of the deformation band (kink-band boundary).

In the ideal case, where slip is restricted to one system nearly normal to the kink-band boundary, the following geometrical relations are required.

1. There is external rotation of the material in the band with respect to that outside the band about an axis which is the intersection of the slip plane and the kink boundary (fig. 4). This requires that the slip direction (t) be perpendicular to the axis of external rotation; if this were not so, complicated slip would be necessary in the kink boundary itself.

2. At the inception of kinking or bending, the boundary must be perpendicular to the slip plane and slip direction.

3. The atom planes parallel to the slip plane must be continuous across the boundaries of a kink band, so that, in the absence of elastic distortion,

$$d \sin \theta_1 = d \sin \theta_2$$

or

$$\theta_1 = \pi - \theta_2 ,$$

where d is the d-spacing of the slip plane and θ_1 and θ_2 are the angles between the slip planes and the boundary on each side of a boundary (fig. 4). Thus if single slip is strictly maintained, asymmetry of the structure on each side of a boundary must be accommodated by elastic strain.

4. In the absence of elastic distortions, from the relations in (2) and (3) it follows that a kink boundary must rotate with respect to the lattice on one or both sides to maintain the symmetrical relationship, unless there is slip of the same amount and opposite sense on each side of the boundary.

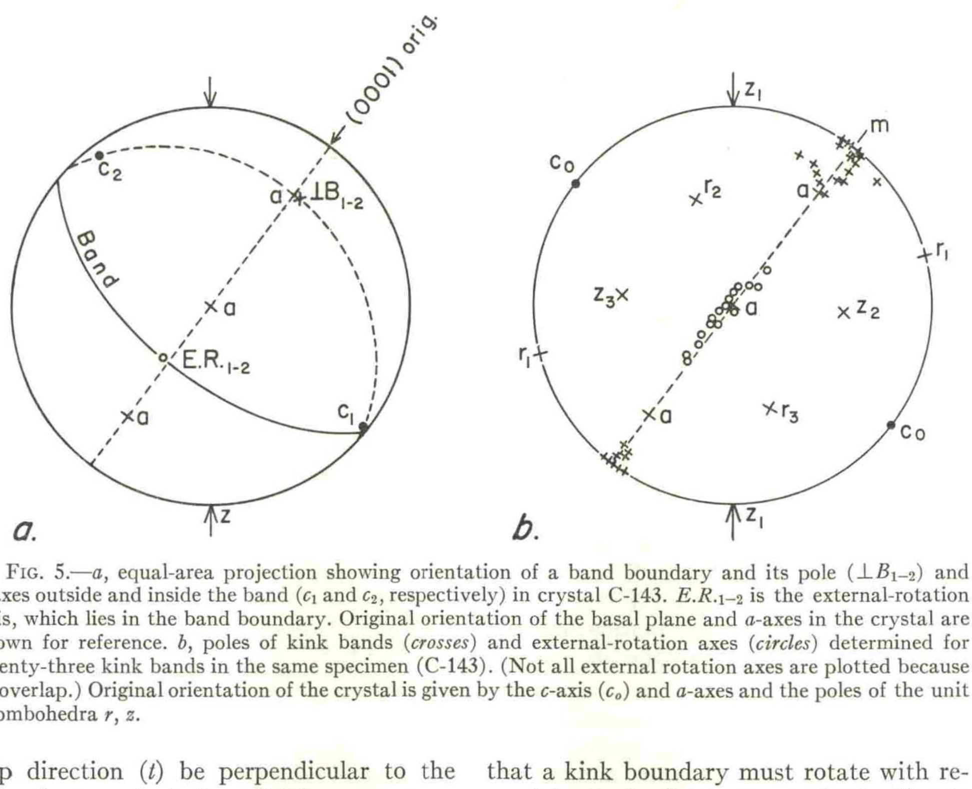

FIG. 5.—a, equal-area projection showing orientation of a band boundary and its pole ($\perp B_{1-2}$) and c-axes outside and inside the band (c_1 and c_2, respectively) in crystal C-143. $E.R._{1-2}$ is the external-rotation axis, which lies in the band boundary. Original orientation of the basal plane and a-axes in the crystal are shown for reference. b, poles of kink bands (*crosses*) and external-rotation axes (*circles*) determined for twenty-three kink bands in the same specimen (C-143). (Not all external rotation axes are plotted because of overlap.) Original orientation of the crystal is given by the c-axis (c_o) and a-axes and the poles of the unit rhombohedra r, z.

