storms extends to a very slight depth. To this rule, however, there are some exceptions, and recent ripple-marks have been observed at the depth of 60 or 70 feet. It has also been ascertained that currents or large bodies of water in motion may disturb mud and sand at the depth of 300 or even 450 feet.* Beach ripple, however, may usually be distinguished from current ripple by frequent changes in its direction. In a slab of sandstone, not more than an inch thick, the furrows or ridges of an ancient ripple may often be seen in several successive laminæ to run towards different points of the compass.

CHAPTER III.

ARRANGEMENT OF FOSSILS IN STRATA—FRESHWATER AND MARINE.

Successive deposition indicated by fossils—Limestones formed of corals and shells—Proofs of gradual increase of strata derived from fossils—Serpula attached to spatangus—Wood bored by teredina—Tripoli and semi-opal formed of infusoria—Chalk derived principally from organic bodies—Distinction of freshwater from marine formations—Genera of freshwater and land shells—Rules for recognizing marine testacea—Gyrogonite and chara—Freshwater fishes—Alternation of marine and freshwater deposits—Lym-Fiord.

HAVING in the last chapter considered the forms of stratification so far as they are determined by the arrangement of inorganic matter, we may now turn our attention to the manner in which organic remains are distributed through stratified deposits. We should often be unable to detect any signs of stratification or of successive deposition, if particular kinds of fossils did not occur here and there at certain depths in the mass. At one level, for example, univalve shells of some one or more species predominate; at another, bivalve shells; and at a third, corals; while in some formations we find layers of vegetable matter, commonly derived from land plants, separating strata.

It may appear inconceivable to a beginner how mountains, several thousand feet thick, can have become filled with fossils from top to bottom; but the difficulty is removed, when he reflects on the origin of stratification, as explained in the last chapter, and allows sufficient time for the accumulation of sediment. He must never lose sight of the fact that, during the process of deposition, each separate layer was once the uppermost, and covered immediately by the water in which aquatic animals lived. Each stratum in fact, however far it may now lie beneath the surface, was once in the state of shingle, or loose sand or soft mud at the bottom of the sea, in which shells and other bodies easily became enveloped.

By attending to the nature of these remains, we are often enabled to determine whether the deposition was slow or rapid, whether it took place in a deep or shallow sea, near the shore or far from land, and whether the water was salt, brackish, or fresh. Some limestones consist

* Edin. New Phil. Journ. vol. xxxi.; and Darwin, Volc. Islands, p. 134.