THURSDAY, MAY 25, 1882

CHARLES DARWIN[1]

II.

NO man of his time has exercised upon the science of Geology a profounder influence than Charles Darwin. At an early period he took much interest in geological studies, and all through life, while engaged in other pursuits, he kept himself acquainted with the progress that was being made in this department of natural knowledge. His influence upon it has been twofold. It arises partly from the importance and originality of some of his own contributions to the literature of the science, but chiefly from the bearing of his work on other branches of natural history.

When he began to direct his attention to geological inquiry the sway of the Cataclysmal school of geology was still paramount. But already the Uniformitarians were gathering strength and, before many years were past, had ranged themselves under the banner of their great champion Lyell. Darwin, who always recognised his indebtedness to Lyell's teaching, gave a powerful impulse to its general reception by the way in which he gathered from all parts of the world facts in its support. He continually sought in the phenomena of the present time the explanation of those of the past. Yet he was all the while laying the foundation on which the later or Evolutional school of geology has been built up.

Darwin's specially geological memoirs are not numerous, nor have they been of the same epoch-making kind as his biological researches. But every one of them bears the stamp of his marvellous acuteness in observation, his sagacity in grouping scattered facts, and his unrivalled far-reaching vision that commanded all their mutual bearings, as well as their place in the general economy of things. His long travels in the *Beagle* afforded him opportunities of making himself acquainted with geological phenomena of the most varied kinds. With the exception of one or two minor papers written in later years, it may be said that all his direct contributions to geology arose out of the *Beagle* voyage. The largest and most important part of his geological work dealt with the hypogene forces of nature—those that are concerned in volcanoes and earthquakes, in the elevation of mountains and continents, in the subsidence of vast areas of the sea-bottom, and in the crumpling, foliation, and cleavage of the rocks of the earth's crust. His researches in these subjects were mainly embodied in the "Geology of the Voyage of the *Beagle*"—a work which, in three successive parts, was published under the auspices of the Lords of the Treasury.

The order chosen by Darwin for the subjects of these three parts probably indicates the relative importance with which they were regarded by himself. The first was entitled "The Structure and Distribution of Coral Reefs" (1842). This well-known treatise, the most original of all its author's geological memoirs, has become one of the recognised classics of geological literature. The origin of those remarkable rings of coral-rock in mid-ocean had given rise to much speculation, but no satisfactory solution of the problem had been proposed. After visiting many of them, and examining also coral-reefs fringing islands and continents, he offered a theory which for simplicity and grandeur strikes every reader with astonishment. It is pleasant after the lapse of many years to recall the delight with which one first read the "Coral Reefs," how one watched the facts being marshalled into their places, nothing being ignored or passed lightly over, and how step by step one was led up to the grand conclusion of wide oceanic subsidence. No more admirable example of scientific method was ever given to the world, and even if he had written nothing else, this treatise alone would have placed Darwin in the very front of investigators of nature.

The second part was entitled "Geological Observations on the Volcanic Islands visited during the voyage of H.M.S. *Beagle*, together with some brief notices on the geology of Australia and the Cape of Good Hope" (1844). Full of detailed observations, this work still remains the best authority on the general structure of most of the regions it describes. At the time it was written, the "Crater of elevation theory," though opposed by Constant Prevost, Scrope, and Lyell, was generally accepted, at least on the Continent. Darwin, however, could not receive it as a valid explanation of the facts, and though he did not adopt the views of its chief opponents, but ventured to propose a hypothesis of his own, the observations impartially made and described by him in this volume must be regarded as having contributed towards the final solution of the question.

The third and concluding part bore the title of "Geological Observations on South America" (1846). In this work the author embodied all the materials collected by him for the illustration of South American geology save some which had already been published elsewhere. One of the most important features of the book was the evidence which it brought forward to prove the slow, interrupted elevation of the South American continent during a recent geological period. On the western sea-board he showed that beds of marine shells could be traced more or less continuously for a distance of upwards of 2000 miles, that the elevation had been unequal, reaching in some places at least to as much as 1300 feet, that in one instance at a height of 85 feet above the sea, undoubted traces of the presence of man occurred in a raised-beach, and hence that the land had there risen 85 feet since Indian man had inhabited Peru. These proofs of recent elevation may have influenced him in the conclusion which he drew as to the marine origin of the great elevated plains of Chili. But at that time, there was a general tendency among British geologists to detect evidence of sea-action everywhere and to ignore or minimise the action of running water upon the land. An important chapter of the volume, devoted to a discussion of the phenomena of cleavage and foliation, is well known to every student of the literature of metamorphism.

The official records of the *Beagle* did not, however, include all that Darwin wrote on the geology of the voyage. He contributed to the *Transactions* of the Geological Society (vol. v. 1840) a paper on the connection of volcanic phenomena. In the same publication (vi. 1842) appears another, on the erratic boulders of South

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America; while a third, on the geology of the Falkland Islands, was published later.

