axes. The change in extinction position would be zero in a section normal to the dislocation lines. A change of extinction position would be evident in a section normal to x_2 and would amount to 1° for the dislocation spacing $h = 250b$, discussed above. (It may be noted in passing that a section parallel to the array would exhibit a change from isotropic to slightly birefringent [.0004], with the principal optic directions inclined at 45° to x_1 and x_2.) Thus arrays of screw dislocations would give a rotation which is not observed and fail to give the changes of indices which are observed.

NATURE AND MOTION OF THE DISLOCATIONS

In the foregoing model of deformation lamellae we have used the elastic properties of dislocations, and for such considerations the nature of a dislocation in a crystal of given elastic properties is specified by the orientation of the dislocation line and the orientation and length of the Burgers vector. We have not tried to construct a model of the atomic structure in the region close to the dislocation line.

The calculations are based on the assumption that the Burgers vectors are the distances between like atoms in the structure and hence are equal to the dimensions of the unit cell in the direction of slip (unit dislocations: Cottrell, 1953, p. 15). The Burgers vector selected for the basal edge dislocations is a (4.91 Å), the shortest dimension of the unit cell. This is consistent with our observation that slip is parallel to the a-axes; it is also the likeliest direction of slip, as dislocations with this Burgers vector have lower energy than any other unit dislocations in the base. Since we have not yet been able to obtain optical and electron microscope data from a lamella yielding a single row of etch pits, we cannot exclude the possibility of departures from this configuration. In particular, the dislocations might be partial rather than unit dislocations; and they might have a screw component rather than being pure edge dislocations.

The average distance (δ) which the dislocations have moved may be estimated from the measured strain and the dislocation density indicated by the electron micrographs:

$$\delta = \frac{s}{nb},$$

where s is the shear strain, n is the dislocation density, and b is the Burgers vector. In specimen C-240, s is 0.3 and n is 1.4×10^9 dislocations/cm,[2] from etch-pit counts in plate 4, *A*. Hence $\delta = 0.0044$ cm. or $9 \times 10^4 b$. Thus the dislocations must originate throughout the volume of the crystal and move only a microscopic distance before being trapped.

EVIDENCE FROM KINK BANDS

GEOMETRY OF KINK BANDS

The deformation bands produced in single crystals of quartz deformed in the cubic apparatus are illustrated in the preceding paper (Carter *et al.*, 1964, pls. 2, *E*, 3, *C*, and 4, *E*). Bands subparallel to the c-axis are developed in crystals compressed so that there is high shear stress on the basal plane. The boundaries of deformation bands in our samples vary in degree of sharpness, depending on the radius of curvature of the bent zone. Commonly, the boundaries are perfectly sharp and planar when viewed in thin section between crossed polarizers. The orientation of such a boundary may be measured with a universal stage in the same way as a cleavage or twin boundary. In many band boundaries, however, the radius of curvature is greater, though small compared with the half-width of the reoriented zone; the orientation of these boundaries cannot be determined fully by optical measurement. These bands grade into zones of indulatory extinction as the radius of curvature in the boundary becomes comparable with the half-width of the reoriented zone.

The incidence of deformation bands parallel to the c-axis appears to depend on the orientation of the crystals and the temperature at which the deformation occurred. Bands are rare in crystals of orientation 0^+, in which the maximum resolved shear stress in the basal plane was parallel to an a-axis; undulatory extinction is characteristic of these specimens. Bands are common in crystals compressed normal to r and z (that is, with maximum resolved shear stress in (0001) parallel to an a^*-axis), particularly at temperatures between 500° and 1000° C. In crystals of these orientations ($\perp r$, $\perp z$) deformed below 500° C., undulatory extinction is more typical than well-defined bands; and in crystals deformed above 1,000° C. the bands, though present, are local, narrow, and relatively short.

