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Though Mr. Darwin tells in his preface that this book is little more than a reprint, we readily agree with him that it was advisable that the "observations" which formed his first contribution to cosmical science should be republished. The amount of scientific value to be attached to them has diminished but very slightly by the work of thirty years which has followed them, for every page is marked by that rigid adherence to fact which has been the unvarying characteristic of Mr. Darwin's writing; and even in the few instances where his explanations of phenomena have been superseded by more recent investigations, it has rather been in the way of extension than of contradiction.

When the memorable cruise of the 'Beagle' opened, on the 27th of December, 1831, few of those who were interested in the expedition could have anticipated the wonderful results which had their origin in that little brig. It was the beginning of a line of physical research of which the last outcome has been the voyage of the 'Challenger.' Of the immediate effects of such research it is impossible to speak too highly, for if nothing more than the forging of an electric link between the Old World and the New had been effected, an abundant return for the labour would have been received. But of the remote effects of these voyages it is as yet premature to speak. In the five years during which Mr. Darwin sailed about with Captain Fitzroy, the basis-structure of a system of philosophy was laid down which has already, even in its author's life-time, revolutionised almost every phase of scientific thought.

The "Journal" of that voyage now forms one of the most interesting books which either the young naturalist or the student of philosophy can read, for in its pages are to be found the elements of the doctrines of evolution which Mr. Darwin's later work has so firmly established. In the present book the geological observations made during the voyage are given separately, and for the general reader this has the disadvantage of making the book too technical for pleasant reading. If the geological observations had been given as a part of the text of the "Journal," a pleasanter book would have been the result, and the charming

\*Geological Observations on the Volcanic Islands and Parts of South America visited during the Voyage of H.M.S. 'Beagle.' By Charles Darwin, MA., F.R.S., &c. Second Edition. London : Smith, Elder, and Co.

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gossip of the latter would have attracted a larger class of readers to the former. Some of the most interesting of Mr. Darwin's observations were made on the volcanic formations of districts seldom visited by men of science, indeed, in some cases it is doubtful if they have ever been visited by any other skilled examiner than our author. One field Mr. Darwin has made especially his own,—and in all questions concerning the Galapagos Islands, Mr. Darwin has constituted himself the authority. This singular group consists of about a dozen islands, situated immediately under the Equator, about 600 miles west of the American coast, and they are formed entirely of volcanic rocks, some of the craters being of immense size.

In the whole archipelago, Mr. Darwin estimated that there must be at least 2,000 craters, most of which, if not all, seem to owe their origin to eruptions of volcanic mud, without any lava, the southern lips being almost uniformly broken down or removed by the action of the trade-wind whilst the craters were being formed. Very few eruptions seem to have occurred in recent times, and in these cases streams of lava have been formed. The views taken by Mr. Darwin on the processes by which the various results of volcanic action, as pitchstone and obsidian, are formed, are not such as would now be wholly accepted by mineralogists. Since the observations under consideration were made, the method of examining these products by the microscope, after their sections have been cut, has revealed evidence which pretty clearly indicates the chain of volcanic events.

Into the details of this interesting question we cannot now enter, but not the least interesting amongst the observations are those which show that in certain pitchstones the showers of fine ashes have been periodic, the dust having fallen in layers on a matrix of molten glass, and having been retained in that form. Also in certain obsidians it becomes evident that the peculiar "shot" appearance is due to a regular streaking in one direction, with elongated air-bubbles, the direction of the elongation corresponding with the axis of the current. These bubbles are probably the result of some admixture of steam or gas with the molten mass as it flowed along, and their observation is a remarkable illustration of how closely interdependent various methods of research become. Mr. Darwin suggests that the remarkable Kicker Rocks are really a cast of one of the craters, the tuff walls surrounding it and forming the crater having been washed away, leaving the more solid cone. This view, however, seems to involve a supposition of emergence and subsequent submergence, of which corroborative testimony is required, for Mr. Darwin admits that proofs of the rising of the land are very scanty.

In the tuff of these extinct craters numerous pisolitic balls, about the size of small bullets, were found, differing from the surrounding matter only in being harder and more finely grained. These balls seem to be a less complete formation of what Mr. Darwin has elsewhere described as volcanic bombs. These curious structures are met with in great numbers on the Island of Ascension, and vary in size from that of an apple to that of a man's body. They are spherical or pear-shaped, or sometimes have a distinct tail, like a Prince Rupert's drop. In some specimens, beneath a compact but fissured shell, the substance was coarsely cellular, the cells averaging in diameter about the tenth of an inch, but decreasing somewhat towards the surface. Mr. Darwin gives an explanation of these curious structures, which is probably the correct one, and which is to the effect that they are the result of masses of viscid molten matter, partaking more or less of the nature of glass, being projected through the air, the cells being formed by the liberation of the contained and condensed vapours. Similar bombs have been found in many other volcanic areas.

Not the least interesting of the many observations recorded by Mr. Darwin during this voyage are the influences of earthquakes in geological disturbance, and he had the good fortune to be able to make personal observation of the effects of these terrible occurrences without being a sufferer from it. His description of an earthquake at Concepcion forms one of the most graphic records of such an event which has ever been written. These disturbances are known to affect very considerable areas, and he found abundant evidence of their power to alter the relative levels of land and water. He found in the Chiloe Islands remains of numerous beds containing shells of recent kinds still living in the neighbouring waters, indicative of elevation of the land to a height of as much as fifty feet, and probably even very much higher. The earthquake at Concepcion raised the whole island of St. Mary many feet, but after a few weeks a corresponding subsidence slowly occurred. Besides these erratic elevations, Mr. Darwin has collected evidence of a general elevation having occurred within historic times along the west coast of South America. Thus at the mouth of the valley of

Coquimbo he found a series of terraces which undoubtedly give proof of this elevation. The bottom of this range is a plain about a mile in width, of a sandy nature, and abundantly strewn with shells. From this five terraces rise to a height of between 600 and 700 feet, the highest being composed of beach shingle. What has caused these occasional elevations is not yet known, but they can hardly be attributed to mere local accidents.

In the shell-beds formed by this process of elevation Mr. Darwin found, at San Lorenzo, some fossil remains of man's work which possess great interest. These included some heads of Indian corn, a piece of woven rushes, and a piece of nearly decayed cotton string. Comparing these with similar objects taken from the burial-grounds of the ancient Peruvians, they were undistinguishable; and it must be noted that these ancient people used string made of cotton only. He also found enormous quantities of broken earthenware of Indian manufacture, and other indications which make it clear that these elevations have taken place since Peru was inhabited by man possessing a high degree of civilisation. On the eastern coast other evidence of elevation is rendered by the sand dunes and salinas of the plains and the raised shell-beds of Tierra del Fuego.

Into the more purely technical parts of the book it is impossible to enter. It stands as yet perhaps the most complete record of the geological facts of the area visited, and its value is greatly enhanced by the appendices, in which the opinions of experts are given on the various fossil remains collected.