

4th edition (*Dr. F. V. Hayden*). Climate of New South Wales, by H. C. Russell (*Author*). Travels in the Valley of the Obi, by J. S. Palyakoff, in Russian (*Author*). The route to Bolivia viâ the river Amazon, by Col. G. E. Church (*Author*). North-east Madagascar, by J. A. Houlder (*Author*). Atjeh en de Atjehers, door J. A. Kruijt (*Author*). Selections from the Records of the Madras Government, No. L.; Papers relating to Survey of the Trichinopoly district (*H.M. Sec. of State for India*); and the current issue of publications of corresponding Societies, periodicals, &c.

DONATIONS TO THE MAP-ROOM, FROM 11TH TO 25TH JUNE, 1877.—Map of Turkish Armenia, and map of distribution of religions in Bosnia and Herzegovina, by H. Kiepert (*Author*). Map of route from Foga to El Obeiyad, by Major Prout (*General Stone*). Map of routes travelled and discoveries made by Ernest Giles in South and Western Australia.

On introducing the subject of the evening, the PRESIDENT said the Society was highly honoured by the presence of His Majesty the Emperor of Brazil, who had come to hear the last of the series of scientific lectures for this session. The subject of the lecture was one of extreme interest, and of larger scope even than its predecessor. Mr. Wallace, whose name was so well known among all naturalists as well as physicists, had been good enough to undertake to address them on the antiquity of the continents as illustrated by their animals, both extinct and living. This, of course, was a very wide subject, and he was sure that after listening to Mr. Wallace the meeting would be of opinion that Physical Geography never took a more attractive form than when it was treated in its most scientific aspect, united both with geology and natural history, showing what the surface of the earth now was, and how it had been modified from what it was in ages far back.

The following Lecture, the third of the Session, was delivered by the author:—

The Comparative Antiquity of Continents, as indicated by the Distribution of Living and Extinct Animals. By ALFRED RUSSEL WALLACE.

It may be truly said, that Geography and geographical discovery owe much of their interest to the peculiarities of animal and vegetable life that characterise remote countries, and which frequently give them an altogether distinctive character. The camel and the date-palm are intimately associated with the Syrian and Arabian deserts; the elephant, the tiger, and the deadly cobra, are suggested to us whenever we speak of India; while the lion, the giraffe, and the antelopes are no less closely associated with Africa. We can hardly think of Brazil without picturing to ourselves its sloths, its humming-birds and its toucans; or of Australia without its kangaroos and its gum-trees.

If we study the distribution of animals and plants in greater detail, we find that these general and more popularly-known relations of organic forms to the countries they inhabit, are supplemented by a whole series of less conspicuous, but not less remarkable facts, all going to show the existence of intimate yet complex relations between the earth and its inhabitants. We find that each continent, each island, and, generally, every tract of land marked out by natural boundaries or by peculiarities of soil and climate, is distinguished by a more or less peculiar flora or fauna.

It was very soon ascertained that some of the facts of distribution were due to diversities of climate, of altitude, and of geological structure as determining the nature of the soil; but as observations multiplied it was found that only some of the general features could be thus explained, leaving a mass of interesting details quite unaccounted for. Further inquiry showed, that a far more important cause of the phenomena was the existence of barriers which limit the range and migrations of organisms, such as oceans, seas, mountains, deserts, swamps, and forests. But still, something more was wanted to enable us to explain, or even to comprehend the import of the facts, and this want is supplied by those grand views of the course of nature associated with the names of Lyell and Darwin—on the one hand of slow but never-ceasing changes in the physical conditions, the outlines, and the mutual relations of the land-surfaces of the globe; and on the other hand, of equally slow and never-ceasing changes in the forms and structures of all organisms, to a great extent correlated with, and perhaps dependent on, the former changes. Combining these two great principles with the other ascertained causes of distribution, we are at length enabled to deal adequately with the problem before us, and give a rational, though often only an approximative and conjectural solution of the many strange anomalies we meet with in studying the distribution of living things.

Having thus obtained a clue which enables us to unravel the complex causes which have determined the range and limitations of the more important groups of animals, and having tested its application in a variety of critical cases,* we feel justified in applying the same rules and arguments inversely, so as to make the facts of distribution in present and past time yield us some information as to the changes in Geography which have produced them, thus supplementing in some degree the fragmentary indications afforded by Geology and Physical Geography. A new interest is thus given to the study

* See the Author's 'Geographical Distribution of Animals,' 2 vols., 1876.

of the earth's surface. We learn which of its features are of comparatively recent origin, and which are more ancient and more permanent; and we are enabled to trace some of the later steps in the long series of changes by which our continents and islands, and our more important isthmuses and straits, have acquired their present outlines. It is this branch of the subject which I now propose to discuss, though necessarily in brief and rapid outline, dwelling especially on the more important general results to which it conducts us.

The extreme inequality with which land and water is distributed has often been remarked, but what is less frequently noted is the singular way in which all the great masses of land are linked together. Notwithstanding the small proportion of land to water, the vast difference in the quantity of land in the northern and southern hemispheres, and the apparently hap-hazard manner in which it is spread over the globe, we yet find that no important area is completely isolated from the rest. We may even travel from the extreme north of Asia to the three great southern promontories,—Cape Horn, the Cape of Good Hope, and Tasmania—without ever going out of sight of land; and, if we examine a terrestrial globe, we find that the continents in their totality may be likened to a huge creeping plant, whose roots are at or around the North Pole, whose matted stems and branches cover a large part of the northern hemisphere, while it sends out in three directions great offshoots towards the South Pole. This singular arrangement of the land surface into what is practically one huge mass with diverging arms, offers great facilities for the transmission of the varied forms of animal life over the whole earth, and is no doubt one of the chief causes of the essential unity of type which everywhere characterises the existing animal and vegetable productions of the globe.

There is, moreover, good reason to believe that the essential features of this arrangement are of vast antiquity, and that throughout much of the Tertiary period, at all events, the relative positions of our continents and oceans have remained the same, although they have certainly undergone some changes in their extent, and in the degree of their connection with each other. This is proved by two kinds of evidence. In the first place, it is now ascertained by actual measurement that the depths of the great oceans are so vast over wide areas, while the great elevations of the land are limited to comparatively narrow ridges, that the mass of land (above the sea-level) is not more than $\frac{1}{36}$ th part of the mass of the ocean. Now we have reason to believe that subsidence and elevation bear some kind of proportion to each other, whence it follows that although

several mountain ranges have risen to great heights during the Tertiary period, this amount of elevation bears no proportion to the amount of subsidence required to have changed any considerable area of what was once land into such profound depths as those of the Atlantic or Pacific Oceans. In the second place, we find over a considerable area of all the great continents fresh-water deposits containing the remains of land animals and plants; which deposits must have been formed in lakes or estuaries, and which therefore, speaking generally, imply the existence in their immediate vicinity of land areas comparable to those which still exist. The Miocene deposits of Central and Western Europe, of Greece, of India, and of China, as well as those of various parts of North America, strikingly prove this; while the Eocene deposits of London and Paris, of Belgium, and of various parts of North and South America, though often marine, yet by their abundant remains of land-animals and plants, equally indicate the vicinity of extensive land-areas. For our purpose it is not necessary to go further back than this, but there is much evidence to show that throughout the Secondary, and even some portion of the Palæozoic periods, the land-areas coincided to a considerable extent with our existing continents. Professor Ramsay has shown* that not only the Wealden formation, and considerable portions of the Upper and Lower Oolite, but also much of the Trias, and the larger part of the Permian, Carboniferous and Old Red Sandstone formations, were almost certainly deposited either in lakes, inland seas, or extensive estuaries. This would prove, that throughout the whole of the vast epochs extending back to the time of the Devonian formation, our present continents have been substantially in existence, subject, no doubt, to vast fluctuations by extension or contraction, and by various degrees of union or separation, but never so completely submerged as to be replaced by oceans comparable in depth with our Atlantic or Pacific.

This general conclusion is of great importance in the study of the Geographical distribution of animals, because it bids us avoid the too hasty assumption that the countless anomalies we meet with are to be explained by great changes in the distribution of land and sea, and leads us to rely more on the inherent powers of dispersal which all organisms possess, and on the union or disruption, extension or diminution, of existing lands—but always in such directions and to such a limited extent as not to involve the elevation of what are now the profoundest depths of the great oceans.

* 'Nature,' 1873, p. 333. 'Quarterly Journal of the Geological Society,' 1871, pp. 189 and 241.

We will now proceed to sketch out the zoological features of the six great biological regions, and will afterwards discuss their more recent changes in accordance with the principles here laid down.

The Palæartic, or North Temperate region of the Old World, is not only by far the most extensive of the zoological regions, but is the one which agrees least with our ordinary geographical divisions. It includes the whole of Europe, by far the largest part of Asia, and a considerable tract of North Africa; yet over the whole of this vast area there prevails a unity of the forms of animal life which renders any primary subdivision of it impossible, and even secondary divisions difficult. But besides being the largest of the great zoological regions there are good reasons for believing this to represent the most ancient, and therefore the most important centre of the development of the higher forms of animal life,—and it is therefore well to consider it first in order.

In enumerating the most important animal groups characteristic of this and other regions, it must be clearly understood that such groups are not always absolutely confined to one region. Here and there they will often overlap the boundaries, while in other cases single species may have a wide distribution in one or more of the adjacent regions; but this does not at all affect the main fact, that the group in question is very abundant and very widely spread over the region in question, while it is very rare, or confined to a very limited area in adjacent regions, and is therefore specially characteristic of the one as compared with other parts of the world. Bearing this in mind, we shall find, that the Palæartic region is well characterised by a considerable number of typical groups, although, as we shall presently see, it has, in recent geological times, lost much of its ancient richness and variety of animal life.

