tain masses of crystalline strata several miles in thickness. Now it has been stated that the plutonic influence of the syenite of Norway has sometimes altered fossiliferous strata for a distance of a quarter of a mile, both in the direction of their dip and of their strike. (See fig. 705, p. 593.) This is undoubtedly an extreme case; but is it not far more philosophical to suppose that this influence may, under favorable circumstances, affect denser masses, than to invent an entirely new cause to account for effects merely differing in quantity, and not in kind? The metamorphic theory does not require us to affirm that some contiguous mass of granite has been the altering power; but merely that an action, existing in the interior of the earth at an unknown depth, whether thermal, hydro-thermal, electrical, or other, analogous to that exerted near intruding masses of granite, has, in the course of vast and indefinite periods, and when rising perhaps from a large heated surface, reduced strata thousands of yards thick to a state of semi-fusion, so that on cooling they have become crystalline, like gneiss. Granite may have been another result of the same action in a higher state of intensity, by which a thorough fusion has been produced; and in this manner the passage from granite into gneiss may be explained.

In considering, then, the various data already enumerated, the forms of stratification and lamination in metamorphic rocks, their passage on the one hand into the fossiliferous, and on the other into the plutonic formations, and the conversions which can be ascertained to have occurred in the vicinity of granite, we may conclude that gneiss and mica-schist may be nothing more than altered micaceous and argillaceous sandstones, that granular quartz may have been derived from siliceous sandstone, and compact quartz from the same materials. Clay-slate may be altered shale, and granular marble may have originated in the form of ordinary limestone, replete with shells and corals, which have since been obliterated; and, lastly, calcareous sands and marls may have been changed into impure crystalline limestones.

"Hornblende-schist," says Dr. MacCulloch, "may at first have been mere clay; for clay or shale is found altered by trap into Lydian stone, a substance differing from hornblende-schist almost solely in compactness and uniformity of texture."* "In Shetland," remarks the same author, "argillaceous-schist (or clay-slate), when in contact with granite, is sometimes converted into hornblende-schist, the schist becoming first siliceous, and ultimately, at the contact, hornblende-schist."†

The anthracite and plumbago associated with hypogene rocks may have been coal; for not only is coal converted into anthracite in the vicinity of some trap dikes, but we have seen that a like change has taken place generally even far from the contact of igneous rocks, in the disturbed region of the Appalachians.‡ At Worcester, in the state of Massachusetts, 45 miles due west of Boston, a bed of plumbago and impure anthracite occurs, interstratified with mica-schist. It is about 2 feet

* Syst. of Geol. vol. i. p. 210

† Ibid. p. 211.

‡ See above, p. 388, 394.