or in highly twinned grains one can easily mistake well developed e_2 lamellae for e_1 lamellae. The angle between compression axes derived from e_1 and e_2 lamellae, respectively, is 70 degrees, while that for the extension axes is 32 degrees. Clearly, Turner's technique can be expected to give the most meaningful results when applied to slightly and moderately deformed rocks (strain less than about 20 per cent), for in such rocks, the effects of limitations 1, 3, and 4 are usually negligible.

Rotation Phenomena

Intragranular Rotations. Gliding in a constrained crystal is accompanied by an external rotation of the gliding planes toward the axis of extension and away from the axis of compression. Turner[95] recognized that this would cause an internal rotation of any intersecting pre-existing plane to an irrational position within the lattice.* He was then able to develop an important new technique to identify gliding systems and to compute shear strain (e.g., for calcite, Ref. 95; for dolomite, see Ref. 55) and to utilize translation gliding systems for dynamic analysis.[125]

Consider, for example, a lamella P in existence prior to deformation (Fig. 33). This will be rotated to a new position by gliding on the set of parallel planes T. In an unconstrained crystal, the lamella P has been rotated internally to the position L in the deformed sector. In a constrained crystal the gliding plane T and the lamella P in the deformed sector have both been rotated externally relative to the load axis to T′ and P′, and P′ has also been internally rotated to L. Internal rotation is always opposite in sense to that of external rotation.

The concept of intragranular rotation is applicable to any crystal that can be examined in thin section with the petrographic microscope

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*External rotation is defined as rotation of crystallographic elements relative to external coordinates (e.g., rotation of the optic axis relative to the load axis). Internal rotation is defined as rotation of visible elements relative to internal coordinates (e.g., rotation of twin lamellae relative to the c_v of the crystal in the immediate vicinity of the lamellae).

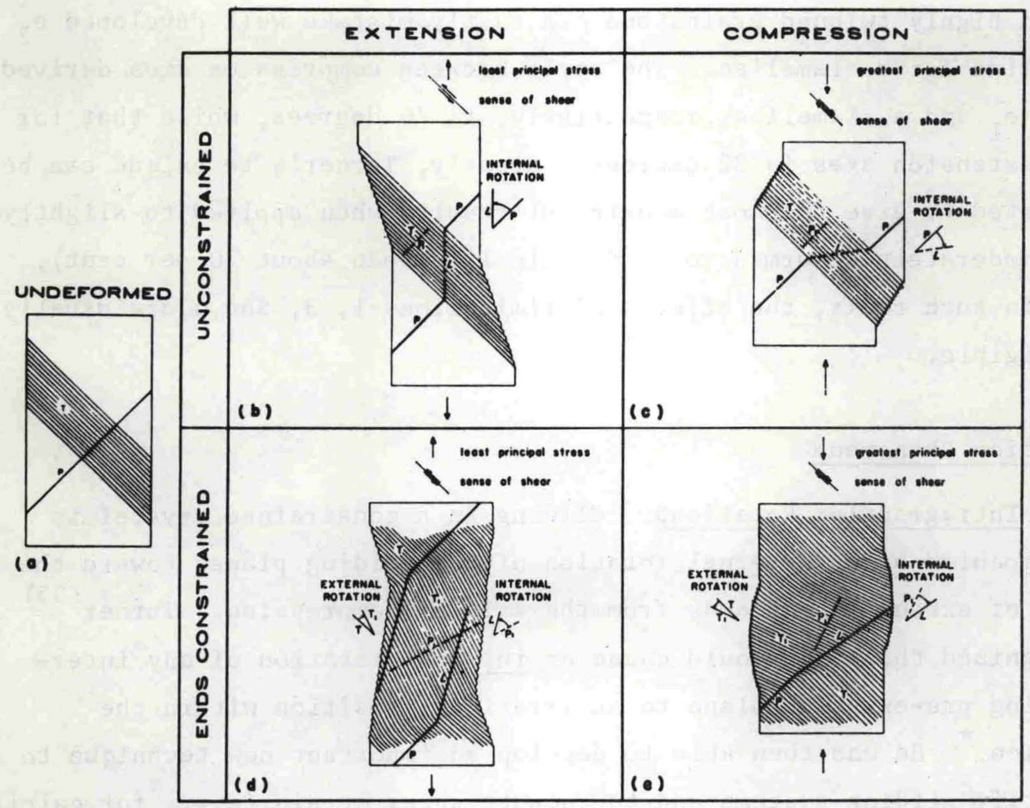

Fig. 33—Schematic illustration of internal and external rotations (from Higgs and Handin, Ref. 55, Fig. 1).

and universal stage. Visible rotations (Fig. 34) can be utilized even though the mechanism by which a pre-existing lamella is rotated through a crystal structure is not yet understood. Of importance here is that internal rotation of a visible feature is evidence that translation gliding has occurred even though there may be no visible trace parallel to the translation gliding plane itself. Once the translation gliding system is established, the directions of compression and extension that would best cause the gliding can then be determined in a manner similar to that employed for twin gliding. Christie[125] has utilized this approach and found good agreement between the principal stresses derived from internal rotation phenomena and those derived from f twin lamellae in dolomite.

Intragranular rotation phenomena in an experimentally deformed dolomite single crystal[55] serve to illustrate how a translation gliding system can be recognized and how the stresses that would most favorably produce the translation can be derived. A specimen was