granite is igneous granite, and if it is forced up opened fissures, it is eruptive granite.

Metamorphism in the above cases is simply crystallization, so far as there is any change; for chemical change is not needed for the results mentioned. But in many cases it is even simpler than stated; for in the process the grains of feldspar and quartz may be only enlarged or finished out by surface additions, in a crystalline way, *conformably* to their crystallographic axes. In a quartz sandstone, the quartz grains, under the process, are made into quartz crystals (Fig. 284) if there is space for it (Sorby); and they may continue growing until the sandstone becomes a compact mass of quartz rock (or quartzyte) showing its original grains only indistinctly. In a similar way, the feldspar grains present in a rock, and any hornblende or pyroxene grains, may be enlarged or finished out. This process would convert a granitic sandstone into granite, making the rock without the heat of fusion or plasticity. In California Cretaceous sandstones, according to Becker, the feldspar crystals made by metamorphic change occupy the positions of previous groups of grains of feldspar; and the same for pyroxene and hornblende.

A granitic sandstone having its quartz grains changed to quartz crystals, in a process of metamorphism, becomes thus a *quartz-porphyry*. As quartz crystals are usually formed from siliceous solutions instead of from fusion, the occurrence of such imbedded crystals through the mass of a rock is presumptive evidence against its igneous origin.

3. Paramorphic Metamorphism.

When the minerals aragonite and calcite are present together in a limestone (page 69), the first effect of metamorphic action is the conversion of the aragonite into calcite — that is, the making it rhombohedral in cleavage structure, like calcite, its paramorph. Crystallinic metamorphism, also, may go forward simultaneously and make the rock coarsely crystalline. The change of pyroxene crystals to hornblende is a common example of paramorphic change. It has often gone on extensively, changing whole pyroxenic rocks to hornblendic. The inner part of a crystalline grain of pyroxene often has its lines of cleavage crossing at angles of 87°, the angle of pyroxene, when in the outer, the part altered, they are changed to 124½°, the angle of hornblende. The altered pyroxene was named *uralite* (from the Urals) by G. Rose (1830), and the change is hence called *uralitization*. Many Archæan crystalline rocks now hornblendic have been proved, by such evidence, to have been originally pyroxenic; and so it is with many other rocks, including some of igneous origin. Even the pyroxene of dikes of doleryte has been found changed to hornblende.

This change in a rock of the basalt type (the doleryte of Land's End, Cornwall) was first observed by Allport (1876); in augite-syenyte of New Hampshire, by S. W. Hawes (1878); in Wisconsin Archæan rocks, by Irving and Van Hise (1883). The mineral hy-