PSEUDOBROOKITE

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The best position and the elements of the uncommon mineral pseudobrookite have been the subject of numerous studies and there is little uniformity in their treatment by various authors. Doubtless the small size and poor average quality of the crystals available have combined to lead to this result. A recent crystallographic study of pseudobrookite from Utah by the writer yielded results that seem at least as good as any previously published and led him to review the data on the subject which are here collected in brief résumé and in tabular form.

Pseudobrookite was first described and named by A. Koch (1) whose crystals came from cavities in the andesite of Aranyer Berg, Transylvania. Groth (2) reviewed this article, showing that Koch's calculations were erroneous. He made a new calculation from the original data, interchanging the *b* and *c* axes in order to bring out a somewhat remote isomorphism with brookite.

Schmidt (3) remeasured Koch's crystals and others from the same locality. He retained Koch's position and calculated new axes from his two reliable angles. Vom Rath (4) gave values for the same two angles and also rejected Groth's brookite position. Lewis (5) measured a single minute crystal from Jumilla, Spain. He gave two angles as dependable, used Koch's position but chose a different unit form. Oebbecke (6) described the pseudobrookite of Mt. Dore, France. He adopted the position of Groth, determined elements on the basis of the same two fundamental angles, and described several pyramid forms for the first time.

Cedarström (7) studied the large rough crystals from the wagnerite vein of Havredal, Norway. He first determined the true chemical nature of pseudobrookite, having for the first time sufficient material for adequate analysis. Latterman (8) isolated microscopic crystals from the nephelinite of the Katzenbuckel, Baden, but added no crystallographic data. Krenner (9) described a crystal from Vesuvius, determining elements based on two measured angles. Groth (10) abandoned the brookite analogy, readopting Koch's position and using the elements of Schmidt. Goldschmidt (11) interchanged the *a* and *c* axes of Groth's earlier position and employed mean values of the elements. Dana (12) adopted Groth's position and Schmidt's axes, recalculated to that position. He was

followed by Goldschmidt (13) in the Winkeltabellen, who, however, used as elements the mean of several determinations.

Traube (14) restudied the pseudobrookite of Aranyer Berg, having collected new and more abundant material. His crystallographic results reduce, however, to two angles, means of widely varying observations, measured on a single crystal. He added one new and very dubious pyramid.

Bruno Doss (15), after giving a full summary of previous work on the mineral, presented a study of artificial crystals of pseudobrookite formed by sublimation in a furnace. He gave elements in the position of Koch and a simplified chemical formula. He also showed a possible isomorphic relation to andalusite, no more probable than was Groth's to brookite.

Lacroix (16) added nothing to Oebbecke's description of the Mt. Dore crystals, but used the Koch position for his figure. Palache (17) described pseudobrookite from Crater Lake, Oregon, but his measurements served only for identification of forms.

Mark and Rosbaud (18) and Pauling (19) made *x*-ray measurements on crystals of pseudobrookite from Aranyer Berg. They established unit cells of very similar dimensions, both requiring a *c* axis but one-third the length of that assumed by the morphological investigators. Pauling also accepted as established by his work the simplified chemical formula, Fe_2TiO_5.

Palache (20) measured several crystals of pseudobrookite from Topaz Mountain, Utah. The crystals were needles, elongated in the direction taken as the vertical axis. Before the identity of the mineral was known he had taken as unit form a pyramid which gave elements practically identical with those demanded by the dimensions of the unit cell of Pauling. He, therefore, feels no hesitation in adopting those elements as the most appropriate for the mineral. In the following Table 1 will be found the data given by the authors whose work has been cited above. Consideration of this table makes it clear that the angles of pseudobrookite from different localities show considerable variation. It was, therefore, thought best to take the mean of the elements which seemed based on the best data. For this purpose those of Schmidt, Lewis, Oebbecke, Krenner, Traube, Doss and Palache were selected. The average of these values gives as the most reliable elements of pseudobrookite $a=0.9777$, $c=0.3727$. From these elements there has been calculated a new Angle—table 2.

