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## BOOKS.

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### MR. WALLACE ON THE DISTRIBUTION OF ANIMALS.\* [FIRST NOTICE.]

To do a work of this kind justice in an ordinary review is almost impossible, and to exhibit in a satisfactory light the enormous labour which its author has undertaken cannot be accomplished, without supposing an amount of technical knowledge on the part of our readers which would be unreasonable.

But the conclusions to which Mr. Wallace's work points are so important, as bearing upon the recent teachings of biology, that we should like to give a general idea of the book. First of all, let us say that it is got up in a style which is worthy of the publishers, the type being clear and distinct; and it is wonderfully free, for a book of its kind, from printers' mistakes. The only matter for regret is that it has not been put in three volumes instead of two, and made uniform in size with Murray's issue of Mr. Darwin's books, of which it really forms a complement. The size of the volumes makes them rather unhandy and fatiguing to any one who goes straight through them, a task which we need scarcely say has to be done with much thought and patience.

There are many instances of important discoveries having been made simultaneously by two different and independent workers, and the usual result is that they quarrel bitterly for the credit. As far as we know, there has been only one exception to this, a case where each discoverer has attributed the praise to the other, and Mr. Wallace shares this unusual position with Mr. Darwin. We can now characterise the theory of the origin of species as a

\* *Geographical Distribution of Animals.* By Alfred Russel Wallace. London: Macmillan and Co.

gigantic discovery, the working-out of which has established the law of evolution. In Mr. Darwin's great work on the changes which have taken place in *Animals and Plants under Domestication*, the proof of this discovery is based on a careful investigation of what has been effected by man himself. In the work now before us, further proof is advanced, from a careful observance of what has been done by the great factor of natural selection; and if Mr. Darwin and Mr. Wallace both hesitate to claim the greater honour in the discovery, it is to the outside reviewer a matter of absolute impossibility to determine who of these two naturalists have laboured the harder or the more honestly, and is the more free from points open to attack. It is equally difficult to determine which of the two works already named is the more important contribution to biology. Both authors are stamped with the same modesty, for Mr. Wallace, at the end of his preface, writes this remarkable sentence:—"It is, therefore, with some hesitation that I venture to express the hope that I have made some approach to the standard of excellence I have aimed at,—which was, that my book should bear a similar relation to the eleventh and twelfth chapters of the *Origin of Species*, as Mr. Darwin's *Animals and Plants under Domestication* does to the first chapter of that work. Should it be judged worthy of such a rank, my long and often wearisome labours will be well repaid." We can only say that we think his hope will be fully sustained by all competent judges.

The book is divided into four parts, the first volume being occupied by the first, second, and a portion of the third parts, and the second volume by the remainder of the third and the fourth part. Both volumes are illustrated by most useful maps, on which are depicted by different shadings, various districts, according to their elevation, and contour-lines giving ocean depth and regional divisions. These maps are necessarily on a small scale, and are, therefore, rather puzzling until the eye gets accustomed to them; and a real service would be rendered to science by having these maps produced on a larger scale for educational purposes. Maps, as at present constructed, giving the results chiefly of mere political accidents, are far less worthy of study than those displaying the great physical facts set forth by Mr. Wallace. Illustrations are also given which, though of no great merit as artistic compositions, are wonderfully true, and very valuable as affording a sort of bird's-eye view of the characters of the animal population of each district of the earth's surface as divided by Mr. Wallace. Not the least valuable part of the work, and what must have been by far the most laborious, are the tables of the distribution of animals, from which it may be seen at a glance where each is found; and reference to them is greatly facilitated by a most copious and accurate index, without which the value of the book would have been greatly diminished.

The author advises that persons not well acquainted with zoology should not read the book as it stands, but should take the fourth part before the third. We think this advice well intended, but it is really somewhat unnecessary, for the book must remain pretty much of a sealed treasure to such as are not already fairly well versed in natural history; and we venture to throw out the suggestion that some of the many writers who excel in condensing the works of others should take the *Origin of Species*, *Animals and Plants under Domestication*, and Mr. Wallace's new book, and make a small handbook out of them, for popular or even school instruction. In this way only can popular delusions on the subject of evolution be dispelled.

During all historic time the remarkable facts of the distribution of animals over the earth's surface have afforded a constant source of speculation. The story of the Noachian Deluge evidently has grown out of the necessity of explaining some local catastrophe which the limited knowledge of the sufferers imagined to be general; and of course, now its only interest is its antiquity. Even if it could be made to explain the preservation of animals, it would in no way help us to understand such facts as that while we have a kind of grouse peculiar to this country, there is no such animal as the echidna out of Australia and Tasmania, and yet that the *vespertilio* is found all over the world.