Among Mammalia the groups most characteristic of this region are the moles (Talpidæ), a family consisting of eight distinct genera which range over the whole region, but beyond it barely enter the Oriental region in North India, and the Nearctic region in North-West America; camels, confined to the deserts of North Africa and Asia; sheep and goats (*Capra*), only found beyond the region in the Nilgherries and Rocky Mountains; several groups of antelopes, and many peculiar forms of deer; hamsters (*Cricetus*), sand rats (*Psammomys*), mole rats (*Spalax*), and pikas (*Lagomys*) with several other forms of rodents. Wolves, foxes, and bears, are also very characteristic, though by no means confined to the region.

Among birds the most important group is certainly the small-sized, but highly-organised warblers (Sylviidæ), which, although

almost universally distributed, are more numerous, and have more peculiar and characteristic genera here than in any other region. Most of our song-birds, and many of the commonest tenants of our fields, woods, and gardens, belong to this family, and identical or representative species are often found ranging from Spain to China, and from Ireland to Japan. The reedlings (Panuridæ), the tits (Paridæ), and the magpies (*Pica*), are also very characteristic; while among the finches (Fringillidæ), a considerable number of genera are peculiar. A large number of peculiar groups of grouse (Tetraonidæ), and pheasants (Phasianidæ) are also characteristic of this region. Although the reptiles and fresh-water fishes are comparatively few, yet many of them are peculiar. Thus, no less than 2 genera of snakes, 7 of lizards, and 16 of batrachia, are confined to the Palæarctic region, as well as 20 genera of fresh-water fishes.

The insects and land-shells offer their full proportion of peculiar types, but it would lead us beyond our special object to enter into details with regard to these less known groups of animals. Some of the more important will however be found enumerated in the subjoined note.*

* The following is a summary of the more important of the peculiar and characteristic animals of the Palæarctic Region. Among the Mammalia are *Talpa* (moles) almost peculiar; *Meles* (badgers) almost peculiar, but entering the Oriental region in China; *Camelus* (camels) confined to the deserts on the southern borders of the region; several peculiar genera or sub-genera of deer, as *Capreolus* in Europe, and *Moschus* in Mongolia; many peculiar Bovidæ, as *Poepagus* (the yak), several peculiar antelopes in N. Africa, Thibet, and Mongolia; *Rupicapra* (the chamois), and *Saiga* (the Tartarian antelope), while *Capra* (sheep and goats) is highly characteristic. Among Rodents there are 4 peculiar genera of Muridæ (rats and mice), 2 of Spalacidæ (mole-rats), while *Myoxus* (dormice), and *Lagomys* (pikas) are almost peculiar.

Among birds, there are 14 peculiar or very characteristic genera of Sylviidæ (warblers), 4 of Panuridæ (reedlings), 1 of Paridæ (tits), 4 of Corvidæ (crows and magpies), 12 of Fringillidæ (finches), 2 of Alaudidæ (larks), 1 of Pteroclidæ (sand-grouse), 4 of Tetraonidæ (grouse and partridges), 5 of Phasianidæ (pheasants), while there are 5 very characteristic genera of wading birds, *Ortygometra* and *Otis* being good examples.

In reptiles, the Palæarctic, like all temperate regions, is poor, yet it has many peculiar types. Among these are 2 genera of snakes, *Rhinechis* and *Halys*; 7 of lizards, *Trigonophis*, *Psammotromus*, *Hyalosaurus*, *Scincus*, *Ophiomorus*, *Megalochilus*, and *Phrynocephalus*; 8 of tailed Batrachians, *Proteus*, *Salamandra*, *Seiranota*, *Chioglossa*, *Hynobius*, *Onychodactylus*, *Geotriton*, and *Sieboldia*; and 8 of tailless Batrachians, *Bombinator*, *Pelobates*, *Didocus*, *Alytes*, *Pelodytes*, *Discoglossus*, *Laprissa*, and *Latonia*.

Of fresh-water fish there are also about 20 peculiar genera, belonging to the following families, Percidæ (3 genera), Comephoridæ (consisting of the genus *Comephorus* confined to Lake Baikal), Salmonidæ (3 genera), Cyprinodontidæ (1 genus), and Cyprinidæ (13 genera).

In insects, there are 15 peculiar genera of Diurnal Lepidoptera or butterflies; while among the Coleoptera, the Carabidæ, or ground beetles, are very numerous, no less than 50 genera being peculiar. Other important families of beetles are Buprestidæ, with 9 peculiar genera, and Longicorns, with 50 peculiar genera,

The Ethiopian region, consisting of Africa south of the Tropic of Cancer with Madagascar, is of very small area compared with the Palæarctic region; yet owing to the absence of extreme climates, and the tropical luxuriance of a considerable portion of its surface, it supports a greater number and variety of large animals than any other part of the globe of equal extent. Much of the speciality of the region is, however, due to the rich and isolated fauna of Madagascar, the peculiarities of which may be set aside till we come to discuss the past history of the Ethiopian region.

Considering then, first, the zoological features of tropical and southern Africa alone, we find a number of very peculiar forms of mammalia. Such are the golden moles, the Potamogale, and the elephant-shrews among Insectivora; the hippopotami and the giraffes, among Ungulata; the hyæna-like *Proteles* (Aard-wolf), and *Lycæon* (hyæna-dog), among Carnivora; and the Aard-varks (*Orycteropus*) among Edentata. These are all peculiar, but, among highly characteristic forms are the baboons, and several genera of monkeys and apes; several peculiar lemurs; a great variety of the civet-family (Viverridæ), and of rodents; peculiar genera of swine (*Potamochoerus* and *Phacochoerus*), and a greater abundance and variety of antelopes than are to be found in all the other regions combined. But the Ethiopian region is strikingly distinguished from all others, not only by possessing many peculiar forms, but by the absence of a number of common and widely-distributed groups of mammalia. Such are the bears, which range over the whole northern hemisphere, and as far south as Sumatra in the eastern and Chili in the western hemisphere, yet they are totally wanting in Tropical and South Africa; the deer, which are still more widely distributed, ranging all over North and South America, and over all Asia to Celebes and the Moluccas, yet they are totally absent from the Ethiopian region; goats and sheep, true oxen (*Bos*), and true pigs (*Sus*), are also absent; though as to the last there is some doubt, certain wild pigs having been observed, though rarely, in various parts of tropical Africa, but it is not yet determined whether they are indigenous, or escaped from domestication. The absence of such wide-spread families as the bears and deer is, however, most important, and must be taken into ac-

many of which are large and important; while such families as Staphylinidæ, Aphodiidæ, Copridæ, Geotrupidæ, Melolonthidæ, Elateridæ, Pimeliidæ, Curculionidæ, and many others, are very abundant.

Land-shells are tolerably abundant, there being about 1250 species, but few if any peculiar genera. *Helix*, *Clausilia*, and *Pupa*, are the genera most abounding in species.

count when we come to consider the geographical changes needed to explain the actual state of the Ethiopian fauna.

The birds are not proportionately so peculiar, yet there are many remarkable forms. Most important are the plantain-eaters, the ground-hornbills, the colies, and the anomalous secretary-bird;—while among characteristic families there are numbers of peculiar genera of flycatchers, shrikes, crows, sun-birds, weaver-birds, starlings, larks, francolins, and the remarkable sub-family of the Guinea-fowls. There are not such striking deficiencies among birds as among mammals, yet there are some of importance. Thus, there are no wrens, creepers, or nuthatches, and none of the wide-spread group comprising the true pheasants and jungle-fowl—a deficiency almost comparable with that of the bears or the deer. Among the lower vertebrates there are 3 peculiar families of snakes and 1 of lizards, as well as 1 of toads, and 3 of fresh-water fishes.*

* The following is a summary of the more important groups of animals which characterise the Ethiopian region:—

There are 9 peculiar families of Mammalia (6 confined to the Continent), Potamogalidæ and Chrysochloridæ belonging to the Insectivora, Protelidæ to the Carnivora, Hippopotamidæ and Camelopardalidæ to the Ungulata, and Orycteropodidæ to the Edentata; and 3 to Madagascar,—Chiromyidæ, containing the Aye-aye, Centetidæ, and Cryptoproctidæ. There are also 7 peculiar genera of apes, 3 genera of lemurs in Africa, and 6 in Madagascar, 3 genera of bats, 2 genera of Macroscelididæ or elephant-shrews, 17 peculiar genera of Viverridæ, 2 of Canidæ, 2 of Mustelidæ, 2 of Suidæ, 12 of Bovidæ (all antelopes), 13 of Muridæ, 3 of Spalacidæ, 1 of Dipodidæ, 1 of Sciuridæ, 1 of Octodontidæ, and 2 of Echimyidæ.

Birds are not so strikingly peculiar, there being only 6 families confined to the region. These are Paictidæ, Musophagidæ, Coliidæ, Leptosomidæ, Irrisoridæ, Serpentariidæ. The peculiar genera are numerous and interesting; there being 2 of Turdidæ, 10 of Sylviidæ, 5 of Timaliidæ, 1 (*Mesites*) doubtfully belonging to the Cinclidæ, 1 of Sittidæ, 2 of Paridæ, 5 of Pycnonotidæ, 2 of Oriolidæ, 2 of Campephagidæ, 13 of Muscipidæ, 17 of Laniidæ, 3 of Corvidæ, 4 of Nectariniidæ, 1 of Dicæidæ, 3 of Hirundinidæ, 3 of Fringillidæ, 22 of Ploceidæ, 12 of Sturnidæ, 5 of Alaudidæ, 1 of Motacillidæ, 4 of Picidæ, 7 of Megalæmidæ, 3 of Cuculidæ, 3 of Coraciidæ, 1 of Meropidæ, 1 of Trogonidæ, 3 of Alcedinidæ, 3 of Bucerotidæ, 3 of Caprimulgidæ, 5 of Psittacidæ, 4 of Columbidae, 3 of Tetraonidæ, 4 of Phasianidæ (all Guinea-fowls), 1 of Turnicidæ, 1 of Vulturidæ, 11 of Falconidæ, 1 of Strigidæ, and 4 of wading birds.

