

## REVIEWS.

## WALLACE'S GEOGRAPHICAL DISTRIBUTION OF ANIMALS.\*

THE progress of science is well served when the provisional acceptance of a theory facilitates the methodical exposition of facts. Zoology, in several departments of comparative investigation, has already gained much incidental help from the suggestive consideration of recent philosophical systems. Our most learned and observant naturalists are led by their faith in the Law of Natural Selection to more comprehensive and precise examination of the structure and habits of different species, and the surrounding conditions of their development. Mr. Darwin himself, since he propounded about sixteen years ago the pregnant idea which commonly bears his name, has enriched the history both of plants and of animals with delightful additions to our knowledge. Mr. Wallace, again, during his long residence among the isles of the Far East, without hearing of Mr. Darwin's theory, anticipated, and to some extent worked out, its great principle, of which he now appears the modest and zealous disciple; but he too has made it a guide to fresh actual researches, the substantial value of which, independently of the received hypothesis, is as much beyond dispute as that of Mr. Darwin's inquiries concerning the variations caused apparently by influences attending domestication. It has been the aim of Mr. Wallace, in this important work of scientific description and classification, to set forth a scheme of "geographical zoology" with reference to the origin of species, as affected by past or present conditions of the different terrestrial regions. A corresponding study is that of "zoological geography," which is here previously treated of, presenting a complete review of the main divisions and subdivisions of the globe, as characterized by their exhibition of distinct animal types. Rather more than half the space in the two volumes is filled with this descriptive account of zoological regions, which to an ordinary reader will seem the most interesting part of the book.

The merit of first defining the six primary regions of the earth's surface, distinguished respectively by the presence of some important groups of animals and by the absence of others, is due to Mr. Sclater. He propounded the idea so long ago as 1857. If we agree with Mr. Wallace in adopting this scheme of division, instead of those since proposed by Mr. Huxley, Mr. Andrew Murray, and others, the map of the world, having each region distinguished by a colour, readily shows it to the eye. We see at a glance that it has the advantage of coinciding pretty nearly with the main divisions of physical geography, and roughly also with those of ethnology, as well as with popular notions which have already advanced beyond the old "four quarters of the globe." These six regions are not indeed by any means approximately equal in size; and their boundaries, in more than one in-

stance, are not formed by the oceanic coast-lines of continental land-masses, but arise from intervening mountains or deserts. Such an exception is perceived to occur twice along the southern frontier of the "Palæartic" or eastern Old World Region, which is properly limited by the African Sahara, the Arabian Desert, the Hindoo Koosh, the Himalayas, and the ranges parting the Chinese river-basins from the Siamese. This region includes all Europe, the bulk of Asia without its southerly peninsular projections, and the part of Africa called "Cis-Atlantean" by Mr. Sclater, looking towards the Mediterranean. It is about twice as large as North America, which constitutes the "Nearctic Region," and vastly greater than any of the four remaining zoological divisions. But Mr. Sclater and Mr. Wallace are nevertheless fully justified in their definition of the Palæartic Region, as well by its geological past history and physical conditions, as by its possession of many peculiar kinds of birds and mammals. The other regions which appear in Mr. Wallace's coloured chart of the world are the "Ethiopian," consisting of tropical and southern Africa, with the adjacent lands of southern Arabia and Madagascar; the "Oriental," composed of the Indian, Indo-Chinese, and Indo-Malay peninsulas and islands; the "Australian," to which he adds, not only Papua, but the "Austro-Malay" islands, including Celebes, and the widely scattered groups of the South Pacific; lastly, the "Neotropical Region," comprehending with South America the Antilles, the Central American isthmus, and part of Mexico within the tropic zone. These four divisions of the lands now existing in the tropics and the southern hemisphere obviously stand forth in the map amidst the vast space of separating water. But there are also to be considered some important geological problems with regard to the submersion of former continental masses, which have a bearing also upon the past distribution of animal races to the south of the Equator. In the northern hemisphere, on the contrary—that is to say, in the two Arctic and dependent temperate regions, those of the Old and the New World—geological processes of a different nature have determined the course of zoological development. The Glacial epoch, with the attending changes of surface level, soil, and climate, and thereby of vegetation, must here account for the migration, dispersion, or extinction of many remarkable animals, and for the proportion still maintained of peculiar families and genera in the great northern continents. This is an example, like the application of the spectroscope to astronomical research, of the success with which one branch of natural philosophy may come to the assistance of another, and by their allied pursuit obtain a more complete result.

