

*Philosophy, Metaphysics, and General Science.*

*Island Life*; or, The Phenomena and Causes of Insular Faunas and Floras; including a Revision and attempted Solution of the Problem of Geological Climates. By ALFRED RUSSEL WALLACE, author of "The Geographical Distribution of Animals," etc. 8vo, pp. xvi, 522. New York: Harper & Brothers.

It is well known that Mr. Wallace might justly dispute with Mr. Darwin the honor of having originated the now very famous theory of development by natural selection. As an author he became known by his work on the "Malay Archipelago," and (in 1870) his "Contribution to the Theory of Natural Selection;" and, about four years ago, he gave to the world his two substantial volumes on "The Geographical Distribution of Animals," a work worthy to be placed alongside of those of Darwin and Lyell in the field of biological and geological research. The present volume is, as the author tells us in his Preface, designed to be supplementary to this last-named work, and to be of a more popular character. It may be regarded, however, as in fact a more deliberate and matured expression of Mr. Wallace's views as to the origin of the present island faunas and floras of the globe—the tracing back of them to their original ancestors, and an explanation of how they became *what* they are, and *where* they are. The

appearance of a South American species in the far-off islands of the Indian Ocean, or of the plants of Great Britain in the island of Japan, was naturally pointed to by the opponents of evolution as an insurmountable objection in the way of that theory. They found the barn-owl (*Strix flammea*) in countries the most remote from each other; the osprey, or fishing-hawk, at once in Brazil, South Africa, the Malay Islands, and Tasmania; and the raven extending from the Arctic regions to Texas and New Mexico, as well as to India and Lake Baikal in Asia. We and they were naturally driven to infer that the same specific form had, on the theory of development, been produced in different parts of the world. Yet more perplexing is it to find two species of the serpentine amphibia, *Cæcilia oxyura* and *Cæcilia rostrata*, in the Seychelles Islands, and, at the same time, one of these species on the Malabar coast, and the other in West Africa and South America. We find the same fact illustrated in connection with the dispersion of plants. Identical plants appear in Scandinavia, in India, in New South Wales, in New Zealand, and in Iceland. Thirty-nine species of the plants of New Zealand are identical with species found in Europe, and there are eleven species common to New Zealand and South America.

Lyell and recent English geologists got over these difficulties by boldly affirming that during the vast periods of geological time the existing continents and ocean-basins of the globe have, more than once, changed places, and that continental areas have stretched across the widest seas. But Mr. Wallace joins issue with the school of Lyell on this point, and undertakes to prove, by incontestable facts, that the existing continents were outlined from the beginning, as long ago taught by Professor Dana, and that the waters have rolled over the "deep unfathomed caves of ocean" from the most remote period. It becomes necessary, therefore, for Mr. Wallace to explain the wide distribution of genera and species on other grounds; and this he undertakes to accomplish, in part, by showing that, while there was no continental extension between two such remote areas, for example, as Madagascar and the Malay Archipelago, there has existed in times, more or less remote, a *chain of considerable islands* connecting Southern Africa and Southern Asia. Even this would involve upheavals of the ocean bottom to the extent of a thousand fathoms.

We have in this connection an incidental discussion of the existence in tertiary times of the supposed *Lemurian continent*

between Madagascar and the Indian peninsula. By many arguments, and especially appealing to the results obtained by the recent deep-sea soundings, it is shown, that no such continental area existed in tertiary times; and the significance of this becomes apparent when we remember that it is on the existence of this continent that many evolutionists rely in order to connect man with the lower animals. It is in the rocks of this sunken continent, they allege, that we should find the missing links between man and the apes, if we could have access to its paleontological treasures; for here, they tell us, was the special *habitat* of the anthropomorphous apes. With the annihilation of this fancy, and in view of the entire absence of all such links in the tertiary beds of the existing continents, the advocates of the derivation of man from lower animal forms are left entirely without any *evidence* of the fact; and there the matter rests. Mr. Wallace, it is well known, has never pushed the theory of development so as to include our *homo sapiens*.

