

rocks, intense pressure and electro-chemical agencies generated in the vast laboratory of nature.

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"If we consider our planet as a cooling mass of matter," observes De la Beche—the great practical and theoretical geologist of England—"the present condition of its surface being chiefly due to such a loss of its original heat by long-continued radiation into the surrounding space, that, from having been wholly gaseous, then fluid and gaseous, and subsequently solid, fluid and gaseous, the surface at last became so reduced in temperature, and so little affected by the remaining internal heat, as to have its heat chiefly regulated by the sun,—there must have been a time when solid rock was first formed, and also a time when heated fluids rested upon it. The latter would be conditions highly favorable to the production of crystalline substances, and the state of the earth's surface would then be so totally different from that which now exists, that mineral matter, even abraded from any part of the earth's crust, which may have been solid, would be placed under very different conditions, at these different periods: we could scarcely expect that there would not be a mass of crystalline rocks produced at first, which, however they may vary in minor points, should still preserve a general character and aspect; the result of the first changes of fluid into solid matter, crystalline and sub-crystalline substances prevailing, intermingled with detached portions of the same substances, abraded by the movements of the first-formed aqueous fluids."

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Chemists have shown that similar materials, when fused, yield dissimilar products, dependent on the rapidity or slowness with which they cooled, and the degree of pressure to which they have been subjected. The researches of Mitscherlich and Gustav Rose have thrown much light on the process of metamorphism. The artificial mineral products, such as garnet, idocrase, magnetic oxide of iron, &c., and even some of the rarer gems which have been produced in the laboratory of the chemist, or found among the scoræ of furnaces, afford us an insight as to the manner in which nature has operated on a grander scale.

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Since the theory of metamorphism has been generally recognized, many of the rocks which were formerly regarded as igneous, are now referred to aqueous agency, and the transformations which they may have undergone traced to the presence of erupted rocks.

Von Buch has shown that the gneiss around the Gulf of Finland has been produced by the metamorphic action of granite.

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Hoffman points out an instance in the Fichtelgebirge, in which argillaceous schist, which can be traced for sixteen miles, is transformed into gneiss only at the two extremities, where they come in contact with granite.

In the Pyrenees, compact limestone is changed into granular limestone, where it comes in contact with the erupted rocks. The dolomite of the southern Tyrol and of the Italian side of the Alps, is but a metamorphism of calcareous beds, exhibiting no signs of stratification, and no vestiges of organic remains.

The marbles of Carrara and Siena, which have afforded so many blocks for sculpture, and which were formerly cited as examples of "primitive limestone," are as recent as the öolite, while the sandstones which flank the Appenines, and were once supposed to rest at the base of the fossiliferous series, are proved to belong to the tertiary. So too, the slates of Glaris, which were formerly regarded as transition, have been proved by Agassiz, from the fishes, to belong to a period as recent as the chalk.