Reptiles.—There are 3 peculiar families of snakes, Rachiodontidæ, Dendraspidæ, and Atractaspidæ; and 1 of lizards, Chamæosauridæ. There are besides, 4 peculiar genera of Colubridæ, 2 of Dendrophidæ, 1 of Dryophidæ, 1 of Dipsadidæ, 5 of Lycodontidæ, 2 of Pythonidæ, 3 of Elapidæ, and 1 of Viperidæ. There are also 15 genera of lizards either peculiar or characteristic, and 4 of tortoises. Of Amphibia there is only one peculiar family, the Dactylethridæ.

Of fresh-water fish there are 3 peculiar families, Mormyridæ, Gymnarchidæ, and Polypteridæ.

Insects.—Eleven out of the sixteen families of butterflies are represented in Africa, but none are peculiar; but there are a large number of characteristic or peculiar genera, chiefly belonging to the Acræidæ, Satyridæ, Nymphalidæ, Lycænidæ, and Pieridæ. Of beetles there are an immense number of peculiar genera, the most remarkable belonging to the Cicindelidæ, Carabidæ, Buprestidæ,

The Oriental region comprises all tropical Asia east of the Indus, with the Malay Islands as far as Java, Borneo, and the Philippines. In its actual land-area it is the smallest region except the Australian; but if we take into account the wide extent of shallow sea connecting Indo-China with the Malay Islands, and which has, doubtless, at no distant epoch, formed an extension of the Asiatic Continent, it will not be much smaller than the Ethiopian region. Here we find all the conditions favourable to the development of a rich and varied fauna. The land is broken up into great peninsulas and extensive islands; lofty mountains and large rivers everywhere intersect it, while along its northern boundary stretches the highest mountain-range upon the globe. Much of this region lies within the equatorial belt, where the equability of temperature and abundance of moisture produce a tropical vegetation of unsurpassed luxuriance. We find here, as might be expected, that the variety and beauty of the birds and insects is somewhat greater than in the Ethiopian region; although, as regards mammalia, the latter is the most prolific, both in genera, species, and individuals.

The families of Mammalia actually peculiar to this region are few in number, and of limited extent. They are,—the Galeopithecidae, or flying lemurs; the Tarsiidae, consisting of the curious little Tarsier, allied to the lemurs; and the Tupaiidae, a remarkable group of squirrel-like Insectivora. There are, however, a considerable number of peculiar genera forming highly characteristic groups of animals—such as the various apes, monkeys, and lemurs—almost all the genera of which are peculiar; a large number of civets and weasels; the beautiful deer-like Chevrotains, often called mouse-deer; and a few peculiar antelopes and rodents. It must be remarked, that we find here none of those deficiencies of wide-spread families which were so conspicuous a feature of the Ethiopian region—the only one worth notice being the dormice (*Myoxidae*), a small family spread over the Palæarctic and Ethiopian regions, but not found in the Oriental.

The birds of the Oriental region are exceedingly numerous and varied, there being representatives of about 350 genera of land-birds, of which nearly half are peculiar. Three families are confined to the region—the hill-tits (*Liotrichidae*), the green Bulbuls (*Phyllornithidae*), and the gapers (*Eurylæmidae*); while four other families are more abundant here than elsewhere, and are so widely

Cetoniidae, and Longicorns. *Manticora* (Cicindelidae), and *Goliathus* (Cetoniidae), are pre-eminently large and remarkable forms.

Terrestrial mollusca are not very numerous, but the genus *Achatina* is very characteristic, containing some of the largest known land-shells.

distributed throughout the region as to be especially characteristic of it. These are—the elegant pittas, or ground-thrushes (*Pittidæ*), the trogons (*Trogonidæ*), the hornbills (*Bucerotidæ*), and the pheasants (*Phasianidæ*); represented by such magnificent birds as the fire-backed pheasants, the ocellated pheasants, the Argus-pheasant, the pea-fowl, and the jungle-fowl.

Reptiles are very abundant, but only 3 small families of snakes are peculiar. There are also 3 peculiar families of fresh-water fishes.*

Having thus briefly sketched the main features of the existing faunas of Europe, Asia, and Africa, it will be well, while their resemblances and differences are fresh in our memory, to consider what evidence we have of the changes which may have resulted in their present condition. All these countries are so intimately connected, that their past history is greatly elucidated by the knowledge we possess of the Tertiary fauna of Europe and India; and we shall find that when we once obtain clear ideas of their mutual

* The following is a summary of the chief groups of animals which characterise the Oriental region:—

Besides the peculiar families of Mammalia noticed above, there are a large number of peculiar genera, viz., 6 of apes and monkeys, and 2 of lemurs, 11 of bats, 1 of *Erinaceidæ*, 12 of *Viverridæ*, 1 of *Canidæ*, 5 of *Mustelidæ*, 2 of *Ursidæ*, 1 of *Delphinidæ*, 1 of *Tragulidæ*, 1 of *Cervidæ*, 4 of *Bovidæ*, 3 of *Muridæ*, 1 of *Sciuridæ*, and 1 of *Hystrioidæ*.

The following families of birds contain peculiar genera, in addition to the three peculiar families noticed above; 3 of *Turdidæ*, 9 of *Sylviidæ*, 21 of *Timaliidæ*, 2 of *Panuridæ*, 2 of *Cinclidæ*, 3 of *Troglodytidæ*, 2 of *Certhiidæ*, 1 of *Sittidæ*, 4 of *Paridæ*, 4 of *Pycnonotidæ*, 1 of *Oriolidæ*, 3 of *Campephagidæ*, 4 of *Dicruridæ*, 12 of *Muscicapidæ*, 2 of *Laniidæ*, 7 of *Corvidæ*, 3 of *Nectariniidæ*, 1 of *Fringillidæ*, 6 of *Sturnidæ*, 2 of *Motacillidæ*, 2 of *Pittidæ*, 13 of *Picidæ*, 4 of *Megalaemidæ*, 11 of *Cuculidæ*, 1 of *Meropidæ*, 1 of *Trogonidæ*, 2 of *Alcedinidæ*, 7 of *Bucerotidæ*, 1 of *Psittacidæ*, 1 of *Columbidæ*, 2 of *Tetraonidæ*, 6 of *Phasianidæ*, 2 of *Falconidæ*, 3 of *Strigidæ*, and 1 of *Parridæ*.

Reptiles.—There are only 3 peculiar families of snakes; *Xenopeltidæ*, *Uropeltidæ*, and *Acrochordidæ*; but the following are abundant and characteristic, *Oligodontidæ*, *Homalopsidæ*, *Dendrophidæ*, *Dryiophidæ*, *Dipsadidæ*, *Lycodontidæ*, *Pythonidæ*, *Elapidæ*, and *Crotalidæ*. There are no peculiar families of lizards, but the *Varanidæ*, *Scincidæ*, *Geckotidæ*, and *Agamidæ*, are wide-spread and characteristic groups. Of *Amphibia* the most characteristic families are *Engystomidæ*, *Polypedatidæ*, and *Ranidæ*.

Fresh-water fishes are abundant, the *Nandidæ*, *Labyrinthici*, *Ophiocephalidæ*, *Siluridæ*, and *Cyprinidæ* being characteristic families, and the last especially abundant.

Insects are very numerous and varied. The most remarkable butterflies belong to the *Danaidæ*, *Nymphalidæ*, *Lycænidæ*, *Pieridæ*, and *Papilionidæ*, the genera *Euplæa*, *Hestia*, *Cethosia*, *Iphia*, *Teinopalpus*, and *Ornithoptera*, being the most remarkable.

Beetles abound: *Mormolyce* (*Carabidæ*), *Odontolabis* and *Cladognathus* (*Lucanidæ*), *Catoxantha* (*Buprestidæ*), *Batocera* (*Lamiidæ*), and *Chalcosoma* (*Scarabæidæ*), are the largest and most remarkable.

Land-shells are exceptionally abundant in the Philippine Islands.

relations, we shall be in a better position to study the history of the remaining continents.

Let us therefore go back to the Miocene or Middle Tertiary epoch, and see what was then the distribution of the higher animals in these countries. Extensive deposits, rich in animal remains of Miocene age, occur in France, Switzerland, Germany, Hungary, Greece; and also in North-Western India at the Siwalik Hills, in Central India in the Nerbudda Valley, in Burmah, and in North China; and over the whole of this immense area we find a general agreement in the fossil mammalia, indicating that this great continent was probably then, as now, one continuous land. The next important geographical fact that meets us, is, that many of the largest and most characteristic animals, now confined to the tropics of the Oriental and Ethiopian regions, were then abundant over much of the Palæarctic region. Elephants, rhinoceroses, tapirs, horses, giraffes, antelopes, hyænas, lions, as well as numerous apes and monkeys, ranged over all Central Europe, and were often represented by a greater variety of species than exist now. Antelopes were abundant in Greece, and several of these appear to have been the ancestors of those now living in Africa; while two species of giraffes also inhabited Greece and North-West India. Equally suggestive is the occurrence in Europe of such birds as trogons and jungle-fowl characteristic of tropical Asia, along with parrots and plintain-eaters allied to forms now living in West Africa.

Let us now inquire what information Geology affords us of changes in land and sea at this period. From the prevalence of early Tertiary deposits over the Sahara and over parts of Arabia, Persia, and Northern India, geologists are of opinion that a continuous sea or strait extended from the Bay of Bengal to the Atlantic Ocean, thus cutting off the Peninsula of India with Ceylon, as well as all tropical and South Africa from the great northern continent.* At the same time, and down to a comparatively recent period, it is almost certain that Northern Africa was united to Spain and to Italy, while Asia Minor was united to Greece, thus reducing the Mediterranean to the condition of two inland seas. We also know that the north-western Himalayas and some of the high lands of Central Asia were at such a moderate elevation as to enjoy a climate as mild as that which prevailed

* Mr. Searles V. Wood, "On the Form and Distribution of the Land-tracts during the Secondary and Tertiary Periods respectively," 'Philosophical Magazine,' 1862.

in Central Europe during the Miocene epoch,* and was therefore perhaps equally productive in animal and vegetable life.

