

Geological Observations on the Volcanic Islands and Parts of South America Visited during the Voyage of H.M.S. 'Beagle.' By CHARLES DARWIN, M.A., F.R.S. &c. Second Edition, with Maps and Illustrations. Smith, Elder, and Co.

No more interesting volume, in the department of science and natural history, than the well-known 'Voyage of the Beagle' was ever published, perhaps, in this country. It is with great satisfaction that we see it now reprinted in so convenient and cheap a form. The short preface modestly and truly states that, since the publication of the two volumes (which are now condensed into one) in 1844 and 1846, geology has made great progress; but the author believes his views, as there put forward, if 'some-what antiquated,' yet 'contain matter of scientific value.' No observer of the present day equals Mr. Darwin in either the wideness of his knowledge of different branches of physiology, or in the skill with which he deduces from them results. Everything that he records is worth reading; and we repeat that, for persons with even a moderate store of scientific knowledge, this book is really delightful reading.

The marvellous group of tertiary volcanic islands which border the west coast of Africa, from the Azores in the north to Ascension on the south, and the equally interesting Galapagos Archipelago, off the west coast of South America and on the Equator, form the subjects of the first five chapters of Mr. Darwin's work. In most cases pushed up from below, and occasionally containing masses of limestone and granite in their lower rocks, these islands have been enlarged by successive eruptions of lava and basalt from elevated craters and cones, a great many of which still exist in a more or less perfect or shattered condition. On the other hand, they have been continually subjected to a process of denudation, which has left the central volcanoes mere wrecks and shadows of their former selves. The overflow of basalt is indeed often marvellous; in some of these islands nearly perpendicular cliffs of one, and even two thousand feet in height may be seen, the whole substance of which, from top to bottom, is basaltic. The craters, on the other hand, and the rocks at the base and on the sides of the volcanoes are often of trachyte; while the forms of lava, more or less porous or vesicular, and charged with felspar, or the characteristic crystals of augite or olivine, are more numerous than can easily be counted. The limestone masses often contain shells, proving that it is a portion of the sea-bed upheaved; and where hot lava or basalt has subsequently flowed over it, the metamorphic or crystalline structure supervenes, as indeed may be seen in the chalk capped with basalt in many parts of the north of Ireland.

Vast beds of conglomerate too exist, implying tremendous forces of disruption at some remote period. These are generally in the form of *breccias*, or angular rather than water-worn fragments, and they often lie cemented in a tufaceous matrix, which implies the action of hot mud or jets of steam during their deposition. Very often, too, *dykes* of

trap or basalt intersect the mountain sides, and sometimes they stand out naked like the walls of a fortress, the scoriaceous matter having been separated from them by long-continued denudation. In some of the islands, especially in the Canary group, cones of small height, and resembling those in the district of Auvergne, show evidences of lava and showers of ashes having been ejected in a comparatively recent period. Such are some of the wonders of these volcanic islands; the cones and craters are so numerous that to explore them all,—and hardly any two are the same in structure or appearance—is a task of no ordinary difficulty. In the Galapagos these vary ‘from mere spiracles to huge caldrons several miles in circumference’; they are extraordinarily numerous, so that ‘I should think’ (he says, p. 111), ‘if enumerated, they would be found to exceed two thousand.’ The interest of such explorations is indeed extreme, but Mr. Darwin never gives utterance to the platitudes of a mere enthusiast. Calm narrative of fact and accurate description are the characteristics of a writer whose trustworthiness as an observer has never been fairly called in question.

Mr. Darwin considers it a very remarkable fact (p. 141) ‘that, with rare exceptions, the innumerable islands scattered throughout the Pacific, Indian, and Atlantic oceans, were composed either of volcanic or of modern coral rocks.’ He considers this fact an evident extension of the yet unexplained law, whether chemical or mechanical, by which nearly all active volcanoes are either islands or near the sea shore. He remarks, too, that while mountain-chains on continents are comparatively seldom volcanic, ocean islands for the most part are so; and he asks if volcanic eruptions do not more easily break through sea-bottoms than through the older rocks of mainlands?

All volcanoes are classed under the heads of *central volcanoes* or *volcanic chains*, like the Andes. In other words, the ruptures of the earth’s crust are either fractures or ‘weak places’ in the deep sea, or long vents extending many hundreds of miles on a mainland. Among the few volcanic or trap hills of our country, the Malvern and the Wrekin, both of trap rock, appear to mark the two extremities of such a rupture. Mr. Darwin defines the difference between an elevated mountain-chain and a volcano to consist in this—that in the former (*i.e.*, under it) plutonic matter has been injected, in the latter volcanic matter has been ejected (p. 145).

Chapter ix. is a most interesting and important chapter on the elevation or upheaval of continents,—one of the great, indeed the greatest, of geological phenomena, and apparently one that prevails at the present day, though seldom brought under the observation of man, as much and as regularly as at any former period. ‘In South America,’ the author says, p. 600, ‘all geological phenomena are still in active operation.’ The whole coast of Chili, including a long district at Valparaiso, was, so to say, literally *jerked up* after the earthquake of 1822. The occurrence of shell-beds in our own country, sometimes of quite recent geological date, like the Red crag on the coast of Suffolk, is so common, that no observer can have failed to infer how unstable is the earth’s crust, and that its

history from the earliest times has been mainly that of alternations from seas to continents and from continents to seas.

We wish it were possible in so brief a notice even to touch upon the account of Patagonia (Chapter xii.), or the important treatise on that obscure subject, the cleavage of rocks, in Chapter xiii. *Cleavage*, our readers are aware, means the lines of division more or less at right angles to stratification. They are partings of rock, caused either by contraction of the masses, or by the subtle agency of earth-currents of electricity, and of such practical importance in quarrying that by this means alone blocks of freestone and lengths of slate can be raised which would otherwise be fixed immovable in the bed in which they lie, and useless to man. Mr. Darwin inclines to attribute cleavage to the tension to which a given area is subjected after its upheaval, and before the subsidence of molecular movement and the final consolidation of the mass. If so, it may be compared with the cracks and subsidences which sometimes show themselves in buildings before the structure has settled finally on its foundations.

The geological plans and sections add great value to the work. If there is too much that is technical, especially in the mineralogy, to please the ordinary reader, he will remember that the accuracy of science depends mainly on its technology. We cannot communicate our thoughts and researches accurately without exact words to express them by, and therefore the frequent use of these strange-looking and strange-sounding terms is inevitable.