

A trap dike intersecting the clayey layers, sandstones, and coal-beds of the island of Nobby, near Newcastle, New South Wales, has baked the clayey layers to a flint-like rock to a distance of 200 yards from the dike, the whole length of the island. (D., 1849.)

In the Spanish Peaks region, southeastern Colorado, the injection of igneous rocks across coal-beds has produced, according to R. C. Hills, a dense natural coke or an impure powdery graphite. The outcrop of coke thus made near Trinidad is probably two miles long; and at other places similar outcrops are four to five miles in length.

A region of igneous eruptions is often also, as a consequent or concurrent fact, a region of steaming fissures and of hot springs, conveying the heated moisture widely through the strata of the region; and in this way probably the sand-beds of the Mesozoic formations of eastern America were generally *reddened* as well as consolidated.

Baking effects, and sometimes crystallizations, have been occasioned by the *burning of coal-beds*. (See page 266.)

In the Tyrol, near Monzoni and Predazzo, a Peruvian limestone, in the vicinity of masses of igneous rocks, has been crystallized, and near the contacts occur garnet, idocrase, gehlenite, epidote, spinel, mica, anorthite, magnetite, hematite, and apatite. (Dœlter, 1875.) In the White Mountains, near Crawford's, alongside of granite, an argillitic mica schist is much altered and penetrated with crystals of orthoclase and tourmaline. (Hawes, 1881.)

These examples of alteration illustrate not only *local* but also *regional* metamorphism, for the minerals formed are among those that figure extensively in metamorphic rocks. Chlorite, garnet, tourmaline, are among the most common of such minerals; and if these and other species can be made under the rather rapid and coarse conditions afforded by the eruption of an igneous rock, the results of slow-working metamorphism should be much more complete.

It is observed, also, that these minerals are made by selecting and combining the needed elements. The iron of the epidote, chlorite, garnet, tourmaline, must be the iron that gives the red color almost everywhere else to the enclosing rock, or is present in occasional grains of magnetite. The tourmaline crystals seem to show that marine waters (or, perhaps, borate springs, made earlier from the ocean's waters) may supply boracic acid which they require. The hematite crystals (Fe_2O_3) may be derived from disseminated red hematite coloring the rock, or from the oxidation of grains of magnetite (Fe_3O_4). The quartz crystals were made out of silica taken from the siliceous minerals (feldspar, etc.) that were decomposed by the steam to furnish material for the new crystallizations; and the heat, as far as it reached through the sand-beds, even if of low degree, in the same way made the siliceous solutions that produced the consolidation of the rocks adjoining.

Special metamorphic power is often attributed to granite in the dike-like condition, and the minerals in the rock adjoining are regarded as contact minerals when the granite