On crystals of Albite from Alp Rischuna, and pericline twins from La Fibbia, Switzerland.

(*With Plate VII.*)

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THE Cambridge Museum recently acquired a number of albite specimens from Alp Rischuna, near Vals Platz in Switzerland. Many of the crystals had good faces, so that measurement of the angles seemed likely to give trustworthy crystal-elements. The forms observed by me are:—

b (010), *z* (1$\bar{3}$0), *m* (1$\bar{1}$0), *t* (110), *f* (130), *n* (0$\dot{2}$1), *c* (001), *y* (20$\bar{1}$), *o* ($\bar{1}\bar{1}$1), *p* ($\bar{1}$11), *η* ($\bar{1}\bar{3}$1), *δ* ($\bar{1}\bar{1}$2), *x* ($\bar{1}$01); and on the pericline crystals *λ* ($\bar{3}$32) and *r* (40$\bar{3}$). Most of them are shown in Plate VII, figs. 1 and 2.

In his 'Minéralogie', 1862, Des Cloizeaux gives the fullest account known of Swiss albites, his determination being largely based on the measurement by Marignac of numerous crystals from St. Gotthard. What precise locality they came from is unknown, for the term is often used by dealers and collectors to denote places far removed from the Pass. Albite is common throughout the whole of the Central Alps, but measurable crystals are rare. My results differ greatly from those of Des Cloizeaux, and this is to some extent due to the dependence placed by him on the angles made by *b* (010) and *c* (001) with one another and with other faces. Three of his fundamental angles are *bn*, *cn*, and *cm*; and, as will be seen from what follows, these angles are very untrustworthy.

Des Cloizeaux and other authors remark on the fact that the face *b* is displaced in the vertical zone [*bmt*] in such a way that the two faces *b*, which should be parallel, make a thin wedge whose edge is to the front. On one of my crystals, which seemed at first sight to be a twin with the normal to (100) as axis of rotation and (010) as combination-face, the angle between the two *b* faces closely accords with that required by such a twin. Examination showed, however, that a very thin lamina was twinned to the one on its left according to the albite law and to that on its right according to the Carlsbad law; the extreme portions being then in a relative position with respect to one another as if twinned about an axis perpendicular to the axis *OZ* and parallel to the face (010). Plate VII, fig. 3, represents such a twin, in which the lamella sandwiched between the other twin components has an appreciable thickness. Dreyer and Goldschmidt say that the face *b* on their crystals is accurately in the zone [*mt*]. This I have found to be frequently the case on Rischuna crystals, but not always so; and the faces *b, z, m* of one individual are often distinctly out of the zone of the homologous faces on the second, though the deviation from tautozonality is small. As the inclination of the zones [*bzm*] and [*bn*] is about $63\frac{1}{2}°$, it is clear that *bn* should not be used as a fundamental angle.

The face *c* is often divided into segments, each of which gives a separate bright image. The parallel cleavage is almost always uneven, and often gives two images, neither of which is parallel to any image on the natural face. Melczer blackened parts of the face and so obtained a single reading, but it does not follow that this was correct. In one case I obtained a brilliant even cleavage comparable with that often seen in calcite, but its position did not satisfy what I deem its true one. In this crystal the faces *b* and *n* also gave good images, which lie in a zone with *c* and the cleavage c_1. The angles made are:—$c_1b = 86° \ 32\frac{1}{2}'$, $bn = 46° \ 35'$; but $c_1c = 179° \ 4\frac{1}{2}'$ or $179° \ 11'$. If the cleavage be accepted as true and the natural face ignored, we should get for *cn* the angle $46° \ 53'$. But the other zones on this crystal are not of such goodness as to justify the rejection of the measurements on other equally good and even better crystals. The above crystal is interesting in another way, for it supplies a good instance of what I have noticed in other cases. This is that we cannot judge of the correctness of an angle by the brightness and clearness of the images; for *m* gives two images, one brilliant and good, the other faint. The angle *bm* (bright) is $59° \ 6\frac{1}{2}'$, that to the faint image is $59° \ 40'$. Again, in the zone [*ymn*] the bright image is out of the zone and makes with *y* an angle of $42° \ 54'$, whilst the faint image is in adjustment and its inclination to *y* $42° \ 34'$. The face *n* gives in this zone two images separated by $5'$.

