For the reverse case the formulas are identical but λ, μ, and ν are substituted for α, β, and γ respectively thruout and *vice versa*.

These fundamental relations are deduced and proved by Goldschmidt in *Index der Krystallformen*, pages 5–9. They form the foundation of his whole system of crystallographic discussion, and it is hoped that they may some day be adequately presented to American readers.

Calculation of Angles from Elements

The following relations may be derived from the diagram of figure 40.

$$\tan \varphi = \frac{x}{y} = \frac{x_0 + pp_0 \sin \nu}{y_0 + qq_0 + pp_0 \cos \nu} \qquad \tan \rho = \frac{x}{h \sin \varphi} = \frac{y}{h \cos \varphi}$$

For a prism $\infty \frac{q}{p}$, $\tan \varphi = \frac{pp_0 \sin \nu}{qq_0 + pp_0 \cos \nu}$; $\rho = 90°$

Forms for the most rapid carrying out of the somewhat laborious computations, with adequate controls, will be found in *Winkeltabellen*, pages 19b and 20.

CALCULATION IN THE TRICLINIC SYSTEM, ILLUSTRATED BY ANORTHITE.

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The methods involved in the complex problem of measuring and calculating the axial ratios of a triclinic crystal are illustrated by the following measurements and calculations of a crystal of anorthite from Vesuvius, made by the writer in the laboratory of Professor Victor Goldschmidt in 1909.

The crystal was slightly elongated but there was no cleavage apparent to guide in orienting it, so that the zone with the longest edges was assumed to be the prism zone, and the crystal was adjusted on the goniometer with this zone parallel to the axis of the vertical circle. Readings were obtained from 19 faces as shown in Table 1.

From these readings a gnomonic projection was made (Fig. 42), from which it is at once evident that this crystal is a simple

individual and not a twin. By measuring the angles between the faces in the principal zones it was found that faces 15, 5, 4, 11, 12 and 18 were in the prism zone. For the purpose of identifying the forms present on the crystal it was only necessary to find the angle-point of each zone, and to measure the angles between the normals to the faces represented by the points in the projection, as shown for the prism zone (Fig. 42). By this means it was also found that face 17 was the base (001)—on the negative end of the crystal, using the standard orientation—thus necessitating an adjustment of the values of σ for the various faces on account of the inverted position of the crystal.

For purposes of calculation two methods of procedure were available: transposing the projection to a plane parallel with the normals to the prismatic zone, or readjusting the crystal so that the edges in the prism zone were parallel with the axis of the vertical circle, and remeasuring the crystal. The latter method was adopted, as there are fewer sources of error in the final calculation. For convenience the prismatic faces were kept separate from the terminal faces. The results of the second measurement are shown in tables 2 and 3.

TABLE 1. ANORTHITE. PRELIMINARY MEASUREMENTS

No.	V	H $H_0=70°$	$\rho=H-H_0$
14	300°51′	159°55′	89°55′
17	347 33	159 55	89 55
16	30 13	159 54	89 54
15	73 21	159 56	89 56
13	120 43	159 58	89 58
19	167 30	160 00	90 00
18	253 24	159 56	89 56
7	346 41	125 10	55 10
10	23 34	116 13	46 13
6	66 22	121 54	51 54
5	88 04	132 30	62 30
4	113 15	107 08	37 08
9	168 32	118 35	48 35
11	218 22	110 12	40 12
12	239 22	133 19	63 19
8	260 20	122 15	52 15
3	306 24	114 55	44 55
2	266 52	103 33	33 33
1	342 01	79 08	9 08

TABLE 2. ANORTHITE. PRISM ZONE MEASUREMENTS. $H_0=70°$. $V_0=\overline{71}°\ 57'$

No.	Symbol		V	H	$V-V_0=V'=\varphi$	$\rho=H-H_0$
18	M	$0\,\infty$	288°02′	159°58′	359°59′	89°58′
12	f	$\infty 3$	258 04	159 58	330 01	89 58
11	l	$\frac{\infty}{\infty}\vert\frac{}{\infty}$	229 57	159 58	301 54	89 58
4	T		170 27	159 58	242 24	89 58
5	z	$\infty\overline{3}$	138 57	159 59	210 54	89 59
15	M	$0\,\infty$	108 05	159 56	180 02	89 56
21	f	$\infty 3$	78 40	159 55	150 37	89 55
22	l	$\frac{\infty}{\infty}\vert\frac{}{\infty}$	50 06	159 52	122 03	89 52
23	T		350 35	159 54	62 32	89 54
24	z	$\infty\overline{3}$	319 00	158 54	30 57	88 54

TABLE 3. ANORTHITE.

