and beyond the Massachusetts line — Cambrian fossils in the sandstone or quartzyte, and Cambrian and Silurian in the crystalline limestone or marble belt next west; and a few miles farther west they occur going southward in limestones and schists for 150 miles to Poughkeepsie in Dutchess Co., N. Y., and beyond. In the more crystalline parts of the same region to the eastward in Massachusetts, the quartzyte graduates into gneiss and alternates with mica schists, and the slates change to staurolitic mica schists and gneiss. The fossils in the Taconic region were found by A. Wing, Walcott, Dwight, Dale, Wolff, and others.

Again, near Bernardston, Mass., and the region northward along the Connecticut Valley, Crinoids and Brachiopods occur in a crystalline limestone of Devonian age, associated with hydromica schist, gneiss, granite, dioryte, hornblende schist, quartzyte, all of one Devonian series, and of synchronous metamorphism. (E. Hitchcock, B. K. Emerson.)

In the Alps, at the St. Gothard tunnel, crinoidal remains occur in calcareous mica schist (Müller). In the Apuan Alps, Orthocerata exist in limestone between beds of gneiss and mica schist (Meneghini). At Brevig, Norway, a Silurian limestone contains garnets, scapolite, and fossils, and, according to Reusch, mica schist containing *Halysites*, *Favosites*, *Cyathophyllum*, *Murchisonia*, *Calymene*, *Dalmanites*. Schists, in Brittany, afford andalusite crystals and species of *Orthis*, *Spirifer*, and *Calymene*, in one and the same specimen (Boblaye). At Rothau, in the Vosges, in a hornblende rock, corals occur replaced, as stated by Daubrée, without losing their form, by crystals of hornblende, garnet, and axinite, and among the corals the species *Calamopora spongites* is quite distinct.

The rocks that have become changed into metamorphic rocks are for the most part the *fragmental* rocks, as sandstones, shales, conglomerates, with the limestones. These, according to their various constitution, have been changed to gneiss, granite, mica schist, and the several other kinds of schist; and the limestones to crystalline limestones; and this change has been the chief method of origin of the schists. In addition, the many crystalline rocks, both the metamorphic and igneous, have undergone, to some extent, related changes.

Under metamorphism might be included the chemical changes in rocks and minerals that take place at the ordinary temperature. But these run down into the common results of decay, and are more conveniently kept separate. They have been described on page 118 and beyond.

Causes of Metamorphism.

1. *Not generally due to infiltrating waters.* — The metamorphic changes which rocks have undergone is no evidence of their instability under existing conditions. It has been already shown that the sandstone, shales, and other fragmental rocks are seldom so porous at depths below as to admit the passage of infiltrating waters. It is true also of the crystalline rocks, granite, gneiss, syenyte, and the various igneous rocks, that they are commonly too close in texture to admit the passage of underground waters. The moisture they hold is stable, and the rocks are stable against changes from

http://www.geology.19thcenturyscience.org/books/1896-Dana-ManGeol/README.htm