The faces which gave the most trustworthy measurements are *y, n, z,* and *m*. The zone [*ymno*] is throughout fairly trustworthy; the similar zone [$tc\delta o$] is far less good, and but little dependence has been placed on it. Des Cloizeaux points out that t is untrustworthy. He says: 'Sur les petits cristaux d'albite la face t ne se trouve jamais exactement dans la zone $pb^1b^{\frac{1}{2}}$ [$c\delta o$]... ; d'après les indications du goniomètre, le plan qui ferait partie de cette zone serait compris entre t et u.' Both m and t frequently give two or three images, and under a strong lens the faces are often seen to be composite. In some cases it has been impossible to disentangle the angle mt from the twin-angles $m\underline{m}$ and $t\underline{t}$. I think also that in other cases each of the faces is to some extent false in the same way as is that face on Carlsbad twins of orthoclase, where adjacent portions of c and x are coplanar, although on simple crystals the inclination of these faces to the vertical differs by as much as 1° 54′.

My solution of the Rischuna crystals is based on the two triangles myt and znm, which have a common angle $tmy = zmn = 56° \; 34{\cdot}2'$. After much trial the following angles were adopted:—

mt 52° 16½′, mz 29° 36′, my 42° 26′, ty 45° 50½′, mn 51° 21′.

The other angles in the zone [$ymno$] were utilized in fixing the values of my and mn, for the four faces make a harmonic ratio. Unfortunately no good faces could be found in other zones which might serve to check the values ascribed to the other fundamental angles. For though the zone [zn] has four faces in it, p ($\bar{1}11$) is so poor and so much out of place that the angles from it to other faces were valueless. Again, the face η ($\bar{1}\bar{3}1$) is very narrow and dull, and the angles it makes with other faces serve only to establish its symbol. The face δ ($\bar{1}\bar{1}2$) is in some cases largely developed and then gave a good image, but it generally gave two; o ($\bar{1}\bar{1}1$) is a large uneven face, not in all parts bright, which usually gave two images. It will be noticed that the agreement of the observed means of angles in the zone [$c\delta o$] with the computed values is not very close. The face x ($\bar{1}01$) is very poor and ill-developed, and a worthless reading from it was only got in one or two cases. A rounded face r in the zone [cy], similar to that mentioned by Des Cloizeaux, was largely developed on some of the crystals, but no measurements of any value could be made. On one of the pericline crystals, described later on, a fairly good reading corresponding to ($40\bar{3}$) was obtained, and in figs. 1 and 2 this symbol has been adopted for the face.

Since 1862 many memoirs on albite-crystals from different localities have appeared, the references to some of which are given in the foot-note.[1]

[1] G. Melczer, Földtani Közlöny, Budapest, 1905, vol. xxxv, p. 153; translation in Zeits. Kryst. Min., 1905, vol. xl, p. 571. S. Glinka, Russ. Bergjournal,

That of Melczer describes very good crystals from Nadabula in Hungary, and gives a fairly full account of the work published by others up to 1905. The memoir of Dreyer and Goldschmidt describes crystals of unusual excellence from Greenland, but, though full and exhaustive, their paper has not been so useful as Melczer's, for the observations were made with a two-circle goniometer, and the only interfacial angles measured were those of the prism-zone. In my tables I have given Melczer's observed angles, and also under the heading 'D. & G.' a table of angles computed by me from the two-circle readings. Glinka's papers on albite-crystals from Russian localities are inaccessible to me, and the abstracts in Groth's 'Zeitschrift' are unfortunately full of misprints.

Melczer's crystals have much the habit of those from Alp Rischuna, and his diagrams can serve very well for many of my crystals. A common habit is that of two distinct individuals, such as those shown in figs. 1 and 2, twinned according to the albite law and with a pair of good *t* faces which make, according to him, a re-entrant angle of 58° 47·6′. The mean of twelve readings of this angle on my crystals is 58° 34′, and its computed value 58° 3′. In both his and my crystals the faces *t* are often very small, and in some cases disappear entirely, when the prism-zone resembles one of a crystal of the prismatic system with *b*, *z*, and *m* shown on both sides of the twin-plane acting as one of symmetry. At the back of some crystals I obtained *f* (130) and a cleavage parallel to *t*. The face *x* ($\bar{1}01$) seems to be well developed on Nadabula crystals, for Melczer gives the observed angles *xy*, *xo*, *xm*, and *xδ*. The large rounded face *r* ($40\bar{3}$) also gave him a fair angle.