The leading idea, indeed, of Mr. Wallace's endeavour to trace the history of the production and distribution of various animal forms all over the globe, is to be clearly recognized. It is, in the first place, that of a comparison of the present with the past fauna of each region, but attending chiefly to the mammalia, and seldom going back further than the Tertiary geological periods, in order to see the process of evolution, as he regards it, by which all the types peculiar to the region were developed. His next inquiry is that concerning the probable communication of animal types from one region to another, taking into account the geological evidence of a former different relative position, more especially of the southern regions to the more ancient land-masses in the Arctic hemisphere. He finds reason to believe that the mainland of Europe and Asia, and likewise of North America, existing as land from before the earliest of the Tertiary periods, constituted the area in which alone the successive types of vertebrate animal structure were originally produced. Not only the adjoining regions of equatorial Africa and southern Asia, but also the Indo-Malayan sub-region, the Australian region, the tropical American, and the sub-regional territories now isolated by later geographical changes, received from the northern continents all those higher forms of life. These southern regions, except perhaps Australia, were in the Tertiary formations alternately united to the upper mainlands and separated from them; so that each region had an opportunity, in some period of its detached existence, of developing lower forms peculiar to itself. Australia, having had its period of junction with Asia probably not later than the Secondary formations, is found to possess only the primitive types of mammals, the marsupials and monotremes, while the Polynesian fauna has none at all. In general, it may be observed that, for the development of the superior forms, the largest area seems to have been required, as well as the longest time. It was only in the Palæartic and Nearctic continents that such magnificent creatures as the nobler beasts and man could be evolved from the zoological laboratory, which was here sufficiently commodious; and it was here, in the northern hemisphere, which may perhaps in its entirety be called "the Old World," that the evolution of animal life was first begun.

These views appear more than plausible, without reference to the merits of the evolution theory; since the distribution of species must obey its own laws, whatever be the origin of species. They furnish new proof of the unity of plan, if we may so speak, that rules all nature. We are gratified by the masterly skill with which Mr. Wallace has marshalled an immense number and complex variety of facts into his detailed exposition of a threefold argument, dealing with classified zoology, with palæontology, and with physical geography, in combined support of his ideas. We can give but the mere outline of his arrangement of the principal divisions of so vast a subject, without examining the grounds upon which his proposed sub-regions—usually four to each main region—have been allotted. In this particular respect, to judge from the different views of other naturalists before Mr. Wallace's book came out, some discussion is likely to arise, and we cannot yet ex-

\* *The Geographical Distribution of Animals; with a Study of the Relations of Living and Extinct Faunas, as elucidating the Past Changes of the Earth's Surface.* By Alfred Russel Wallace. 2 vols. London: Macmillan & Co. 1876.

pect unanimity of opinion. Mr. Sclater, in his essay read at last year's Bristol meeting of the British Association, made seven distinct sub-regions of the Palæarctic, six of the Ethiopian, as many of the Indian or Oriental, but two of the Nearctic, five of the Neotropical, and three of the Australian, while he formed a seventh region, the "Pacific," of New Zealand and the Oceanic isles. It is sufficient for us here to observe that these minor subdivisions of zoological geography, though convenient for natural history, do not seem essential to the elucidation of Mr. Wallace's general idea, which may stand firmly upon the ample basis of the larger divisions. One illustration of it has been mentioned in the supposed development of all the Australian mammals from those primeval forms which abounded in Europe and Asia before the Eocene period, as shown by their fossil remains in oolite formations. They were in Australia, by the subsequent detachment of that region from the Palæarctic during the Tertiary epoch, saved from the competition of more advanced forms; hence the existing kangaroo. South America, too, having probably been severed from North America by an arm of the sea in the Miocene and Pliocene periods, owes to a similar immunity, for some time continued, its possession of certain marsupials, and of the toothless ant-eater, the sloth, and the armadillo. It even sent northward, when the land connexion was established, some of its antique forms. But the extinct mammalian fauna of that region, with its resemblances to that of Europe in the later Tertiary periods, cannot very easily be explained, seeing its differences from the Nearctic fossil world. Palæontology, however, demands more complete researches in South America and Central America than have yet been made, and some passages only of zoological history are clearly on record in that part of the earth. Its amazing variety and richness of living genera and species, favoured by its geographical and atmospheric conditions, renders it one of the most attractive regions to the naturalist, as is the case likewise with the Indo-Chinese and Malayan sub-regions, personally explored by Mr. Wallace. But a not less important exhibition of the processes here discussed might be seen also in the Ethiopian region, if its geology and fossil remains were better known. It is certainly proved, by Tertiary deposits all over the Sahara and the Arabian and Persian deserts, to the North Indian plain, that a deep sea once flowed across there, cutting off tropical Africa from the Palæarctic continent. Before that temporary separation, in Ethiopia as in Australia and South America, quadrupeds of a low type had already come down from their northern birthplace, along with the struthious or ostrich type of birds. They were protected for a time by the sea just mentioned from the advent of destructive felines and other foes or competitors for subsistence. What the inhabitants of Africa were in that age of comparative simplicity and security is seen in the existing fauna of Madagascar, which has kept its insular protection by a strait more recently formed. It has none of the formidable beasts that afterwards came into Africa, passing over the upheaved bed of the former sea; no elephant or rhinoceros, no lions or leopards, not even zebras, antelopes, giraffes, or monkeys. Lemurs are prominent in Madagascar, as well as in Southern India and Ceylon, which were perhaps once united with it by a continent now sunk in the Indian Ocean; and insectivorous animals of remote antiquity, peculiar to this island, prove a local exemption from later experiences of the African mainland. The one of four Southern regions which has undergone the least amount of such changes, in its relation to the two Northern regions of primary zoological development, is the Oriental, because it was practically combined with the Palæarctic, sharing its warm climate during the Eocene and Miocene periods. It ultimately received and preserved, at the approach of the Glacial epoch in Europe and Asia, many of the animals now living in hot countries which had before inhabited our own latitudes. The elevation of the Central Asiatic plateau must have driven them to the south-east and to the south-west. The elephant went both ways; so did the rhinoceros; the South Asiatic tiger, and the lion, which latter is also found in Africa, belong to one genus, which was expelled in that age from the colder North.

