

the interpretation that seems the most probable. As a general rule an attempt will be made to explain the facts by reference to similar phenomena taking place on the land surfaces, or in shallow water, which have been for a long time under the direct observation of geologists and chemists. In sea-water the sulphates are deoxidised by carbon and hydrogen,—one of the greatest chemical changes which occurs in the sea; in fresh water, where sulphates are absent or present in small amount, this reaction cannot take place. It is probable that the reactions follow a nearly similar order in the shallow waters of the ocean and in the abysmal regions, but at the same time the intensity of these reactions, and their subsequent results, may be considerably modified in those deep-water deposits where there is a great pressure, an absence of mechanical action and of solar rays.

The chemical products under consideration will be discussed under the following heads:—I. Clay; II. Manganese Nodules; III. Zeolites; IV. Phosphatic and other concretions.

I. CLAY.

The fundamental basis of all clayey deposits, whether in geological formations or the deposits of modern oceans, is the hydrated silicate of alumina— $\text{Al}_2\text{O}_3, 2\text{SiO}_2, 2\text{H}_2\text{O}$, which is derived from the decomposition of all the aluminous silicates in rock masses under the action of water, and especially of water containing carbonic acid. The silicates of potash, soda, lime, protoxides of iron and manganese are thus decomposed at ordinary temperatures, and these silicates—the felspars, pyroxenes, amphiboles, for instance—also contain more or less alumina and magnesia. The first-mentioned bases—the potash, soda, lime, and protoxides of iron and manganese—are transformed into carbonates and, dissolving in the water, may be carried away in solution, silica being at the same time set free; the silicates of alumina and magnesia, being much less soluble, remain behind as a residue, are transformed into hydrated silicates, and give rise on the one hand to clay, and on the other to talc. As all the eruptive and metamorphic rocks are composed for the most part of aluminous silicates, they all undergo these changes resulting in the production of hydrated silicate of alumina, and it follows that these rocks and minerals are the original source of all the clayey material so widely distributed in recent and past geological formations.

Although hydrated silicate of alumina may occur, in nature, in a pure state in the form of crystals, they are exceedingly rare. It usually occurs in an amorphous condition and mixed with many foreign substances. Even kaolin, which is usually regarded as pure clay, always contains more or less debris derived from the rock from which it originated. Kaolin, and clays approaching kaolin in composition, have always been transported suspended in water from their place of origin, and thus when deposited may, in special circumstances, be freed from many of the extraneous particles with which they