Should any member of the Society wish to see a portion of the original specimen, or to examine with the spectroscope sections thereof or of the Oxford mineral, I am prepared to submit them to him.

XX. *On the Dichroism of two European Andalusites.* *By* W. G. Lettsom, *Esq.**

Two years ago or so there was received in London from Brazil a batch of Andalusites, the transparency of which allowed of their remarkable dichroism being well observed. This induced me to make trial as to the amount of dichroism which Andalusites from European localities might exhibit if suitably cut by a lapidary; for none of our Andalusites that I am acquainted with are capable of being examined, as is the case with Brazilian specimens, in their natural state.

I beg leave to lay before the Society a few sections of Andalusite from a locality in Germany the name of which I have not at hand, but which I hope to obtain in a day or two. Those sections show in one image a rich chocolate-brown colour, the other being all but colourless.

Other sections, from Goldenstein in Moravia, exhibit, in one image a deep blood-red colour, the other image in this case too being almost colourless.

XXI. *Crystallographic Notes.* *By* W. J. Lewis, *M.A.*†

[Plate VII.]

Pseudobrookite.—A pupil of mine, whilst making a list of the apatites in the Brooke collection preparatory to their registration, called my attention to a specimen of asparagus-stone from Jumilla, Murcia, on which were some minute black crystals of apparently rhombic symmetry. They were clearly not hematite, which is frequently found in thin laminæ in the matrix from this locality. The measurements obtained show it to agree well with the mineral discovered by

* Read November 23, 1878.

† Read June 3, 1882.

Dr. Koch (Groth's *Zeitschrift f. Krys.* iii. p. 306), which he has called pseudobrookite.

The crystals are very small, and consist of simple prisms with the makrodiagonal pinakoid, strongly striated parallel to their intersections, and terminated by minute bright dome-planes (figs. 1 and 2). They have a considerable tendency to more or less parallel growth; and the opposite planes of the prism are not, as a rule, accurately parallel. They are brittle, and seem to have no good cleavage.

The quantity so far obtained from the specimens in the Cambridge collection is very small (not more than one grain), and it has been impossible to get a chemical analysis made. A preliminary examination by Dr. Hugo Müller confirms, to a certain extent, the belief that it is identical with Koch's pseudobrookite. The following table gives the angles observed and calculated, as also the corresponding angles given by Dr. Koch:—

	Lewis.		Koch.	
	Calculated.	Observed means.	Calculated.	Observed.
a m	25° 49′	*25° 49′ (mean of 5 best)	25° 51′	26° 31′
		25 45½ (mean of 20)		
a l	44 3⅓	......	44 6	44 6
a e	69 1½	69 2 (mean of 5)	68 50	68 56
$ee_{,}$	41 57	*41 57 (mean of 6)	42 20	41 19
m e	71 12	71 7½ (mean of 6)		
$me_{,}$	108 48	108 42		

The development requires us, in my opinion, to take *m* as (1 1 0). The plane *e* might conveniently have the indices (1 0 3); and the elements would then be:—

System Rhombic.

$$D=(0\,1\,0,\ 0\,1\,1)=29^\circ\ 5'{\cdot}5;\quad E=(0\,0\,1,\ 1\,0\,1)=48^\circ\ 59'{\cdot}6;$$

$$F=(1\,0\,0,\ 1\,1\,0)=25^\circ\ 49'.$$

or

$$a : b : c = 1 : 2{\cdot}067 : 1{\cdot}150.$$

The mineral is specially interesting, as, from Dr. Koch's analysis, it seems to be a compound of ferric oxide and titanic acid, and to be therefore a dimorphous form of ilmenite. Its crystal-elements do not approach those of brookite sufficiently near to justify us in considering it isomorphous with the latter mineral. It offers, therefore, a fresh instance of the peculiar connexion which exists between oxide of iron and oxide of titanium.

Ludlamite.—In the Brooke collection is a specimen with a label in Heuland's handwriting, "Phosphate of Iron on a fossil, Stösgen near Linz on the Rhine, *new.*" The phosphate of iron is in minute pale green translucent crystals, having the characteristic three-faced-wedge habit of ludlamite on the free terminations. The best crystals of Cornish ludlamite, as described by Prof. Maskelyne, give angles which vary greatly, owing to more or less parallel growth. The crystals from Stösgen, although half a dozen different crystals have been tried, have such imperfect faces that no measurements have been yet obtained which render a comparison with the ludlamite from Cornwall possible. They seem to have a good cleavage, which, however, manifests the irregular growth of the minute crystals by the indefiniteness of the reflexion obtained from the cleavage-face. They are deposited on the sides of a cavity in the midst of a small mass of greenish-grey matrix, which consists of bundles of coralloid structure containing apparently a quantity of the same substance. I hope during the course of the long vacation to be able to settle definitely the crystallography of the mineral.

