Conn., where spodumene crystals occur a yard long, the alteration of the spodumene, a lithia-alumina bisilicate, has produced (as described and explained by G. J. Brush and E. S. Dana, 1878–1880) eucryptite, a different lithia-alumina silicate; also microcline or potash feldspar, muscovite mica, killinite, which are *potash*-bearing silicates, free of lithia; also the *soda* feldspar, albite, each, excepting killinite, in large crystallizations. Besides, it is evident that the mica and albite were unitedly results of change from the spodumene (the mica, through the eucryptite as a first step), since they occur in minute scales *together*, making half an inch or more of the outside of the spodumene crystals, the material looking so much like a single simple mineral that it was first (1867) named as such, cymatolite. In addition to these changes, half a dozen phosphates were made out of triphylite (an iron-manganese phosphate), part by combination with the lithia and other bases set free from the alteration of the spodumene; also uranium minerals were made from uraninite.

In mineral veins a still wider range of changes has taken place, through the metallic and other vapors that have ascended the opened fissures and the waters that have descended.

Since most crystalline metamorphic rocks are only recrystallizations of the detritus from such rocks, the feldspar and quartz being earlier feldspar and quartz, and so with many other minerals, and since the ocean's waters have distributed its salts among the formations, it is not necessary to appeal for producing silicates to "springs bringing up mineral waters from below." There is no place in geology for the *crenitic hypothesis* of Hunt (1884), so named from the Greek for a fountain or spring.

5. Endo-Crystallic Metamorphism.

In crystallized limestones, either calcyte or dolomyte, the crystalline grains have commonly a compound twin-structure, which is attributed to the pressure among the grains attending the original crystallization. Another effect of pressure is the breaking and displacement of crystals in rocks.

Professor J. W. Judd and others have drawn especial attention to the changes that have taken place within the crystalline grains of rock through pressure, without aid from rock-movements as a source of heat, endeavoring to distinguish them as far as possible from metamorphic work of other kinds. Like the compound twinning in the grains of crystalline limestone, the lamellar twinning in a triclinic feldspar, including microcline, is referred to stresses attending crystallization.

To the same cause are to be attributed the bronzy luster developed by incipient change in pyroxene and hypersthene, arising from the production interiorly of minute points of mineral material in parallel planes — an effect called by Judd *schillerization* — and its usual accompaniment, a laminated or diallage-like structure. Of similar origin are changes in orthoclase, giving its crystals an aventurine or iridescent character, or a new direction of cleavage, as in the variety murchisonite, or interlaminations of albite or of some other feldspar, as in perthite. Related changes occur also in other species.

6. Heat used in Metamorphism.

The heat for most metamorphic results was probably comparatively low, or between 500° F. and 1200° F. It was heat in slow and prolonged action, operating through a period that is long, even according to geological measure.