

SCIENCE.

The Geographical Distribution of Animals. With a Study of the Relation of Living and Extinct Faunas as Elucidating the Past Changes of the Earth's Surface. By Alfred Russel Wallace. Two Vols. (London: Macmillan & Co., 1876.)

THE advance of all the physical sciences within the last five-and-twenty years has been wonderfully rapid, but in few have the results gained under new leadership and by a new line of tactics been so striking and important as in the sister-studies of Zoology and Botany. If one turns back to the works of the best biologists written twenty years ago, it is impossible not to be struck with the total change of thought and effort which has since taken place. Here and there some of the new school may have wandered beyond their sphere, or have been hurried into a dogmatism which has been most hurtful to real progress; but the conquests which have already been made, and the ground which lies open before us show that the re-organisation has been as wholesome as it has been complete. In truth, it has been no revolution but a constitutional reform, based on the labours of the good men and true of the old time, and directed and controlled by leaders who saw and understood the changes in the position of affairs and moved in unison with them.

So long as the belief was unanimously held that each form of life was, and always had been, perfectly independent, and that each distinct fauna and flora was separate in its origin as well as in its maturity, the minor details of Biology were necessarily wanting in continuity and value. Its students were exposed to the reproach that their researches led to no results of general importance. Whether some petty weed or noxious insect was a native of this or that country, or whether it should be arranged in this or that family, were questions which might interest the specialist, but were beneath the attention of the philosopher. Now all is changed. Upon the minutest comparisons, upon the most diligent collection of seemingly trivial facts, generalisations and deductions are advanced and combated which will not yield in importance to the profoundest problems of the physicist, the geologist or the astronomer.

Among the chief causes of this reform in Biology have been the wonderful advance of our knowledge of the history of extinct life and of the development of living beings, the scientific study of the geographical distribution of animals and plants, and—springing from these—the promulgation of the doctrine of Evolution. With the latter two of these studies the name of Alfred Russel Wallace must ever remain inseparably connected.

Mr. Darwin and he were the first to give a distinct and intelligible form to the wandering fancies which had been floating in men's brains as to the origin of animals and plants. His travels and personal explorations in South America and in the Malay Archipelago brought to light some of the most interesting facts of zoological geography, and now in the handsome volumes before us we have the results of his mature and deliberate consideration of the whole range of our knowledge of the subject. His aim, he tells us, has been that his 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." This is undoubtedly a very high standard, but we think that most zoologists will consider that it has been fully attained.

Mr. Wallace's work is divided into four principal sections. Part I., on "The Principles and General Phenomena of Distribution," discusses the migrations and means of distribution of animals, the modes in which their ranges have been affected by geological changes, the arrangement of zoographical provinces and the systematic classification adopted. Part II., "On the Distribution of Extinct Animals," gives an excellent review of the present state of our knowledge of vertebrate palaeontology. In Part III., on "Zoological Geography," the great regions and their subdivisions are treated in detail, while Part IV., on "Geographical Zoology," gives a systematic revision of all the families of the vertebrated classes, and of some of the more important groups of insects and mollusks, with their geographical ranges. This last constitutes an invaluable work of reference, but all the matter of more general interest is included in the first three portions, and it is to these that the attention of most readers will be attracted. Before going further it may be remarked that the author has, very wisely as it seems to us, based his conclusions on the study of families and genera, to the exclusion of the consideration of species. This is done because the number of the latter would have been quite unmanageable, and because they are regarded as representing only the more recent and unimportant modifications of form.

As is well known, the credit of having proposed the first really scientific scheme for the division of the earth's surface into zoological provinces is due to Mr. P. L. Sclater. In a paper on the "Distribution of Birds," read before the Linnean Society so far back as 1857, he divided the world into two primary sections, *Palaeogaea* and *Neogaea*, answering respectively to the Eastern and Western Hemispheres, and into six "regions." These latter were, (1) the *Palaearctic*, embracing (roughly speaking) Europe, Asia, and Africa, north of the Sahara and the Himalayas; (2) the *Ethiopian*, comprising the rest of Africa; (3) the *Indian*, consisting of India, Malaya, and part of the Eastern Archipelago; (4) the *Australasian*, with Australia, New Guinea, New Zealand, and the Pacific Islands; (5) the *Nearctic*, equivalent to North America north of Mexico; and (6) the *Neotropical*,

embracing Central and South America, and the West Indian Islands. Since that date the boundaries of these regions have been rectified, and some important changes in the primary divisions have been suggested, but the scheme as a whole has stood the tests of criticism and of fresh discovery in a way which must be most gratifying to the distinguished naturalist by whom it was propounded. The most important modifications which have been brought forward are those which were proposed by Prof. Huxley in 1868. According to his views the differences between the faunas of the Old and New Worlds are not of equal importance to those between the northern and southern hemispheres, and he consequently made the primary divisions to be *Arctogaea* and *Notogaea*. A modification of this alteration has recently been adopted by Mr. Sclater himself in his "Davis Lectures" at the Zoological Gardens and in his Presidential address to Section D of the British Association at Bristol. In these he recognised Mr. Huxley's *Arctogaea*, but divided his *Notogaea* into three, *Dendrogaea* (the neotropical region), *Antarctogaea* (the Australian), and *Ornithogaea* (New Zealand and the Pacific Islands). Mr. Wallace, on the other hand, accepts no higher divisions than the six regions originally instituted by Mr. Sclater, contending that the separation of the eastern and western, and that of the northern and southern hemispheres, each indicates important differences, but leaves others out of sight.