Idocrase.—The Brooke collection contains a small crystal of idocrase, probably from Zermatt, which has minute planes adjoining the base which do not seem to have been hitherto noticed. They are striated, and the measurements obtained are not good. Using p and $p_{\prime}$ to denote two of the planes in a zone with c, and $p_{\prime\prime}$ one of the others, the measurements obtained were $c\,p=6^\circ\ 3'$ (best), $c\,p_{\prime}=6^\circ\ 19'$, and $p\,p_{\prime\prime}=9^\circ\ 26'$. The form $(1\ 1\ 7)$ is that which agrees best with these measurements; the angles required by it being $(0\ 0\ 1,\ 1\ 1\ 7)=6^\circ\ 10\frac{1}{5}'$, and $(1\ 1\ 7, 1\ \bar{1}\ 7)=8^\circ\ 42\frac{1}{2}'$.

Zoisite.—In the Cambridge collection is a small specimen of zoisite in small bright green crystals imbedded in calcite. One of them had terminal planes; and by careful extraction from the calcite, I obtained a crystal showing four terminal pyramidal faces. The faces were rough, and deeply striated parallel to the edge lying in the brachydiagonal plane, so that the measurements obtained were not good. They agree, however, sufficiently well with those given by Brögger (Groth's *Zeitschrift*, iii. p. 471); and they have led me to the conclusion that Brooke must have been mistaken in giving the angle $wk=56° 30'$, an angle which has been assumed in all the mineralogical works to give the elements of the crystal. DesCloizeaux observed a poor dome-plane, of which I seemed to have doubtful indications, and has given a table of angles calculated from Brooke's data. The positions of the faces are shown in the stereographic projection (fig. 3). The angles given by M. DesCloizeaux are compared in the following table with those of Brögger and with those observed and calculated by me.

	Calculated.	Means of observed angles.	Angles adopted by Brögger.	Angles calculated by Dx.
	° ′	° ′	° ′	° ′
bs	*58 8	58 9½	*58 17	*58 8
sk	14 36	14 36		
$ss_{,}$	63 44	63 35	63 26	63 44
bw	*73 9	73 10½ 73 19 (Miller)	73 9	72 28½
sw	56 42	56 52½	56 32½	55 13½
$ww_{,,}$	66 36	66 14	66 55	69 33
aw	62 12½	62 54	......	61 1
ww_3	55 35	55 5	55 57	57 58
$s_{,}w$	75 56	75 35 (Miller)	75 43	75 23
wk	57 54⅓	.....	......	*56 30
$ll_{,}$	58 19	60° near (Dx.)	......	61 3

The plane a is doubtful. The planes k were only measured on one side of the crystal; and a, possibly a result of repetitions of the opposite k planes, was found on the other side. The difference in the angles $ww_{,,}$ and ww_3 given by Brooke's data and those adopted by me suffice, I think, to justify my belief in an erroneous impression as to the prism-plane which gave the reading 56° 30′. The angles bs and bw are unmistakable, and are those used in determining the elements; the remaining angles found by Brögger and myself agree as nearly as can be expected with those calculated.

Quartz.—In the Cambridge collection are two crystals of quartz, each of which has a well-developed plane whose indices were determined by the late Prof. Miller to be $(50\ \overline{19}\ \overline{19})$. Professor Miller seems never to have published this result; nor has any record of the measurement which led to it been found amongst his papers. I therefore remeasured the crystals, and obtained an angle which agrees almost exactly with that required by the indices $(50\ \overline{19}\ \overline{19})$. The larger crystal is a broken prism about 40 millim. long by 8 millim. across. The face *y* on this crystal is about 1·5 millim. long by about ·75 millim. broad, and is smooth and bright. Near the edge $[b\,y]$ it is slightly rounded. As shown in the diagram (fig. 4), it has to the left a large rough *x* plane and a long somewhat narrow *s* plane. The *r* plane above *y* is developed so as to all but blot out the other terminal planes, and is traversed by a few horizontal lines, due to repetition of *r* and some plane in the zone $[r\,y]$. At the extreme top the plane *r* is more strongly striated, and is penetrated in a perfectly arbitrary way by small crystals of quartz which are ill developed. In the zone $[z\,r_{,}]$ are three minute planes, angular measurement of which places them in the position *s*, *l*, *u*. These planes, however, do not succeed one another in this order, but form re-entrant angles, *u* being that adjacent to $r_{,}$, *l* next, and *s* last, and adjacent therefore to $b_{,,}$. The planes *u* and *l* are strongly striated parallel to the edge $[b_{,,}s]$. The planes observed on this crystal are $b\,(2\,\overline{1}\,\overline{1})$, $r\,(1\,0\,0)$, $z\,(2\,2\,\overline{1})$, $y\,(50\,\overline{19}\,\overline{19})$, $\phi\,(8\,\overline{13}\,8)$, $s=\alpha\,(4\,\overline{2}\,1)$, $x\,(4\,\overline{2}\,\overline{1})$, $u\,(6\ 17\ \overline{12})$ or $(5\ 14\ \overline{10})$, $l\,(3\ 10\ \overline{6})$.

