or the unit rhombohedral planes she postulated that they retained their initial orientation while the lattice was reoriented by a later deformational process in which one of the directions of closest packing of Si atoms in the grain lattices becomes oriented parallel to the *a* kinematic axis of the deformation. Hietanen also suggested that the early translation might take place on planes which diverge slightly from {0001}, in view of the 'screw-like' lattice structure of quartz.

Fairbairn (1941) and Ingerson and Tuttle (1945) have made extensive studies of the orientation of deformation lamellae in the Ajibik quartzite and other rocks. Fairbairn found that there was a stronger preferred orientation of the lamellae in the Ajibik quartzite than of the [0001]-axes, and inferred from this that the preferred orientation in the rock resulted from movements on the lamellae. The lamellae are inclined at variable angles to {0001}, but there is a strong maximum between 7° and 36°. The lack of a fixed crystallographic orientation for the lamellae obliged him to assume only a fixed glide-line [m:r], lying in the base, with variable glide-planes containing this line. Ingerson and Tuttle (1945) also demonstrated a conspicuous lack of crystallographic control in the orientation of the lamellae in the Ajibik quartzite, and their measurements show an even greater range of crystallographic orientation. These investigators also examined data for many grains with two or three sets of lamellae and concluded that these lamellae were not parallel to rational crystallographic planes. The angles between the lamellae and {0001} in the grains, however, did appear to be closely controlled by the orientation of individual grains in the fabric of the rock. Ingerson and Tuttle concluded that the lamellae are deformation-planes "such as would form in homogeneous material"; and that such crystallographic control as exists is only apparent, being actually dependent on the orientation of the grains with respect to the fabric axes. The poles of the lamellae in the Ajibik quartzite (as in many other rocks with quartz grains containing lamellae) form two strong maxima lying in the *ac* plane of the fabric and symmetrically oriented approximately 45° from the foliation. Ingerson and Tuttle claimed that in this and other specimens examined by them the pole of the lamellae in any grain lies between the [0001]-axis in the grain and the *a* fabric axis of the specimen. They suggested that this relationship might be used to locate the fabric axes in a rock, such as a massive quartzite, in which there is no other means of determining the fabric axes.

In his analysis of the microscopic structures in the Baraboo Quartzite, Riley (1947) found that deformation lamellae were extensively developed in rocks which showed very weak preferred orientations of the quartz grains. Applying the method suggested by Ingerson and Tuttle for locating fabric axes from the patterns of lamellae, Riley showed that the fabric axes thus obtained do not coincide with the fabric axes determined from megascopic data. He therefore inferred that, if the fabric axes determined from deformation lamellae are, in fact, related to the megascopic fabric axes in other areas, as Ingerson and Tuttle reported, the lamellae in the Baraboo Quartzite must date from a phase of deformation different from that which produced the foliation and folds.

Savul (1948) measured the orientation of deformation lamellae and optic axes in different parts of individual deformed grains of quartz in a number of granitic rocks and quartz porphyries, selecting particularly grains with several sets of lamellae. On the basis of the angle between the poles of the lamellae and [0001], he distinguished 3 groups of lamellae; in one group the angles are between 8° and 36°, in the second, between 53° and 59°, and in the third, between 72° and 75°. These do not correspond to any of the common crystal faces in quartz. Savul superimposed the stereograms for measured quartz grains on a projection of a quartz crystal showing all the possible forms. This was also done for a number of quartz grains with several sets of lamellae and a few well-developed crystal faces. The lamellae, according to Savul, coincide most closely with the forms $\{10\bar{1}2\}$, $\{\bar{1}2\bar{1}6\}$, $\{3\bar{1}\bar{2}2\}$, and $\{10\bar{1}4\}$ and he considered them to be produced by translation-gliding on these planes.

In the majority of cases in which deformation lamellae have been investigated in quartz tectonites, they have been interpreted as visible traces of the deformations which oriented the grains in the rocks. But Turner (1948) drew attention to incompatibility between the patterns of preferred orientation of lamellae and of other elements in the fabric in many of the examples described in the literature. Continuity of lamellae across grain boundaries (Mackie, 1947) implies that the grains must have had their present orientation in the rocks before the formation of the lamellae. Turner therefore suggested that the lamellae probably represent, in most cases, late-stage structures unrelated to the preferred orientation of the lattices of the grains. The lamellae are commonly oriented so that their poles define two strong maxima between 60° and 90° apart, a relationship which would indicate that the formation of the lamellae "is favored by simple compression (as in a vise) with consequent relatively slight differential movement upon surfaces of maximum resolved shear stress so induced" (Turner, 1948, p. 567).

Weiss (1954) has described the orientation of deformation lamellae and the somewhat similar deformation bands (Riley, 1947) in the quartzitic rocks of the Barstow area in Southern California. Weiss also considered that the lamellae were of rather late origin, and unrelated to the movements which produced the preferred orientation of the grains in which they occur.

NEW DATA

Introduction.—Several authors have stated that deformation lamellae are of rather uncommon occurrence in rocks, but we have found that they are extensively developed in quartzites in metamorphic terranes in north-west Scotland (Christie, 1956) and Southern California. In the present paper the results of detailed microscopic analyses of four quartzite specimens are presented and an interpretation of the lamellar structures is proposed. Three of the specimens (I, II, III) are crystalline quartzites from the Orocopia Schists in the north-west corner of the Orocopia Mountains in Southern California, and the fourth (IV) is a deformed Cambrian quartzite collected a few feet below the outcrop of the Moine Thrust near the Stack of Glencoul, in the Assynt district of Scotland. The grains in all four specimens contain abundant deformation lamellae and other evidence of post-crystalline strain, such as undulose extinction.

Nature of the structures examined.—The planar structures whose orienta-