preferred orientation are considered to date from the late imprint of this deformation, when the strain had orthorhombic or higher symmetry, but the patterns preserve certain traces inherited from the earlier monoclinic movement.

The fabric of specimen IV differs from that of the other three specimens in that there is no evidence of complete crystallization of the quartz grains: the grains are relics of the clastic grains of the original sediment. The symmetry of the strain appears, however, to have been similar to that of the late paracrystalline imprint in the other specimens. Although recrystallization may have played a part in achieving the flattening of the rock, it was not sufficiently strong to obliterate the original texture. Plastic strain within the grains and intergranular shear appear to have been more important mechanisms of deformation.

The origin of the deformation lamellae.—Examination of the patterns of preferred orientation of the lamellae and of [0001]-axes in grains containing lamellae shows that in each rock these two elements show identical symmetry. But, as Turner has pointed out for other examples described in the literature (1948), the preferred orientation of the lamellae does not correspond in symmetry with that of the [0001]-axes in the rocks. This is particularly noticeable in the patterns for specimen IV; the pattern of preferred orientation of lamellae poles is almost perfectly orthorhombic and the three symmetry axes do not coincide with any of the fabric axes evident in the pattern of [0001]-axes (the 'flattening-foliation', S, and the axis of flattening, $\perp$ S). This lack of correspondence is also seen in the other specimens to a lesser extent; the symmetry of the pattern of lamellae poles is different from that of the [0001]-axes in each case.

From this we infer that the lamellae are secondary structures, dating from a late stage in the deformation of the rocks, and unrelated to the preferred orientation of the lattices of the quartz-grains (see Turner, 1948). They are not present in grains with all orientations in the general pattern of [0001]-axes. The patterns of preferred orientation of lamellae poles are not, however, so simple as those previously represented in the literature: although two maxima of poles, approximately 90° apart, are developed in the patterns for three of the specimens, a more constant feature of the patterns is the small-circle girdle about the axes designated A in the diagrams. The axial distribution of the lamellae poles in the specimens suggests that the lamellae have been produced by a simple compression (or tension) parallel to the axis A, as proposed by Turner (1948), but the surfaces of maximum shearing strain appear to be conic surfaces rather than two intersecting plane surfaces.

Before a further discussion of the origin of deformation lamellae is attempted, the nature of the structures must be considered. Several theories have been proposed to account for the orientation of deformation lamellae in the lattice of quartz: the lamellae have been considered as

a) Planes of twin-gliding (Judd, 1888) or translation-gliding parallel to rational crystallographic planes (Sander, 1930; Fischer, 1926; Schmidt, W., 1927; Savul, 1948)

b) Intragranular shear-surfaces with limited crystallographic control on the orientation (Fairbairn, 1941; Turner, 1948; and to some extent Hietanen, 1938)

c) Intragranular shear surfaces with no direct crystallographic control on their orientation (Ingerson and Tuttle, 1945).

The histograms in figure 6 show that the orientation of the lamellae in the lattices of the grains is rather highly restricted, but certainly not to the extent that {01$\bar{1}$2} twin-lamellae are restricted in the lattice of calcite. A great variety of rational indices have been assigned to deformation lamellae by previous writers (Savul, 1948) but the following facts lead us to conclude that the lamellae are not parallel to rational planes in the quartz lattice:

a) The angle between the lamellae and the base {0001} varies *continuously* in any single specimen from 0° to 40°, and larger angles also occur.

b) There are slight variations in the position of the main maximum in histograms for different specimens.

The lamellae therefore are not parallel to rational crystallographic planes, but their orientation in the lattice is otherwise restricted, as Fairbairn (1941), Ingerson and Tuttle (1945) and Turner (1948) have maintained.

Ingerson and Tuttle (1945) accounted for the apparent crystallographic control over the orientation of deformation lamellae in the grains of the Ajibik Quartzite by demonstrating that the angle between the [0001]-axis and the pole of the lamellae in the grains varies systematically with the inclination of the [0001]-axes to the *B*-axis of the fabric; they concluded that the crystallographic control was only apparent and due to the fact that i) lamellae were cozonal with the B-axis and ii) the [0001]-axes were generally inclined at high angles to the B-axis. It is impossible, however, to account for the restricted crystallographic orientation of the lamellae in specimens I-IV in this way. Examination of diagrams 2d, 3d, 4d and 5d shows that the angle between [0001] and the pole of the lamellae in any grain is not controlled by the relationship between [0001] and any of the fabric axes defined by the foliation and fold-axis; nor is there any evidence from the patterns (figs. 2d, 3d, 4d, 5d) that the angle between the lamellae and [0001] varies systematically with the inclination of the [0001]-axes to the symmetry axes of the quartz [0001]-patterns. The restriction in the crystallographic orientation of the lamellae in these specimens is therefore not merely apparent (and controlled by the orientation of the grain lattices in the fabrics). It must be accounted for in some other fashion.

A striking and hitherto unexplained feature of the diagrams (figs. 2d, 3d, 4d, 5d), showing the relationship between the lamellae and the [0001]-axes in individual grains in the rocks, is the fact that, in each specimen, the great-circles containing the pole of the lamellae and [0001] pass through, or close to, the axes (A_1, A_2, A_3, A_4) of the small-circles defined by lamellae poles. This feature is so consistently evident (see also Riley 1947, fig. 8) that it must have some significance. The control of quartz orientation and, more particularly, the development of undulose extinction in zones sub-parallel to [0001] has commonly been attributed to limited bend-gliding on the surfaces represented by the deformation-lamellae (Johnsen and Becke in discussion of Schmidt, 1927; Hietanen, 1948). But the radial arrangement of the zones containing