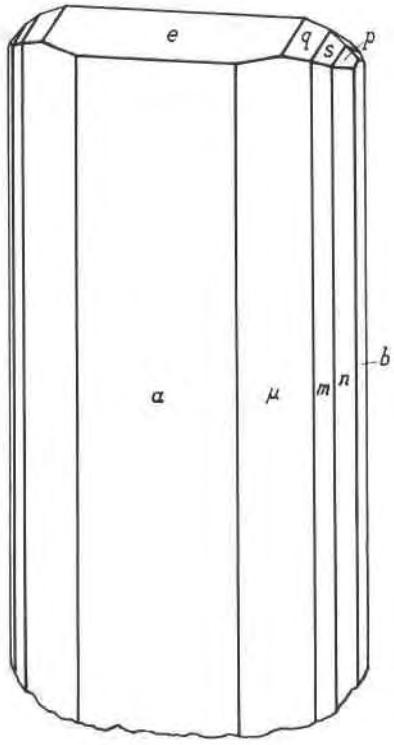
1. Table of Observations on Crystals of Pseudobrookite

Author	Locality	Fundamental Angles	Elements of author	Elements recalculated to new position	Forms (letters of present author)
Koch (1) Groth (2)	Aranyer Berg	$a:m$ 44°06′ $a:l$ 41 19	$a=$ .8790 $c=$ .9071	$a=.9690$ $c=.3675$	b, a, m, μ, e, l, y
Schmidt (3)	Aranyer Berg	$a:\mu$ 26 23 $a:l$ 41 16½	$a=$ .9922 $c=1.1304$	$a=.9922$ $c=.3768$	b, a, n, m, μ, e, l, y
Vom Rath (4)	Aranyer Berg	$a:\mu$ 25 50 $a:l$ 41 15	$\left(\begin{matrix}a=.9683\\c=1.1403\end{matrix}\right)$	$a=.9683$ $c=.3801$	
Lewis (5)	Jumilla	$a:\mu$ 25 46 $a:e$ 69 02	$a=$ .9676 $c=$ .5564	$a=.9676$ $c=.3709$	a, μ, e
Oebbecke (6)	Mt. Dore	$a:\mu$ 26 03½ $a:e$ 69 04	$a=$ .8714 $c=$ .8910 } mean	$a=.9780$ $c=.3741$	b, a, μ, e, l, q, s, p
Krenner (9)	Vesuvius	$a:\mu$ 25 50 $a:e$ 69 20	$a=$ .9683 $c=1.0957$	$a=.9683$ $c=.3652$	a, μ, e
Traube (14)	Aranyer Berg	$a:\mu$ 26 08 $a:l$ 41 02½	$a=$ .9812 $c=1.1268$	$a=.9812$ $c=.3756$	b, a, m, μ, e, l, o (772) ?
Doss (15)	Artificial	$a:\mu$ 26 02½ $a:e$ 69 11	$a=$ .9773 $c=1.1147$	$a=.9773$ $c=.3716$	b, a, μ, e, q
Mark & Rosbaud (18)	Aranyer Berg	Unit Cell	$a=$ .998 $c=$ .375	$a=.998$ $c=.375$	
Pauling (19)	Aranyer Berg	Unit Cell	$a=$ .986 $c=$ .375	$a=.986$ $c=.375$	
Palache (20)	Topaz Mt.	$a:\mu$ 26 09 $a:e$ 69 00		$a=.9791$ $c=.3757$	$b, a, n, h, m, \mu, e, q, s, p$
Mean of elements of Schmidt, Lewis, Oebbecke, Krenner, Traube, Doss & Palache		Calculated $a:\mu$ 26 03 $a:l$ 41 10 $a:e$ 69 08		$a=.9777$ $c=.3727$	

TABLE 2

PSEUDOBROOKITE

No.	Miller	ϕ	ρ
1	010	0°00′	90°00′
2	100	90 00	90 00
3	120	27 05	90 00
4	340	37 29½	90 00
5	110	45 39	90 00
6	210	63 57	90 00
7	031	0 00	48 11½
8	101	90 00	20 52
9	301	90 00	48 50
10	111	45 39	28 04
11	121	27 05	39 56
12	131	18 49½	49 45



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