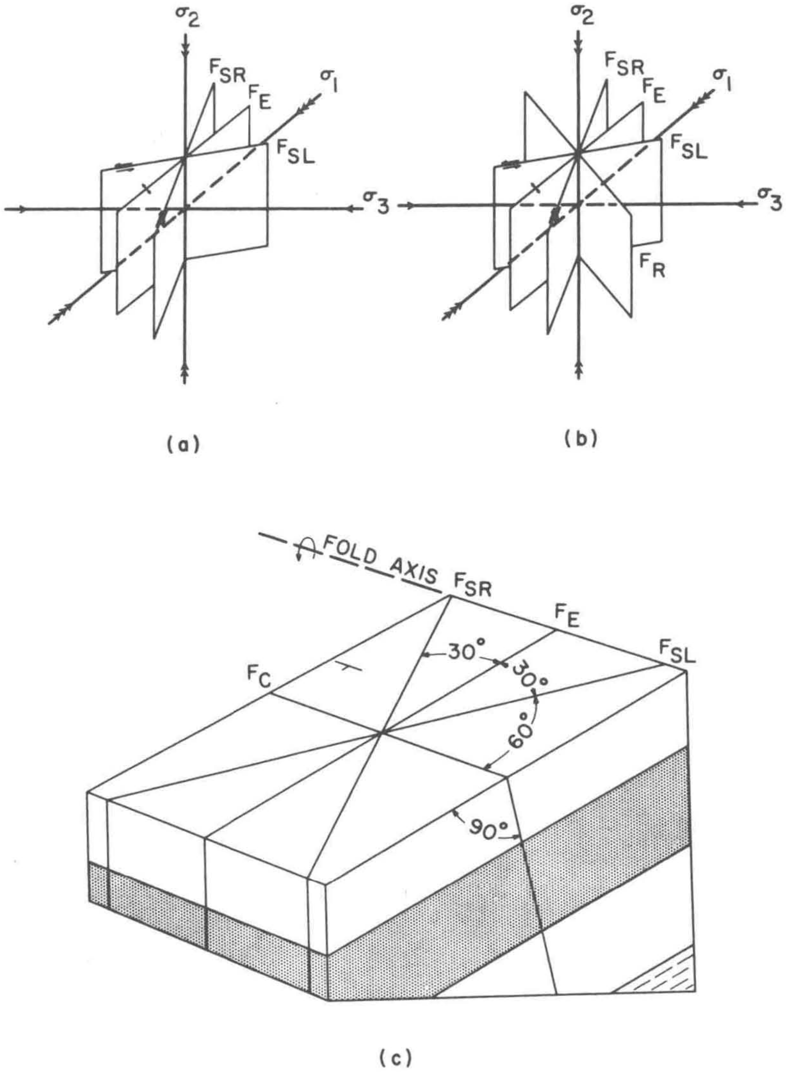

Fig. 8—Idealized geometric relationships between the principal stresses and fractures. (a) Two shear fractures (F_{SL} and F_{SR}) are illustrated with the enclosed extension fracture (F_E). (b) A relaxation fracture (F_R) is added to the configuration in (a). (c) An additional extension fracture (F_C) is added to the geometry in (a) in folded beds only.

along which the shear displacement is greater than about 1 m. These terms are then descriptive within the bounds of shear failure and do not necessarily imply distinction between the shear fracturing and the faulting processes.

The correlation between faults (including shear fractures) and the principal stresses has been established by a wealth of empirical data. In homogeneous, isotropic materials in which $\sigma_1 > \sigma_2 > \sigma_3$, a fault may occur along one or both of two equipotential surfaces, each inclined from 45 degrees to a few degrees to the direction of σ_1. When faulting occurs along both surfaces, σ_1 is the acute bisector; σ_2 lies in the plane of the faults (parallel to their line of intersection); and σ_3 is the obtuse bisector (Fig. 8(a)). For rocks that do not have pronounced planar anisotropy, the angle between σ_1 and the fault (θ) varies within narrow limits. In 70 short-time triaxial compression tests on a variety of dry sedimentary rocks at room temperature and 0 to 2-kb confining pressure, θ ranges from 25 to 35 degrees in 65 per cent of the cases and from 20 to 40 degrees in 95 per cent of the cases.(3) Subsequent work by Handin and Hager(35) at elevated temperatures and in the presence of pore water(36) has confirmed the earlier results. In fact, one of the outstandingly consistent observations from all properly designed short-time experiments on a wide variety of rock types is that faults tend to occur at less than 45 degrees to σ_1.(3,33-59) This holds also for sandstone, Solenhofen limestone, and diorite deformed at strain rates from 10^{-1} to 10^{-5} sec^{-1},(60) and for Solenhofen limestone, granite, diabase, dunite, and quartzite deformed at strain rates to 10^{-7} sec^{-1}.(61)

In rocks with strong planar anisotropy the value of θ is dependent upon the orientation of the foliation, schistosity, or cleavage (s-planes) with respect to the load axis (Fig. 9).(62-64) For rocks experimentally deformed at room temperature and under confining pressures up to 2000 bars, faults tend to develop parallel to the s-planes for inclinations up to 60 degrees to the direction of maximum principal stress. When the s-planes are at 60 and at 75 degrees to the load axis, θ tends to be between 40 and 60 degrees; and when the s-planes are at 90 degrees to the load axis, θ is again at about 30 degrees. Moreover, in all except the 90-degree orientation the strike of the fault tends to parallel that of the s-planes in the test specimens.(63)

No entirely satisfactory theory of shear fracture or faulting is yet available. This is not to say, however, that there are no criteria which qualitatively describe shear failure in rocks. The Coulomb-Mohr