

These observations relative to the time at which the eruption of these lapilli took place are also applicable in a certain way to all the volcanic rocks found in a fragmentary condition in pelagic deposits. Some of these lapilli are allied in fact by insensible transitions to the vitreous type described above. Such, for instance, are fragments of felspathic basalt with a highly developed vitreous base; they are associated with the basic glasses, and probably belong to the same age.

In other cases some fragments of basalt, of augite-andesite, of trachyte, appear to be the products of eruptions of a more recent date, for, although there may be among them fragments coated with thick layers of manganese, there are others which have only a thin coating of that substance, and it seems legitimate to conclude that the greater or less thickness of the deposits of manganese indicates in a manner the relative length of time that the fragments have lain on the bottom of the sea. The relative age indicated by these different layers of manganese, which surround volcanic fragments and remains of organisms, will be fully referred to when treating of manganese nodules.

In the descriptions of the Challenger specimens, in Chapter II., palagonitic materials are mentioned twenty times in Red Clay, four times in Radiolarian Ooze, once in Diatom Ooze, ten times in Globigerina Ooze, three times in Blue Mud, four times in Volcanic Mud, and twice in Volcanic Sand. It will thus be observed that it is especially in the pelagic deposits, and among these in the red clay areas, that the palagonitic substances were most frequently observed.

*Basaltic and other lapilli.*—We may be brief with the description of *basaltic lapilli*, which are often found associated with the lapilli of basic glass, and form along with them centres of manganese nodules. Some basaltic fragments are less angular than those found in the manganese nodules, and might even be taken for rolled pebbles, from their smooth surface and rounded exterior, and these, from the thin coating of manganese with which they are covered, have not, in all probability, the same origin as those forming the nuclei of nodules. Basaltic fragments are as frequent in the deposits as the palagonitic lapilli, but their determination is not always so easy, especially when they are small and altered, for their characters are much less sharply marked than those of the palagonitic materials. In consequence we have often distinguished the basaltic fragments, in the Tables of Chapter II., under the vague names of scorixæ, lapilli, and glassy volcanic particles, it being impossible to be more specific. However, many of the little fragments thus indicated belong undoubtedly to basalts, generally to basalts with a vitreous base, to felspathic basalts; basalts with leucite or nepheline cannot be said with certainty to have been observed.

Basaltic fragments are found under the same conditions as the basic glasses, their dimensions are the same, and they are specially numerous in the same stations where the palagonitic tufas were dredged. They are distinguished from the vitreous lapilli by their mineralogical composition, which is that of ordinary basalts—olivine,