We have, therefore, good evidence that the great Euro-Asiatic continent of Miocene times exhibited in its fauna a combination of all the main features which now characterise the Palæarctic, Oriental, and Ethiopian regions; while tropical Africa, and such other tropical lands as were then, like the peninsula of India, detached and isolated from the continent, possessed a much more limited fauna, consisting for the most part of animals of a lower type, and which were more characteristic of Eocene or Secondary times. Many of these have no doubt become extinct, but they are probably represented by the remarkable and isolated lemurs of West Africa and Southern Asia, by the peculiar Insectivora of South Africa and Malaya, and by the Edentata of Africa and India. These are all low and ancient types, which were represented in Europe in the Eocene and early Miocene periods, at a time when the more highly specialised horses, giraffes, antelopes, deer, buffaloes, hippopotami, elephants, and anthropoid apes had not come into existence. And if these large herbivorous animals were all wanting in tropical Africa in Miocene times, we may be quite sure that the large felines and other carnivora which prey upon them were absent also. Lions, leopards, and hyænas can only exist where antelopes, deer, or some similar creatures abound; while smaller forms allied to the weasels and civets would be adapted to a country where small rodents or defenceless Edentata were the chief vegetable-feeding mammalia.

If this view is correct (and it is supported by a considerable amount of evidence which it is not possible here to adduce), all the great mammalia which now seem so specially characteristic of Africa,—the lions, leopards, and hyænas,—the zebras, giraffes, buffaloes and antelopes,—the elephants, rhinoceroses and hippopotami,—and perhaps even the numerous monkeys, baboons, and anthropoid apes,—are every one of them comparatively recent immigrants, who took possession of the country as soon as an elevation of the old Eocene and Miocene sea-bed afforded a passage from the southern borders of the Palæarctic region. This event probably occurred about the middle of the Miocene period, and it must have effected a vast change in the fauna of Africa. A number of the smaller and more defenceless of the ancient inhabitants must have been soon exterminated, as surely as our

* This part of the Himalayas was elevated during the Eocene period, and remains of a fossil *Rhinoceros* have been found at 16,000 feet elevation in Thibet.

introduced pigs, dogs, and goats, exterminate] so many of the inhabitants of oceanic islands; while the new comers, finding a country of immense extent, with a tropical climate and not too much encumbered with forest vegetation, spread rapidly over it, and thenceforth greatly multiplying became more or less modified in accordance with the new conditions. We shall find that this theory not only accounts for the chief specialities, but also explains many of the remarkable deficiencies of the Ethiopian fauna. Thus, bears and deer are absent, because they are comparatively late developments, and were either unknown or rare in Europe till late Miocene or Pliocene times; while, on the other hand, the immense area of open tropical country in Africa has favoured the preservation of numerous types of large mammalia which have perished in the deteriorated climate and diminished area of Europe.

Our knowledge of the geology of Africa is not sufficiently detailed to enable us to determine its earlier history with any approach to accuracy. It is clear, however, that Madagascar was once united with the southern portion of the continent, but it is no less clear that its separation took place before the great irruption of large animals just described; for all these are wanting, while lemurs, insectivora, and civets abound, just the low types which were once the only inhabitants of the main land. It is worthy of note, that south-temperate Africa still exhibits a remarkable assemblage of peculiar forms of mammalia, birds, and insects,—the two former groups mostly of a low grade of organisation; and these, taken in connection with the wonderfully rich and highly specialised flora of the Cape of Good Hope, point to the former existence of an extensive south temperate land in which so many peculiar types could have been developed. Whether this land was separated or not from Equatorial Africa, or formed with it one great southern continent, there is no sufficient evidence to determine.

Turning now to Tropical Asia, we find a somewhat analogous series of events, but on a smaller scale and with less strongly-marked results. At the time when tropical and South Africa were so completely cut off from the great northern continent, the peninsula of India with Ceylon was also isolated, and it seems probable that their union with the continent took place at a somewhat later period. The ancient fauna of this south-Asiatic island may be represented by the Slow Loris, a peculiar type of lemur, some peculiar rats (*Muridæ*), and perhaps by the Edentate scaly ant-eater; by its *Uropeltidæ*, a peculiar family of snakes, and by many peculiar genera of snakes and lizards, and a few peculiar amphibia. On the other hand, we must look upon the monkeys,

the large carnivora, the deer, the antelopes, the wild pigs, and the elephants, as having overrun the country from the north, and their entrance must, no doubt, have led to the extermination of many of the lower types.

But there is another remarkable series of changes which have undoubtedly taken place in Eastern Asia in Tertiary times. There is such a close affinity between the animals of the Sunda Islands and those of the Malay Peninsula and Siam, and between those of Japan and Northern Asia, that there can be little doubt that these islands once formed a southern and eastern extension of the Asiatic continent. The Philippines and Celebes perhaps also formed a part of this continent, but if so, the peculiarity and poverty of their mammalian fauna shows that they must have been separated at a much earlier period.* The other islands probably remained united to the continent till the Pliocene period. The result is seen in the similarity of the flora of Japan to that which prevailed in Europe in Miocene times; while in the larger Malay Islands we find, along with a rich flora developed under long-continued equatorial conditions of uniform heat and moisture, a remnant of the fauna which accompanied it, of which the Malay tapir, the anthropoid apes, the tupaias, the galeopithecii or flying lemurs, and the sun-bears, may be representatives.

There is another very curious set of relations worthy of our notice, because they imply some former communication between the Malay Islands, on the one hand, and South India with Ceylon, on the other. We find, for example, such typical Malay forms as the Tupāia, some Malay genera of cuckoos and Timaliidæ, some Malayan snakes and amphibia, the remarkable genus *Hestia* among butterflies, and no less than seven genera of beetles of purely Malay type,† all occurring either in Ceylon only or in the adjacent parts of the peninsula, but in no other part of India. These cases are so numerous and so important, that they compel us to assume some special geographical change to account for them. But directly between Ceylon and Malaya there intervenes an ocean-depth of more than 15,000 feet, and besides the improbability of so great a subsidence, of which we have no direct evidence, a land communication of this kind would almost certainly have left more general proofs of its existence in the faunas of the two countries. But, when in Miocene times a sub-tropical climate extended into Central Europe, it seems probable that the equatorial belt of vege-

* For a full account of the evidence and conclusions as to these islands, see the Author's 'Geographical Distribution of Animals,' vol. i., pp. 345, 359, 426, 436.

† For details see 'Geographical Distribution of Animals,' vol. i., p. 327.

tation, accompanied by its peculiar fauna, would have been wider than at present, extending perhaps as far as Burma. If then the shallow northern part of the Bay of Bengal had been temporarily elevated during the late Miocene or Pliocene epochs, a few Malayan types may have migrated to the Peninsula of India, and have been preserved only in Ceylon and the Nilgherries, where the climate still retains somewhat of its equatorial character, and the struggle for existence is somewhat less severe than in the northern parts of the region, so much more productive in varied forms of life.

There are also indications, hardly less clear, of some communication between India and Malaya on the one hand, and Madagascar on the other; but as these indications depend chiefly on resemblances in the birds and insects, they do not imply that any land-connection has occurred. If, as seems probable, the Laccadive and Maldivé Islands are the remains of a large island, or indicate a western extension of India, while the Seychelles, with the shallow banks to the south-east and the Chagos group, are the remains of other extensive lands in the Indian Ocean, we should have a sufficient approximation of these outlying portions of the two continents to allow a certain amount of interchange of such winged groups as birds and insects, while preventing any intermixture of the mammalia.

The presence of some African types (and even some African species) of mammals in Hindostan appears to be due to more recent changes, and may perhaps be explained by a temporary elevation of the comparatively shallow borders of the Arabian Sea, admitting of a land-passage from North-East Africa to Western India.

There remains to be considered the supposed indications of a very ancient communication between Africa, Madagascar, Ceylon, Malaya, and Celebes, furnished by the occurrence over this extensive area of isolated forms of the lemur tribe. The anomalous range of this group of animals has been thought to require for its explanation the existence of an ancient southern continent, which has been called Lemuria; but a consideration of all the facts does not seem to warrant such a theory. Had such a continent ever existed, we are sure that it must have disappeared long before the Miocene period, or it would assuredly have left more numerous and widespread indications of the former connections of these distant lands than actually exist. And when we go back to the Eocene period, we are met by the interesting discovery of an undoubtedly Lemurine animal in France, and what are supposed to be allied forms in North America. This proof of the great antiquity and wide range

of lemurs is quite in accordance with their low grade of development; while the extreme isolation and specialisation of many of the existing types (of which the Aye-aye of Madagascar is a wonderful example), and their scattered distribution over a wide tropical area, all suggest the idea that these are but the remnants of a once extensive and widely-distributed group of animals, which, in competition with higher forms, have preserved themselves either by their solitary and nocturnal habits, or by restriction to ancient islands like Madagascar, where the struggle for existence has been less severe. Lemuria, therefore, may be discarded as one of those temporary hypotheses which are useful for drawing attention to a group of anomalous facts, but which fuller knowledge shows to be unnecessary.

We will now pass across the Atlantic to the Western Hemisphere, and consider first the Nearctic region, or temperate North America, whose present and past zoological relations with the rest of the world are of exceeding interest.