Terminal Face Measurements and Calculation of x′ and y′.

$H_0 = 70°$ $V_0 = \bar{7}\bar{1}°57'$

No.	Symbol			V	H	V − V₀ = V⁻ = φ′	H − H₀ = ρ	logsin φ logtan ρ logcos φ	log x′ log y′	x′ y′
8	v	$\bar{2}$	$\bar{4}$	255°06′	139°20′	327°03′	69°20′	973 552 042 342 992 384	015 894 034 726	$\bar{1}$.4419 $\bar{2}$.2247
2	u	$\bar{2}$	$\bar{2}$	235 42	131 20	307 39	61 20	989 859 026 223 978 592	016 082 004 815	$\bar{1}$.4482 $\bar{1}$.1173
3	o	$\bar{1}$	$\bar{1}$	245 32	105 14	317 29	35 14	982 982 984 899 986 752	967 881 971 651	$\bar{0}$.4773 $\bar{0}$.5206
6	w	$\bar{2}$	4	141 21	139 07	213 18	69 07	973 959 041 847 992 211	015 806 034 058	$\bar{1}$.439 2.1907
10	p	$\bar{1}$	1	147 19	107 00	219 16	37 00	980 136 987 711 988 886	967 847 976 597	$\bar{0}$.4796 0.5834
7	q	$\bar{\frac{2}{3}}$	0	181 04	79 17	253 01	9 17	998 063 921 341 946 552	919 404 867 893	$\bar{0}$.1563 0.04775
17	P	0		27 21	96 12	99 18	26 12	999 425 969 202 920 845	968 627 890 047	0.4856 0.07952
14	n	0	$\bar{2}$	313 19	118 37	25 16	48 37	963 026 005 497 995 633	968 523 001 130	0.4844 $\bar{1}$.0264
16	e	0	2	85 49	121 57	157 46	51 57	957 793 010 641 996 645	968 434 007 286	0.4834 1.1826
1	y	$\bar{2}$	0	198 14	124 56	270 11	54 56	000 000 015 370 750 512	015 370 765 882	$\bar{1}$.4246 0.0045
27	t	2	0	19 14	140 38	91 11	70 38	999 991 045 407 831 495	045 398 876 902	2.8443 0.05875

The polar position of the instrument h_0 was 70°. Subtracting this value from each H reading we obtain the angle ρ of each face. Plotting the faces by means of the angles V and ρ, we obtain the gnomonic projection of figure 43 which permits a graphical determination of the forms and elements. In order to determine them mathematically it was necessary to have the face 010 $(0\,\infty)$ at zero on the vertical circle; or to subtract a value from the vertical circle readings which would give the

value 0 for this face and corresponding values for the other faces. The latter plan was followed and the amount to be subtracted was called v_0.

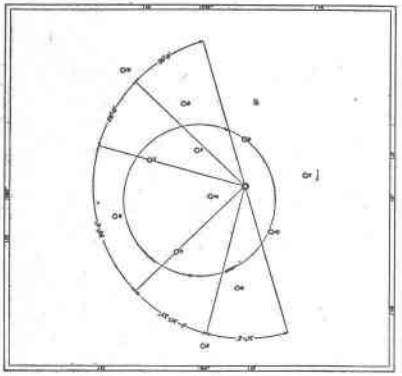

FIG. 42

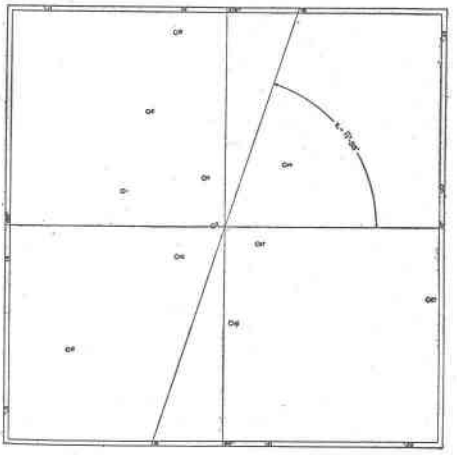

FIG. 43

Gnomonic projections of anorthite crystal (Parsons, p. 187).
Preliminary. Final.

DETERMINATION OF v_0

This calculation may be made in three ways:

(1) By means of the projection and the *Winkeltabellen*.
(2) By means of the angles of the terminal faces.
(3) By means of the angles of the prism faces.

