in featherlike form. Conchoidal structure consists of concentric grooves and ridges which usually center about one or two points on the surface. It is not clear whether conchoidal structure is merely a part of a larger plumose structure or a separate phenomenon with distinct genetic implications. The only certain fact about these features is that where they occur there has been little shear movement along the surface in question. Hodgson (Ref. 77, p. 29) implies that plumose and conchoidal structure are not diagnostic criteria. On the other hand, Parker (Ref. 74, p. 397) and Roberts (Ref. 78, p. 486) find that plumose structures are apparently restricted to shear fractures or faults. This would imply at least some shear displacement at the time of formation. Further analysis of these features, perhaps experimentally, would seem justified as it might lead to diagnostic criteria.

Field Examples--Microfractures. To the writer's knowledge there are only a few published studies in which the subfabrics of microfractures have been used to derive the orientations of the principal stress in rocks at the time of deformation. On the microscopic scale, fractures occur in the individual grains or crystals of the rock. They may or may not cross grain contacts. Their size, therefore, is somewhat dependent upon grain size. Though they may be visible to the unaided eye, they are best studied in thin section with the aid of the petrographic microscope and universal stage. The microfractures are often essentially planar features such that their dip and strike can be measured by one setting of the universal stage. Commonly they are developed in sets of two or more parallel individual features. They are fresh clean breaks in all experimentally deformed rocks and are commonly healed or filled in naturally deformed rocks.

That microfractures can be valid dynamic fabric elements has been demonstrated by studies of experimentally deformed, dry, unconsolidated, quartz sand aggregates and calcite-cemented sandstones.[58,59] Results show statistically that the grains tend to fracture with respect to the principal stresses across the boundaries of the whole specimen rather than with respect to local stress concentrations at grain contacts (Fig. 11). That is, even though the stresses must be transmitted

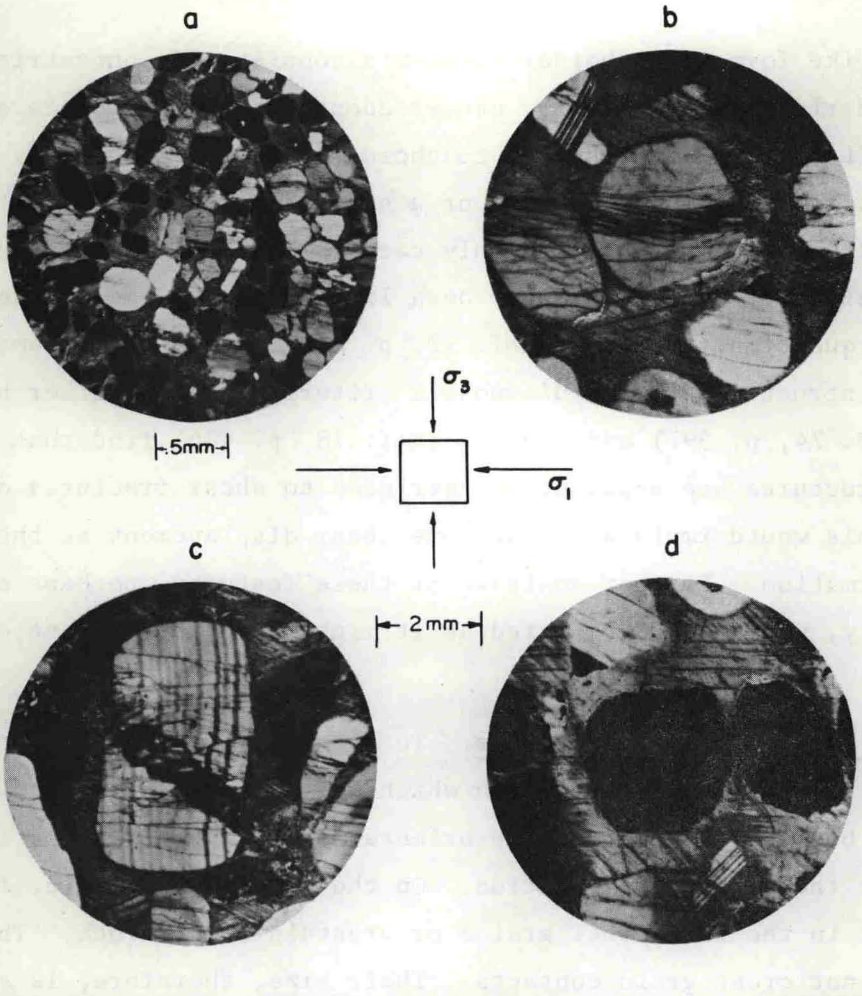

Fig. 11—Photomicrographs of microfractures in quartz and feldspar grains in an experimentally deformed calcite-sand crystal (from Friedman, Ref. 59, plate 2). The orientation of the principal stresses across the boundaries of the whole specimen is shown; extension fractures predominate.

through grain boundaries, the individual grains tend to fracture as if each grain were loaded in the same manner as the whole aggregate. This is a statistical statement, but reference to the photomicrographs in Fig. 11 shows that the phenomenon is quite pronounced. Moreover, the phenomenon in quartz grains is essentially independent of the crystal structure of quartz.*(59)

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*This result for quartz sand aggregates is in marked contrast to recent data on quartz single crystals deformed at very high pressure. In such specimens the fracturing and faulting is controlled by the anisotropy of the crystal structure.