If we omit such animals as the musk-sheep (*Ovibos*), which is purely Arctic, and the peccaries (*Dicotyles*), which are hardly less distinctly tropical, the land-mammalia of North America are not very numerous; and they can be for the most part divided into two groups, the one allied to the Palæarctic, and the other to the Neotropical fauna. The bears, the wolves, the cats, the bison, sheep and antelope, the hares, the marmots, and the pikas, resemble Palæarctic forms; while the racoons, skunks, opossum, and vesper-mice are now more peculiarly Neotropical. There are also many genera which are altogether peculiar and characteristic of the region, as the prong-horn antelope (*Antilocapra*), the jumping-mouse (*Jaculus*), five genera of pouched rats (*Sacomys*), the prairie dogs (*Cynomys*), the tree porcupines (*Erethizon*), and some others.

Birds present the same mixture of the two types, but the wild turkeys (*Meleagris*), the passenger pigeon (*Ectopistes*), the crested quails (*Lophortyx*, &c.), the ruffed grouse (*Cupidonia*), and some other groups of less importance, are peculiar; while the family of the wood warblers (*Mniotiltidæ*) is so largely developed that it may claim to be more characteristic of North than of South America.

Reptiles and Amphibia present a number of peculiar types; while no less than five peculiar families of fresh-water fishes would alone serve to mark out this as distinct from every other part of the world.

Considering the evident affinity between the Nearctic and Palæ-

arctic regions, there are here some curious deficiencies of groups which are common and widely spread in the latter. Thus hedgehogs, wild horses and asses, swine, true oxen, goats, dormice, and true mice are absent; while sheep and antelopes are only represented by solitary species in the Rocky Mountains. Among birds, too, we have such striking deficiencies as the extensive families of flycatchers, starlings, and pheasants.*

Turning now to the Neotropical region, comprising all South America and the tropical parts of the northern continent, we find that the Old World types have still further diminished, while a number of new and altogether peculiar forms have taken their place. Insectivora have wholly disappeared, with the exception of one anomalous form in the greater Antilles; bears are represented by one Chilian species; swine are replaced by peccaries; the great Bovine family are entirely unknown; the camel tribe are confined to the Southern Andes and the south temperate plains; deer are not numerous; and all the varied Ungulata of the Old World are

* The following is a summary of the most important groups of animals characteristic of the Nearctic region:—

There are only 2 peculiar families of mammalia—Sacomylidæ, or pouched rats, and Haploodontidæ, a peculiar squirrel-like animal of the west coast. The peculiar genera belong to the following families:—2 genera of bats (*Vespertilionidæ*), 3 of moles (*Talpidae*), 2 of *Mustelidæ*, 3 of *Bovidæ*, 3 of *Muridæ*, 1 of *Dipodidæ*, 1 of *Sciuridæ*, and 1 of *Cercolabidæ*.

There is but one wholly peculiar family of birds—*Chamæidæ*—containing a single Californian species; but the peculiar or highly characteristic genera are numerous, as the following enumeration will show:—2 genera of *Turdidæ*, 1 of *Sylviidæ*, 2 of *Troglodytidæ*, 2 of *Paridæ*, 2 of *Corvidæ*, 6 of *Mniotiltidæ*, 1 of *Ampelidæ*, 2 of *Icteridæ*, 13 of *Fringillidæ*, 1 of *Motacillidæ*, 2 of *Picidæ*, 2 of *Trochilidæ*, 1 of *Columbidæ*, 5 of *Tetraonidæ*, 1 of *Phasianidæ* (the wild turkey), 1 of *Strigidæ*, and 1 of *Scolopacidæ*.

Reptiles, considering the climate, are well represented. There are 11 peculiar genera of snakes—4 *Colubridæ*, 2 *Homalopsidæ*, 1 *Pythonidæ*, and 4 *Crotalidæ*. Of lizards, 1 (*Chirotes*) forms a peculiar family, and there are 7 other peculiar genera—1 *Zonuridæ*, and the remainder *Iguanidæ*.

Amphibia are abundant and remarkable, there being two peculiar families—*Sirenidæ* and *Amphiumidæ*, 1 peculiar genus of *Proteidæ*, 9 of *Salamandridæ*, and 3 peculiar genera of tailless batrachians.

Fresh-water fishes are very numerous in the Nearctic region, and there are an unusual number of peculiar forms. There are at least five peculiar families—*Aphredoderidæ*, *Heteropygii* or *Amblyopsidæ*, *Percopsidæ*, *Hyodontidæ*, and *Amiuidæ*—while *Lepidosteidæ* is almost peculiar, and two groups—*Etheostomidæ* and *Ichthelidæ*—have recently been separated from the perches as distinct families. There are in all about 120 genera of fresh-water fishes in the region, a considerable number of which are peculiar to it.

Insects.—The butterflies of the Nearctic region present little peculiarity, almost all being representatives of either Palæarctic or Neotropical forms. The beetles are more interesting. There are 2 peculiar genera of *Cicindelidæ*, and a large number of *Carabidæ* and *Longicornes*.

The land-shells are not very remarkable; but the fresh-water forms are, as might be expected, exceedingly numerous. The generic types are, however, as in all fresh-water productions, widely spread over the globe.

represented only by a few species of tapirs. These great gaps are, however, to some extent filled up by a variety of interesting and peculiar types. Two families of monkeys (Cebidæ and Hapalidæ) differ in many points of structure from all the *Quadrumana* of the eastern hemisphere. There is a peculiar family of bats—the vampires; many peculiar weasels and Procyonidæ; a host of peculiar rodents, comprising five distinct families, among which are the largest living forms of the order; and a great number of Edentata, comprising the families of the sloths, armadillos, and ant-eaters; and lastly, a considerable number of the marsupial family of opossums. As compared with the Old World, we find here a great abundance and variety of the lower types, with a corresponding scarcity of such higher forms as characterise the tropics of Africa and Asia.

In birds we meet with corresponding phenomena. The most abundant and characteristic families of the Old World tropics are replaced here by a series of families of a lower grade of organisation, among which are such remarkable groups as the chatterers (Cotingidæ), the manakins (Pipridæ), the ant-thrushes (Formicariidæ), the toucans (Rhamphastidæ), the motmots (Momotidæ), and the humming-birds (Trochilidæ), the last perhaps the most remarkable and beautiful of all developments of the bird-type. Parrots are numerous, but these, too, are mostly of peculiar families; while pheasants and grouse are replaced by curassows and tinamous, and there are an unusual number of remarkable and isolated forms of waders.

Reptiles, amphibia, fresh-water fishes, insects, and land-shells, are all equally peculiar and abundant, so that South America presents, on the whole, an assemblage of curious and beautiful natural objects, unsurpassed—perhaps even unequalled—in any other part of the globe.*

* The following is a summary of the peculiar families and most characteristic types of the Neotropical region:—

The following 8 families of Mammalia are peculiar to this region. Of monkeys 2 families, Cebidæ and Hapalidæ; of bats, 1 family, Phyllostomidæ (except one species in California); of rodents, 2 families, Chinchillidæ and Caviidæ; of Edentata, 3 families; Bradypodidæ, Dasypodidæ, and Myrmecophagidæ. Peculiar genera in other families are very numerous; of bats (Vespertilionidæ and Noctilionidæ), there are 10 peculiar genera; of Insectivora, 1; of Canidæ, 5; of Mustelidæ, 3; of Procyonidæ, 2; of Ursidæ, 1; of Otariidæ, 1; of Delphinidæ, 1; of Tapiridæ, 1; of Suidæ, 1; of Camelidæ, 1; of Muridæ, 6; of Saccomyidæ, 1; of Octodontidæ, 6; of Echimyidæ, 8; of Cercolabidæ, 2; and of Didelphyidæ, 2.

Of birds there are no less than 24 peculiar families, a larger number than is found in any other region. These are 8 of Passeres—Cærebidæ, Oxyrhamphidæ, Pipridæ, Cotingidæ, Phytotomidæ, Dendrocolaptidæ, Formicariidæ, and Pteroptochidæ; 6 of Picariæ—Rhamphastidæ, Bucconidæ, Galbulidæ, Todidæ, Momotidæ,

We will now proceed to examine what is known of the past history of the two American Continents, and endeavour to determine what have been their former relations to each other and to the Old World, and how their existing zoological and geographical features have been brought about. And first let us see what knowledge we

and Steatornithidæ; 2 of Gallinæ—Cracidæ and Tinamidæ; 1 of Opisthocomi—Opisthocomidæ; and 7 of Grallæ—Chionididæ, Thinocoridæ, Cariamidæ, Aramidæ, Psophiidæ, Eurypygidæ, and Palamedeidæ. Almost peculiar are Tanagridæ, Tyrannidæ, Trochilidæ, and Conuridæ, of which but a few species are Nearctic. The peculiar genera (in addition to those in the peculiar families) are also very numerous; Turdidæ has 8, Sylviidæ 1, Troglodytidæ 7, Corvidæ 3, Mniotiltidæ 6, Vireonidæ 6, Ampelidæ 2, Hirundinidæ 1, Icteridæ 15, Tanagridæ 42, Fringilidæ 30, Tyrannidæ 65, Picidæ 6, Megalæmidæ 2, Cuculidæ 10, Trogonidæ 5, Caprimulgidæ 9, Cypselidæ 4, Trochilidæ 115, Conuridæ 6, Psittacidæ 7, Columbidæ 9, Tetraonidæ 3, Vulturidæ 2, Falconidæ 19, Strigidæ 7, Rallidæ 1, Charadriidæ 3, Ardeidæ 2, Anatidæ 3, and Struthionidæ 1.

The Neotropical reptiles are also very numerous and peculiar. Of snakes there are, however, no peculiar families, but the Scytalidæ are nearly so. Sixteen families occur in the region,—Colubridæ, Amblycephalidæ and Pythonidæ being richest in peculiar forms. There are 25 peculiar or characteristic genera, the most important being, *Dromicus* (Colubridæ), *Boa*, *Epicrates*, and *Ungalia* (Pythonidæ), *Elaps* (Elapidæ), and *Craspedocephalus* (Crotalidæ).

