

THE DISTRIBUTION OF ANIMALS.

NO branch of natural history has been more cultivated of late, and has shown better results, either in number or kind, than that which inquires into the distribution of animals over the earth's surface, and seeks to find out the reasons for their being placed as we find them. The master in this department, in many respects, is Alfred Russell Wallace, who last year was President of the biological section of the British Association, and whose instructive address we have been printing in our Natural History columns. Mr. Wallace has always been a leader in the Darwinian ranks, and has the credit of originating that aspect of it which is known as "natural selection." His "Maylay Archipelago" with its history of the resplendent Paradise birds, attracted much attention upon its appearance three years ago, and Mr. Wallace has just issued an exhaustive work, which has been reprinted by the Harpers, upon the Geographical Distribution of Land Animals. Some of the more remarkable and interesting facts in this volume we wish briefly to indicate.

The object of his studies, Mr. Wallace tells us, "has been to show the important bearing of researches into the natural history of every part of the world upon the study of its past history. An accurate knowledge of any groups of birds or of insects, and of their geographical distribution may enable us to map out the islands and continents of a former epoch—the amount of difference that exists between the animals of adjacent districts being closely related to preceding geological changes." This well shows the scope of the work, and marks out the depth to which his investigations and arguments often carry us, startling us sometimes by the portentous conclusions to which we are led by the irresistible logic of the simplest facts.

The author first shows that all land animals have means of locomotion, are naturally disposed to wander, and that their means of dispersal are limited only by unfavorable climatic conditions, the resistance of enemies, and by such barriers as rivers, arms of the sea, deserts and mountain ranges. But as obstacles these of course vary in their significance according to the animals themselves. Many larger beasts, like the lion, rhinoceros and the oxen, seem to have the ability to go anywhere. But other groups are much more limited. Our gophers and prairie dogs would not extend themselves into a forest country; nor could our pronghorn and the antelopes of South Africa abandon their grassy plains. The open country limits the spread of such as these. On the other hand many groups, such as the lemurs and monkeys, the squirrels, the opossums, the arboreal cats, the sloths and others are so strictly adapted to an arboreal life that the edges of the forest forever limit their range. The camel and gazelle are well off only in the desert, where it would be death for the beaver and otter to venture. Rivers often form the boundary to the range of certain families, and high ranges of mountains, especially those extending north and south, always divide faunas with greater or less precision. This is the case even with birds, whose wings might seem able to bear them anywhere; yet it is found that nearly the same causes which limit the distribution of mammals from their metropolises act similarly upon birds—those which are adapted to forests rarely being found in a plain country, and *vice versa*. Even great rivers, like the Amazon, form boundary lines for many species.

The range of most insects seems to be determined by the presence of their food, and as in many cases this is confined to a single sort of plant, the area over which some species occur is narrow. In respect to terrestrial and fluviatile mollusks, the myriapods, and the like, they are almost entirely dependent upon accidental methods of dispersal—drifting from one shore to another on tree-trunks, having their eggs carried adhering to the feet of birds, etc., so that it is hard to attach much significance to their distribution at present.

The subject of migrations naturally follows, and it is regarded "as an exaggeration of a habit common to all locomotive animals of moving about in search of food." Much evidence is presented to establish the idea that migration is governed by certain intelligible laws, and it is a less mysterious matter than is generally supposed. The nightingale is taken as a typical migrant, and the account of its annual movements brings out a very interesting bit of history. After describing its annual incursion in spring into the temperate parts of Europe and return to North Africa and Syria across the Mediterranean, Mr. Wallace says: "Migrations of this type probably date back from at least the period when there was continuous land along the route passed over; and it is a suggestive fact that this land connection is known to have existed in recent geological times. Britain was connected with the continent during and probably before the Glacial epoch, and Gibraltar, as well as Sicily and Malta, were also recently united with Africa, as is proved by fossil elephants and other large mammalia found in their caverns, by the comparatively shallow water still existing in this part of the Mediterranean, while the remainder is of oceanic profundity, and by the large amount of identity in the species of land animals still inhabiting the opposite shores of the Mediterranean. The submersion of these two tracts of land, which were, perhaps, of considerable extent, would be a slow process, and from year to year the change might be hardly perceptible. It is easy to see how the migration that had once taken place over continuous land would be kept up, first over lagoons and marshes, then over a narrow channel, and subsequently over a considerable sea, no one generation of birds ever perceiving any difference in the route," Mr. Wallace

dwells in great detail upon the migrations of North American birds, drawing his facts chiefly from the labors of Mr. J. A. Allen, of Cambridge, and tells us that the phenomenon may best be studied on our shores.