In determining the elements and theoretical angles of our crystals Melczer and I proceeded on closely parallel lines. We both begin by adopting values for *mt* and *mz*, from which all other angles in their zone are deduced. We then adopt values of the angles made by *n* and *y* with one another and with certain of the faces in the prism-zone, and then compute other interfacial angles from the triangles which are thus established in succession. Melczer gives a table of several readings of ten of his principal angles, of which the means and adopted values, as also my observed values, are given in the following table:—

1889; abstract in Zeits. Kryst. Min., 1894, vol. xxii, p. 63. C. Dreyer and V. Goldschmidt, Meddelelser om Grønland, 1910, vol. xxxiv, p. 1; reprinted in Neues Jahrb. Min., 1910, Beil.-Bd. xxix, p. 537. C. Viola, Min. Petr. Mitt., 1895, vol. xv, p. 135.

Angle.	Melczer.			Lewis.	
	No. of readings.	Observed means.	Adopted values.	Observed means.	
				Rischuna.	Fibbia.
zm	17	29° 49′	29° 49·8′	29° 35′	29° 53′
mt	5	59 17·9	59 17·9	59 16¼	59 19
zn	2	40 51½	40 55	40 59	40 47
my	6	42 26·4	42 28·2	42 28	42 25
mn	5	51 20·5	51 22·4	51 20½	51 19½
no	4	47 1½	46 58·4	46 56	—
mo	12	98 21	98 20¾	98 17	—
xy	2	150 3¼	150 4⅓	—	150 4
cy	2	97 54½	97 52	97 54	97 43½
mc	5	69 53	69 5⅓	69 5	68 45

It will be noticed that the only serious divergence between our observations occurs in *zm*. The value found by me is exceptionally low, but it is in my belief much more trustworthy than *mt*. Melczer and I differ in the triangles which we use in succession. His order seems to have been, *mzn*, *bmo*, *bmn*, *bzn*, &c. Mine is *myt*, *mzn*, *zyt*, *zym*, *otm*, &c. Melczer clearly laid stress on the readings from *b*, but does not seem to have used *t* to any extent, whereas I have given it great weight. He says that he made some use of the angles between like faces on the pair of twinned individuals. These angles, even in the best crystals, are of such doubtful value that I did not allow them any weight. In most cases the agreement between the observed and computed values of the thirty-four angles given in his final table is good, save in the angles which involve (010) and (001). It is unfortunate that he does not give the angle *zy*, for it is in my crystals a good angle and serves as a useful check on the correctness of the angles in the triangle *ymt*. Again, the only angle involving $p(\bar{1}11)$ given by him is *bp*, and one is unable to judge of the value of the face. I did not often find the faces *b*, *p*, *o*, and *x* tautozonal. There can, however, be no hesitation in accepting Melczer's crystal-elements as very close approximations to the true values for Nadabula crystals; but the claim that the angles are correct to an accuracy of $\pm 1'$ is open to question, seeing that in so good an angle as *zn* there is a difference of 3½′ between the theoretical and observed values.

It is a curious fact that my observed value differs from that adopted by exactly the same error, especially as it seems to me one of the three or four most trustworthy angles.

To the following linear and angular elements, as usually given, of the Rischuna and Fibbia crystals I have appended those of some of the principal observers:—

	a	: b :	c	α	β	γ
Lewis (Rischuna) ...	0·6335	1	0·5564	93° 58′	116° 21′	87° 31¼′
„ (Fibbia)	0·6354	1	0·5593	93 57½	116 37	87 57½
Melczer (Nadabula) ...	0·6350	1	0·5778	94 6	116 36⅓	87 52
D. and G. (Greenland) ...	0·6367	1	0·5593	94 15	116 37	87 41
Glinka (Kirebinsk) ...	0·6341	1	0·5574	94 5⅓	116 27	88 6¾
Viola (Crete)	0·635	1	0·557	94 14½	116 31¾	88 5
Lacroix-Des Cloizeaux (St. Gotthard)	0·633	1	0·557	94 3	116 27	88 9

