## CHAPTER XXXVII.

## ON THE DIFFERENT AGES OF THE METAMORPHIC ROCKS.

Age of each set of metamorphic strata twofold—Test of age by fossils and mineral character not available—Test by superposition ambiguous—Conversion of dense masses of fossiliferous strata into metamorphic rocks—Limestone and shale of Carrara—Metamorphic strata of older date than the Cambrian rocks— Others of Lower Silurian origin—Others of the Jurassic and Eocene periods in the Alps of Switzerland and Savoy—Why scarcely any of the visible crystalline strata are very modern—Order of succession in metamorphic rocks— Uniformity of mineral character—Why the metamorphic strata are less calcareous than the fossiliferous.

According to the theory adopted in the last chapter, the age of each set of metamorphic strata is twofold—they have been deposited at one period, they have become crystalline at another. We can rarely hope to define with exactness the date of both these periods, the fossils having been destroyed by plutonic action, and the mineral characters being the same, whatever the age. Superposition itself is an ambiguous test, especially when we desire to determine the period of crystallization. Suppose, for example, we are convinced that certain metamorphic strata in the Alps, which are covered by cretaceous beds, are altered lias; this lias may have assumed its crystalline texture in the cretaceous or in some tertiary period, the Eocene for example. If in the latter, it should be called Eocene when regarded as a metamorphic rock, although it be liassic when considered in reference to the era of its deposition. According to this view, the superposition of chalk does not prevent the subjacent *metamorphic* rock from being Eocene.

When discussing the ages of the plutonic rocks, we have seen that examples occur of various primary, secondary, and tertiary deposits converted into metamorphic strata, near their contact with granite. There can be no doubt, in these cases, that strata, once composed of mud, sand, and gravel, or of clay, marl, and shelly limestone, have for the distance of several yards, and in some instances several hundred feet, been turned into gneiss, mica-schist, hornblende-schist, chlorite-schist, quartz rock, statuary marble, and the rest. (See the two preceding Chapters.)

But when the metamorphic action has operated on a grander scale, it tends entirely to destroy all monuments of the date of its development. It may be easy to prove the identity of two different parts of the same stratum; one, where the rock has been in contact with a volcauic or plutonic mass, and has been changed into marble or be