The first discovery, which led up to a further and more critical inquiry, was the result of geological labour, to the effect that the relative land and sea levels are not only not constant, but have changed and changed again, the changes bringing with them variations of climate, which must, again, have induced alterations in the animal population. This was followed by the discovery that everywhere the remains of animals are found which are now either wholly extinct, or have completely changed their habits. Then came an expression of the suspicion, followed by an

elaborate proof by Mr. Darwin, that what we call *species* of animals are not constant, but are liable to slow but certain variation. We may now say that Mr. Wallace's book is the coping-stone of this great arch, for it is nothing short of a demonstration that the facts of animal distribution are the results of the action of two factors, the chief of which is progressive development; and the second, the repeated variations in the relations of the land and sea.

Into the various theories which have been advanced to explain the alterations of these levels, we have no space here to enter, but we wish that Mr. Wallace had given them a fuller consideration. Speculations on the subject are to be met with in classic authors, for we find Nero's greatest victim writing the lines,—

"Venient annis  
Sæcula seris, quibus Oceanus  
Vinculum rerum laxet, et ingens  
Pateat Tellus, Tiphusque novos  
Detegat orbis; nec sit terris  
Ultima Thule."

And in this country we do not think sufficient prominence has been given to the theory of the periodicity of such movements, as advanced so long ago as 1842 by J. Adhemar, though Mr. Croll has recently attracted attention to a doctrine somewhat similar.

In the first part of his book, Mr. Wallace deals with the principles and general phenomena of distribution, and first of all, he discusses the influence of barriers. The most important of these are deep seas, high mountains, and broad rivers. Islands far away from land almost always have very peculiar animals, found nowhere else; but the differences are sure to depend really more upon the depth of the intervening sea than upon mere distance, a fact which is extremely significant. Shallow straits, like the English Channel or the Straits of Malacca, are not found to have much effect, the animals being nearly or quite identical on their opposite shores. "A change of climate or a change of vegetation may form an equally effective barrier to migration. Many tropical and polar animals are pretty accurately limited by certain isothermal lines, and the limits of the great forests in most parts of the world strictly determine the ranges of many species." Besides these geographical barriers, many others exist, which have influences more localised, but quite as powerful. Thus the existence of the Tsetse fly in South Africa, and of another of similar habits, utterly prevent the existence of wild cattle and horses in the districts they inhabit, and thus serve as most effective barriers to the spread of these animals. On the other hand, the absence of enemies, as in the case of the great tortoises of the Galapagos and Mascarene Islands, and the wingless birds of New Zealand, has been the direct cause of the origin of these peculiar species:—

"Naturalists," says Mr. Wallace, "have now arrived at the conclusion that by some slow process of development or transmutation all animals have been produced from those which preceded them, and the old notion that every species was specially created as they now exist, at a particular time and in a particular spot, is abandoned, as opposed to many striking facts, and unsupported by any evidence. This modification of animal forms took place very slowly, so that the historical period of three or four thousand years has hardly produced any perceptible change in a single species. Even the time since the last glacial epoch, which on the very lowest estimate, must be from 50,000 to 100,000 years, has only served to modify a few of the higher animals into very slightly different species. The changes of the forms of animals appear to have accompanied, and perhaps to have depended on, changes of physical geography, of climate, or of vegetation; since it is evident that an animal which is well adapted to our condition of things will require to be slightly changed in constitution or habits, and therefore generally in form, structure, or colour, in order to be equally well adapted to a changed condition of surrounding circumstances."

The *a priori* difficulty of believing that such changes actually do take place in species is quite removed by a consideration of what actually takes place in individual animals every year. If two ptarmigan were presented as new and unknown birds to some species-manufacturer, one in its winter and the other in its summer plumage, he would certainly divide them; and we shall see by-and-by that changes no greater in extent than these have really originated new species, under altered conditions of life.

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 MR. WALLACE ON THE DISTRIBUTION OF ANIMALS.\*

[SECOND NOTICE.]

GRANTING the facts, now completely established by geologists, that the surface of the earth has been through all time, and is still, undergoing a series of changes, and that there is a constant tendency for all living things to adapt themselves to their surroundings by the simple process of those which are unfit being killed off, we come almost inevitably to Mr. Wallace's further conclusions. His merit is in working out the details:—

"Animals," he says, "multiply so rapidly, that we may consider them as continually trying to extend their range, and thus any new land raised above the sea by geological causes becomes immediately peopled by a crowd of competing inhabitants, the strongest and best adapted of which alone succeed in maintaining their position."

No better illustration of this could be taken than that afforded by insects, whose rate of increase is familiar to every one. Their two chief functions are, to afford food for other animals, and to be the means of fertilising flowers. A new field where they would be free from those who prey upon them would place them under different circumstances, and would free them from the necessity of being provided with the means for escape which they generally possess, either in the shape of wings or some kind of mimicry. If we take some isolated spot, as Kerguelen Island or Madeira, as a new habitat for them, without in the meantime considering what geological change produced it, we find at once that in their new home the insects whose wings are deficient or absent would not be destroyed, as they would be in their old home. That insects are occasionally born without wings, in every class of them, if not established by actual observation, is quite certain to be the case by analogous monstrosities met with elsewhere. We find, further, that in the new locality not only would the wingless insects be protected in a negative way by the absence of their former destroyers, but that they would have a positive advantage due to a local peculiarity. Mr. Darwin long ago connected the occurrence of wingless insects in such places as Madeira with the frequency and violence of the gales which occur there, and he came to the conclusion that the winged individuals were blown out to sea and drowned, whilst those which had no wings were protected by their deprivation. The report of the Transit expedition to Kerguelen Island completely establishes this discovery, for moths, flies, and beetles were there found to be quite incapable of flight, though many had stumps or abbreviated wings, showing that their progenitors were formerly fully provided.