While dealing with the subterranean agents in geological change, he kept at the same time an ever watchful eye upon the superficial operations by which the surface of the globe is modified. He is one of the earliest writers to recognise the magnitude of the denudation to which even recent geological accumulations have been subjected. One of the most impressive lessons to be learnt from his account of Volcanic Islands is the prodigious extent to which they have been denuded. As just stated he was disposed to attribute more of this work to the action of the sea than most geologists would now admit; but he lived himself to modify his original views, and on this subject his latest utterances are quite abreast of the time. It is interesting to note that one of his early geological papers was on the Formation of Mould (1840), and that after the lapse of forty years he returned to this subject, devoting to it the last of his volumes. In the first sketch we see the patient observation and shrewdness of inference so eminently characteristic of the writer, and in the finished work (so recently noticed in these columns) the same faculties enriched with the experience of a long and busy life. In bringing to light the operations of the earthworm, he called the attention of geologists to an agency, the real efficiency of which they probably do not yet appreciate. Élie de Beaumont looked upon the layer of grass-covered soil as a permanent datum-line from which the denudation of exposed surfaces might be measured. But, as Darwin showed, the constant transference of soil from beneath to the surface, and the consequent exposure of the materials so transferred to be dried and blown away by wind, or to be washed to lower levels by rain, must tend slowly but certainly to lower the level even of undisturbed grass-covered land.

To another of his early papers reference may be made, from its interest in the history of British geology. Buckland, following in the footsteps of Agassiz, had initiated that prodigious amount of literature which has now been devoted to the records of the Glacial period in this country, by reading to the Geological Society a paper "On Diluvio-glacial Phenomena in Snowdonia and in Adjacent Parts of North Wales" (1841). Darwin, whose wanderings in South America had led him to reflect deeply upon the problems presented by erratic blocks, took an early opportunity of visiting the Welsh district described by Buckland, and at once declared himself to be a believer in the former presence of glaciers in Britain. His paper (1843) in which this belief is stated and enforced by additional observations, stands almost at the top of the long list of English contributions to the history of the Ice Age.

The influence exercised upon the progress of geology by Darwin's researches in other than geological fields, is less easy to be appraised. Yet it has been far more widespread and profound than that of his direct geological work. Even as far back as the time of the voyage of the *Beagle*, he had been led to reflect deeply on some of Lyell's speculations upon the influence of geological changes on the geographical distribution of animals. From that time the intimate connection between geological history and biological progress seems to have been continually present in his mind. It was not, however, until the appearance of the "Origin of Species" in 1859 that the full import of his reflections was perceived. His chapter on the "Imperfection of the Geological Record" startled geologists as from a profound slumber. It would be incorrect to say that he was the first to recognise the incompleteness of the record; but certainly until the appearance of that famous chapter the general body of geologists was blissfully unconscious of how incredibly fragmentary the geological record really is. Darwin showed why this must necessarily be the case; how multitudes of organic types, both of the sea and of the land, must have decayed and never have been preserved in any geological deposit; how, even if entombed in such accumulations, they would in great measure be dissolved away by the subsequent percolation of water. Returning to some of his early speculations he pointed out that massive geological deposits rich in fossils, could only have been laid down during subsidence, and only where the supply of sediment was sufficient to let the sea remain shallow, and to entomb the organic remains on its floor before they had decayed. Hence, by the very conditions of its formation, the geological record, instead of being a continuous and tolerably complete chronicle, must almost necessarily be intermittent and fragmentary. The sudden appearance of whole groups of allied species of fossils on certain horizons had been assumed by some eminent authorities as a fatal objection to any doctrine of the transmutation of species. But Darwin now claimed this fact as only another evidence of the enormous gaps in geological history. Reiterating again and again that only a small fraction of the world had been examined geologically and that even that fraction was still but imperfectly known, he called attention to the history of geological discovery as furnishing itself a strong argument against those who argued as if the geological record were a full chronicle of the history of life upon the earth. There is a natural tendency to look upon the horizon upon which a fossil species first appears as marking its birth, and that on which it finally disappears as indicating its extinction. Darwin declared this assumption to be "rash in the extreme." No palæontologist nor geologist will now gainsay this assertion. And yet how continually do we still hear men talking of the stages of the geological record, as if these were sharply marked off everywhere by the first appearance and final disappearance of certain species. The boldness with which Darwin challenged some of these long-rooted beliefs is not less conspicuous than the modesty and deference with which his own suggestions were always given. "It is notorious," he remarked, "on what excessively slight differences many palæontologists have founded their species; and they do this the more readily if the specimens come from different sub-stages of the same formation."