By such alterations in the physical conditions of different parts of the globe, and in the conformation of their masses of land, the Oriental, Ethiopian, Australian, and Neotropical regions obtained their zoological characters. Their place was to become the field of secondary and derivative operation, being colonized, so to speak, by immigrations from the Old World regions. This has led some zoological geographers to prefer dividing the globe, first of all, into a northern and a southern hemisphere, which they have termed "Arctogæa" and "Notogæa"; instead of the common east and west division, similarly termed "Palæogæa" and "Neogæa," or the Old and the New World. One rather important question is whether the Nearctic region—that is to say, North America—should not be united with the Palæarctic, as Professor Huxley and Mr. Blyth recommend. Mr. Wallace is disposed to lay greater stress upon the fundamental diversity of the eastern and western continents, while constantly recognizing the strict parallelism of their functions in zoological distribution. Their relations to each other would seem to have the more significance when the original seat of the development of vertebrate animals, probably also of insects and land-molluscs, is found in the Palæarctic region. It was connected with the Nearctic by two northern tracts of land, the remnants of which still exist in Iceland and Greenland, on the one side, and in the opposite promontories of Kamtchatka and Alaska on the other. At the same time there is evidence in their respective floras that Europe and North

America were widely separated, and perhaps had very different climates, even during the Cretaceous formation. But notwithstanding this permanent, though incomplete, separation, the Nearctic region was enabled to get from the Palæarctic, or Old World, during some part of the Miocene period, many existing kinds of animals, bears, oxen, horses, sheep, and swine, besides others now extinct. Camels, on the other hand, are supposed to have been first produced in America, and to have thence passed into Asia, while the Nearctic fauna had exclusive possession of some entire families and a large number of genera. As Mr. Wallace remarks, "the Eastern and Western hemispheres are the two great branches of the tree of life on our globe." But the Palæarctic, formerly including the Oriental region, "is the source from which all the other regions were supplied with the higher forms of life." It is the birthplace of the whole mammalian class, and we may perhaps, after all, look back to an original progenitive unity which arose somewhere in Central Asia. Here is much to provoke serious reflection, with which we shall take leave of Mr. Wallace's instructive work.

The regular student of zoology will find a great deal more in this book than we have noticed. Along with the distribution of mammalia, Mr. Wallace describes that of birds, to which Mr. Sclater has given his particular attention. It exhibits many curious and interesting peculiarities, which are to be explained and reconciled with the general scheme. An account is also furnished, in each region and sub-region, of the reptiles, fishes, insects, and molluscs, but these are less relied upon for proofs of the argument. In his "Geographical Zoology," which occupies much of the second volume, the author supplies for reference a systematic revision of all the families and genera of the vertebrate classes, and some groups of insects and molluscs, with their local distribution, forming a counterpart to the main subject of his book. A chapter on the means of dispersion and migration, which most readers will find only too short, is prefixed, but not very conveniently, to the history of the zoological regions, near the beginning of the first volume. But Mr. Wallace's labours cannot fail to be highly useful, and what he shows us is not less delightful, apart from its value as a contribution to the "Darwinian" theory.