The following are the values of my five fundamental angles either given by the above authors, or computed by me from their data:—

	mt	mz	my	ty	mn
Rischuna	59° 16½′	29° 36′	42° 26′	45° 50½′	51° 21′
Fibbia	59 19	29 53	42 25	45 43	51 19½
Nadabula	59 18	29 50	42 26½	45 52	51 22
Greenland ...	59 26	29 46	42 25½	45 49½	51 15½
Kirebinsk	59 18	29 46	42 35	—	51 34
St. Gotthard ...	59 13	29 57	42 27	45 42	51 36

I have much pleasure in thanking Mr. S. Kôzu and Mr. H. B. Cronshaw for valuable help. The former has determined the refractive indices and optic axial angle of the crystals; his results are published in the following memoir, and are plotted in Plate VII, fig. 4. They bear on their face evidence of much skill and great care. Mr. Cronshaw's analyses were made on material carefully selected and dried at 110° C., and one gram was used in each fusion. His results are:—

SiO_2	68·28
Al_2O_3	19·95
CaO	0·45
Na_2O	11·35
K_2O	0·06
Loss on ignition	0·10
	100·19

MULTIPLE MANEBACH AND PERICLINE TWINS.

Some years ago I found on the Fibbia, at the summit of the St. Gotthard Pass, a number of small albite crystals, which are multiple twins according to the two above laws. Somewhat similar twins from Pfunders, Tyrol, were described by G. vom Rath,[1] and other like ones from the Weidalp, in the Habach Valley, Salzburg, by Professor Viola.[2] Plate VII, fig. 6, is a copy of a photograph of the best of these twins, which was made to show the arrangement of the edges between the faces *b* of the several individuals. Fig. 5 shows the specimen more completely and with a fair approximation to its actual development. The length of the crystal is about 12 mm., and the breadth of its face *c* about 6 mm. It consists of two slightly unequal portions, which are twinned according to the Manebach law—twin-face (001). The edges, such as $[b_1b_2]$, in which these portions meet are parallel to the face *c*; and the angle b_1b_2 is a salient one of nearly 7° 45′. The portion labelled *b* is uneven, and there is some slight indication of lamellation parallel to *c*, but there are no salient or re-entrant angles such as characterize the lamellae shown so conspicuously in the photograph.

As shown in fig. 5, the uppermost portion above the slanting lamella seems to belong to a single individual bounded by the faces *c, b, f, t, m,* and *z*. There is no difficulty in discriminating between the faces *m* and *t*; for the former is bright and more or less regularly striated parallel to the edge $[mt]$, whilst *t* is dull, fairly even and free from striae. In the next place comes a fairly uniform lamella twinned to the upper portion according to the pericline law—twin-axis $OY = [cy]$. It slants across the right-hand half in such a direction that the combination-plane is parallel to a face lying between *c* and $x(\bar{1}01)$. In drawing the figure I have assumed this plane to be $(\bar{1}05)$, for such a plane makes an angle of 9° 41′ with (001). At the upper edges of the lamella the angles are alient, at the lower edges they are re-entrant. At the edge $[mt]$ the lamella widens out so as to occupy the whole of the left-hand part labelled $\underline{t}$. The upper limit of the lamella is continued across the upper individual, and is perceived in the edges $[m\underline{t}]$ and $[\underline{z}f]$, where the angles are re-entrant. The salient and re-entrant edges of the lamella seem fairly straight, but will not bear the test of close observation with the microscope even when the magnification is small; and, as is seen in both figures, the lamella thins out towards the back. Below the principal

[1] G. vom Rath, Monatsber. K. Akad. Wiss. Berlin, 1876.

[2] C. Viola, Zeits. Kryst. Min., 1900, vol. xxxii, p. 305.

lamella is a second much thinner and less uniform lamella in the same twin orientation as the first. It disappears in the midst of b_1 and $\underline{t}$. Finally, as shown by the shaded patch m in fig. 5, there is an irregular piece at the apex, where the original orientation transgresses the vertical edge. It is hence clear that the internal structure is much confused in the way described as intercrossing twin formation. Vom Rath represents the intercrossing of the Pfunders multiple twin as taking place very regularly, so that he shows four nearly equal intercrossing portions. He also states that on the faces b the pericline twin-edges were all re-entrant, both to right and left.

