there are two "null zones" on opposite sides of the cylinders (fig. 1, *b;* pl. 2, *A*). In both specimens the tangent planes to the cylinders at these zones contain the *a*-axis with maximum resolved shear stress, indicating that this *a*-axis was the slip direction. In the samples deformed so that the direction of highest resolved shear stress in the base was intermediate between two *a*-axes (that is, parallel to an a^*-axis; C-193, C-246, C-253) the slip bands show variable development around the surfaces of the cylinders. They are very obvious in the direction parallel to a^*, however, and it is evident that slip did not take place parallel to the direction of highest resolved shear stress (a^*). The slip bands on C-253 are weak or absent along two longitudinal zones 80°–90° apart on the circumference of the cylinder; these do not have counterparts on the opposite ends of diameters. It is clear that the slip was complex and very inhomogeneous. The simplest explanation for the distribution of the slip bands in this group of crystals is that slip took place in alternate slip zones parallel to the two *a*-axes with highest (and equal) resolved shear stress coefficients.

The slip markings on polished crystals show, therefore, that slip occurs on the basal plane of quartz with an *a*-axis as the preferred slip direction. It may be noted that the *a*-axis is the shortest Burgers vector for a unit dislocation in the quartz lattice (4.91 Å).

EVIDENCE FROM DEFORMATION LAMELLAE

RELATION BETWEEN LAMELLAE AND SLIP MARKINGS

Plate 1, *C, D*, shows deformation lamellae in a thin section cut from specimen C-193 viewed with phase-contrast illumination. These lamellae are parallel to the basal plane within the limits of measurement. It was not possible to preserve the surface slip lines in the sectioning process, so we do not have a correlation between individual slip lines and lamellae. There seems to be little doubt, however, that the lamellae are actually traces of active slip planes. These lamellae are seen to be discontinuous and widely spaced, corresponding to the nature of the surface slip lines.

In more highly deformed specimens, the lamellae are more continuous and more closely spaced. In specimens containing kink bands, the lamellae are more continuous and more closely spaced in the more deformed kink bands than in the surrounding crystal. This is illustrated in plate 2, *E* of the preceding paper. In crystals oriented so that there is high shear stress on the basal plane, basal-deformation lamellae are profuse, while in crystals with low shear stress on the basal plane (e.g., compressed $\parallel c$ or $\perp m$), basal lamellae are absent. In quartzite, lamellae develop preferentially in those crystals whose basal plane has the highest shear stress. Thus wherever basal translation is indicated, basal lamellae develop in

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PLATE 2

A, Photomicrograph (reflected light) of "null zone" in polished crystal C-247 (0^+ orientation) shortened by *ca.* 10 per cent at 500° C., 20 kb. confining pressure. NE.-trending slip bands parallel to (0001) on left side of photo vanish in central light zone (for *ca.* 5° of rotation) and reappear on right. Similar zone occurs at *ca.* 180° of rotation, on other side of cylinder. Planes tangent to the null zones contain the slip direction. Photo is *ca.* 1.5 mm. wide.

B, Deformation lamellae (thin NW.-trending features) in slightly deformed region of C-193. Lamellae are asymmetric, dark on one side (higher index and birefringence than host quartz) and light on other side (lower index and birefringence by same amount). Lamellae in regions of low deformation are discontinuous; note the lamella which is continuous in the lower right, disappears near the center, and reappears as isolated nodes in the upper left. Scale lines represent 25 μ.

C, D, Same field of deformation lamellae (N.-S. linear features) in crystal C-116 in bright-field illumination (*C*) and phase contrast illumination (*D*); photos taken with 100× oil-immersion objective. Lamellae in *C* appear to be thick (1–2 μ wide) fuzzy features; in *D* they are sharp to 0.2 microns, the resolving power of optical system. Gradational kink-band boundary at bottom contains more profuse, slightly bent lamellae. Scale lines represent 25 μ.

intensity roughly proportional to the strain. Where basal translation is not favored, basal lamellae do not develop.

