

*Basic Volcanic Glass.*—In many regions of the deep sea the Challenger Expedition collected numerous lapilli and pebble-like fragments of compact volcanic glass, which, although more or less limited and localised in their distribution, appear to be the most important volcanic products in deep-sea deposits after the pumice fragments above described. While these glasses are known only from a few geological formations, and from a few eruptions of recent volcanoes at the surface of the continents, they, on the other hand, appear in abundance and in most typical form among the products of submarine eruptions, as if the deep oceans had been in some way specially favourable to the development of this lithological type. We devote, in consequence, a considerable space to the description and illustration of these glassy particles and the products of their alteration. All the chief varieties found at the different stations are included in these descriptions, and in their structure they pass, on the one hand, into basic pumice, and on the other into basaltic fragments with a vitreous base.

The most characteristic of these lapilli of basic volcanic glass collected by the various trawlings and dredgings vary from the size of a walnut to that of a pea, and minuter fragments descend to the mean dimensions of the mineral particles found in the clays and oozes, when their nature becomes masked from their small size; it is only by following the transitions from the larger particles, upon which the characters are sharply impressed, to the smaller, that it is possible to recognise the minute splinters disseminated in the deposits. In nearly all cases, whatever their size, these fragments have undergone a more or less profound alteration, their primitive vitreous matter being transformed by hydrochemical agencies into a secondary product, which is designated palagonite in all our descriptions. Frequently these fragments form the centres of manganese nodules, and generally they are more or less incrustated by manganese depositions; sometimes they are isolated in the deposits, or associated with other lapilli, volcanic ashes, and free zeolitic crystals. They are most abundant in certain red clay areas of the Pacific, but may be found in all the types of deep-sea deposits. The form of the fragments is generally rounded, elliptical, or flattened, but they are sometimes quite irregular. The larger fragments have, as a rule, a vitreous centre, with external highly-altered zones; the smaller fragments are frequently entirely transformed into palagonite.

When one of the larger fragments is taken from the centre of a manganese nodule, or found in a free state, the external surface is always covered by a resinoid yellowish green or reddish brown coating. When the fragment is broken, the interior is seen to be a true unaltered glass. This vitreous material is compact or scoriaceous, and resembles in some respects acid volcanic glasses, like obsidian, but the fracture is less conchoidal. The rock breaks into little splinters, due to a latent perlitic structure and to microscopic fissures, and a shock often produces a pulverisation of the mass. The fragments are dark green or brown, with a pronounced vitreous aspect and resinoid lustre, and they melt easily before the blow-pipe into a dark glass. Their density ranges