The lower half of the crystal bears letters with subscripts 2 and 3. The pericline twin-edge $[b_2 b_3]$ is somewhat uneven, and the angle is re-entrant. Parallel to it are two fine lamellae having the same orientation as the portion to which b_2 belongs, and their surfaces reflect the light simultaneously with b_2. As in the upper half the intercrossing of the pericline twin is irregular and takes place about midway across the joint face m_2 and t_3. The face m_2 (shaded in the wrong direction) is easily recognized in spite of the fact that its free growth seems to have been prevented. At the points where the faces $\underline{m}$ and m_2 meet the Manebach combination-plane, narrow shelves exist, each of which is parallel to the y face of the individual. They have been omitted, for their introduction would have uselessly confused the drawing.

Several other crystals on the specimen show similar multiple twinning —one at least seems to include a larger number of twinned portions, in which the Manebach law occurs twice.

As is well known, vom Rath gave as the combination-plane of the pericline twin the plane of the rhombic section. This plane satisfies the condition that there is no overlapping of the individuals, and that the prism-faces are congruent in edges. Further, he observed that, in accordance with the change in the crystal elements of albite and anorthite, the combination-plane in the former inclined upwards to the front whilst in anorthite it is inclined downwards. He brought as further proof that on one of his crystals the edge $[b\underline{b}]$ made with $[bc]$ an angle of 13°, agreeing with an angle of 13° 12′ computed by him from Breithaupt's angles for pericline. On another twin from Kragerö the angle was 22°, which he thought agreed with the angle computed from elements deduced in part from Schmirn crystals. Unfortunately an error crept into the computation, and the first computed angle should be 31° 29′, very nearly that needed by the Fibbia crystals.

To test the view that the rhombic section is the combination-plane

I have measured under the microscope the angle made by the edge [bc] with [$b\underline{b}$] that of pericline twinning. Only rough approximations were possible, and in different parts the angle varied between the limits of $7\frac{1}{2}°$ and $11°$. As a fair approximation the face ($\bar{1}05$), inclined to c at $9° 41'$, seems the best; and fig. 5 was drawn on the assumption that this is the combination-plane. From the crystal-elements obtained by me, the angle made by the rhombic section with c is $30° 53'$; and the angle between [bc] and the twin-edge [$b\underline{b}$] would be $30° 57'$, an angle clearly inconsistent with the observed values.

The crystals were all embedded in chlorite, and have suffered a certain amount of corrosion which has specially affected the faces t, λ, and o, and to a less degree the faces b and x. The faces c are not very bright; in some cases the parallel cleavage was obtained, and reflection from the artificial face was used in preference to that from the natural one. The crystals measured were all very small, and several of them showed pericline twinning. The faces m, z, n, and y, when present, were all fairly bright, but the three last were very small, whilst m is striated and often gave two images. None of the angles will, however, compare in goodness with those measured on the Rischuna crystals. No reflection could be got from t, but in one crystal (the only one on which λ has been found) I was fortunate enough to obtain a parallel cleavage, which gave me the angle $mt = 59° 19'$.

The very rare face λ (332) is fairly large but has been corroded, so that the angles are only approximate. There can, however, be no doubt as to its presence in the two zones [tco] and [zy]. It is given by Des Cloizeaux as having been observed by Marignac on pericline, the angle $c\lambda = 74°$ being, however, marked as very questionable. My reading is $74° 52'$, and the computed angle $75° 7'$. It has also been observed on albite from Sterzing by Hessenberg, who deduced its symbol from the zones [cot] and [xf]. He adds that he is inclined to think that the face on his specimen was due to fine alternations of the faces t and o.

In order to determine the crystal-elements I had to employ the angles made by the cleavages parallel to c and t with the faces m, n, z, and y. After some trials the sides of the triangle cmt, the position of the pole A (100), and also the angle Ay were adopted; the values being:—

cm $69° 1'$, ct $65° 15'$, mt $59° 19'$, Am $29° 35'$, Ay $34° 19'$.