OPTICAL PROPERTIES OF DEFORMATION LAMELLAE

As noted in the preceding paper, the experimentally produced deformation lamellae closely resemble natural lamellae. In bright-field illumination they have the appearance of thin bands 1–2 μ thick with an index of refraction and a birefringence slightly less than that of the host quartz. When the microscope is focused on the upper surface of the thin section, they appear brighter than the quartz (in plane-polarized light) and are bordered by fuzzy dark regions. Figure 2, *a* is a plot of light intensity versus distance across a lamella in focus.

This appearance could result either from a change in the indices of refraction or from a change in thickness of the section at each lamella, since it is difference in optical thickness that is being observed. No change of relief is observable, however, on ground or polished surfaces in the vicinity of lamellae by optical or electron microscopy, so that the changes must result from changes in index.

In phase-contrast illumination deformation lamellae appear quite different, but again many natural lamellae are similar to the experimental lamellae. Experimental lamellae are easier to study at high magni-

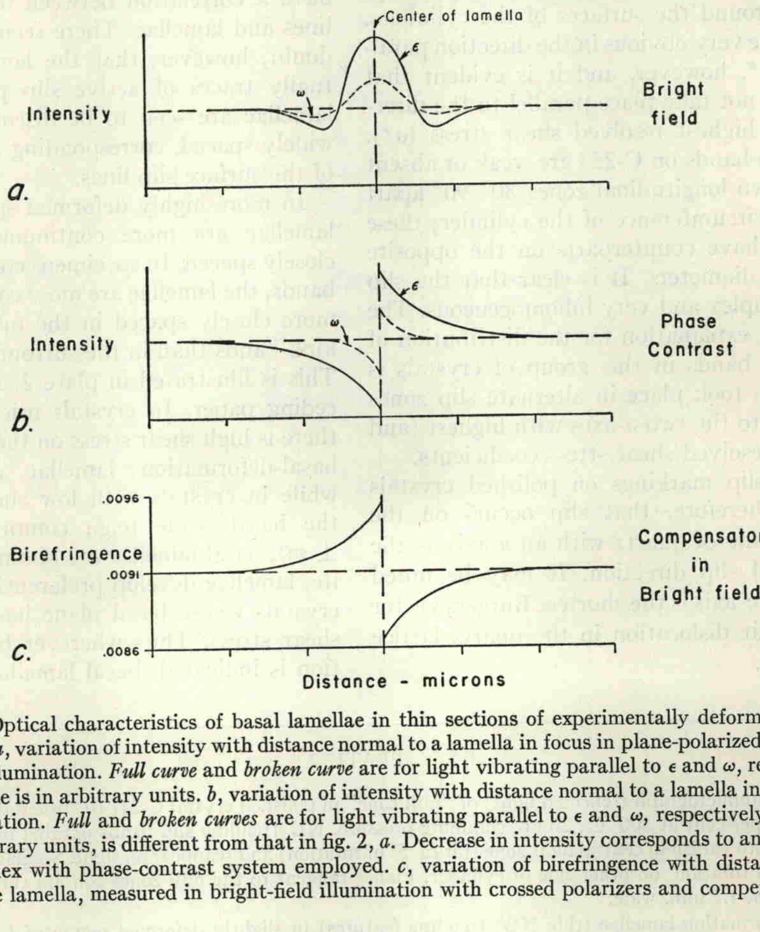

FIG. 2.—Optical characteristics of basal lamellae in thin sections of experimentally deformed crystals (schematic). *a*, variation of intensity with distance normal to a lamella in focus in plane-polarized light, with bright-field illumination. *Full curve* and *broken curve* are for light vibrating parallel to ε and ω, respectively. Intensity scale is in arbitrary units. *b*, variation of intensity with distance normal to a lamella in phase contrast illumination. *Full* and *broken curves* are for light vibrating parallel to ε and ω, respectively. Intensity scale, in arbitrary units, is different from that in fig. 2, *a*. Decrease in intensity corresponds to an increase of refractive index with phase-contrast system employed. *c*, variation of birefringence with distance normal to an average lamella, measured in bright-field illumination with crossed polarizers and compensator.