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## ISLAND LIFE.

IN looking at the distribution of animal and vegetable life over the various countries of the globe, the question of how the distribution has been effected must have occurred to many. So far as the larger divisions, or continents, of the globe are concerned, no particular difficulty at first sight presents itself; but in the case of the numerous *islands* that dot our larger seas and oceans, we at once find ourselves face to face with considerable perplexities. Take the case of the island of St Helena, for instance. It is situated in the South Atlantic Ocean, eleven hundred miles from the coast of Africa on the east, and eighteen hundred miles from that of South America on the west. When first discovered, nearly four hundred years ago, it was found to be densely covered with a luxuriant forest vegetation, which was afterwards almost entirely destroyed in various ways, not least by the ravages of goats bred from those which the Portuguese at first introduced on St Helena, and which in course of time overran it like a plague, leaving the island almost a desert. The destruction of the trees was also accompanied by the disappearance of many kinds of animals originally found on the island. Then take the case of the Azores in the North Atlantic, situated eight hundred miles from land—a group of islands extremely fertile, and abounding in animals of many kinds. In both these instances, which are only two among thousands, the question which presents itself to the scientific mind is: How did life, whether animal or vegetable, manage to reach these distant, solitary, ocean-girdled spots?

So long as men were content to believe that all the variety of life which we see around us was due to acts of 'special creation,' no serious difficulty was to be found in answering the question; but with a wider and more accurate knowledge of the wonderful processes of nature—of the remarkable operation of natural laws—it was at once found that to account for this distribution of animal and vegetable life on scientific grounds, a problem of

great delicacy and difficulty had to be encountered. The name of Mr Alfred Russell Wallace has long been distinguished in connection with the efforts that have been made to solve this problem, and his recent work on *Island Life* (London: Macmillan & Co.) is his latest and fullest contribution to the literature of the question.

Madagascar may be taken as typical of some of the difficulties of the question. This large island, containing three times the territory of England, presents an extraordinary instance of the anomalies in the distribution of animal life. It lies two hundred and fifty miles from the coast of Africa, and yet its mammalia differ entirely in all essential characteristics from the mammalia of the neighbouring continent. Madagascar possesses no less than sixty-six species of mammals which are not only different from those of Africa, but from those of any other existing continent. 'Africa is prominently characterised by its monkeys, apes, and baboons; by its lions, leopards, and hyenas; by its zebras, rhinoceroses, elephants, buffaloes, giraffes, and numerous species of antelopes. But no one of these animals, nor anything like them, is found in Madagascar.' Of the lemurs, there are six genera and thirty-three species on the island—half its entire mammalian population; and nowhere else are these creatures found in such abundance. Then the carnivora of the island are represented by a peculiar cat-like animal, *Cryptoprocta*, forming a distinct family, and having no allies in any part of the globe. In the rodents—the rats and mice—of the island, one genus is said to be allied to another which is indigenous to America; and the Colubrine snakes are represented in Madagascar, not by African or Asiatic genera, but by two American genera. Of the lizards of the island, certain of the genera are again found to be allied to families which are exclusively American.

These facts are very extraordinary, for they show us, that while few of the animals on the island are represented by African families, many others are represented among existing mammals only by families to be found in the far-distant

and utterly foreign continent of America. The explanation which Mr Wallace gives of this peculiar state of things appears to be a reasonable one—namely, that the island of Madagascar was at one time connected with, or formed part of, the continent of Africa, but, with its stock of mammals, was detached therefrom at a period long prior to the descent into Africa of the different race of animals which now inhabit that continent. Thus we have a collection of mammals existing on the island such as we may suppose to have inhabited Africa previous to the immigration of its present mammalia. These have almost completely obliterated all traces of their predecessors, for whom we must therefore now look to the piece of land which was detached from the continent while the older race of animals still inhabited it, and which now forms the great island of Madagascar.

