

The brecciaform character of these eruptive products is clearly represented by some of the figures on the accompanying plates, where these lapilli are shown as they appear aggregated in some of the deposits. The nuclei of the nodules of manganese from Station 276 and other stations in the South Pacific are in some instances crowded with splinters of basic glasses or palagonite. These fragments do not always belong to the same types; they present differences of structure and of mineralogical composition, such as might be found in volcanic tufas, but they have not the homogeneity of an accumulation of fragments derived from the trituration of a lava-flow. It is sufficient to cast a glance at Pl. XXI. fig. 1 to be convinced of the correctness of the above observations; this figure represents a thin section cut from the interior of an elongated manganese nodule, in which numerous fragments of basic glass, of felspathic basalt, and volcanic minerals may be observed, all presenting the character of lapilli. Not only the essentially vitreous nature, the mineralogical composition, and the structure, but also the form of the splinters—angular and without trace of wear and tear—all prove that these particles have not been submitted to the mechanical action of water. Commencing at the top of the figure there are large crystals of plagioclase surrounded by vitreous matter or by microliths; descending towards the centre of the figure is a large number of small angular fragments of basic glass, scoriaceous, yellowish, transparent, coated by zeolites, or black and opaque, and containing lamellæ of plagioclase; in the manganese to the right near the centre are small zeolitic crystals, and lower down is a large lapilli of black opaque volcanic glass; next to it is a section of very vesicular pumice, opposite which is a fragment of basic glass; near the lower part of the figure are accumulated plagioclases and splinters of volcanic glass more or less surrounded by zeolitic zones. In fact the aggregation of about fifty volcanic fragments in this nodule affords a very striking and typical example of the tufaceous character of these fragments of basic rocks as found at the bottom of the sea. This is also clearly shown by the palagonitic fragments enclosed in a manganese nodule, represented in Pl. XVIII. fig. 1. It seems necessary, then, to conclude that the angular form is original and due to the mode of projection, these splinters of basic glass being thrown out in the form in which they are now found. It does not seem possible to admit that they are *clastic* in the ordinary sense of the word, for there is no reason for believing that in the depths from which they were collected the mechanical movements of the sea are capable of producing the accumulation and fragmentation of these splinters. Still another argument in favour of the view as to the origin of these fragments here advocated, is their association with numerous volcanic fragments of very small dimensions; these latter are undoubtedly ashes, and it is necessary to admit the same mode of formation for them as for the larger fragments.

The cementation of these minute particles and lapilli by zeolites presents still another point of resemblance with palagonitic tufas. Not only have the zeolites