arguments, which verge on petulancy, I proposed that metastable crystallization, *with or without metasomatism,* may be responsible for blueschists. There are rocks (metacherts) that clearly show both introduction of sodium and reduction of ferric iron with progressive metamorphism (Coleman and Taylor, 1968, p. 1739; Gresens, 1969, p. 96, 98). There are examples of unusually Fe^{+2}-rich amphiboles and pyroxenes from blueschist rocks that the investigator attributed to the low oxygen fugacity of the metamorphic environment (Black, 1970a, b). There is a report of native iron in glaucophane-lawsonite schist (Quodling, 1964; Joplin, 1968, p. 100). I would argue that these are cases in which the genetic link to the reducing environment generated by serpentinites is established. However, Ernst cited valid examples of metagraywackes in which the ferric/ferrous ratio is virtually unchanged and no introduction of sodium is apparent. Such rocks are unquestionably a problem for my hypothesis. I can only state that I think that metastable recrystallization was produced essentially isochemically in these rocks by the influence of the pore fluid, and I speculated in my paper (1969, p. 99-105) that poorly understood kinetic factors were involved that led to the development of minerals with low amounts of tetrahedrally coordinated Al. With regard to this hypothetical effect of pore fluid chemistry on the structural position of Al, I am heartened by a recent publication by Martin (1969). He showed that the most important factor controlling Al–Si ordering of hydrothermally grown albite is the sodium concentration of the pore fluid (more important than P and T). This is an example of a thermodynamically unpredictable kinetic factor, involving the chemistry of the pore fluid, that can influence the structural position of Al in a silicate mineral. Another encouraging paper by Daniels and Skoultchi (1966) on pressure-induced phase changes in simple ionic compounds speculates that "the surface layers of the crystal have sufficiently different crystal binding compared to the interior, that they will transform at a lower value of the applied pressure than does the interior. . . . Thus there would be some pressure range below the 'true' equilibrium pressure in which the structure of the surface layers of the crystal was unstable with respect to that of the bulk . . . the question arises whether in these circumstances the surface layers will transform and if they do, whether the adjacent layers will become unstable, etc. whence the entire crystal would assume one structure in ambient conditions in which a surfaceless crystal would have a different structure."

With regard to the problem of how the ferric/ferrous ratio could remain virtually unchanged if a reducing pore fluid were present, the process clearly is not understood. But that it is possible is clear from the occurrence of authigenic blue amphiboles and sodic pyroxenes in the Green River formation. Milton and Eugster (1959) reported the presence of these minerals (which grew in a saline, reducing brine in the final evaporation of the ancient lake) and were puzzled by the oxidation-reduction relationships, noting (p. 141) that "The presence of authigenic acmite and an intermediate member of the magnesioriebeckite-riebeckite series in the Green River formation has been a surprise. . . . The oxygen pressures in the Green River formation are generally considered to have been low. . . . Yet both acmite and magnesioriebeckite-riebeckite contain essentially ferric iron only." They went on to say that Ernst (1957) had shown that magnesioriebeckite can exist at very low oxygen pressures.

Ernst's hypothetical dynamic model (p. 101-104) has problems of its own that should be pointed out. Ernst recognized, as do others (for example, Coleman, 1971, p. 1218-1219) that the relative motion on the Benioff zone is in the wrong sense to be able tectonically to juxtapose supposedly deeply metamorphosed Franciscan rocks against the shallower Great Valley sequence. Although Ernst postulated a series of imbricate thrust faults to mix blueschist rocks with weakly metamorphosed Franciscan rocks, the basic problem remains. If his dynamic model of deep tectonic burial is correct, then unless relative motion on the Benioff zone is reversed, there is no way to bring Franciscan blueschists into contact with Great Valley rocks. If buoyant forces brought Franciscan rocks to their present position, there should be some field structural evidence for the reversed relative motion.

Ernst argued (p. 100 and personal commun.) that the "obduction zones" (Coleman, 1971), where an ultramafic slab has been thrust over the continent (for example, New Caledonia), adds an instantaneous increment of pressure without raising temperature, thus producing the physical conditions presumably required to form blueschists. However, such ultramafic slabs are of different thicknesses (Coleman, 1971, p. 1214), and one may suppose that the thrust plane along which they are carried may intersect the continental sedimentary pile at variable levels (that is, variable intersections of the thrust surface with the ambient geothermal gradient). The added pressure increment would result in the necessary P/T conditions being attained in the sedimentary pile at some depth, *but variable depth*, relative to the thrust surface. But the belt of blueschist rocks in such obduction zones invariably lies directly below the ultramafic slab (as in New Caledonia, New Guinea, Turkey(?)) and passes downward into non-blueschist (commonly greenschist) rocks. Ernst tends to discredit these zones of inverted metamorphism, but others (Blake, Irwin, and Coleman, 1969; Coleman, 1971; Brothers, 1970) have emphasized them, and they appear to be a global feature.

A final comment is in regard to the recent work of Brothers (1970) on New Caledonia blueschists. Ernst (p. 100) cited Brothers as advocating tectonic overpressure for the production of these rocks. Actually, Brothers emphasized that there is a *genetic relationship between the blueschists and the ultramafic rocks.* He based this on the fact that the zonation of blueschist rocks under the ultramafic slab follows the trace of the ultramafic contact, while cutting across the regional structure in the underlying rocks. He considered this to be another case of "upside-