Starting from this conception of the nature of the geological record, Darwin could show that the leading facts made known by palæontology could be explained by his theory of descent with modification through natural selection. New species had slowly come in, as old ones had slowly died out. Once the thread of succession had been broken it was never taken up again; an extinct species or group never reappeared, yet extinction was a slow and unequal process, and a few descendants of

ancient types might be found lingering in protected and isolated situations. "We can understand how it is that all the forms of life, ancient and recent, make together one grand system; for all are connected by generation. From the continued tendency to divergence, the more ancient a form, is the more generally it differs from those now living. The inhabitants of each successive period in the world's history have beaten their predecessors in the race for life, and are in so far, higher in the scale of nature; and this may account for that vague, yet ill-defined sentiment, felt by many palæontologists, that organisation on the whole has progressed. If it should hereafter be proved that ancient animals resemble to a certain extent the embryos of more recent animals of the same class, this fact will be intelligible."

Again, what a flood of fresh light was poured upon geological inquiry by the two chapters on Geographical Distribution in the "Origin of Species!" A new field of research, or, at least, one in which comparatively little had been yet attempted, was there opened out. The grouping of living organisms over the globe was now seen to have the most momentous geological bearings. Every species of plant and animal must have had a geological history, and might be made to tell its story of the changes of land and sea.

In fine, the spirit of Mr. Darwin's teaching may be traced all through the literature of science, even in departments which he never himself entered. No branch of research has benefited more from the infusion of this spirit than geology. Time-honoured prejudices have been broken down, theories that seemed the most surely based have been reconsidered, and, when found untenable, have been boldly discarded. That the Present must be taken as a guide to the Past, has been more fearlessly asserted than ever. And yet it has been recognised that the present differs widely from the past, that there has been a progress everywhere, that Evolution and not Uniformitarianism has been the law by which geological history has been governed. For the impetus with which these views have been advanced in every civilised country, we look up with reverence to the loved and immortal name of Charles Darwin.

(*To be continued.*)

THE TOTAL ECLIPSE

THE Special Correspondent of the *Daily News* with the English Eclipse Expedition telegraphs as follows under date, Sohag, May 17:—

This eventful morning was the finest we have yet had, cool and without a cloud. A great crowd of natives in picturesque costumes lined the road and the hill between the camp and Sohag. The shore of the Nile, except before the observatories, was packed with dahabeeahs bringing the governors of the provinces and other notables to observe the eclipse and do honour to the strangers. Thanks to Moktar Bey, in charge of the camp, and a force of soldiery, there was no confusion. Along a line of 300 yards the French, English, and Italian observers were left in undisturbed possession of tents and observatories. Nevertheless, while the sky darkened and assumed a leaden hue, the hills bounding the Nile bathed in purple, the great silence gave way, and from river and palm-shaded slope arose a shout of wonder and fear, which reached its climax at the moment of the sun's disappearance; nor ceased then, for, in addition to the horror of an eclipse—which the natives here as in India attribute to the act of a dragon—there appeared in the heavens on the right of the sun an unmistakable scimetar. The eclipse had, in fact, revealed the existence of a new comet. Despite the short totality, many valuable results have been obtained. I am permitted to send a copy of the collective telegram sent to the various Governments, showing many new facts touching the sun's atmosphere; though matters have not become much simpler, which means more work. The layer to which much absorption has been ascribed seems vanishing from existence. The band K in the spectrum of the corona fully explains the eclipse colouring. The collective note is as follows:—

"Unprecedented facilities have been accorded by the Egyptian Government for the observation of the eclipse. A plan was agreed upon between the English, French, and Italian expeditions. Among the results, the most satisfactory are photographs of the corona, and a complete spectrum obtained by Schuster on Abney's plates. H and K are the most intense lines. A study of the red end of the spectrum of corona and protuberances was made by Tacchini. A comet near the sun was a striking object; it was photographed and observed by the naked eye. Bright lines were observed before and after totality at different heights by Lockyer, with intensities differing from Fraunhofer's lines; by Lockyer and Trépied an absolute determination was made of the place of the coronal line 1474 in Kirchhoff's scale; by Thollon and Trépied the absence of dark lines from the coronal spectrum was noted. Tacchini and Thollon, with very different dispersions, noted many bright lines in the violet. Thollon observed spectrum of the corona, and Schuster photographed it. The hydrogen and coronal line were studied in the grating spectroscope by Buisieux, and with direct vision prism by Thollon. Rings were observed in the grating by Lockyer, of the first, second, and third order. The continuous spectrum is fainter than 1878, stronger than 1871. An intensification of the absorption lines was observed in group B, at moon's edge, by Trépied and Thollon.—(Signed), LOCKYER, TACCHINI, and THOLLON."

When our cases are packed, we shall start directly home.

Captain Abney writes as follows to the *Photographic News*:—

I have received a brief telegram from Egypt regarding the Eclipse Expedition, and as it is in cipher I give the gist of the news. "Very successful all round. The whole of the spectrum with blue lines on a continuous background has been photographed. Prominences photographed with the prismatic camera (showing, of course, ring spectrum). Three photographs taken of the corona. A comet close to sun photographed with the prismatic and also ordinary cameras."

A telegram from the Alexandria correspondent of the *Daily News* states that Mr. Lockyer was to leave for London yesterday by the Peninsular and Oriental Company's steamer *Clyde*, while the other members of the Eclipse Expedition, with their instruments, were to leave next week.