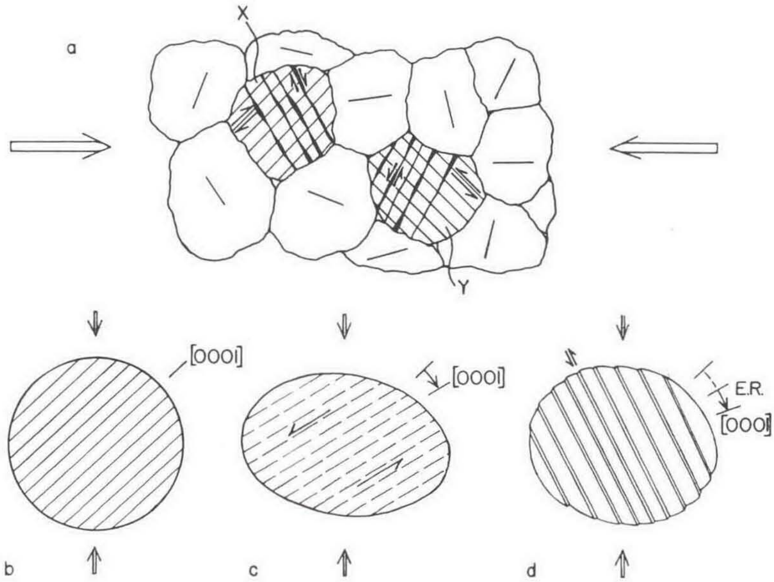

Fig. 7. Diagrammatic representation of the process of formation of deformation lamellae.

a. Aggregate of quartz grains, represented in two dimensions; uniform parallel lines in grains X and Y and short lines in other grains indicate the orientations of the [0001]-axes; irregular lines in grains X and Y represent deformation lamellae.

b,c,d. Change of shape of a grain of initially circular cross-section as a result of 1) shearing on surfaces parallel to [0001] and 2) kinking along planes inclined at a high angle to [0001]. The external rotation (E.R.) of the grain is shown qualitatively. Thick opposed arrows represent the direction of compression. For fuller explanation see text.

the production of kink-bands (fig. 7d) has the effect of correcting, at least to some extent, the change of shape induced by the gliding. Thus, if kink-bands are produced, gliding parallel to [0001] may take place with less change of shape than would be necessary in the absence of kinking.

It is probable that the undulose extinction and deformation lamellae are produced with a relatively small amount of post-crystalline strain, since in most of the specimens (I, II, III) there is no marginal granulation or marked elongation of grains. Moreover, the amount of strain in a grain containing kink-bands is reflected in the degree of external rotation of the kink-bands (that is, in differences of extinction position between the lamellae and host grain). These differences are very slight in deformation lamellae so that the strain must also be slight. It is significant that in highly deformed quartzites containing large amounts of granulated quartz and with very strong undulose extinction in the porphyroclastic relics, deformation lamellae are absent.[1] It is probable, in our opinion, that when deformation is so intense that differential movement and external rotation of grains occur, the restriction on individual grains is removed and deformation lamellae are no longer produced.

We do not wish to suggest that the mechanism postulated above is the

[1] This was noted by one of the writers (J.M.C.) in intensely deformed quartzites of the Assynt region.

only one which is operative in the deformation of quartz, or that it plays an important part in the development of preferred orientations in tectonites. There can be little doubt that solution and recrystallization are important in the reorienting of quartz and other mechanisms of plastic deformation may yet be demonstrated under conditions not yet attainable in the laboratory. However, the evidence described above leads us to conclude that it is significant in the initial stages of post-crystalline deformation of quartz and leads to the production of deformation lamellae.

A few deformation lamellae in the specimens may not have originated as kink-bands in the manner outlined above. Numerous cases are recorded, in specimens described herein and in the literature, of grains in which the lamellae are not inclined at high angles to the [0001]-axis. These lamellae may be shear-planes "induced" in a grain by the deformation of neighboring grains in the aggregate, either by gliding parallel to [0001] or by production of deformation lamellae in a neighboring grain. This view is supported by the existence of lamellae which pass more or less uninterrupted from one grain to another (Mackie, 1947, and present writers' observations). Moreover, some lamellae, particularly those which obviously consist of discrete inclusions and do not differ in refractive index from the host grain, may be relics of earlier fractures or deformation lamellae which have survived recrystallization of the grains (Hietanen, 1938).

Summary of hypothesis.—The deformation lamellae do not date from the deformation which produced the strong preferred orientations of the quartz grains in the rocks, but from a late penetrative deformation which has caused only slight strain and has had little or no effect on the preferred orientation. The grains have deformed by gliding on irregular surfaces in the zone of [0001] parallel to the direction [0001] and the lamellae are interpreted as kink-bands produced by this gliding. The strong preferred orientation of the lamellae is controlled by the preferred orientation of the grains in which such gliding has taken place, these grains being the ones which are oriented so that there is high resolved shear stress suitable for gliding parallel to [0001].

In the specimens described the [0001]-axes in grains with deformation lamellae define a small-circle girdle, representing a circular cone. The glide-surfaces are probably tangential to this cone and the poles of the induced kink-bands (deformation lamellae) also define a small-circle about the same axis. The orientation of the fabric elements suggests that the deformation was produced by a compression parallel to the axis of these small-circles. Two maxima are recognizable in some of the patterns of preferred orientation of lamellae, but the orientation and relative strengths of these maxima appear to be influenced by the existing preferred orientation in the rock before the production of the lamellae, rather than by the stress configuration during the deformation which produced the lamellae.

APPLICATION OF THE HYPOTHESIS

Significance of the proposed hypothesis.—If the above hypothesis is reliable it should be of direct application to the *dynamic* interpretation of the microfabric of deformed rocks.

The axis of the small-circle girdles defined by poles of deformation lamel-