, gives it a specific name.

Professor Maskelyne's paper (*Phil. Mag.* Jan. 1863) gives us by far the greatest information on the mineral, and one cannot help admiring the skill with which crystals of such minute size are there figured and described.

Bertrand has since (*Bull. Soc. Min.*, 1881, IV.) determined the mineral as optically uniaxial and positive.

Our knowledge of the mineral being therefore derived from very scanty material and from such old specimens, a detailed description of it from a new find in the Camborne district seems warranted. I have ventured too to give a detailed description of the associated minerals, and am able

to do this more fully than usual, as, owing to the miners not knowing Connellite, they have put aside specimens of other ores mistaking them for it. We owe our knowledge of this recent discovery largely to the energy of a local mineral dealer, Mr. Wm. Peters of Redruth.

The Camborne district is situated at the western end of the boss of granite in which most of the productive tin mines of the county are now worked. On the west and north flanks of this lies the killas (clay slate) for a distance of several miles, when we again meet with other outcrops of granite.

Like many other minerals which owe their existence to a peculiar combination of conditions, "Connellite does not seem to occur massive, and the little patches that appear compact resolve themselves into a mass of minute crystals. These are generally in radiating and divergent groups, but single crystals are occasionally found standing out distinct and alone."

Dr. Ch. O. Trechmann informed me he was not able to discern the di-hexagonal pyramid of Maskelyne under the microscope even with a power of 35. Dr. Trechmann has, however, since forwarded me a note giving a detailed description of the crystallographical characters of the mineral in two specimens I sent him. As mere extracts therefrom would in my opinion simply spoil the value of this note, I append it in full at the end of this paper.

In one specimen (received since Dr. Trechmann's examination) the crystals are so large that a hand lens of very low power enables one to determine their forms. I notice that we have here only the hexagonal pyramid and the di-hexagonal prism. The faces of the pyramid are unequally developed, some planes being developed at the expense of others as in some quartz crystals.

I am informed that a specimen in the collection of the Museum of Practical Geology also shows this almost complete obliteration of alternate planes.

The colour of the specimens I have seen is blue of various shades. In the well formed and larger crystals we have, when light passes through them, the most charming tints thrown up, and equalling the hues of the finest sapphire.

The other physical characters agree with those given in Dana, *System of Mineralogy*, page 627, as belonging to Connellite.

Associated with Connellite we have crystals of Brochantite of simple form, also very beautiful crystals of chalcophyllite; also cuprite, malachite, azurite, chalcocite and chalcopyrite.

The better way of describing their associations is perhaps to detail the way in which the minerals are found in the specimens produced.

No. 1.—The main mass of the stone consists of massive cuprite, which has been cut into patches by strings of malachite and Brochantite. On the upper surface are octahedral crystals of cuprite, and in sundry small cavities very well defined crystals of Brochantite. In some cases lying directly on the cuprite, and in other cases interlacing and covering the Brochantite, are transparent crystals of Connellite.

No. 2.—Crystals of cuprite (rhombic dodecahedra with slight development of octahedral faces) have a patch of Connellite crystals lying directly on them.

No. 3.—Compact mass of cuprite with traces of decomposition therein to only a small extent. The upper surface is covered with a layer from $\frac{1}{2}$ to $\frac{3}{4}$ inch thick composed of a mixture of compact and crystalline Brochantite with occasionally well defined crystals of the same mineral. Scattered over the surface and also in small cavities are well formed transparent crystals of Connellite.

No. 4.—A mass of compact cuprite, on which there is a small patch of malachite. This is covered in places with minute crystals of Connellite of a charming deep blue colour.

No. 5.—A most interesting stone; the main portion being cuprite, on and in which are malachite and Brochantite, some crystals of the latter being most distinct and perfect. On some undecomposed cuprite crystals are two radiating clusters of Connellite crystals having their terminal planes (hexagonal pyramid) beautifully developed. The crystals from centre of radiation to apex of pyramid are about $\frac{1}{4}$ inch in length, so that their form can be distinguished by the naked eye. The Connellite crystals too are found filling up the interstices between sheaves of radiating Brochantite crystals.

No. 6.—A stone almost entirely composed of azurite and malachite with cuprite. On the malachite is a layer of minute crystals of Brochantite, while a few very small crystals of Connellite are scattered over the stone.

No. 7.—Some minute radiated tufts of Connellite with malachite. Also some distinct crystals of chalcophyllite (copper mica) mixed with the malachite. In one small cavity there are pseudomorphs of malachite after chalcophyllite, the external cast only remaining as the interior is quite hollow. No cuprite found, but in its place copper pyrites.

No. 8.—Very beautiful and well defined hexagonal prisms of chalcophyllite on a base of chalcocite. The latter mineral is much decomposed. Again no trace of cuprite.

No. 9.—Decomposing chalcocite with radiated layers of small but brilliant crystals of chalcophyllite. Again no cuprite. We meet, too, here

with little tufts of minute bluish-green crystals which are probably Connellite.

The result of the above examinations tends to show that Connellite is most frequently associated with cuprite, Brochantite too being almost always present. The mineral, though, also occurs with chalcophyllite, but not so frequently.

We notice that chalcophyllite is found rather with the sulphides chalcocite and chalcopyrite, than with the oxide, cuprite.

Through the kindness of Mr. Thos. Davies, F.G.S., Mr. F. W. Rudler, F.G.S., and Mr. Pringle, I have, during the preparation of these notes, been able to examine the new and old specimens of Connellite in the National Collection at South Kensington, the Ludlam Collection and the Collection of the Museum of Practical Geology. I find the associated minerals with Connellite here also to be cuprite and Brochantite. Connellite in very minute crystals has recently been found in some stones from Marke Valley Mine, which is situate in the Eastern part of Cornwall, and therefore a long distance from any of the previously known localities. I have not been able to examine many of the Marke Valley specimens, but the general appearance of those I have seen is similar to those raised in the Camborne district.

The peculiar resemblance of the Brochantite to that from Peru, which I described to this Society (see *Mineralogical Magazine*, Vol. IV. p. 260), much interested me. There is also found frequently a peculiar amorphous-green copper mineral which gives reactions for both carbonate and sulphate, just as in the Peruvian specimens.

The Peruvian Brochantite was associated with decomposing Atacamite. Although I have not yet seen any trace of Atacamite in the Cornish specimens, it would not at all surprise me if we should find the Connellite has derived its chlorine from this mineral.

In conclusion, I trust that as probably sufficient materials are at hand, we may soon have presented to us a full and complete analysis of this rare and interesting combination.