fragments of these palagonitised glasses, on which the chemical action would continue to be exercised more easily as the materials became more and more subdivided. We should also expect to find, in a more or less isolated condition, the crystals formerly imbedded in the glasses, as these offer more resistance to decomposition than the indeterminate silicate which formed their base. This is what is actually observed, for in the free state in the deposits there are found minute lamellar crystals of plagioclase, often in the form of rhombic tables, sometimes augite, more rarely olivine, magnetite, and fragments of the zeolitic bands just referred to.

It is true that many of these minerals, such as plagioclase, augite, and magnetite, might be projected as volcanic cinders, or be derived from floating pumice, and being surrounded with a vitreous coating this might subsequently be transformed into palagonite; but when these fragments are associated with fibro-radiate and globiform zeolitic minerals, it seems fair to conclude that the great majority of them have been derived from the disintegration *in situ* of brecciaform vitreous lapilli. The other part of the residue, that is to say, the palagonitic matter itself, must necessarily be reduced by transformation into argillaceous matter more or less charged with iron and manganese. The rocks of this type on land surfaces show transformation on a large scale into red argillaceous matter, as, for instance, the argillaceous deposits of Iceland, and the red earths of a large number of islands in the Pacific. We shall have to speak again of these transformations when describing the chemical deposits at the bottom of the sea, but it may now be pointed out that the hydrochemical modifications indicated for basic glasses must, in a certain measure, hold good also for the basalts with a vitreous base, which are so closely allied to the basic glasses.

It is difficult to offer an opinion as to the geological age of the eruptions which gave origin to these tufas, for nothing is known with regard to their stratigraphical relations; all we do know is that they are spread out on the superficial layer of the sea-bed at the points from which they were dredged. Remembering the profound analogies between these tufas and palagonitic tufas, some of which belong to the Tertiary Period, and their association in the deposits of the Pacific with sharks' teeth and earbones of Cetaceans, some of them similar to those of Tertiary species, it is probable that these tufas go back as far as the Tertiary Period. There is no certainty, however, on this point, since eruptions giving rise to basic glasses analogous to those described still take place in the region of the Pacific, where the submarine tufas collected by the Challenger are best represented. The smallest palagonitic particles found free in the deposits may possibly have come from eruptions much more recent than the large lapilli of the same substance, for minute vitreous particles would, on account of their microscopic dimensions, more rapidly undergo decomposition into hydrated silicate than would be possible for the more voluminous fragments enclosed as nuclei in some manganese nodules or free in the deposits.