The angles in the zone [bzm] were then found, and the triangles mty and mzy served as checks. The rest of the solution then followed the lines used with the Rischuna crystals. The principal observed and computed angles are given in the tables.

Angle.	Rischuna.				Fibbia.		Nadabula.	Greenland.
	Compd.	Obsd. means.	No. of readings.	Limits.	Compd.	Obsd.	Melczer. Obsd.	D. & G. Compd.
bz	30° 9½′	29°51′	18	30°11½′ – 29°21′	30°16′	29°29′	29°42′	30°10′
bm	59 45½	59 34½	10	59 50½ – 58 57	60 7	59 47½	59 43	59 56
zm	*29 36	29 35	28	29 50 – 29 9½	29 51	29 53	29 50	29 46
mt	*59 16½	59 16	23	59 37 – 59 0	*59 19	59 19	59 18	59 26
tf	30 24	30 26½	3	30 35 – 30 25	30 9	...	*30 10	30 14
tb	60 58	60 53	6	61 27½ – 60 10	60 34	...	*60 36	60 38
Am	29 26½	...	...	... ...	*29 35	...	...	...
ym	*42 26	42 28	18	42 44½ – 42 18	*42 29	42 25	42 26½	42 25½
mn	*51 21	51 21½	20	51 30 – 51 10	51 21½	51 19½	51 22	51 15½
yn	93 47	93 48½	16	93 58 – 93 40	93 50½	93 41½	*93 50½	93 41
no	47 1	46 56	22	47 7 – 46 46	46 57½	...	47 1½	47 3
mo	98 22	98 17	21	98 28 – 98 2	98 19	...	98 21	98 19
yo	140 48	140 46	17	140 58 – 140 31½	140 48	140 29	*140 49	140 44½
zn	40 55½	40 59	25	41 4½ – 41 53	40 49	40 47	40 51½	40 52
nδ	38 42½	38 34	24	38 47½ – 38 16	38 39	...	38 46½	38 48
zδ	79 38	79 33½	24	79 49½ – 79 17	79 28	...	*79 35½	79 40
zp	51 46½	51 35	10	51 38½ – 51 22½	51 50	51 44	*51 49	51 39½
cm	69 13½	69 5	18	69 25 – 68 51½	*69 1	68 59	69 5¼	69 10½
mp	54 48	54 43	9	54 59 – 54 29	54 56	54 55	...	54 53
cp	55 58½	...	...	... ...	56 3	55 50	...	55 56½
Ac	63 45¼	...	...	... ...	63 27½	...	...	63 28
cx	52 6½	...	...	... ...	52 19	52 58	52 16½	...
cr	65 17	...	...	... ...	65 33	66 20	...	...
cy	81 53	82 6½	16	82 20 – 81 51	82 13½	82 11	82 5½	82 7½
xy	29 46½	...	...	... ...	29 54½	29 56	29 57	...
c:$\bar{1}$05	...	...	...	... ...	9 41	...	...	...
c_1b	86 47¾	86 35½	10	86 45 – 86 28	86 35½	86 36	...	...
bn	46 40	46 35	17	46 55 – 46 23	46 41	47 0	46 35½	46 47
nc	46 32½	46 33	15	46 50 – 46 0½	46 43½	46 29	46 41	46 50
bc	93 12¼	...	...	... ...	93 24½	93 32	93 31	93 37
c_1t	114 30	114 52½	10	115 15½ – 114 43	...	...	...	...
tc	65 30	65 23½	21	65 45 – 65 4½	*65 15	65 12	65 12½	65 7½
cδ	29 56¾	29 57	18	30 15 – 29 40	30 8½	...	30 6½	30 4
δt	95 27	95 19	18	95 40 – 94 30	95 23½	...	...	95 11
δo	27 26	27 30	17	28 4½ – 26 40½	27 37½	...	27 38	27 39
co	57 22¾	57 31	15	57 48 – 57 10½	57 46	57 28	57 41½	57 42½
to	122 53	122 55½	18	123 15½ – 122 36	123 1	122 36	...	122 50
tλ	...	...	...	... ...	140 22	140 5	...	140 2
zy	62 44	62 44	15	62 55 – 62 22	63 1½	63 0	...	62 50
zη	54 13	54 27	5	55 10 – 54 2	54 6½	...	...	54 5
	...	...	...	... ...	33 6	33 17	...	...
ty	*45 50½	45 47	14	45 55½ – 45 40	45 45	45 43	45 52	45 59½
yp	38 57	39 8	8	39 34 – 38 48	39 18	...	...	39 16

