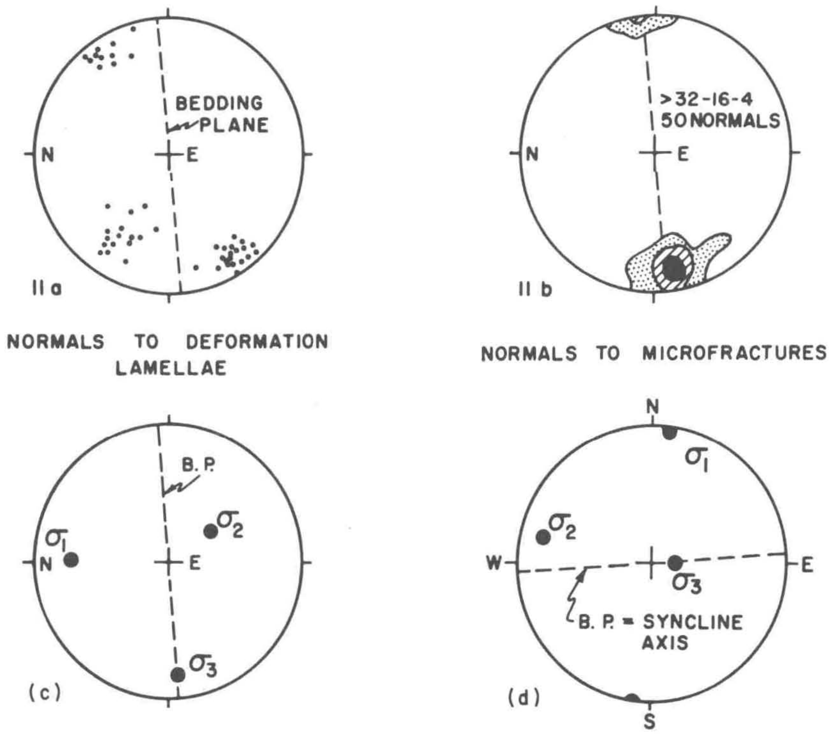

Fig. 40—Diagrams (11a and 11b) illustrating the orientation of 50 sets of quartz deformation lamellae and of microfractures, respectively, in a Baraboo quartzite specimen (from Riley, Ref. 141, Fig. 11). (c) Stereogram shows the orientation of the principal stresses deduced from the deformation lamellae and the microfractures, assuming the latter are extension fractures and the former are in planes of high shear stress and inclined at < 45 degrees to σ_1. (d) Stereogram shows same data rotated to horizontal plane, with north as indicated. σ_1 is nearly perpendicular to both the synclinal axis and the bedding plane.

From his studies of quartz deformation lamellae and microfractures in garnet grains of a quartz-mica schist, Naha (Ref. 149, p. 120) concluded that the normals to "deformation lamellae in quartz ... show two maxima in an incomplete girdle normal to the fold axis [i.e., the lamellae intersect in the fold axis] and are symmetrically situated with reference to late tension cracks in garnet." Thus the lamellae "have formed parallel to the two planes of maximum shearing strain...." His diagrams (see Fig. 41) show that the two sets of lamellae intersect at 78 degrees and that the set of microfractures acutely bisects this angle. This combined geometry is similar to that obtained by Riley. Here the derived σ_1 and σ_3 axes are oriented normal to the fold axis.

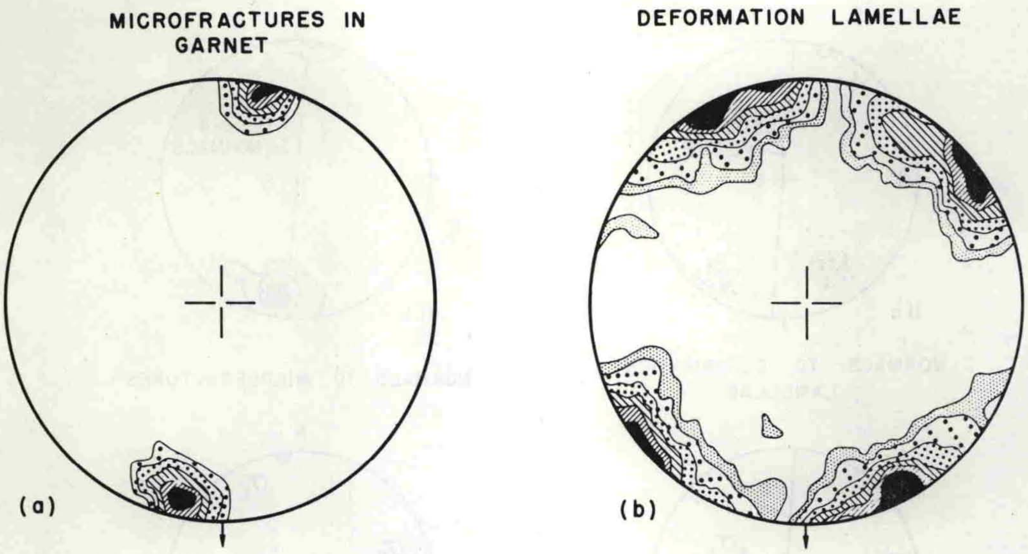

Fig. 41—Diagrams illustrating the orientation of microfractures in garnet (a) and deformation lamellae in quartz (b) (from Naha, Ref. 149, Fig. 2). Plane of each diagram is parallel to the ac plane of a fold, i.e., the fold axis is at the center. (a) Normals to 54 microfractures in 14 garnet grains. Contours are at 5, 10, 20, 30, 40, and 45 per cent per 1 per cent area, 52 per cent maximum. (b) Normals to 158 deformation lamellae in quartz. Contours are at 0.66, 1.3, 3.5, 7, 9, and 11 per cent per 1 per cent area, 13.7 per cent maximum.

Additional confirmation of these interpretations is afforded by Hansen and Borg[120] who studied both quartz deformation lamellae (Fig. 42) and calcite twin lamellae in three oriented samples of Devonian Oriskany calcite-cemented sandstone from an Appalachian fold in eastern Pennsylvania. Compression and extension axes derived from the deformed calcite cement are shown in Figs. 43(a), 43(b), 44(a), 44(b), 45(a), and 45(b). In each case the derived σ_1 is within 10 degrees of the bedding and is normal to the fold axis, and σ_3 is normal to the bedding,* so that σ_2 is subparallel to the bedding and to the fold axis. The orientation patterns of normals to the quartz deformation lamellae (Figs. 43(c), 44(c), and 45(c)) correspondingly show two distinct concentrations connected by an incomplete small circle girdle of 52 to 60 degrees half-angle, i.e., the lamellae lie along the surfaces of cones with half-angles of 30 to 38 degrees.

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*The girdle of extension axes in specimen E2 is an exception. It indicates that $\sigma_2 \simeq \sigma_3$ in magnitude for this specimen.