

probably in most cases began their career as submarine vents, their eventual appearance as subaerial cones being mainly due to the accumulation of erupted material, but also partially, as in the case of Santorin, to actual upheaval of the sea-bottom. The lonely island of St. Paul (Figs. 67 and 69), lying in the Indian Ocean more than 2000 miles from the nearest land is a notable example of the summit of a volcanic mountain rising to the sea-level in mid-ocean. Its circular crater, broken down on the northeast side, is filled with water having a depth of 30 fathoms.¹²⁹



Fig. 67.—Volcanic crater of St. Paul Island, Indian Ocean.

Observations by R. von Drasche have shown that at Bourbon (Réunion), during the early submarine eruptions of that volcano, coarsely crystalline rocks (gabbro) were emitted, that these were succeeded by andesitic and trachytic lavas: but that when the vent rose above the sea, basalts were poured out.¹³⁰ Fouqué observes that at Santorin some of the early submarine lavas are identical with those of later subaerial origin, but that the greater part of

¹²⁹ For a general account of the volcanic islands of the ocean, see Darwin's "Volcanic Islands," 2d edit. 1876. For the Philippine volcanoes, see R. von Drasche, *Tschermak's Mineralogische Mittheil.* 1876; Semper's "Die Philippinen und ihre Bewohner," Würzburg, 1869. For the Kurile Islands, J. Milne, *Geol. Mag.* 1879, 1880, 1881; Volcanoes of Bay of Bengal (Barren Island, etc.), V. Ball, *Geol. Mag.* 1879, p. 16; 1888, p. 404; F. R. Mallet, *Mem. Geol. Surv. India*, xxi. part iv. St. Paul (Indian Ocean), C. Vélain, *Assoc. Fran.* 1875, p. 581; "Mission à l'île St. Paul," 1879; "Description géologique de la Presqu'île d'Aden," etc., 4to, Paris, 1878; and "Les Volcans," 1884. For Isle of Bourbon, see authorities cited on p. 415, and for Hawaii, the references on p. 350.

¹³⁰ *Tschermak's Mineralogische Mittheil.* 1876, pp. 42, 157. A similar structure occurs at Palma (Cohen, *Neues Jahrb.* 1879, p. 482) and in St. Paul (Vélain as above cited).