Angle.	Rischuna.				Fibbia.		Nada-bula.	Green-land.
	Compd.	Obsd. means.	No. of read-ings.	Limits.	Compd.	Obsd.	Melczer. Obsd.	D. & G. Compd.
tn	92 54½	92 50	13	93 1½ – 92 36	93 3	93 12	...	92 56
nη	35 7	35 17	1	... ...	...	...	...	35 16
bp	60 18	59 54½	5	60 5 – 59 47	60 20¾	60 30	60 8	60 3
bη	34 50	34 55	5	35 0 – 34 43	34 36	...	...	34 42½
bo	66 34½	66 41½	11	66 56 – 66 30	66 14½	66 23	66 34	66 31
bx	93 55¼	...	...	... ...	93 41¾	93 50	94 1	94 3
cr	79 56	80 9	6	... ...	79 58½	80 1½	...	80 12

Explanation of Plate VII.

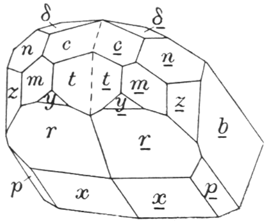
Figs. 1 and 2.—Crystals of albite from Alp Rischuna, Switzerland, each showing two distinct individuals twinned according to the albite law (p. 178).

Fig. 3.—Crystal of albite from Alp Rischuna with an intercalated lamina twinned to the left-hand individual according to the albite law, and to the right-hand individual according to the Carlsbad law (p. 179).

Fig. 4.—Curves plotting the values of the three principal refractive indices and the optic axial angles for light of different wave-lengths of albite from Alp Rischuna. (See S. Kôzu, p. 191.)

Fig. 5.—Crystal of albite from La Fibbia, Switzerland, showing multiple Manebach and pericline twinning (p. 184).

Fig. 6.—Photographic reproduction of the same crystal.



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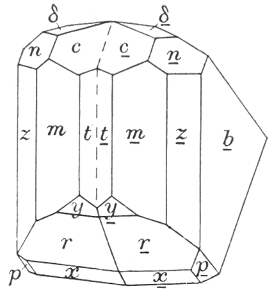

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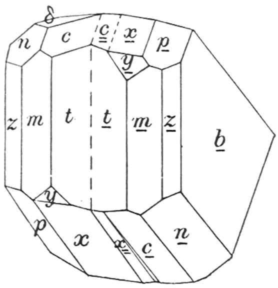

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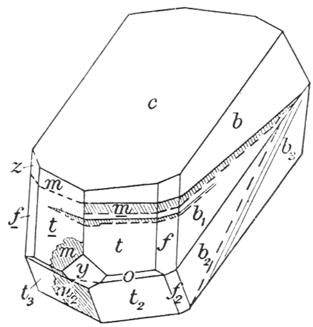

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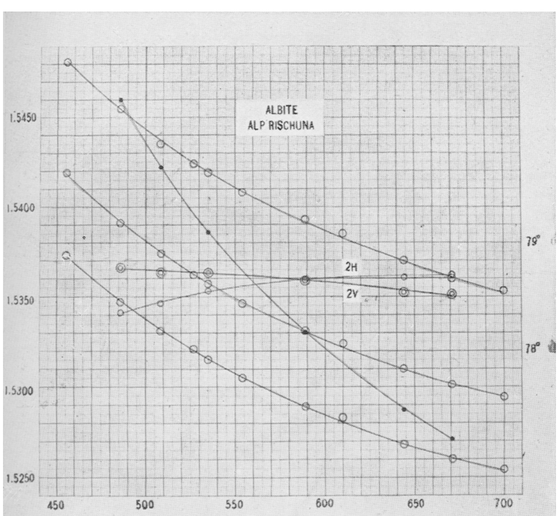

4

6

W. J. Lewis (and S. Kôzu): Albite from Switzerland.