The smaller crystal is a slender prism about 13 millim. long. The plane *y* on it is not so well developed as in the former crystal, and it is considerably more rounded near the edge $[b\,y]$. The image, however, given by it is quite distinct. The plane *s* to the right of *y* is very largely developed; and *x* and *v* appear as very narrow planes below it. The crystal is a combination of $b\,(2\,\overline{1}\,\overline{1})$, $r\,(1\,0\,0)$, $z\,(2\,2\,\overline{1})$, $y\,(50\,\overline{19}\,\overline{19})$, $x\,(4\,\overline{1}\,\overline{2})$, $v\,(16\,\overline{5}\,\overline{8})$, and a plane near ϕ.

The planes observed on these two crystals are given by the stereographic projection (fig. 5).

Mr. Thomas Davies, of the British Museum, lent me a crystal which showed a very prominent plane below the *s* plane, as also some narrow ones, looking somewhat like striations, between them. The distribution of the faces on this crystal is shown by the stereographic projection (fig. 6). It is a combination of $b\,(2\,\bar{1}\,\bar{1})$, $r\,(1\,0\,0)$, $z\,(2\,2\,1)$, $s=\alpha(4\,1\,\bar{2})$, $g=\alpha(3\,2\,\bar{4})$, $t\,(5\,3\,\bar{6})$, $s'\,(7\,2\,\bar{4})$, $x\,(4\,\bar{1}\,\bar{2})$, $\chi\,(\overline{15}\,8\,8)$.

Direct observations of t and s' in the zone $[b_{//}\ s]$ were too little reliable to be of any service. These planes were therefore determined by observations of the angles they make with b and $z_{//}$. The plane s' is somewhat doubtful. The faces w and n are very rounded, and no reliable measurement could be made.

The planes $(50\ \overline{19}\ \overline{19})$, $(3\,2\,\bar{4})$, $(5\,3\,\bar{6})$, $(7\,2\,\bar{4})$ are not given by M. DesCloizeaux; and this is possibly the first time that their existence has been recorded. The following table gives the observed and calculated angles for these planes:—

	Calculated.	Observed.
	° ′	° ′
ry . . .	30 25⅙	30 23½ on the larger crystal. 30 20½ on the smaller crystal.
$z\chi$ . . .	36 15	36 1
$r_{/}s$ . . .	28 54	28 53
$r_{/}l\ (3\,10\,\bar{6})$	33 47	33 57 not good.
$r_{/}u\ (6\,17\,\overline{12})$	38 9	37 52 " "
$r_{/}u\ (5\,14\,\overline{10})$	38 29	"
$b_{//}g$ . . .	10 19	10 16
$b_{//}t$ . . .	13 41½	......
$b_{//}s_{/}$ . . .	34 33	35 0 near.
bg . . .	52 39	52 43
$bt\ (5\,3\,\bar{6})$.	50 44	50 29
$bs'\ (7\,2\,\bar{4})$.	39 10½	39 10½
$z_{//}t$ . . .	30 42	30 28½
$z_{//}s'$ . . .	27 44	28 0

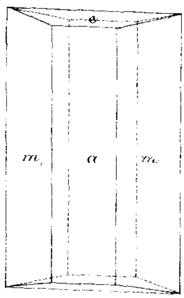

Fig. 1.

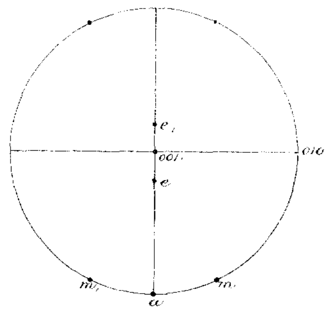

Fig. 2.

Pseudobrookite.

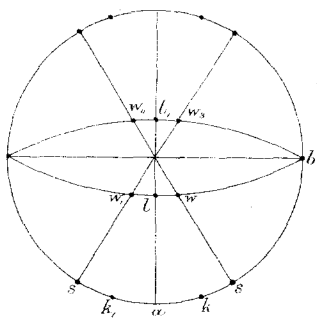

Fig. 3.

Zoisite.

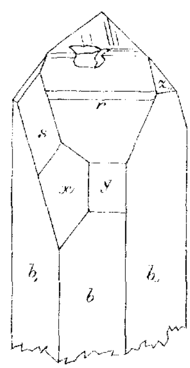

Fig. 4.

Quartz.

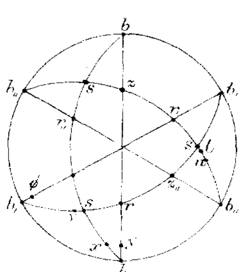

Fig. 5.

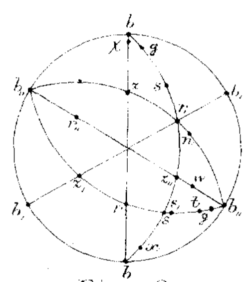

Fig. 6.

Quartz.

Mintern Bros. lith.