Of lizards there are 15 families in the region, 5 of these being peculiar, while 4 others extend only to North America. The peculiar families are Helodermidæ, Anadiadæ, Chirocolidæ, Iphisiadæ, and Cercosauridæ; those which extend also to North America, but not to any other continent, are, Chirotidæ, Chalcidæ, Teidæ, and Iguanidæ. There are more than 50 peculiar or very characteristic genera of lizards in the region, about 40 of which belong to the two families Teidæ and Iguanidæ. The most important of these genera are, *Ameiva* (Teidæ), *Gymnophthalmus* (Gymnophthalmidæ), *Celestus* and *Diploglossus* (Scincidæ), *Sphærodactylus* (Geckotidæ), *Liocephalus*, *Liolaemus*, and *Proctrotetus* (Iguanidæ). The three extensive Old World families, Varanidæ, Lacertidæ, and Agamidæ, are absent from the whole American continent.

In the order Crocodilia, America has the peculiar family of the alligators (Alligatoridæ).

In the order Chelonia or tortoises, there are no peculiar families, but 6 peculiar genera,—*Dermatemys* and *Staurotypus* (Testudinidæ), *Peltocephalus*, *Podocnemys*, *Hydromedusa*, and *Chelys* (Chelydidæ).

Of Amphibia there are 4 peculiar families, Rhinophrynidæ, Hylaplesidæ, Plectromantidæ, and Pipidæ; but these are all small, the most important families being Ranidæ (11 genera), Polypedatidæ (7 genera), Hylidæ (8 genera), and Engystomidæ (5 genera), almost all of the Neotropical genera being peculiar.

Fresh-water fishes are exceedingly abundant, there being 3 peculiar families and about 120 peculiar genera. The peculiar families are Polycentridæ, Gymnotidæ (which contains the electric eel), and Trygonidæ, a family of rays which are usually marine but in South America are found in the rivers of the interior.

Insects are too numerous and varied to be enumerated. Of butterflies there are 3 peculiar families—Brassolidæ, Heliconidæ, and Eurygonidæ—while Erycinidæ only extends into the Nearctic region; and there are about 200 peculiar genera, or nearly as many as in all the rest of the world.

Coleoptera are almost equally rich. There are 10 peculiar genera of Cicindelidæ, 100 of Carabidæ, 12 of Cetoniidæ, 18 of Buprestidæ, and nearly 500 of Longicorns—numbers which sufficiently show the high degree of speciality of the insect fauna.

Land-shells are less remarkable, except in the Antilles, where there are more genera and species than on the continent. There are about 20 peculiar genera in the region.

possess of the past relations of North America with the Eastern Continents.

If we go back to that recent period termed the Post-Pliocene—corresponding nearly to the Post-Glacial period and to that of pre-historic man in Europe—we find at once a nearer approximation than now exists between the Nearctic and Palæarctic faunas. North America then possessed several large cats, six distinct species of the horse family, a camel, two bisons, and four species of elephants and mastodons. A little earlier, in the Pliocene period (although fossil remains of this age are scanty), we have in addition the genus *Rhinoceros*, several distinct camels, some new forms of ruminants, and an Old-World form of porcupine. Further back, in the Miocene period, we find a Lemuroid animal, numerous insectivora, a host of carnivora, chiefly feline and canine, a variety of equine and tapirine forms, rhinoceroses, camels, deer, and an extensive extinct family—the Oreodontidæ—allied to deer, camels and swine. There are, however, no elephants. In the still earlier Eocene period most of the animals were peculiar, and unlike anything now living, but some were identical with European types of the same age, as *Lophotherium* and the family Anchitheridæ.

These facts compel us to believe, that at distinct epochs during the Tertiary period, the interchange of large mammalia between North America and the Old World has been far more easy than it is now. In the Post-Pliocene period, for example, the horses, elephants and camels of North America and Europe were so closely allied, that their common ancestors must have passed from one continent to the other,—just as we feel assured that the common ancestors of the American and European bison, elk, and beaver must have so migrated. We have further evidence in the curious fact that certain groups appear to come into existence in the one continent much later than in the other. Thus cats, deer, mastodons, true horses, porcupines, and beavers, existed in Europe long before they appeared in America; and as the theory of evolution does not admit the independent development of the same group in two disconnected regions to be possible, we are forced to conclude that these animals have migrated from one continent to the other. Camels, and perhaps ancestral horses, on the other hand, were more abundant and more ancient in America, and may have migrated thence into Northern Asia.

There are two probable routes for such migrations. From Norway to Greenland by way of Iceland and across Baffin Bay to Arctic America, there is everywhere a comparatively shallow sea, and it is not improbable that during the Miocene period, or subsequently, a

land communication may have existed here. On the other side of the continent, at Behring Straits, the probability is greater. For here we have a considerable extent of far shallower sea, which a very slight elevation would convert into a broad isthmus connecting North America and North-East Asia. It is true that elephants, horses, deer, and camels would, under existing climatal conditions, hardly range as far north as Greenland and Alaska; but we must remember that most mysterious yet indisputable fact of the luxuriant vegetation, including even magnolias and other large-leaved evergreens, which flourished in these latitudes during the Miocene period; so that we have all the conditions of favourable climate and abundant food, which would render such interchange of the animals of the two continents not only possible but inevitable, whenever a land communication was effected; and there is reason to believe that this favourable condition of things continued in a diminished degree during a portion of the succeeding Pliocene period.

We must not forget, however, that the faunas of the two continents were always to a great extent distinct and contrasted—such important Old-World groups as the civets, hyænas, giraffes and hippopotami, never passing to America, while the extinct *Oreodontidæ*, *Brontotheridæ*, and many others are equally unknown in the Old World. This renders it probable that the communication, even in the north, was never of long continuance; while it wholly negatives the theory of an Atlantis bridging over the Atlantic ocean in the Temperate Zone, at any time during the whole Tertiary period.

But the past history of the North-American fauna is complicated by another set of migrations from South America, which, like those from the Old World, appear to have occurred at distant intervals, and to have continued for limited periods. In the Post-Pliocene epoch, along with elephants and horses from Europe or Asia, we find a host of huge sloths and other Edentata, as well as llamas, capybaras, tapirs, and peccaries, all characteristic of South America. Some of these were identical with living species, while others are closely allied to those found fossil in Brazilian caves and other deposits of about the same age, while nothing like them inhabited the Old World at the same period. We are therefore quite sure that they came from some part of the Neotropical region; but the singular fact is, that in the preceding Pliocene epoch none of them are found in North America. We conclude, therefore, that their migration took place at the end of the Pliocene or beginning of the Post-Pliocene epoch, owing to some specially favourable conditions,

but that they rapidly disappeared, having left no survivors. We must, however, study the past history of South America in order to ascertain how far it has been isolated from or connected with the northern continent.

Abundant remains of the Post-Pliocene epoch from Brazilian caves show us that the fauna of South America which immediately preceded that now existing, had the same general characteristics, but was much richer in large mammalia and probably in many other forms of life. Edentata formed the most prominent feature; but instead of the existing sloths, armadillos and ant-eaters, there were an immense variety of these animals, some of living genera, others altogether different, and many of them of enormous size. There were armadillos as large as the rhinoceros, while the megatherium and several other genera of extinct sloths were of elephantine bulk. The peculiar families of South American rodents—cavies, spiny-rats, and chinchillas—were represented by other species and genera, some of large size; and the same may be said of the monkeys, bats, and carnivora. Among Ungulata, however, we find, in addition to the living tapirs, llamas, peccaries and deer, several species of horse and antelope as well as a mastodon, all three forms due probably to recent immigration from the northern continent.

Further south, in Bolivia, the Pampas, and Patagonia, we also find abundant fossil remains, probably a little older than the cave-fauna of Brazil, and usually referred to the newer part of the Pliocene period. The same families of rodents and Edentata are here abundant, many of the genera being the same, but several new ones also appearing. There are also horses, peccaries, a mastodon, llamas, and deer; but besides these there are a number of altogether peculiar forms, such as the *Macrauchenia*, allied to the Tapir and Palæotherium; the *Homalodontotherium*, allied to the Miocene *Hyracodon* of North America; and the Toxodontidæ, a group of very large animals having affinities to Ungulates, rodents, Edentata and Sirenia, and therefore probably the representative of a very ancient type.

Here then we meet with a mixture of highly-developed and recent with low and ancient types, but the latter largely predominate; and the most probable explanation seems to be that the same concurrence of favourable conditions which allowed the megatherium and megalonyx to enter North America, also led to an immigration of horses, deer, mastodons, and many of the Felidæ into South America. These inter-migrations appear to have taken place at several remote intervals, the northern and southern continents being for the most part quite separated, and each developing its own

peculiar forms of life. This view is supported by the curious fact of a large number of marine fishes of the two sides of Central America being absolutely identical,—implying a recent union of the two oceans and separation of the continents—while the mollusca of the Pacific coast of America bear so close a relation to those of the Caribbean Sea and the Atlantic coasts, as to indicate a somewhat more remote but longer continued sea-passage. The straits connecting the two oceans were probably situated in Nicaragua and to the south of Panama, leaving the highlands of Mexico and Guatemala united to North America.

Around the Gulf of Mexico and the Caribbean Sea there is a wide belt of rather shallow water, and during the alternate elevations and subsidences to which this region has been subjected, the newly-raised land would afford a route for the passage of immigrants between North and South America. The great depression of the ocean, believed to have occurred during the Glacial period (caused by the locking-up of the water in the two polar masses of ice), may perhaps have afforded the opportunity for those latest immigrations which gave so striking a character to the North American fauna in Post-Pliocene times.