But while islands offer the best subjects for the study of distribution, the continents nevertheless present many interesting phenomena. Mr Wallace tells us, for example, that when an Englishman travels by the nearest sea-route from Great Britain to Northern Japan, he passes by countries very unlike his own, both in aspect and natural productions. He skirts the sunny isles of the Mediterranean, the sands and date-palms of Egypt, the cocoa groves of Ceylon, and many other places, and after a circuitous journey of thirteen thousand miles finds himself in Japan. Yet what is his astonishment—after placing between him and England such enormous tracts of land, and with so little in them that is familiar to the English eye—to find himself once more in a country the natural objects of which are in many instances identical with those of his far-off home! Thus, 'he finds the woods and fields tenanted by tits, hedge-sparrows, wrens, wagtails, larks, red-breasts, thrushes, buntings, and house-sparrows; some absolutely identical with our own feathered friends, others so closely resembling them, that it requires a practical ornithologist to tell the difference. If he is fond of insects, he notices many butterflies and a host of beetles which, though on close examination they are found to be distinct from ours, are yet of the same general aspect, and seem just what might be expected in any part of Europe. There are also of course many birds and insects which are quite new and peculiar; but these are by no means so numerous or conspicuous as to remove the general impression of a wonderful resemblance between the productions of such remote islands as Britain and Yesso.'

On the other hand, if an inhabitant of Australia sails to New Zealand, a distance of less than thirteen hundred miles, he will find himself in a country whose productions are totally unlike those of his own. 'Kangaroos and wombats there are none, the birds are almost all entirely new, insects are very scarce, and quite unlike the handsome or strange Australian forms; while even the vegetation is all changed, and no gum-tree, or wattle, or grass-tree meets the traveller's eye.' But still more striking contrasts than these are to be met with. There are two islands in the Malay Archipelago, named Bali and Lombok, each about as large as Corsica, and separated by a narrow strait of but fifteen miles. 'Yet these islands differ far more from each other in their birds and quadrupeds than do England and Japan. The birds of

the one are extremely *unlike* those of the other, the difference being such as to strike even the most ordinary observer.' Such an instance is useful 'as proving that mere distance is one of the least important of the causes which have determined the likeness or unlikeness in the animals of different countries.'

Instances of a similar kind might be given from the western hemisphere; but the above are sufficient to indicate the nature of the problem with which the scientist has to deal in determining the laws and incidental causes that have to do with the phenomena of distribution. Many of the questions arising out of this problem are of singular complexity and interest; and even the solution which Mr Wallace's long experience of the subject enables him to attempt, may not in many points be accepted without considerable discussion in the scientific world.

One of the first things to note in considering the solution which our author advances, is, that the geographical divisions of the globe do not correspond to its zoological divisions. Thus the term 'Europe' does not give, with any approach to accuracy, the range of any one genus of mammals or birds. They may range into Siberia, or into Asia Minor, or Palestine, or North Africa. Consequently, for the purposes of the naturalist, the old geographical divisions are discarded, and a series of zoological divisions substituted. Thus Europe, with north temperate Africa and Asia, form what is called the Palæartic Region; Africa south of the Sahara, the Ethiopian Region; Tropical Asia, the Oriental; Australia, the Australian; North America, the Nearctic; and South America, the Neotropical Region. The various families of birds and mammals are not distributed over this region in any regular or continuous way; but are often discontinuous, and appear as it were in patches, to connect which, or to account for which, is one of the problems of distribution to be solved. Hence it is necessary to make some inquiry into the different powers of dispersal of animals and plants, into the nature of the barriers that limit their migrations, and into the character of the geological or climatal changes which have favoured or checked such migrations.

It is impossible within the limits of a magazine article to give any adequate idea of all that is involved in the elucidation of these important questions; though a few words may be said on the interesting subject of the dispersal of animals. As is readily conceived, a wide extent of ocean forms an almost insuperable barrier to the dispersal of all land animals, and even of birds; for, though the latter can fly far, yet they cannot go thousands of miles without rest or food, unless in the case of aquatic birds, who can find both rest and food on the surface of the ocean. Without artificial help, therefore, neither mammalia nor land-birds can pass over very wide oceans. 'The exact width they can pass over is not determined, but we have a few facts to guide us. Contrary to the common notion, pigs can swim very well, and have been known to swim over five or six miles of sea; and the wide distribution of pigs in the eastern hemisphere may be due to this power. It is almost certain, however, that they would never voluntarily swim away from their native land; and if carried out to sea by a flood, they would certainly endeavour to return to the shore. We cannot

therefore believe that they would ever swim over fifty or a hundred miles of sea; and the same may be said of all the large mammalia. Deer also swim well, but there is no reason to believe that they would venture out of sight of land.

