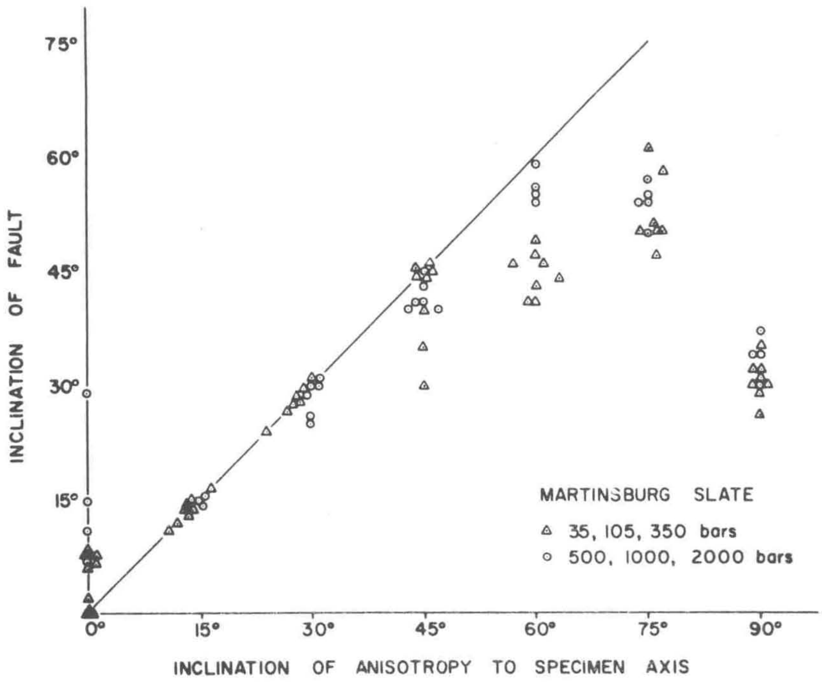

Fig. 9—Effect of cleavage on the angle of faulting, Martinsburg slate (Donath, Ref. 64).

and Griffith theories, for example, have been discussed by Brace earlier in these proceedings.[34] It is significant that all current theories and experimental observations show that θ is less than 45 degrees, and the relationships shown in Fig. 8(a) are essentially valid.

That naturally deformed rocks fault at less than 45 degrees to σ_1 is demonstrated by the attitude of normal faults in regions where it is logical to assume that σ_1 was nearly vertical at the time of faulting. Hubbert[65] points out that in areas of relatively uncomplicated structure normal faults occur with dips consistently greater than 45 degrees. He cites Sax's[66] study of the dip of 2102 individual underground faults in the coal measures of the Netherlands, which shows that 1651 of these were normal faults and had a well-defined preference to dip 63 degrees (the remaining were reverse faults with dip preference at 22 degrees). Moreover, the average dip of normal faults (from United States Geological Survey Folios published to 1913) is 78 degrees.[67] Anderson[68] has generalized these relationships by calling attention to the orientation of the principal stresses with respect to normal, reverse, and wrench faults (Fig. 10).

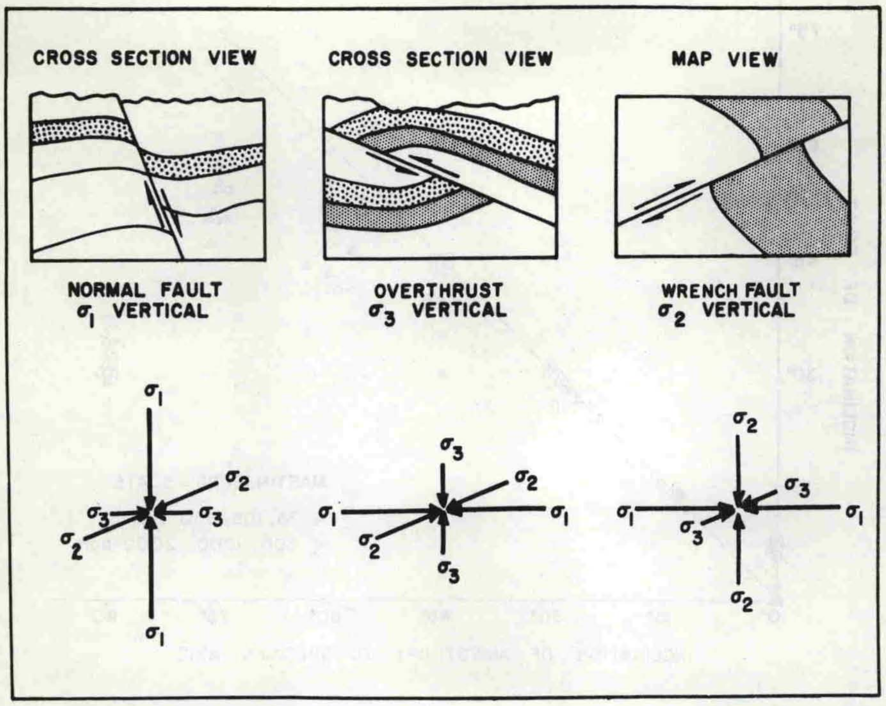

Fig. 10—The orientations of the principal stresses associated with the common fault types (after Anderson, Ref. 68).

Empirically the processes of faulting and of shear and extension fracturing are independent of scale down to at least the microscopic domain (10^{-5} m). Thus one may consider microfractures in individual grains of a rock as essentially identical genetically and geometrically to fractures and faults of outcrop scale and larger. This is a useful concept in petrofabrics as it leads to predictions of large-scale features from statistical inferences drawn from the study of smaller-scale features.

Dynamic Interpretation of Fractures and Faults. Suppose that a given domain contains extension and shear fractures which for the purpose of this discussion have no distinguishing characteristics other than their attitude in space. That is, extension fractures can not be distinguished by any physical feature from shear fractures. The fractures within a given size range are collectively regarded as a fabric element, their orientations are measured, and their subfabric is illustrated by the distribution of their normals on a petrofabric diagram.