To appreciate the nature and qualities of fragmental material, the student should go to the hills where sand and gravel are dug; to the sea-beaches where the waves are at their grinding and assorting work, or to the estuaries where mud-flats and sand-flats have been made by their greater action; to the river-valleys, where plunging streams are at their abrading and destroying work, or where quieter streams are bordered by terraces of sand, or gravel, or loam, or clay. All is fragmental material; and all these results of attrition and partial decomposition may be included under the four divisions of (1) sand, (2) gravel (or a mixture of stones and sand), (3) earth or mud (according as it is wet or not), and (4) clay. The last, the material of brick and pottery, is plastic when wet, and feels a little greasy. Mud of the finest kind is usually more or less pure clay.

Fragmental deposits are made up of successive beds or layers; that is, are *stratified* (using a term from the Latin *stratum, a bed*). They are also, for the most part, *sedimentary* beds, the sand and earth deposited by water being its *sediment;* and hence they are often called *sediments*. The waters that deposited the sediment and made the stratified accumulations were mostly those of the ocean, or of rivers or lakes; and sea-border, fluvial, and lacustrine formations are illustrations therefore of fragmental deposits.

Crystalline Rocks. — Nearly all substances crystallize on passing to the solid state from a previous state of either fusion, solution, or vapor, and many without fusion if subjected to long-continued heat. The grains of a massive crystalline rock are, in the main, or wholly, imperfect crystals. They are generally angular in form; and when so, it is usually because of the cleavages of the constituent mineral grains. Being crowded together, they very seldom have the external planes of crystals. Granite and crystalline limestone (or ordinary white marble) are examples. In crystalline limestone, all the grains are angular and glisten, owing to the cleavage-surfaces. In granite, those of two of the constituent minerals show sparkling cleavage-surfaces, but the third, quartz, is without cleavage. When the grains are distinctly visible without a glass, the texture is described as *macroscopic;* if undistinguishable, the texture is *microscopic*, or *aphanitic*.

Crystalline rocks are, to a large extent, *igneous* or *eruptive* rocks; that is, they have become crystalline masses from a state of fusion, as, for example, lavas and the many kinds of *igneous rocks*. Others have become crystalline by heat without fusion, with or without attending change in composition; for example, a massive limestone has thus been changed by simply long-continued heat to a crystalline limestone or marble, granitic sandstone to granite or gneiss, and so on. Such rocks are called *metamorphic rocks*. Fragmental rocks have been thus metamorphosed on a large scale during times of mountain-making. Metamorphic rocks have sometimes been subjected to a second partial or complete metamorphism, and igneous rocks occur altered in like manner. Crystalline rocks are usually mere mixtures, like the fragmental, as they consist of one, two, or more minerals in various proportions. If of

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