If further proof were needed, Mr. Wallace's careful compilation of facts fully affords it. In Madeira no less than twenty-two genera of insects, which are usually, or sometimes, winged in Europe, have only wingless species; and even the same species which is winged in Europe becomes, in at least three cases, wingless in Madeira, without any other perceptible change having

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taken place. But this is not the most curious fact, for when any new factor makes a change in one direction, it is quite sure not to limit its influence to that one method. The same climatic influence which deprives some insects of their wings increases the size of the wings of others, for Mr. Wollaston has pointed out that those species which have wings in Madeira have them larger than the same species in Europe. The meaning of this is plain, for the insects may obtain a victory over the destroying tendency of the wind, either by avoiding all struggle with it, or by struggling victoriously. The European insects have wings which in Madeira are either too strong or not strong enough, and the struggle for existence may be successfully made in two ways, either by ceasing to have wings at all, or by having them stronger.

"If we keep in mind," says Mr. Wallace, "the facts that the minor features of the earth's surface are everywhere slowly changing, that the forms and structure and habits of all living things are also slowly changing, while the great features of the earth, the continents and oceans and loftiest mountain ranges, only change after very long intervals, and with extreme slowness, we must see that the present distribution of animals upon the several parts of the earth's surface is the final product of all these wonderful revolutions in organic and inorganic nature. The greatest and most radical differences in the productions of any part of the globe must be dependent on isolation by the most effectual and most permanent barriers. That ocean which has remained broadest and deepest from the most remote geological epoch will separate countries the productions of which most widely and radically differ, while the most recently-depressed seas, or the last-formed mountain ranges, will separate countries the productions of which are almost or quite identical. It will be evident, therefore, that the study of the distribution of animals and plants may add greatly to our knowledge of the past history of our globe. It may reveal to us, in a manner which no other evidence can, which are the oldest and most permanent features of the earth's surface, and which the newest. It may indicate the existence of islands or continents now sunk beneath the ocean, and which have left no record of their existence, save the animal and vegetable productions which have migrated to adjacent lands."

Even the habits of certain animals may be made to tell the story of previous conditions of the earth's surface in a way which at first sight is surprising, and would be certainly disputed, if the conclusions drawn from them were not fully supported by other facts. Thus the migrations of birds probably means that they were originally permanent inhabitants of the countries to which they migrate for the purposes of breeding, and that they were slowly driven elsewhere during the winter by very gradual changes in the climate. Any one who has petted birds must have been struck with their intense conservatism, and with the persistence they display in the retention of any little habit they may have acquired. Thus a pet canary will be distressed for weeks if the perch on which he has been accustomed to sleep is removed. If he sleeps out of his cage, he will visit the old spot night after night and refuse to be comforted. The same spirit is displayed in the unvarying routes by which certain migratory birds take in travelling from one place to the other. Thus the nightingales cross from Europe to Africa by three routes only,—one at Gibraltar, another by Sicily and Malta, and another by Greece and Cyprus. They are, therefore, always in sight of land, crossing always in moonlight, and when the wind is steadily east or west. If we look at the soundings of the Mediterranean, and the geological facts displayed by them, we find that not a very great while ago those three routes were tracts of dry land; and the conclusions are inevitable that the present sea-levels have been altered slowly since the birds began to migrate, and that the customary routes have been maintained by the shortening of the life of individual birds permitting of no recollection of the growing differences. What changes in the nightingale have been effected by the new necessities we do not yet know, but we may be certain that an increased power of flight must have been developed by the drowning of those unable to cross the increasing expanse of water.

The tendency to migration would be slowly developed, and would depend, first, upon the changes effected in the foliage. Thus if a bird depends upon some particular caterpillar for its food, it will follow that insect; and if the caterpillar depends in its turn upon some particular leaf, the insect will follow the leaf. Let us suppose, then, that a rise in the sea-level of Western Europe lowered the temperature of our own country by covering a large part of it with water, and thereby increased the severity and length of the winter, so that some plant or other could bear foliage for only four months, instead of six; and that as a result, some particular insect could deposit its eggs with any prospect of their coming to a maturity during this abbreviated period only,—then it would follow as a necessity that the bird feeding on this caterpillar would follow it further south in its migration. If in succeeding epochs of winter these changes became more and more material, the limits of the birds' wanderings

would be enlarged, and so the present migrations would be and undoubtedly were established. We have no space to follow Mr. Wallace further through the mass of information which he has placed in his two volumes. We can only say, in conclusion, that if there still be any left who have lingering doubts concerning the "origin of species," let them read this book.