ACKNOWLEDGMENT

The preliminary work on this mineral occurrence was conducted at the Geology Department of Princeton University, and the chemical analyses were very kindly provided by that department. Subsequent work was supported by National Science Foundation Grant G-14407.

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THE AMERICAN MINERALOGIST, VOL. 47, MAY–JUNE, 1962

# CHOOSING PRECESSION SCREEN SETTINGS

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The layer-line screen setting in the Buerger precession technique is usually obtained from tables like those in the International Tables for *X*-ray Crystallography (1959, p. 197) or by a graphic solution of the equation

$$\frac{r_s}{s} = \tan \cos^{-1} (\cos \bar{\mu} - d^*) \tag{1}$$

where, using the symbolism of Buerger (1944), $r_s$ is the radius of the annular aperture in the layer-line screen, $s$ is the layer-line screen's correct setting, $\bar{\mu}$ is the desired precession angle, and $d^*$ is the spacing in reciprocal lattice units (r.l.u.) between those reciprocal lattice planes that are parallel to the film. The nomograms used for the graphic solution of Equation (1) are usually constructed for a particular value of $\bar{\mu}$ (15°, 20°, 25°, or 30° being the usual values). To photograph as large a portion of the reciprocal lattice as possible, a value of $\bar{\mu}$ other than the four cited may be desired. Two nomograms exist that permit $s$ to be determined for any value of $\bar{\mu}$ between 0° and 35°, that of Evans, *et al.* (1949) and that of Tavora (1951). Both are complex to use and do not

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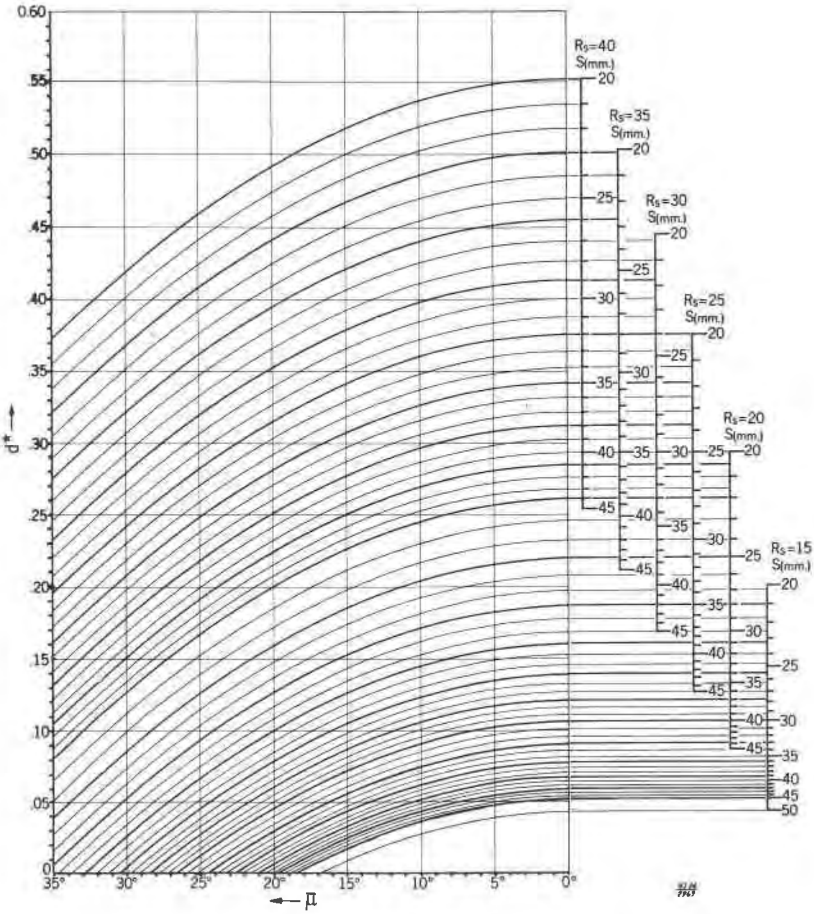


FIG. 1. Nomogram for setting the Buerger precession camera.

permit the largest operational value of $\bar{\mu}$ for a given value of $d^*$ to be determined readily. The present nomogram (Fig. 1) is much simpler to use; therefore, mistakes in determining the $s$ setting for a screen are less likely. It also permits the largest operational value of $\bar{\mu}$ for a given value of $d^*$ to be determined for each of the six screens ($r_s = 15$, 20, 25, 30, 35, or 40 mm) commonly used, simultaneously indicating whether a particular screen can be used at all.

The use of Fig. 1 is easiest to describe with an example. Suppose $d^*$ equals 0.20 r.l.u. and a precession angle ($\bar{\mu}$) of 20° is desired. Locate the point on Fig. 1 whose abscissa is 20° and whose ordinate is 0.20. From this point follow a path that is parallel to the nearest, curved guideline of the chart. This path intersects the scales at the right at the appropriate $s$

value for the screen whose radius ($r_s$) appears at the top of the scale. For this example the correct $s$ settings for the various screens are 44 mm for the $r_s=40$ screen, 38.5 mm for the $r_s=35$ screen, 33 mm for the $r_s=30$ screen, 27.6 mm (*ca.*) for the $r_s=25$ screen, and 22 mm for the $r_s=20$ screen. If the path traced does not intersect the scale for a given screen, this screen would be impractical to use since it would require an $s$ setting that would bring it too close to the film cassette or the goniometer head to permit normal operation of the precession camera. The chart thus shows that for $d^*=0.20$ and $\bar{\mu}=20°$, it is impossible to use the $r_s=15$ screen.

Perhaps the biggest advantage of Fig. 1, other than the simplicity of its use, is that it permits selection of the largest value of $\bar{\mu}$ that can be used with a particular value of $d^*$. By way of example, assume $s=20$ mm to be the minimum layer-line screen setting attainable for the instrument. Under this limitation, if $d^*$ equals 0.40 r.l.u. for a crystal, Fig. 1 indicates that the largest usable values of $\bar{\mu}$ are 32°, 26°, or 17.5° (*ca.*), according to whether the screen radius ($r_s$) is 40, 35, or 30 mm, respectively. In this reverse operation of the chart, it is only necessary to follow a curved (guideline-parallel) path from its intersection with the $s=20$ mm point on a particular scale. Tracing to the left along this path, the path will intersect the horizontal line corresponding to the $d^*$ value of the crystal. A vertical line dropped from this intersection indicates the largest value of $\bar{\mu}$ possible with this $d^*$ value (assuming a minimum $s$ setting of 20 mm). The curved paths from the $s=20$ mm points on the scales for $r_s=25$, 20, and 15 do not intersect the horizontal line for which $d^*=0.40$. These screens are thus seen to be inoperable for situations where $d^*=0.40$.

In the foregoing example 20 mm was assumed as the minimum value for $s$. Actually somewhat different minima may prevail depending upon the model of the precession camera, the arc and sledge settings of the goniometer head, and, to a lesser extent, the value of $\bar{\mu}$. If necessary, the minimum value of $s$ attainable with a particular set-up may be determined empirically, and this value may be used instead of 20 mm as in the example.

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