TABLE 4. CALCULATION OF v_0 FROM PROJECTION AND WINKELTABELLEN

No.	Symbols		v	$v^-(\varphi')$	v_0	No.	Symbols		v	$v^-(\varphi')$	v_0
16	e	02	85°49′	157°41′	$\bar{7}1°52'$	24	z	$\infty\bar{3}$	319°00′	390°58′	$\bar{7}\bar{1}°58'$
15	M	0∞	108 05	180 00	71 55	8	v	$\bar{2}\bar{4}$	255 06	327 03	$\bar{7}1$ 57
18	M	08	288 02	360	$\bar{7}1$ 58	2	u	$\bar{2}\bar{2}$	235 42	307 51	$\bar{7}2$ 09
10	p	$\bar{1}1$	147 19	219 16	$\bar{7}1$ 57	3	o	$1\bar{1}$	245 32	317 25	$\bar{7}1$ 53
12	f	$\infty 3$	258 04	330 31	[$\bar{7}2$ 27]	6	w	$\bar{2}4$	141 21	213 21	$\bar{7}2$ 00
11	l	$\infty\overline{\infty}$	229 57	301 56	$\bar{7}1$ 59	7	q	$\frac{\bar{2}}{3}0$	181 04	252 47	$\bar{7}1$ 43
4	T	$\infty\overline{\infty}$	170 27	242 27	$\bar{7}2$ 00						
5	z	$\infty\bar{3}$	138 57	210 58	$\bar{7}2$ 01	17	P	0	27 21	99 27	$\bar{7}2$ 06
21	f	$\infty 3$	78 40	150 31	$\bar{7}1$ 51	14	n	$0\bar{2}$	313 19	385 27	$\bar{7}2$ 08
22	l	∞	50 06	121 56	$\bar{7}1$ 50	1	y	$\bar{2}0$	198 14	269 20	[$\bar{7}1$ 06]
23	T	$\infty\overline{\infty}$	350 35	422 27	$\bar{7}1$ 52	27	t	20	19 14	94 14	[$\bar{7}5$ 00]

Omitting 12, 1 and 27:—Average $v_0 = 71°57\text{–}1/9'$

1. *Determination of v_0 by the use of the angles of the Winkeltabellen.* Figures 39 and 43 and Table 4

The symbols of the forms having been determined in the projection, the φ angle of each is found in the *Winkeltabellen*, suitably transformed for the inverted position of the crystal; from each is subtracted the reading on V and the resulting differences give a series of values of v_0. $V - v_0 = \varphi$. Therefore $v_0 = \varphi - V$.

(To be concluded)

PROCEEDINGS OF SOCIETIES.

NEW YORK MINERALOGICAL CLUB

The regular monthly meeting of the New York Mineralogical Club was held in the Assembly Room of the American Museum of Natural History on the evening of May 19th, at 8.15 P.M. The President, Dr. George F. Kunz, presided and there was an attendence of 35 members and guests. The minutes of the last meeting were read and approved. On a suggestion by the Chair the report of the Committee on change of name was deferred.

Mr. Roy M. Allen read a paper on "Polarized Light and Its Application to the Study of Crystal Structure." In the course of his paper Mr. Allen took up the explanation of polarized light by analogies, explaining the nature of light and how it is transmitted thru crystalline structures. He took up the vibratory theory of light and pointed out the difference between ordinary light and polarized light. Using a diagram of a Nicol prism he illustrated the phenomena of refraction, reflection and absorption of light. By means of a blackboard demonstration he illustrated the molecular structure of crystalline bodies and showed how polarized light transmitted thru them produced the various effects which are used in determining minerals in thin section under the polarizing microscope.

In the second half of the program, Mr. George E. Ashby, using the polarizing microscope attached to the lantern, showed upon the screen a number of striking illustrations of the behavior of minerals in polarized light. After this exhibition a vote of thanks was tendered to Messrs Allen and Ashby.

Taking up the subject of the Decoration Day Excursion, Mr. Oppenheimer and Mr. Broadwell spoke of the Bronx locality at Burke Avenue as a possible objective. After some discussion this was adopted.

The New York Mineralogical Club and the Newark Mineralogical Society met for a joint field excursion on Decoration Day, May 31st, at the Lexington Avenue Subway Station at 180th Street, and proceeded to the recently opened locality at Burke Avenue, Bronx. Among the Club members attending this Field Excursion were: Miss Catherine Schroder, Messrs. George F. Black, W. H. Broadwell, Louis W. Dunham, Charles Francesconi, J. A. Grenzig, John Holzman, H. M. Lehman, Frank D. Tansley, George S. Scott, E. H. Wilson, J. P. Wintringham and H. P. Whitlock. Practically all the species reported from this locality were encountered and several members secured notable examples.

HERBERT P. WHITLOCK, *Recording Secretary*