With the smaller, and especially with the arboreal mammalia, there is a much more effectual way of passing over the sea by means of floating trees, or those floating islands which are often found at the mouths of great rivers. Sir Charles Lyell describes such floating islands which were encountered among the Moluccas, on which trees and shrubs were growing on a stratum of soil which even formed a white beach round the margin of each raft. Among the Philippine Islands, similar rafts with trees growing on them have been seen after hurricanes; and it is easy to understand how, if the sea were tolerably calm, such a raft might be carried along by a current, aided by the wind acting on the trees, till after a passage of several weeks, it might arrive safely on the shores of some land hundreds of miles away from its starting-point. Such small animals as squirrels and mice might have been carried away on the trees which formed part of such a raft, and might thus colonise a new island; though, as it would require a pair of the same species to be carried away together, such accidents would no doubt be rare. Insects, however, and land-shells would almost certainly be abundant on such a raft or island; and in this way we may account for the wide dispersal of many species of both these groups.

But such causes as these can scarcely be accepted as sufficient to account for the dispersal of mammalia as a whole; and whenever a considerable number of the mammals of two countries are found to exhibit distinct marks of relationship, Mr Wallace thinks we may be sure that an actual land connection, or at all events an approach to within a very few miles of each other, has at one time existed. A great number of identical families and genera are in fact to be found in all the great continents, and the present distribution of land renders it easy to see how this dispersal has been effected. All the great land masses radiate from the arctic regions as a common centre, the only break being at Behring's Strait, which is so shallow, that a rise of less than a thousand feet would form a broad isthmus connecting Asia and America. Continuity of land may therefore be said to be general over the globe; the chief exceptions to this being Australia and a number of large islands. These islands are divided into two classes—(1) those which have been formed in the ocean by volcanic or coralline agency; and (2) those which have simply been detached from continents by the sinking or submergence of the connecting land. On the first class of islands, the oceanic, there is no trace of indigenous mammalia or amphibia, but they usually contain an abundance of birds and insects, and a sprinkling of reptiles. Continental islands, on the other hand, are never far from land, and always contain some land mammals and amphibia, as well as representatives of other classes and orders. It is therefore suggested that all the animals and birds which inhabit the oceanic islands must have reached them by crossing the ocean; or they must be the descendants of ancestors who did so; and that those which inhabit islands adjacent to continents,

may partly have been left there when the separation from the mainland was effected.

But, in Mr Wallace's opinion, the key to the many difficulties which have hitherto prevented the student from forming a clear conception as to the way in which the distribution of life over the globe has been effected, is to be found in the permanency of land masses, and the evolution of species. Some of the author's views will, as already observed, provoke discussion; yet these views, if found to be right, will rank in the future as conclusions of primary importance. He holds, for instance, that in the main the great land and ocean areas of the present time have been permanent ever since the beginning of the geological record. The great ocean deeps have been stable; but the shallows and their associated land areas have been subject to incessant changes of level relatively to the surface of the sea, in consequence of the combined influences of upheaval, subsidence, and denudation. The result of this theory is, that while the same area may have been at one time sea, at another land, in frequent succession, yet the *great* land areas have always been approximately where they are now. Then as regards the effect of the evolution of species on the dispersal of animals, he considers he has established the fact that wild animals are by no means so constant in size and minor characteristics as has generally been assumed. In some extreme cases, it is found that the size of proportional parts may vary to the extent of twenty-five per cent.; and that in many cases it may be three, four, six, or nine per cent. These great variations, in conjunction with incessant climatic and other changes, are sufficient, in his opinion, to account for the present distribution of animals into zoological regions and districts.

So much for his general conclusions. But too much stress must not, as Mr Wallace points out, be laid on isolated causes. The phenomena of distribution cannot be adequately perceived if looked at from a specialised point of view; since every fact is but a link in a great connected series of changes, the beginning of which is to be found in ages long since gone by, and the continuation of which will stretch into the distant future. It is a singularly complicated and difficult question, yet presents points of immense interest to students of nature, who, whether they should or should not agree with Mr Wallace's conclusions, will not rise from the perusal of his book without a deep impression of the masterly way in which he has treated a subject at once so wide and so complex.