NOTES AND NEWS

REFRACTIVE INDICES OF HIGH INDEX LIQUIDS BY THE PRISM METHOD ON THE TWO-CIRCLE GONIOMETER

C. W. Wolfe and Virginia Franklin, *Boston University.*

The determination of the refractive indices of liquids, utilizing a hollow prism mounted on a one-circle goniometer, is a well known procedure (Larsen and Berman, 1934). The purpose of this paper is to discuss the extension of the same method to two-circle goniometers of the Goldschmidt type. Such goniometers (Wolfe, 1948) are comprised of three structural units: the signal collimator which is fixed in position; the telescope which is movable parallel to the horizontal circle but is not attached to it; and the vertical circle unit, which is movable and which is attached to the horizontal circle. This paper stems from the lack of connection between the telescope and the horizontal circle.

The Prism. The prism used by the authors, Fig. 1, was machined by Laboratory Associates of Belmont, Mass., who provide the prism as an accessory to the *Wolfe* goniometer. A standard crystal mounting rod is firmly fixed in the rear of the prism in order that the prism may be mounted on a standard goniometer head. A prism angle of fifty degrees is most serviceable for index measurements in the usual range.

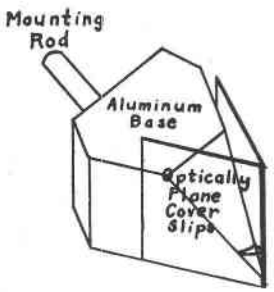

Fig. 1. Prism.

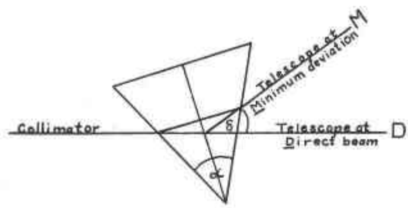

Fig. 2. Determination of δ (Delta).

Optically plane cover slips are cemented on the sides of the prism with water glass or Bakelite varnish, depending on the chemical affinities of the immersion media. Ordinary square cover slips can be used if they are optically plane. They may be tested by mounting on soft wax on the goniometer and observing whether a single, distinct signal from each side of the cover slip is obtained. If both sides are plane and parallel, the second signal will be centered after an exact rotation of 180 degrees of the vertical circle. Unfortunately, many cover slips must be tested before a satisfactory one is discovered; so the authors have resorted to the use of haemacytometer cover slips which, though optically true, are more expensive.

After the cover slips are mounted, they should be rendered opaque with black india ink to sharpen the signals and to reduce the effects of internal reflection and diffraction, leaving a small unpainted aperture in the vicinity of the liquid for passage of the light beam. Monochromatic sodium light, adequately shielded from the worker's eyes, is probably the most satisfactory light source. If greater precision is desired, a special temperature-controlled hollow prism such as that described by Butler (1933) could be machined.

Procedure. The prism is mounted on the goniometer head and adjusted. (as in crystal goniometry) until the reflections from both sides of the prism fall upon the cross hairs with rotation of both the horizontal and vertical circles in turn. The vertical circle is locked in position.

The prism angle α (alpha) is measured by obtaining the horizontal circle angular readings for the two prism faces, A and B, where A is less than B.

$$B - A = 180° - \alpha$$

or

$$\alpha = 180° + A - B$$

The prism angle is twice the angle of refraction, r, at minimum deviation (derivation in any standard description of the method of minimum deviation).

$$r = \frac{\alpha}{2} = \frac{180° + A - B}{2}.$$

Minimum deviation. Since the vertical circle, not the telescope, is attached to the horizontal circle, the procedure for determining the deviation angle between the position of the telescope when receiving the direct beam and when receiving the refracted beam at miniumum deviation Fig. 2, differs slightly from that for the one-circle goniometer where the angle can be read directly. The telescope is moved beyond the direct beam to the position of minimum deviation, which is determined by simultaneous movements of the telescope and of the vertical circle unit. If the prism be not correctly oriented, the signal will inscribe a parabola, not follow a straight line, as it is brought up to and away from the centered position.

The telescope is next locked in the minimum deviation position, and the vertical circle unit is moved until it abuts against some part of the telescope; and a reading M (*M*inimum deviation) is taken on the horizontal circle in this position. The telescope is then rotated back until the direct signal from the collimator is on the cross hairs; and the vertical circle is brought in contact with the telescope again for a second reading, *D* (*D*irect beam). *M* minus *D* gives the usual delta (δ) angle obtained in minimum deviation procedure. Calculation of *n*, following the formula:

$$n = \frac{\sin\left(\frac{\delta}{2} + \frac{\alpha}{2}\right)}{\sin\frac{\alpha}{2}}$$

is a simple matter; and graphs or tables showing variation of index with delta for one or more prism angles are readily prepared.

The mechanics of operation in this procedure are easier than for the one-circle goniometer, and the same accuracy is obtained. The maximum error in index determination by this method is two in the third place, and with proper controls an accuracy of three in the fourth place is easily possible.

Acknowledgment. The authors gratefully acknowledge the time and effort contributed by Laboratory Associates of Belmont, Mass., in the development of a satisfactory prism base.

Since the writing of the above note, Laboratory Associates have developed, under the direction of the senior author, a light filter which can be placed in the collimator, using the usual illumination source. The wave length of light obtained is exactly equal to that of the commercial sodium lamp. In addition to facilitating readings on the goniometer, the use of the filter has another decided advantage:—cost; for the filter can be supplied for $5.00 which is a small fraction of the cost of a sodium lamp.

References

Butler, R. D. (1933), *Am. Mineral.*, **18,** 394.
Larsen and Berman (1934), *U. S. Geol. Surv., Bull.*, **848,** 18.
Wolfe, C. W. (1948), *Am. Mineral.*, **33,** 739.