It is well known that in Tertiary times all the large animals which now inhabit North Africa, as well as many extinct forms, occurred throughout Southern and Middle Europe, to which no doubt they went every summer, returning in winter to their tropical home. But as the two isthmuses—so to speak—extending like causeways from Africa to Europe, grew narrower and narrower, by slowly sinking beneath the waves, less and less numerous herds would be able to go north of the Mediterranean in summer, and finally, as the land sank out of sight, the great carnivores and ruminants would be cut off from wandering to the northward, leaving behind them, however, a single colony of apes on Gibraltar.

These facts disclose one of the ways in which a knowledge of zoology can help the geologist to confirm the truth of his reading of the record of the rocks, or, by disagreement, make more manifest his errors.

In endeavoring to account for the distribution of animals over the earth's surface "the proportion of land and water, the outlines and distribution of continents; the depth of seas and oceans; the position of islands; the height of, direction and continuity of mountain chains; the position and extent of deserts, lakes and forests; the direction and velocity of ocean currents, as well as of prevalent winds and hurricanes; and lastly the distribution of heat and cold, of rain, and snow and ice, both in their extremes and in their means have all to be considered, not only as they are at present, but also with regard to their permanence."

If the dry land of the globe had from the first been continuous and level, the larger groups would probably have spread all over the world, and divided themselves only in accordance with tropical, temperate and arctic zones; and if such a condition of the earth remained a long time the result would be an almost perfect organic balance, and great stability of average numbers and boundaries. But let this evenness and continuity be broken up by the erection of mountain ranges, the introduction of arms of the sea, the influx of oceans by the subsidence of land, making several smaller continents out of what was before one large one, alteration in the temperature, winds and rainfall would ensue, and animal life be affected in every way. Slowly, to be sure, all these changes have actually taken place in the physical geography of the world, and have produced their effect upon its inhabitants in their structure, relations and distribution. In order, therefore, to understand the present zoological geography of the world it is necessary to study the distribution of its extinct races. This Mr. Wallace has done, and for the first time presents a connected view of the geographical distribution of mammals in Tertiary and Post-Glacial times. This part of the book is of the greatest value and interest, and its evidence, looked at from a purely zoological standpoint, is a wonderful corroboration of the conclusions of geology, and throws a flood of light upon every side of the natural history of animals to day.

The first and most startling fact brought out by this review of the past is the very recent and almost universal change that has taken place in the character of the fauna over the whole globe, since the time when enormous animals of every sort, and in astonishing abundance, roamed over the Tertiary world. Nothing like this revolution, resulting in the disappearance of so many forms, has ever taken place before since the introduction of life upon the globe, and clearly we are now in an exceptional period of the world's history. "We live," says our author, "in a zoologically impoverished world, from which all the highest, and fiercest, and strangest forms have disappeared; and it is, no doubt, a better world for us now they have gone. Yet it is surely a marvellous fact, and one that has hardly been sufficiently dwelt upon, this sudden dying out of so many large mammalia, not in one place only, but over half the land surface of the globe. We cannot but believe that there must have been some physical cause for this great change; and it must have been a cause capable of acting almost simultaneously over large portions of the earth's surface, and one which, as far as the Tertiary period at least is concerned, was of an exceptional character. Such a cause exists in the great and recent change known as the Glacial Epoch."

But space forbids further accounts of this highly interesting and suggestive book, which every thinking man ought to read, not only for the general considerations which have been indicated, but for the dryer facts of the distribution of animals and the vast information with which the two thick volumes are replete, and which is made readily accessible by a copious index.