Among the changes which South America itself has undergone, perhaps the most important has been its separation into a group of large islands. Such a change is clearly indicated by the immense area and low elevation of the great alluvial plains of the Orinoko, Amazon, and La Plata, as well as by certain features in the distribution of the existing Neotropical fauna. A subsidence of less than 2000 feet would convert the highlands of Guiana and Brazil into islands separated by a shallow strait from the chain of the Andes. When this occurred, the balance of land was probably restored by an elevation of the extensive submerged banks on the east coast of South America, which in South Brazil and Patagonia are several hundred miles wide, embracing the Falkland Islands, and reaching far to the south of Cape Horn.

Looking then at the whole of the evidence at our command, we seem justified in concluding that the past histories of North and South America have been different, and in some respects strongly contrasted. North America was evidently in very early times so far connected with Europe and Asia as to interchange with those continents the higher types of animal life as they were successively developed in either hemisphere. These more perfectly organised beings rapidly gained the ascendancy, and led to the extinction of most of the lower forms which had preceded them. The Nearctic

has thus run a course parallel to that of the Palæarctic region, although its fauna is, and perhaps always has been, less diversified and more subject to incursions of lower types from adjacent lands in the southern hemisphere.

South America, on the other hand, has had a history in many respects parallel to that of Africa. Both have long existed either as continents or groups of large islands in the southern hemisphere, and for the most part completely separated from the northern continents; and each, accordingly, developed its peculiar types from those ancestral and lowly-organised forms which first entered it. South America, however, seems to have had a larger area and more favourable conditions, and it remained almost completely isolated till a later period. It was therefore able to develop a more varied and extensive fauna of its own peculiar types, and its union with the northern continent has been so recent, and is even now maintained by so narrow an isthmus, that it has never been overrun with the more perfect mammalia to anything like the extent that has occurred in Africa. South America, therefore, almost as completely as Australia, has preserved for us examples of a number of low and early types of mammalian life, which, had not the entire country been isolated from the northern continent during middle and late Tertiary times, would long since have become extinct.

There only remains for us now to consider the relation of the island-continent of Australia to Asia and South America, with both which countries it has a certain amount of zoological connection.

Australia, including New Guinea (which has in recent times been united with it), differs from all the other continents by the extreme uniformity and lowly organisation of its mammalia, which almost all belong to one of the lowest orders—the marsupials. Monkeys, carnivora, insectivora, and the great and almost ubiquitous class of hoofed animals, are all alike wanting; the only mammals besides marsupials being a few species of a still lower type—the monotremes, and a few of the very smallest forms of rodents—the mice. The marsupials, however, are very numerous and varied, constituting 6 families and 33 genera, of which there are about 120 known species. None of these families is represented in any other continent; and this fact alone is sufficient to prove that Australia must have remained almost or quite isolated during the whole of the Tertiary period.

In birds there is, as we might expect, less complete isolation, yet

there are a number of very peculiar types. About 15 families are confined to the Australian region, among which are the paradise-birds, the honey-suckers, the lyre-birds, the brush-tongued lorries, the mound-makers, and the cassowaries.*

Our knowledge of the former mammalian inhabitants of Australia is imperfect, as all yet discovered are from Post-Tertiary or very late Tertiary deposits. It is interesting to find, however, that all belong to the marsupial type, although several are quite unlike any living animals, and some are of enormous size, almost rivalling the mastodons and megatheriums of the northern continents. In the earliest Tertiary formations of Europe remains of marsupials have been found, but they all belong to the opossum type, which is unknown in Australia; and this supports the view that no com-

* The following is a summary of the peculiarities of the Australian fauna:—

Among Mammalia there are 8 peculiar families—6 of Marsupials and 2 of Monotremes. These are—Dasyuridæ, Myrmecobiidæ, Peramelidæ, Macropodidæ, Phalangistidæ, and Phascologyidæ (Marsupialia); Ornithorhynchidæ, and Echidnidæ (Monotremata). In other orders there are a few peculiar genera. These are, 3 of bats, 2 being Pteropidæ, confined to the Moluccas and Pacific Islands, and 1 of Noctilionidæ, to New Zealand. Among rodents there are five peculiar genera, of Muridæ, all found in Australia.

The peculiar families of birds are—Pachycephalidæ, Paradiseidæ, Meliphagidæ, Drepanididæ, Menuridæ, Atrichiidæ (Passeres)—Cacatuidæ, Platycercidæ, Trichoglossidæ, Nestoridæ, Stringopidæ (Psittaci)—Didunculidæ (Columbæ)—Megapodiidæ (Gallinæ)—Rhinocerotidæ (Grallæ)—Casuariidæ, Apterygidæ (Struthionæ).

Peculiar genera of other families are numerous. There are 20 of Sylviidæ, 4 of Timaliidæ, 1 of Certhiidæ, 3 of Sittidæ, 2 of Paridæ, 2 of Oriolidæ, 3 of Campephagidæ, 1 of Dicuridæ, 9 of Muscipapidæ, 2 of Laniidæ, 9 of Corvidæ, 1 of Nectariniidæ, 1 of Dicaeidæ, 3 of Ploceidæ, 7 of Sturnidæ, 1 of Pittidæ, 2 of Cuculidæ, 10 of Alcedinidæ, 2 of Podargidæ, 1 of Caprimulgidæ, 5 of Palæornithidæ, 15 of Columbaidæ, 7 of Falconidæ, 6 of Rallidæ, 1 of Scolopacidæ, 4 of Charadriidæ, and 6 of Anatidæ.

Of reptiles there are 4 peculiar families, all small—Pygopodidæ, Aprasiadæ, and Lialidæ (lizards), and Rhynchocephalidæ, containing the lizard-like *Hatteria* of New Zealand. Among snakes Pythonidæ and Elapidæ contain many peculiar genera, while Viperidæ and Crotalidæ are altogether absent. Of lizards there are 36 peculiar genera, most of them belonging to the two families Scincidæ and Geckotidæ. Of fresh-water turtles there are 3 peculiar genera.

Amphibia are not numerous, but there are a few peculiar genera, belonging to the families Phryniscidæ, Engystomidæ, Alytidæ, Pelodyadæ, and Bufonidæ.

Fresh-water fish are also comparatively scarce. There is one peculiar family, the Gadopsidæ, containing one species only. Most of the genera are peculiar, and they belong to the following families—Trachinidæ, Atherinidæ, Mugillidæ, Siluridæ, Homaloptera, Haplochitonidæ, Galaxidæ, Osteoglossidæ, Symbranchidæ, and Sirenoidei.

Among insects, butterflies are scarce, except in the Moluccas and New Guinea. There are in all about 14 peculiar genera. Coleoptera are much more abundant, there being about 94 peculiar genera of Carabidæ, 7 of Lucanidæ, 3 of Cetoniidæ, 20 of Buprestidæ, and 260 of Longicornis. Land-shells are abundant in the islands, but comparatively scarce in the continent of Australia itself. There are only 3 or 4 peculiar genera, all confined to the islands of the Pacific.

munication existed between the Palæarctic and Australian regions even at this early period. Much farther back, however, in the Oolite and Trias formations, remains of a number of small mammalia have been found which are almost certainly marsupial, and bear a very close resemblance to the *Myrmecobius*, a small and very rare mammal still living in Australia. An animal of somewhat similar type has been discovered in rocks of the same age in North America; and we have, therefore, every reason to believe, that it was at or near this remote epoch when Australia, or some land which has been since in connection with it, received a stock of mammalian immigrants from the great northern continent; since which time it has almost certainly remained completely isolated.

The occurrence of the marsupial opossums in America has been thought by some writers to imply an early connection between that continent and Australia; but the fact that opossums existed in Europe in Eocene and Miocene times, and that no trace of them has been found in North or South America before the Post-Pliocene period, renders it almost certain that they entered America from Europe or North Asia in middle or late tertiary times, and have flourished there in consequence of the less severe competition with more highly developed forms of life.

The birds of Australia and South America only exhibit a few cases of very remote and general affinity, which is best explained by the preservation in each country of once wide-spread types, but is quite inconsistent with the theory of a direct union between the two countries during Tertiary times.

Reptiles are even more destitute of proofs of any such connection than even mammalia or birds; but in amphibia, fresh-water fishes, and insects the case is different, all these classes furnishing examples of the same families or genera inhabiting the temperate parts of both continents. But the fact that such cases are confined to these three groups and to plants, is the strongest possible proof that they are not due to land-connection; for all these organisms may be transmitted across the ocean in various ways. Violent storms of wind, floating ice, driftwood, and aquatic birds, are all known to be effective means for the distribution of these animals or their ova, and the seeds of plants. All of them too, it must be noted, are to a considerable degree patient of cold; the reverse being the case with true reptiles and land-birds which are essentially heat-loving; so that the whole body of facts seems to point rather to an extension of the Antarctic lands and islands reducing the width of open sea, than to any former union, or even

close approximation of the Australian and South American continents.

Summary and Conclusion.

Let us now briefly review the conclusions at which we have arrived. If we could look back to remote Tertiary times, we should probably find that all our great continents and oceans were then in existence, and even bore a general resemblance to the forms and outlines now so familiar to us. But in many details, and especially in their amount of communication with each other, we should observe important changes. The first thing we should notice would be a more complete separation of the northern and the southern continents. Now, there is only one completely detached southern land—Australia; but at that period Africa and South America were also vast islands or archipelagos, completely separated from their sister continents. Examining them more closely, we should observe that the great Euro-Asiatic continent had a considerable extension to the south-east, over what are now the shallow seas of Japan, China and Java. In the south-west it would include Northern Africa, the Mediterranean then forming two inland seas; while to the west and north-west it would include the British Isles, and perhaps extend even to Iceland and Greenland. As a balance to these extensions, much of Northern Siberia and North-Western Asia may have been under water; the peninsula of India would be an island with a considerable south-west extension over what are now the Laccadive and Maldivé coral-reefs. The Himalayas would be a moderate range of hills, the great desert plateau of Central Asia a fertile plain, the greater part of the continent would enjoy a tropical or sub-tropical climate, while even the extreme north would support a luxuriant vegetation. This great continent would abound in animal life, and would be especially remarkable for its mammalia, which would comprise ancestral forms of all our existing higher types, along with a number of those lower grades of organisation (such as lemurs and opossums) now found chiefly in the southern hemisphere.