The key-note of the general scheme of distribution as propounded by Mr. Wallace in the present work is the comparison of the extinct and existing faunas of each country, and the attempt to trace the course by which that now peculiar to each region assumed its present character. As far as we know, this is the first time that such a mode of research has been worked out on anything like so large a scale, or with such complete materials, and Mr. Wallace's conclusions will be discussed with as much interest by the geologist and physical geographer as by the biologist.

The main result arrived at, round which all the rest group themselves, is that all the higher forms of life seem to have originally appeared in the northern hemisphere, which has sent out migration after migration to colonise the three southern continents. These also appear to have been of great antiquity, varying, indeed, from time to time in form and extent, but each keeping essentially distinct, and each receiving wave after wave of animal life from the northward. In this way Mr. Wallace believes that the main peculiarities and anomalies of the various faunas may be explained.

According to these views the Palaearctic and Nearctic regions appear to have remained distinct throughout the whole of the Tertiary period, as is shown by their Cretaceous Eocene and Miocene fauna and flora, but land connexion existed between them, probably to the northwards, and allowed of intermigrations taking place. The former region was much more extensive than it is now; it included the modern Indian, or, as Mr. Wallace prefers to call it, the Oriental region, and it is here, as he believes, that the

vertebrate type was first developed. At a very early period, probably in Secondary times, the Australian region was united to it, and received the then existing mammals—marsupials and monotremes, the former perhaps allied to those whose remains are found in our own Oolite. Since then Australia has remained completely isolated, and its lowly-organised mammals, protected from the competition of their superiors, have survived in the form of its existing kangaroos, wombats, and duck-bills. This is the simplest illustration of Mr. Wallace's hypothesis; the case of the Ethiopian region is more complicated but equally interesting. First it seems to have been peopled by animals of a low type, of which lemurs, Insectivores, Edentates, and ostriches were characteristic, and which were certainly derived from the northward. Becoming isolated by the great sea which has left the Tertiary deposits of the Sahara and Arabia, this fauna spread abroad, and a most interesting remnant has been preserved to our own time by the early separation of Madagascar, which is probably the remains of a former eastern extension of the African continent. Then by the upheaval of the more northern parts the highly organised animals, which had come into existence in the meantime in the Palaeartic region, were enabled to cross over, and the apes, monkeys, large Carnivores, elephants, hippopotamuses, rhinoceroses, and antelopes spread over the continent, and the old fauna disappeared before them, leaving only a few stragglers behind. The Oriental region, as already said, was practically combined in early times with the Palaeartic, and shared with it the hot climate of the Eocene and Miocene ages. When the elevation of the Central Asian plateau and the gradual approach of the glacial epoch destroyed or drove southwards such tropical types as were incapable of modification, many of them survived in South-eastern Asia; and thus the Oriental fauna may be regarded as the least changed from that which was once predominant over the whole of Asia and Europe.

As already observed, the North American or Nearctic Continent has remained permanently distinct from the Palaeartic, but was connected with it by land, probably where the North Pacific is still shallow between Kamschatka and Alaska. Although many very extraordinary and distinct forms were developed in the Nearctic region during Tertiary times, yet the majority of the types seem to have been derived from the Old World, where their remains have been found in more ancient strata than in America. Among these were horses, elephants, antelopes, and perhaps lemurs and rhinoceroses; but the *Camelidae*, on the other hand, had their origin in the Nearctic region, where they became extinct after sending out the migrations from which the camels of Asia and the llamas of South America have been derived. Most of this Tertiary fauna disappeared under the influence of the glacial epoch, which was even more severely felt in the Nearctic than in the Palaeartic region, owing to the great mass of land lying in the higher latitudes. Last of the six great regions we have the Neotropical, in

some respects the most interesting of them all. Never apparently connected in Neozoic times with any other continent than the Nearctic, it seems to have been separated and re-united repeatedly, and to have undergone consequent changes in its fauna. First, during the Secondary epoch, it received Rodents and Edentates, which remained long protected from competition and became differentiated into numerous forms, the latter developing such huge and extraordinary types as the Megatherium, the Mylodon and the Glyptodon. A reunion in early Tertiary times appears to have introduced the ancestors of the peculiar Neotropical monkeys, which were followed at a later period by mastodons, tapirs, horses, antelopes and camels. In return, the great Edentates just mentioned spread northwards over the southern half of the Nearctic region, but were soon after destroyed by the advent of the glacial epoch.

In a review of this nature it is of course impossible to do more than allude to the immense mass of facts from which Mr. Wallace draws these and other deductions. They have been collected with an industry and discrimination, and are marshalled with a clearness and conciseness, which probably his great colleague Mr. Darwin alone could rival. Nor is it possible here to discuss the minor details of distribution, though it may be remarked that the part which seems most likely to be criticised is the constitution of the sub-regions into which each of the greater divisions is separated; Mr. Wallace gives four of these to each region, an arrangement to which we suspect many naturalists will demur. Of course the specialist will find small errors and omissions in his peculiar department (though few, we fancy, of importance); and it is to be hoped that all naturalists will comply with the author's request to send him such additions and corrections as may help to make the future editions still more perfect. When such appear we trust that they will be illustrated by a greater number of maps; those of the present edition are beautifully executed, but they are small, and so much information is crowded into each that some confusion is the result. This is especially the case in the difference of shading by which the various altitudes are expressed; minute in themselves, they are almost totally obscured by the colouring which indicates the character of the soil and vegetations. The plates represent groups of the characteristic animals of the various regions, and appeal rather to the general than to the scientific public.

In conclusion, we can but concur in Mr. Wallace's hope that the attention of new workers may be directed to a line of research "not inferior in attractions to the lofty heights of transcendental anatomy, or the bewildering mazes of modern classification," and we have to thank him for a work which can only find a fit place on our book-shelves between Lyell's *Principles of Geology* and Darwin's *Origin of Species*.

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