A LABORATORY METHOD OF TEACHING ELEMENTARY CRYSTALLOGRAPHY

JOSEPH E. POGUE

Washington, D. C.

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DIRECTIONS FOR DETERMINING THE AXIAL-RATIOS OF MODELS AND CRYSTALS

Outside of the Isometric System, the relative lengths of the crystallographic axes must be determined.

I. Tetragonal System

Length of *a*-axis is 1; of *b*-axis is 1; of *c*-axis is to be determined.

(1) Draw a plan of the *b*- and *c*-axes on cross-section paper. Label these axes and indicate with heavy dots *unity* and *multiples of unity* on the *b*-axis. The unit length on this axis should include 10 or 20 or 30 small divisions of the cross-section paper.

(2) *Center* the model or crystal over the cross-section paper so that it is *oriented* in respect to the plan of the axes drawn on the latter.

(3) Select a face that cuts *both* the *b*- and *c*-axis. If more than one face does this, select the most prominent. The inclination of this face, then, determines the length of the *c*-axis. Project the inclination of this face onto the paper, lay your pencil parallel to the line so obtained, and roll the pencil until it coincides with *unity* on the *b*-axis; then the pencil cuts the *c*-axis also at *unity*, which is read off and recorded as a *decimal fraction*.

Note 1.—Unity on the *c*-axis may be greater or less than 1.

Note 2.—Unity on the *c*-axis, once determined, remains the same for all the faces on a model or crystal.

Note 3.—Prism and pinacoid faces cannot be used for determining axial ratios in this system.

Note 4.—The determination may be made more accurately by using a triangle and ruler.

II. Hexagonal and Trigonal Systems

Orient the model over a plan of the a_1-, a_2-, and a_3-axes. Then center the oriented model over a plan of the a_2- and c-axes and plot the inclination of a face cutting these two axes.

Note 1.—In some Trigonal models the inclination of the face is difficult to project.

III. Orthorhombic System

Proceed as under I; using, however, first a plan of the a- and b-axes to determine the relative lengths of those axes; and, second, a plan of the b- and c-axes in order to get the length of the c-axis.

Note 1.—The axial ratio must be determined *before* the indices of the forms present can be worked out.

IV. Monoclinic System

Here the angle β as well as the axial ratio must be determined.

(1) Draw on cross-section paper a plan of the a- and b-axis. In this plan the a-axis, because of its slope, is *fore-shortened*. Center the model with its c-axis vertical and use the inclination of a prism face. This gives a *fore-shortened* value for unity on the a-axis which must be corrected under (3).

(2) Draw a plan of the b- and c-axes, and determine the length of the c-axis.

(3) Draw a vertical line representing the c-axis. Lay off unity on it as determined under (2). Center the model so that its plane of symmetry parallels the paper. Note the inclination of the a-axis as determined by the basal pinacoid or by the intersection of two clinodomes. Now draw in the a-axis; also draw in an axis at right angles to the c-axis, calling this the a'-axis. Lay off on the a'-axis the foreshortened *unit length* found under (1); drop a perpendicular to the a-axis and this will intercept it at unity. The angle between the a-axis and the c-axis should be measured by a goniometer to obtain the value for β.

V. Triclinic System

The axial ratios and angular values may be only very roughly approximated by graphical means. Their accurate determination is a problem in spherical trigonometry.