Connected with this continent by what is now Behring Straits and the Sea of Kamschatka, we should find North America, perhaps somewhat diminished in the east, but more extensive in the south and north, and abounding as now with great inland lakes which were situated to the west of the present lake district. This continent seems to have had a less tropical climate and vegetation than

prevailed in the eastern hemisphere, but it supported an almost equally varied though very distinct fauna. Ancestral horses no larger than dogs, huge tapir-like and pig-like animals, strange forms allied to rhinoceroses, the Dinocerata—huge horned animals allied to elephants and to generalised Ungulata, and the Tillodontia, still more unlike anything now living, since they combined characters now found separated in the carnivora, the Ungulata, and the rodents. Ancestral Primates, allied to both the lemurs and the South American monkeys, also inhabited this continent.

The great land masses of the northern hemisphere thus appear to have possessed between them all the higher types of animal life; and some of these seem to have been developed for a time in one continent, and then to have been transferred by migration to the other, where alone they have continued to maintain themselves. Thus the elephants and the camels appear to be descended from what were once exclusively American types, while the opossums were as certainly European. Many groups, however, never passed from the continent in which they originated—the civets, hyænas, and giraffes being wholly eastern, while the Oreodontidæ and Brontotheridæ were no less exclusively western.

South America seems to have been united to the northern continent once at least in Secondary or early Tertiary times, since it was inhabited in the Eocene period by many forms of mammalia, such as rodents, felines, and some ancient forms of Ungulata. It must also have possessed the ancestors of the Edentata (though they have not yet been discovered), or we should not find such a variety of strange and gigantic forms of this order in later Tertiary deposits in this part of the world only. During the greater part of the Tertiary period, therefore, South America must have been separated from the North, and thus protected from incursions of higher forms of mammalia which were there so abundant. Thus only does it seem possible to understand the unchecked development of so many large but comparatively helpless animals as the Edentata of the Pampas and the Brazilian caves—a development only comparable with that of the Australian marsupials, still more completely shut off from all competition with higher forms of life.

In Africa the evidence of a long period of insulation is somewhat more complex and less easily apparent, but, it seems to me, equally conclusive. We have, first, the remarkable fauna of Madagascar, in which lemurs and insectivora predominate, with a few low forms of carnivora, but none of the higher animals, such as apes, antelopes, buffaloes, giraffes, rhinoceroses, elephants, lions, leopards,

and hyenas, which swarm on the continent. The separation of Madagascar from Africa must therefore have occurred before these important groups existed there. Now, we know that all these large animals lived in Europe and Asia during late Miocene times, while lemurs are only known there during the Eocene period, and were probably even more abundant in late Secondary times. It is almost certain, therefore, that Southern Africa must have been cut off from Europe and Asia during the whole intervening period, or the same development of high forms and extinction of low would have gone on in the one country as in the other. The persistence of a number of low and isolated types in South and West Africa, which are probably a remnant of the ancient fauna of the country, is also favourable to this view.* At the time we are considering, therefore, we must look upon tropical and South Africa, with Madagascar, as forming a completely isolated land or archipelago, while the Seychelles and Chagos banks, with Bourbon and Mauritius, perhaps, formed another island or group permanently separated from the larger masses. The extra-tropical portion of South Africa was also probably more extensive, affording an area in which its remarkable flora was being developed.

Turning to Australia, we should probably find it, at this remote period, more extensive than it is now, including in its area New Guinea and some of the adjacent islands, as well as Tasmania; while another extensive land may have occupied the site of the New Zealand group. It may be considered certain that, whatever elevations and subsidences these countries have undergone, they have not been connected either with Asia, Africa, or South America during the whole Tertiary period.

In conclusion, I would especially remark, that the various changes in the outlines and mutual relations of our continents, which I have now endeavoured to establish, must not be supposed to have been all strictly contemporaneous. Some may have been a little earlier or a little later than others; some changes may have been slower,

* These peculiar forms are, in West Africa, *Perodicticus* and *Arctocebus*, peculiar genera of Lemuridæ—*Potamogale*, an aquatic form of Insectivora—*Poiana* and *Nandinia* (Viverridæ), and *Anomalurus* (Sciuridæ). In South Africa, the Chrysochloridæ or golden moles, most of the Macroscelididæ or elephant-shrews, 3 genera of Viverridæ (*Ariela*, *Cynictis*, and *Suricata*), *Proteles* forming the family Protelidæ, *Hydrogale* one of the Mustelidæ; *Dendromys*, *Malacothrix*, and *Mystromys* (Muridæ); *Bathyerges* and *Heleophobius* (Spalacidæ)—*Pedetes*, or the Cape hare (Dipodidæ); *Petromys* (Echimidæ); and a species of *Orycteropus* (Orycteropodidæ).

others more rapid; some may have had but a short duration, while others may have persisted through considerable geological periods. But, notwithstanding this uncertainty as to details, the great features of the geographical revolutions which I have indicated appear to be established by a mass of concurring evidence; and the lesson they teach us is, that although almost the whole of what is now dry land has undoubtedly once lain deep beneath the waters of the ocean, yet such changes on a great scale are excessively slow and gradual; so that, when compared with the highest estimates of the antiquity of the human race, or even with that of most of the higher animals, our existing continents and oceans may be looked upon as permanent features of the earth's surface.

The PRESIDENT said the Society might be congratulated on having heard in a compendious form, the principal results of the great work of Mr. Wallace on the distribution of animals throughout the globe. The views which had been expressed had been arrived at after a long and active life devoted to this branch of science. They showed how wide-reaching was the study of physical geography, to which the three lectures they had heard this Session had been devoted. The questions discussed by Mr. Wallace were so original and profound, and embraced such a variety of facts, that they must be content to recommend them to the serious consideration of the scientific world, and therefore they would very shortly be published in the 'Proceedings' of the Society. He was quite sure that all who had heard the lecture and felt its comprehensiveness, would be glad to have an opportunity of reading at their leisure the vast variety of facts that had been brought under their notice. There could be only one opinion as to the lecture being a very fitting continuation of those which had preceded it. It was the last of the series for the Session, and he trusted that the Society would feel that they had thoroughly realised the object that the Council had in view in instituting them. Want of time had prevented Mr. Wallace attempting to deal with the flora, but he had shown what an interdependence there was between the physical conditions of the earth and the distribution of animal life, and it was impossible to notice how peculiar that distribution was, without desiring to know something of the causes which had led to it. In order at all to comprehend the great physical problems that Mr. Wallace had dealt with, it was necessary to refer back to fossil and extinct life, as well as to the present distribution. Why should the camel and the date-palm be so especially distinctive of Arabia and Syria? Why should the elephant, tiger, and deadly cobra always be associated in the mind with India? Why should the lion, the giraffe, the antelope and the ostrich (although there were ostriches in America) be regarded as the types of animal life in Africa? So with regard to the country in which His Majesty must take the deepest interest: why was Brazil associated in the mind with the sloth, the humming-bird, the toucan, and many of the most beautiful developments of nature, both in animals and birds, which were not found in other parts of America? So with regard to Australia, which suggested the kangaroo and the gum-tree. Why should there be these distinctive types and these great peculiarities attached to particular parts of the world? Mr. Wallace had shown that in distant geological periods the present continents and islands were not continents and islands; for instance, there was undoubted evidence from fossils that Siberia and all the north-west of Asia

once enjoyed a tropical or subtropical climate, where the magnolia and all the great specimens of tropical life were abundant, though now the country consisted of sterile steppes and deserts. Mr. Wallace had shown considerable reason for believing that India was at one time, what probably many persons would be relieved to know it was now, isolated by an ocean that ran round it to the north as well as to the south; and that a portion of Arabia must at one period have been deep under the ocean. Italy and Greece, too, were once connected with Africa, as Spain undoubtedly was, while the Mediterranean formed two basins instead of one large sea. A good deal had been heard lately of an ingenious French engineer's idea for bringing the Sahara into the Atlantic basin, and exchanging a sterile desert for a deep navigable sea. There was very little doubt that at all events southern Africa was once entirely isolated from the north. These were very interesting facts, showing the strict interdependence between the geographical changes which took place long before man appeared upon the scene, and the distribution of life. Originally geography took very little account of the earth, except as it was the habitation of the human race; but even that led to inquiries as to why there were such different types of men, and those inquiries led deeper into questions of geology. Such considerations involved attention to a vast mass of facts, and geography, which dealt only with the surface of the earth, was but a very small part of the whole question. Facts must be co-ordinated which were not merely derived from the surface but from fossil remains. If a rhinoceros was found embedded high on the Thibetan ranges, it showed conclusively that that which was now covered with snow and ice must at one time have had a tropical temperature. All these things revealed by geology taught that the earth was not now what it was many unknown ages ago, but that it had undergone gradual changes. It perhaps was some consolation to know that these changes had been very slow in their progress. It was pretty evident from what Mr. Wallace had so well pointed out, that the earth was at present very much what it was as regards oceans and continents many millions of years ago. He was glad that the meeting had been honoured with the presence of the sovereign who stood at the head of the list of the Society's honorary members. The Emperor of Brazil had also honoured them the last time he was in England, and he had always been a very loyal and faithful member of the Geographical Society, and had given many evidences of the interest he continually took in the progress of science. No doubt His Majesty would be glad to see that endeavours were being made to extend the Society's work, and at the same time to give it a thoroughly scientific character. In conclusion he proposed a vote of thanks to Mr. Wallace for the intellectual treat he had afforded them.

The PRESIDENT then announced that the Meetings were adjourned until next Session, in November.