There is little consistency in the use of the terms "deformation band" and "kink band" in the literature on crystal deformation. The extensive literature on bands in metals has been reviewed by Barrett (1952) and by Cottrell (1953). The term "deformation band" is generally used for any lamellar region in a crystal whose orientation differs from that of the crystal as a result of deformation (excluding twinned layers). Various types of deformation bands have been described (see, e.g., Honeycombe, 1952). The term "kink band," originally coined by Orowan (1942) for structures produced in cadmium crystals by compression parallel to the basal slip plane, commonly implies a band resulting from localized slip on a single slip system; and it has been shown that kink bands in metals originate perpendicular to the slip plane and the slip direction (Barrett, 1952, p. 375). We therefore reserve the term "kink band" for those deformation bands in which there is evidence that the primary mechanism of deformation is single slip on planes nearly normal to the boundary

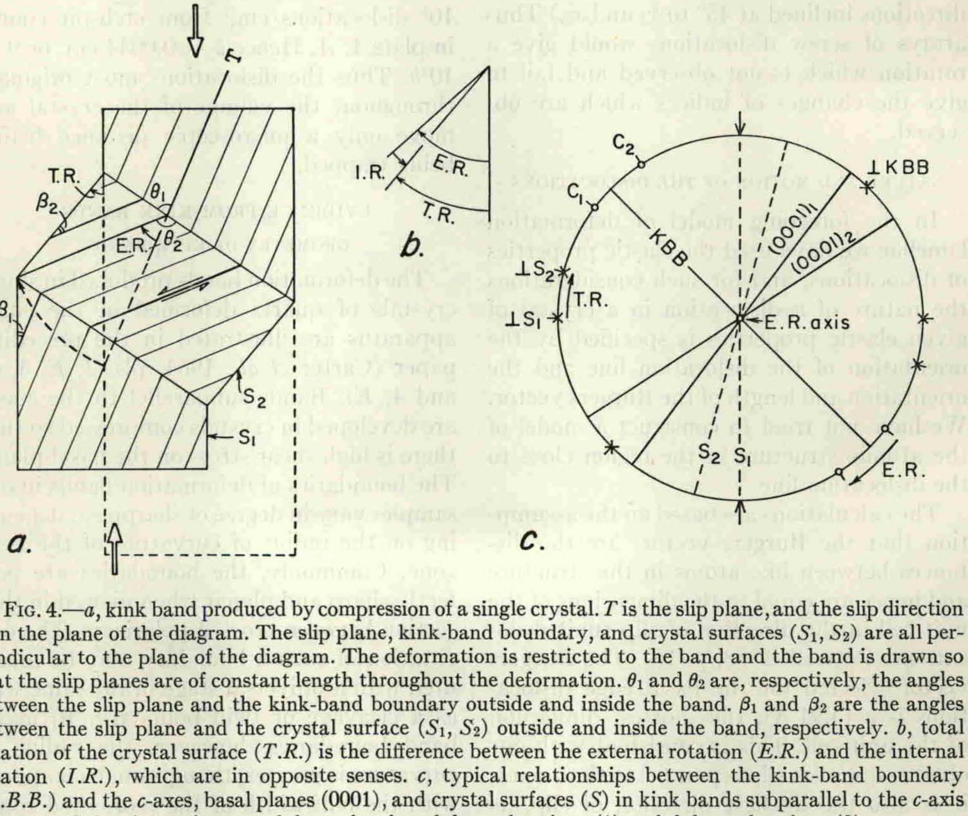

FIG. 4.—a, kink band produced by compression of a single crystal. T is the slip plane, and the slip direction is in the plane of the diagram. The slip plane, kink-band boundary, and crystal surfaces (S_1, S_2) are all perpendicular to the plane of the diagram. The deformation is restricted to the band and the band is drawn so that the slip planes are of constant length throughout the deformation. θ_1 and θ_2 are, respectively, the angles between the slip plane and the kink-band boundary outside and inside the band. β_1 and β_2 are the angles between the slip plane and the crystal surface (S_1, S_2) outside and inside the band, respectively. b, total rotation of the crystal surface ($T.R.$) is the difference between the external rotation ($E.R.$) and the internal rotation ($I.R.$), which are in opposite senses. c, typical relationships between the kink-band boundary ($K.B.B.$) and the c-axes, basal planes (0001), and crystal surfaces (S) in kink bands subparallel to the c-axis in quartz. Subscripts refer to undeformed or less-deformed regions (1) and deformed regions (2).