twinning has been discussed by Bell[97] and Pabst[98] and the metallurgical literature includes reviews by Cahn[99] and Hall.[100]

It is adequate for our present purpose to consider the model of twin gliding illustrated by the hypothetical structure shown in Fig. 23. If the relative displacement (sense of shear) of the upper layers is

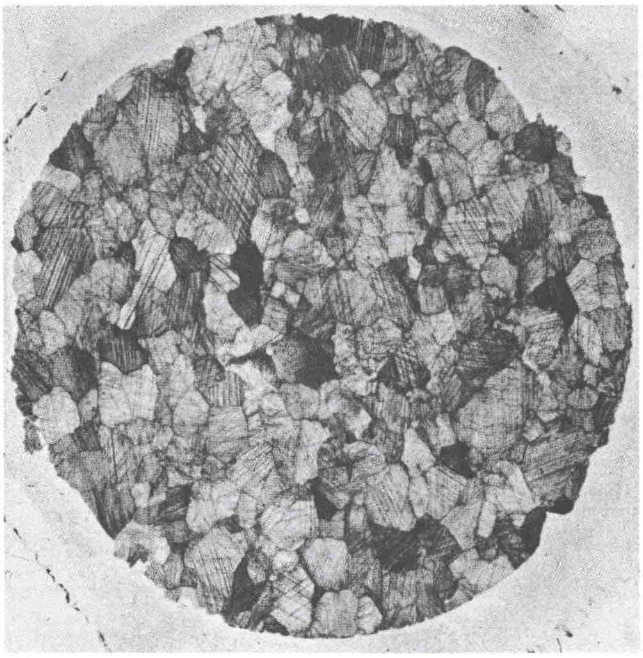

Fig. 22—Photomicrograph of e{01$\bar{1}$2} twin lamellae in calcite grains of a Pre-Cambrian (?) marble, Schell Creek Mountains, near Ely, Nevada. Diameter of the specimen is 1/2 in.

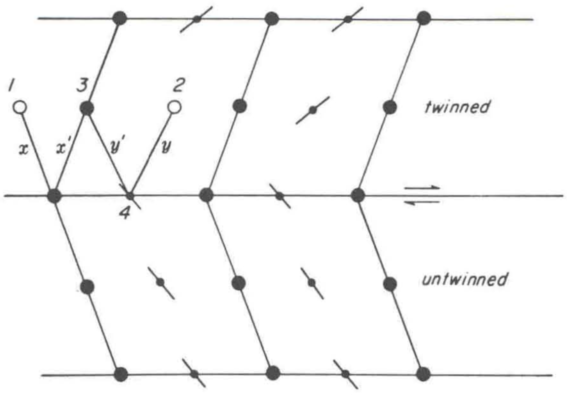

Fig. 23—Section through a hypothetical lattice illustrating different movements of the ions for different senses of shear in twin gliding (after Higgs and Handin, Ref. 55, Fig. 4). The plane of the paper is normal to the gliding plane and contains the gliding direction.

from left to right, the ion at position 1 (initial position) moves to position 3. The angle between lines x and x′ is the angle of shear (ψ), and the shear (s) is given by

$$s = 2 \tan \frac{\psi}{2} .$$

If the displacement of the upper layers is from right to left, the ion at position 2 (initial position) moves to position 3 and the angle of shear ψ' is between y and y′. Actually, twin gliding on a particular gliding plane is restricted to movement in only one direction, presumably that requiring the least energy. The proper sense of shear is indicated by the arrows. This qualitative picture of twin gliding involving only initial and final states of the ions is useful even though the actual paths of the ions may be unknown. Twin gliding systems for some 70 minerals have been compiled by Higgs.[96]

Dynamic Inferences from Gliding Systems. Twin and translation gliding is initiated for a given system when the resolved shear stress along the gliding direction and in the correct sense of shear exceeds a critical value τc. As gliding is largely independent of the normal stress, τc is reached most effectively when the resolved shear stress coefficient (S_o) is maximum (0.5). Accordingly, the most favorable state of stress in the crystal is characterized as follows: (1) σ_2 is parallel to the gliding plane (T) and normal to the gliding direction (t); (2) σ_1 is inclined at 45 degrees to T in the plane normal to T that contains t and is oriented so as to produce the correct sense of shear; and (3) σ_3 is inclined at 45 degrees to T in the plane containing t and σ_1. Clearly, if the gliding system(s) for a given crystal is known and if T and t can be recognized and measured, then one can derive the orientations of the principal stresses within the crystal that would best produce gliding. Petrofabric techniques are employed to locate these stresses in a number of individual crystals in polycrystalline aggregates, to plot them in fabric diagrams, and then to evaluate the average local state of stress in the rock at the time of gliding.