

## Section i. Volcanoes and Volcanic Action<sup>1</sup>

### § 1. Volcanic Products

The term volcanic action (volcanism or volcanicity) embraces all the phenomena connected with the expulsion of heated materials from the interior of the earth to the surface. Among these phenomena, some possess an evanescent character, while others leave permanent proofs of their existence. It is naturally to the latter that the geologist gives chief attention, for it is by their means that he can trace former phases of volcanic activity in regions where, for many ages, there have been no volcanic eruptions. In the operations of existing volcanoes, he can observe only superficial manifestations of volcanic action. But examining the rocks of the earth's crust, he discovers that amid the many terrestrial revolutions which geology reveals, the very roots of former volcanoes have been laid bare, displaying subterranean

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<sup>1</sup> The student is referred to the following general works on the phenomena of volcanoes. Scrope, "Considerations on Volcanoes," London, 1825; "Volcanoes," London, 2d edit. 1872; "Extinct Volcanoes of Central France," London, 1858; "On Volcanic Cones and Craters," *Quart. Journ. Geol. Soc.* 1859. Daubeny, "A Description of Active and Extinct Volcanoes," 2d edit., London, 1858. Darwin, "Geological Observations on Volcanic Islands," 2d edit., London, 1876. A. von Humboldt, "Ueber den Bau und die Wirkung der Vulkane," Berlin, 1824. L. von Buch, "Ueber die Natur der vulkanischen Erscheinungen auf den Canarischen Inseln," *Poggend. Annalen* (1827), ix. x.; "Ueber Erhebungskratere und Vulkane," *Poggend. Annalen* (1836), xxxvii. E. A. von Hoff, "Geschichte der durch Ueberlieferung nachgewiesenen natürlichen Veränderungen der Erdoberfläche" (part ii., "Vulkane und Erdbeben"), Gotha, 1824. C. W. C. Fuchs, "Die vulkanischen Erscheinungen der Erde," Leipzig, 1865. R. Mallet, "On Volcanic Energy," *Phil. Trans.* 1873. J. Schmidt, "Vulkanstudien," Leipzig, 1874. Sartorius von Waltershausen and A. von Lasaulx, "Der Aetna," 4to, Leipzig, 1880. E. Reyer, "Beitrag zur Physik der Eruptionen," Vienna, 1877; "Die Euganeen; Bau und Geschichte eines Vulkanes," Vienna, 1877. Fouqué, "Santorin et ses éruptions," Paris, 1879. Judd, "Volcanoes," 1881. G. Mercalli, "Vulcani e Fenomeni vulcanici in Italia," Milan, 1883. Ch. Vélain, "Les Volcans," Paris, 1884. J. D. Dana, "Characteristics of Volcanoes," 1890. "Volcanoes Past and Present," E. Hull, 1892. "The South Italian Volcanoes," H. J. Johnston-Lavis, Naples, 1891. References will be found in succeeding pages to other and more special memoirs.