The first part of the present work applies itself to the establishment and mapping out of the different "zoological regions;" the "Palearctic," the "Ethiopian," the "Oriental," etc. The author then proceeds to show that the existence of these zoological provinces is the necessary result of the "law of evolution"—tracing the origin, growth, and decay of species and genera. The next subject considered is the means by which the various groups of animals are enabled to overcome the natural barriers which often seem to limit them to very restricted areas, and what are the exact nature and amount of the changes of sea and land experienced by the earth in past ages. The author then takes up the consideration of the set of changes—those of climate—which have probably been agents of the first importance in modifying specific forms and in the dispersion of animals. Three chapters, in this connection, are devoted to the Causes of Glacial Epochs. Here the author finds only two explanations suggested, which seem tenable; and while adopting generally Mr. Croll's views as to the causes of the "glacial epoch," he introduces certain limitations and modifications of that theory. From this examination the important conclusion is reached that the alternate phases of precession—causing the winter in each hemisphere to be in aphelion and perihelion each 10,500 years—would produce a complete change of climate only where a country was *partially* snow-clad; while, whenever a large area became almost *wholly* buried in snow and ice, as was certainly the case with Northern

Europe during the glacial epoch, then the glacial conditions would be continued, and perhaps even intensified, when the sun approached nearest the earth in winter, instead of there being at that time, as Mr. Croll maintains, an almost perpetual spring. With regard to the existence of glacial epochs in earlier times it is shown that Mr. Croll's views are opposed by a vast body of facts.

The general conclusion is reached that geographical conditions are the primary cause of great changes of climate, and that the radically different distribution of land and sea in the northern and southern hemispheres has generally led to great diversity of climate in the arctic and antarctic regions. It is only in recent times that the great northern continents have become so completely consolidated as they at present are, so as to shut out the warm water from their interiors, and render possible a wide-spread and intense glacial epoch. But this great climatic change was actually brought about by the high eccentricity which occurred about 200,000 years ago. It is, thus, the *concurrence* of the astronomical causes with the geographical revolutions which has resulted in bringing about glacial conditions. The glacial age lasted, we are told, about 120,000 years, and closed about 80,000 years ago.

Mr. Wallace proceeds then to one of the most interesting discussions in the volume—geological time as bearing on the development of the organic world. Geologists in the past have generally represented that geological time had to be measured by hundreds of millions rather than by millions of years. We believe that Mr. Darwin estimated that the denudation of the weald alone demanded more than 300,000,000 of years. Geologists have dwelt continually on the slowness of the processes of upheaval and subsidence, of denudation, and of the deposition of strata; while, on the theory of development, as expounded by Mr. Darwin, the variation and modification of organic forces is also exceedingly slow. Most geologists regarded the estimate of Sir Charles Lyell, of 240,000,000 of years since the Cambrian period, as very moderate; and Mr. Darwin, in his "Origin of Species," remarks, that before the Cambrian period commenced long periods had elapsed—probably far longer than the whole interval from the Cambrian age to the present day. Professor Huxley has expressed himself in terms equally strong as to the enormous periods which are required for the development of the higher forms of life; and Mr. Wallace remarks, that, according to these views, "the date of the commencement of life on the earth

cannot be less than 500,000,000 of years." On the other hand, physicists pointed out that the earth must once have been too hot to support life; while the friction of the tides is checking the earth's rotation, and this cannot have gone on indefinitely without making our day much longer than it is. A limit is therefore placed to the age of the habitable earth; and it was argued that the time so allowed was much too short for the long processes of the geologists and biologists. Mr. Wallace undertakes to demonstrate, that no such enormous periods are required. The rate of denudation, he says, has been recently approximately measured; and if, then, we take the *maximum* thickness of the *known* sedimentary rocks to represent the *average* thickness of *all* the sedimentary rocks, and we know also the *amount* of sediment carried to the sea, and the *area* on which that sediment is spread, we have a means of calculating the *time* required for the building up of all the sedimentary rocks of the geological system. The mean rate of denudation over the whole earth is about one foot in three thousand years; therefore the rate of *maximum* deposition (deposition going on as compared with denudation in the ratio of 19 to 1,) will be at least nineteen feet in the same time; and as the total *maximum* thickness of all the stratified rocks of the globe, according to Professor Haughton, is 177,200 feet, the time required to produce this thickness of rock, at the present rate of denudation and deposition, is only 28,000,000 years—a considerable reduction on Lyell, Darwin, and Huxley.

The author then proceeds to the discussion of a series of typical insular faunas and floras, with a view to explain the phenomena they present, and in a number of chapters passes in review the faunas and floras of the Azores and Bermuda, St. Helena and the Sandwich Islands, the British Isles, Borneo and Java, Japan and Formosa, Madagascar, Seychelles, Mauritius, New Zealand, etc.

We have rather undertaken to present to the reader an outline of Mr. Wallace's views than to criticise them. We will only remark that a great deal of the book is mere *speculation*.

We need only add that the Messrs. Harper, in bringing out this very valuable work, have gotten it up in their most attractive style.