The more obvious characteristics of the deformation bands subparallel to the c-axis in our samples suggest that they are kink bands formed by basal slip:

a) The c-axes on each side of a band boundary lie in a plane normal to the boundary (figs. 4, 5), so that the external-rotation axis is the intersection of the band boundary with the basal planes on each side of it, as in (1) above. Moreover, the basal planes on both sides are inclined to the boundaries at angles close to $\pi/2$.

b) Deformation lamellae approximately parallel to the base are present in all bands of this type; these were shown above to be evidence of basal slip. The lamellae are more profuse in bands with larger external rotations and are commonly more closely spaced in the immediate vicinity of the boundaries.

c) The bands develop only in crystals in which there is high shear stress on the base and the sense of external rotation is consistent with slip on the base in the sense favored by the applied stress.

It is commonly possible to identify slip mechanisms in crystals by measuring the internal rotations of pre-existing planar structures (Turner, Griggs, and Heard, 1954). Unfortunately, the only such surfaces available in our samples are the cylindrical surfaces of the crystals, which are represented in thin sections (30 μ thick) by almost planar segments. Accurate measurement of the rotation of these surfaces in thin section is rendered difficult by the roughness of the surface in thin section and the fact that only a few kink bands extend without complication to the edge of the crystal as seen in thin section. Several localities were found, however, in which the orientations of the crystal surface inside and outside bands could be measured with an accuracy of 2° or 3°.

Figure 4 illustrates diagrammatically the rotation of the crystal edge within a kink band. The kink-band boundary and the slip plane (T) are normal to the plane of the diagram, so that the axis of external rotation must be perpendicular to the diagram and the slip direction must lie in the plane of the diagram. The slip is considered to be homogeneous within, and restricted to, the kink band. For single slip there should be no strain in the slip plane (T), and the diagram is drawn so that the length of the slip planes in the band is unchanged. It should be noted that this implies a decrease or increase in the dimension normal to the slip planes if they are not equally inclined to the kink-band boundary on each side of the boundary. The boundaries in our *c*-axis bands are in fact asymmetrical, as in figure 4; this departure from the ideal symmetrical kink boundary is discussed later. The internal rotation of any plane in the deformed part of the crystal is $(\beta_2 - \beta_1)$, where β_1 and β_2 are the angles between the plane being rotated and the slip plane outside and inside the kink band, respectively. These angles are related to the shear on the slip plane (s) by

$$\cot \beta_1 - \cot \beta_2 = s \sin \gamma ,$$

where γ is the angle between the slip direction and the axis of internal rotation, which is the intersection of the rotating plane and the slip plane (Turner *et al.*, 1954).

The external rotation $(\theta_2 - \theta_1)$ is related to the shear strain on the slip plane by the approximate relation,

$$\cot \theta_1 - \cot (\pi - \theta_2) \simeq s .$$

Hence

$$\cot \beta_1 - \cot \beta_2 \simeq \cot \theta_1 - \cot (\pi - \theta_2) ,$$

when $\gamma = 90°$.

In a section of crystal C-266 cut perpendicular to the external-rotation axis of the bands, the following angular values were measured in a band in which there were no subsidiary kinks or bend zones at the surface of the crystal:

$$\theta_1 = 89°, \quad \theta_2 = 108°, \quad \beta_1 = 44°, \quad \beta_2 = 53°.$$

The crystal surface was found to be parallel to the external-rotation axis; hence γ is 90°. Substituting the measured values of θ_1, θ_2, and β_1 in the above equation, the value 54° is obtained for β_2. Thus the rotation of the crystal surface is perfectly consistent with the operation of a basal slip mechanism. While this is the most accurate set of measurements obtained in our crystals, several other sets of measurements on bands with some degree of complication at the crystal surface are listed in table 2. The values of β_2 calculated on the assumption of basal slip