146. On the Symmetrical Extinction Angles of Albite-twinned Plagioclases.

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In plagioclases twinned according to the albite law, any section cut perpendicular to (010) presents two or more twinned parts having like extinction angles measured in opposite directions from the trace of (010), the line separating the twinned lamellae. These symmetrical extinction angles vary with the crystallographic position of the cutting plane perpendicular to (010), in each kind of plagioclase ranging within certain limits which are characteristic of the kind. Michel-Lévy prepared long ago diagrams showing the range of symmetrical extinction angles for a number of different members of the albite-anorthite series; and on the basis of these diagrams F. E. Wright¹⁾ plotted the maximum symmetrical extinction angles of albite-twinned plagioclases, $X' \wedge$ trace of (010), as in Fig. 1. His graphical plot has been reproduced in many of modern text-books on rock-minerals,²⁾ and is now widely used in connection with the petrographic-microscopic work.

Recently it happened to come to my notice that this familiar diagram (Fig. 1) is inconsistent with what are known of the optical orientation of plagioclases. The following two points are especially to be remarked:

Fig. 1. Maximum symmetrical extinction angles of albite-twinned plagioclases, $X' \wedge$ trace of (010). (F. E. Wright.)

1) F. E. Wright, Amer. Jour. Sci., Vol. XXXVI, 1913, Pl. X.

2) For example: F. Rinne, Gesteinskunde (6. u. 7. Auflage), 1921, p. 81; A. Johannsen, Essentials for the Microscopic Determination of Rock-forming Minerals and Rocks, 1922, folding table; M. Berek, Mikroskopische Mineralbestimmung mit Hilfe der Universaldrehtischmethoden, 1924, Tafel 5; P. Niggli, Lehrbuch der Mineralogie, II (2. Auflage), 1926, p. 543; H. Rosenbusch, E. A. Wülfing, O. Mügge, Mikroskopische Physiographie, 1-2, 1927, p. 790; A. N. Winchell, Elements of Optical Mineralogy, II (3rd Ed.), 1933, pp. 318 & 340.

symmetrical extinction angles must show discontinuity at the point corresponding to $\text{Ab}_8\text{An}_{92}$.

Taking what have been remarked in the above into consideration, a new diagram, Fig. 3, is presented here as a substitute of Fig. 1.

Fig. 3. The range of symmetrical extinction angles of albite-twinning plagioclases, $X' \cap$ trace of (010). (S. Tsuboi.)

It gives the range of symmetrical extinction angles, $X' \cap$ trace of (010), in albite-twinning plagioclases, ABCDE representing the maximum angles and A'B'C'D'E' the minimum. The extinction angles C (58°) and D' (31°), in plagioclase $\text{Ab}_8\text{An}_{92}$, were calculated from simple spherical trigonometric relations, assuming the position of the optic axes for this plagioclase to be as follows:¹⁾

$$\text{Optic axis A: } \phi = -62^\circ \quad \lambda = +57^\circ$$

$$\text{Optic axis B: } \phi' = 0^\circ \quad \lambda' = -5^\circ$$

E' (34°) was adopted from Rosenbusch-Wülfing-Mügge's "Mikroskopische Physiographie," 1-2, 1927, p. 788, Fig. 204. All extinction angles are plotted as positive in Fig. 3, because there is no need of distinguishing their sign in most cases where this diagram may be used.

1) ϕ (or ϕ') and λ (or λ') are respectively the latitude and the longitude of the optic axis A (or B) in the spherical projection, taking the great circle parallel to (010) as the equator, and the meridian of the c-axis as the initial meridian (cf. Fig. 2). In Fig. 2, ϕ (or ϕ') is positive when measured to the right (i.e. in the first and fourth quadrants); and λ (or λ') is positive when measured upward (i.e. in the first and second quadrants).