

and Mr. Necker has proposed the term "underlying" for the granites, to designate the opposite mode in which they almost invariably present themselves.

*Metamorphic, or stratified crystalline rocks.*—The fourth and last great division of rocks are the crystalline strata and slates, or schists, called gneiss, mica-schist, clay-slate, chlorite-schist, marble, and the like, the origin of which is more doubtful than that of the other three classes. They contain no pebbles, or sand, or scoræ, or angular pieces of imbedded stone, and no traces of organic bodies, and they are often as crystalline as granite, yet are divided into beds, corresponding in form and arrangement to those of sedimentary formations, and are therefore said to be stratified. The beds sometimes consist of an alternation of substances varying in color, composition, and thickness, precisely as we see in stratified fossiliferous deposits. According to the Plutonian theory, which I adopt as the most probable, and which will be afterwards more fully explained, the materials of these strata were originally deposited from water in the usual form of sediment, but they were subsequently so altered by subterranean heat, as to assume a new texture. It is demonstrable, in some cases at least, that such a complete conversion has actually taken place, fossiliferous strata having exchanged an earthy for a highly crystalline texture for a distance of a quarter of a mile from their contact with granite. In some cases, dark limestones replete with shells and corals, have been turned into white statuary marble, and hard clays, containing vegetable or other remains, into slates called mica-schist or hornblende-schist, every vestige of the organic bodies having been obliterated.

Although we are in a great degree ignorant of the precise nature of the influence exerted in these cases, yet it evidently bears some analogy to that which volcanic heat and gases are known to produce; and the action may be conveniently called plutonic, because it appears to have been developed in those regions where plutonic rocks are generated, and under similar circumstances of pressure and depth in the earth. Whether hot water or steam permeating stratified masses, or electricity, or any other causes have coöperated to produce the crystalline texture, may be matter of speculation, but it is clear that the plutonic influence has sometimes pervaded entire mountain masses of strata.

In accordance with the hypothesis above alluded to, I proposed in the first edition of the *Principles of Geology* (1833), the term "Metamorphic" for the altered strata, a term derived from *μετα*, meta, *trans*, and *μορφη*, morphe, *forma*.

Hence there are four great classes of rocks considered in reference to their origin,—the aqueous, the volcanic, the plutonic, and the metamorphic. In the course of this work it will be shown, that portions of each of these four distinct classes have originated at many successive periods. They have all been produced contemporaneously, and may even now be in the progress of formation on a large scale. It is not true, as was formerly supposed, that all granites, together with the crystalline or metamorphic strata, were first formed, and therefore entitled to be called "primitive," and