VII.—*Note on the occurrence of Achroite at Rock Hill, in the parish of St. Austell, Cornwall, and on the black tourmaline of the same locality.*

By J. H. Collins, F.G.S.

Read September 6th, 1876.

As black tourmaline or "schorl" is one of the most abundant and widely distributed of the minerals of the West of England, it is perhaps somewhat remarkable that the variously colored and colorless varieties are extremely rare both in Cornwall and Devon. Among recorded localities, I am not aware that the green or brownish green *Zeuxite* has occurred, except at Huel Unity, Carn Marth, and Great Work Mine, in Cornwall, and near Okehampton in Devon, while the colorless variety *Achroite* has only been observed at Roscommon Cliffs, in St. Just; and the red, blue, and yellow varieties are so far quite unknown in the two western counties. I have lately been examining a number of specimens obtained in a large open tin working at Rock Hill, in the parish of St. Austell, Cornwall, in 1871 and 1872, and among them I have found several specimens of Achroite. When I first obtained them I thought they were quartz, and, indeed, I referred to them as such in a paper which I read to the Miners' Association of Cornwall and Devon, in 1872,* but I am now satisfied that they are colorless tourmaline or Achroite.

The mineral occurs in long flexible glistening prisms, which are from $\frac{1}{500}$th to $\frac{1}{2000}$th of an inch in thickness, perhaps averaging $\frac{1}{1000}$th of an inch. Some are $\frac{1}{4}$ of an inch long or even more.

Viewed by ordinary transmitted light they are all perfectly colorless and transparent, but when viewed by polarized light the thicker ones are occasionally colored. Being so extremely thin, I have not been able to get a cross-section, but the prisms appear to be 6-sided in some instances. Very few terminations can be seen, but I have observed some which appear like fig. 8, Pl. 2, the pyramid being much less acute than in quartz, very often the crystals form divergent groups as in fig. 9.

* Rep. Min. Assoc. Corn. and Dev., 1872.

The mineral occurs in such very small quantity that I have not been able to get enough for a complete analysis, but I have detected silica, fluorine, and boron by the aid of the blowpipe, which, coupled with the form of the crystals and their constant association with ordinary black tourmaline, (as shewn in the specimens exhibited,) leaves little doubt that it is really Achroite.

The mode of occurrence is of considerable interest, and I propose to describe it somewhat in detail.*

Rock Hill forms part the Hensbarrow granite mass, and there are some considerable tin workings on its eastern side.

The main excavation is of a nearly circular form, about 100 feet in diameter, and varying from 40 to 70 feet deep. Opening from this on the east side, is another excavation about 100 feet long, 30 feet wide, and 20 feet deep. The main mass of the hill consists of granite, the felspar of which is, in parts, completely decomposed into kaolin or china clay. The main pit itself is crossed by a very large schorlaceous tin lode, whose bearing is nearly N.E., and this consists chiefly of schorl and quartz, but contains on an average about 4 to 8 lbs. of oxide of tin per ton of rock. It is crossed at a very acute angle by a cross-vein of very similar mineral character, which, like the lode just described, contains a little tin, at any rate near the point of intersection. The cross-vein bears nearly north, and appears to be of somewhat more recent formation than the tin lode, as it "heaves" or faults it a little.

The lode dips or "underlies" to the W. of N. about 2 feet in the fathom; the cross-course underlies East at about the same rate. Besides the lode and cross-course, a great number of smaller lodes and branches traverse the pit in every direction. Many of them come together near the centre of the pit, a little east of the point of intersection of the two larger veins, so as to form a kind of knot of quartz and schorl with a little oxide of tin. At some of the intersections rich masses of tin ore occur, some containing 50 or even 60 per cent. of tin oxide. From one such intersection, about 1869, in the deepest part of the pit, 17 tons of oxide of tin was obtained.

To the chemical geologist this network of hard schorlaceous bands occurring in the decomposed granite is of great interest, for it affords evidence of pseudomorphism on a large scale. The bands present

* As the mine is now stopped, specimens should be looked for on the rubbish heaps.

much more the appearance of veins of segregation than of true fissure veins, although a fissure has probably been the determining cause of each one. Sometimes the fissures appear to have been re-opened at different and successive epochs as in so many other districts, but the schorlaceous and stanniferous matter which has passed into these fissures not finding room enough has, so to speak, overflowed, and saturated, the surrounding rocks.

The complex lodes so formed, appear to have contained at one time large crystals of felspar like the decomposed granite of the immediate neighbourhood. These crystals have been in every case changed. In the "country" they now consist of kaolin; in the lodes the felspar has usually been replaced by quartz, frequently by schorl, and occasionally by oxide of tin, or by all three minerals together. In some instances the cavities caused by the removal of the felspar have been only partially filled, when they are seen to be lined with the replacing material in the state of crystals projecting inwards from the sides, or in a pasty or pulverulent form.

It is usually in such partially filled cavities that the Achroite occurs as shewn in the specimens on the table, while sometimes small cavities in almost pure black or bluish black massive schorl are covered with the same silky looking prisms.* This almost massive schorl forms an interesting object for the microscope, when cut into thin sections.

As to the order of changes some ideas are suggested by the manner of association of the schorl and quartz. Schorl is frequently seen enclosed in quartz, but the reverse has not been observed. In some instances crystals of schorl are found, which are only partially enclosed in the quartz, part remaining free; one such example is illustrated in fig. 10. Moreover, many fissures in the complex masses of schorl rock may be observed, and these are almost always lined with quartz. Some of the fissures are lined with both schorl and quartz, but if so, the quartz is always the later to be deposited, being always found nearest the centre of the fissure. Figs. 5, 6, and 7, illustrate some of the more commonly occuring veins. a. is in each case partially decomposed granite, b. is greisen, c. is schorl,

* The more massive schorl is often accompanied by a bluish mineral, which is semi-transparent. Its nature has not yet been determined.

d. is quartz. We have, I believe, evidence of at least the following series of successive operations, conditions, and changes, in this interesting hill.

1.—Original formation of the granite mass.

2.—Fissuring of the same at two or more distinct epochs; alteration of felspar into kaolin; deposition of schorl, oxide of tin, felspar, and quartz in the fissures; and impregnation of the surrounding country with schorlaceous matter.

3.—Removal of the felspar crystals from some parts of the larger veins leaving open cavities.

4.—Partial filling of these with schorl and oxide of tin.

5.—Completion of the filling of some of them by quartz enclosing the previously deposited schorl and oxide of tin.

6.—Fracturing of the complex schorl rock so formed.

7.—Partial filling of the fissures with a lining of schorl.

8.—Deposition of a secondary lining of quartz.