

The Geographical Distribution of Mammals.

A LECTURE, Delivered in the Hulme Town Hall, Manchester, on Wednesday, November 25th, 1874.

By P. L. SCLATER, Esq., M.A., F.R.S.,

Secretary to the Zoological Society of London.

ANIMALS and plants of various sorts and kinds are found all over the surface of the globe which we inhabit, from the poles to the equator, and from the lowest valleys to far above the snow-limit of the highest mountains. The rivers, lakes, and oceans that cover a large portion of the earth's surface are likewise replete with life. Recent discoveries have shown that even the profoundest depths of the Atlantic, formerly supposed to be utterly void of organic life, are tenanted by numerous forms of living beings. Now, these multitudes of plants and animals are not scattered broadcast over the earth's surface, as the casual observer might suppose; nor do they vary according to the modifications of climate or of any other set of external circumstances, as an unlearned person might well imagine. But they are distributed strictly according to certain natural laws, concerning our present knowledge of which—more especially as regards one class of animals, that of Mammals—I have to speak to you on the present occasion.

Before, however, I begin to treat of the geographical distribution of Mammals specially, I must say a few words as to what we know generally of the manner in which living organisms, whether plants or animals, are arranged over the world which we inhabit.

Let us take two distant parts of the world—England and New South Wales for example, and study their natural productions respectively. The “Fauna” and “Flora,” as the sums of the animal and vegetable life are called, of these two countries, when compared together, are found to be almost entirely different. On

examining the indigenous animals and plants found in the vicinity of London, and comparing them with those observed in the neighbourhood of Sydney, or of any other part of Australia, the naturalist will find them to be utterly dissimilar. Instead of foxes and hares, the woods are tenanted by kangaroos. In place of squirrels, opossums climb about the trees. Instead of sparrows and thrushes, parrots and honeyeaters abound. So likewise the snakes, frogs, insects, snails, and plants met with during a walk in the Australian bush would be quite different from the corresponding objects met with in the neighbourhood of this city. But let our roving naturalist shift his quarters from Australia half-way home towards England, and make a similar investigation in the neighbourhood of Calcutta. Here in India he will still find the animals and plants very different from those of his native shores, although not so different as those of Sydney. If he approaches still nearer—say to Egypt, there will be a much greater resemblance between the two floras and faunas; and finally, when he reaches Paris, the animal and vegetable productions, when compared with those of Middlesex, will be found to be almost, although not quite, identical.

But it will be said that these variations in animal and vegetable life may be attributable to climate. That this, however, is not the case, is at once shown by the comparison of the natural products of far-distant places of which the climate is as nearly as possible similar. Take, for example, three spots under the equator—in America, Africa, and Asia. Their faunas and floras will be found to be completely different; so much so, that a single insect, a single bird, or a single plant, out of a collection made in one of them, would usually enable the naturalist to say at a glance from which of the three spots it had been procured. Again, take the two polar extremities of the earth, of which the climates are nearly similar. Their natural products are utterly different. At the North Pole we meet with ice-bears, seals, and awks; at the South Pole, sea-lions, sea-leopards, and penguins. It is, therefore, manifest, and has been clearly shown by naturalists, that differences in the animals and plants of different countries cannot be accounted for by climate. At the same time, there can be no question that certain groups of animals specially affect particular climates, and are only found where these prevail.

The process of comparison of the organic beings of far and near countries may be (and has been) carried on to any extent, and the result arrived at has been the discovery of the following general

law—which, however, like most general laws, admits of exceptions : *That the more distant countries are, the more dissimilar are their animals and plants ; and the nearer they are, the more similar are their animals and plants.*

So certain, indeed, has the law been found to be of adjoining countries producing similar or nearly similar animals and plants, that the converse of this proposition is now generally accepted by naturalists—namely, *that if the animals and plants of two countries are alike, they must either now be or recently have been in geographical connection.*

I will point out a few instances on the map of the way in which this argument has been used.

(1) The Antilles, or West India Islands, have in many respects a peculiar fauna ; that is, contain a certain number of animals not known to occur elsewhere. But in Trinidad—the most remote of them—these animals do not occur, but another set, the same as those of Venezuela, are found. It is therefore evident, if the last proposition put before you be true, that Trinidad is merely a little bit of the South American continent, broken off at a comparatively recent epoch. And this, I believe, has also been shown to be the case from an examination of its geological structure.

(2) In the same way we know that the animals and plants of the British Islands are identical, or very nearly so, with those of the rest of Northern Europe. And we conclude therefore, as is likewise manifest from geological investigations, that the Straits of Dover are of comparatively recent formation.

(3) A third well-known instance is afforded by the islands of Sumatra, Java, and Borneo. Java is much nearer to Sumatra than Borneo. But the animals of Sumatra and Borneo are very nearly alike, whereas those of Java are in many cases different. It has been argued, therefore, and will no doubt be ultimately found to have been the case, that Sumatra has been joined to Borneo more recently than to Java.

But in comparing the animals and plants of two countries, it is not only necessary to ascertain, in such cases as these and others, merely whether they agree or differ—we must know exactly how far and to what degree they are like or unlike. To this end it is necessary to understand the mode of estimation of the similarities of animals (for we will in future speak only of animals, although plants follow nearly the same laws) which is usually employed by Naturalists.

The aggregation of all the similar individuals of any one animal

that now live, or that have recently lived in the world, is called a "species." Thus, when we speak of "The Lion," or *Felis leo*—as a scientific naturalist would call it—we understand by that term, not one particular lion, but all the lions that have lately lived, or now do live, on the earth's surface, or lion-kind in general, just as by the term mankind we mean men (and women) in general.

The lion (*Felis leo*) has a particular structure, shape, and colour, which distinguish it from all other kinds of cats, and, indeed, from all other known animals. This particular structure, shape, and colour, constitute what are called its "specific" characters, or marks by which any lion may be distinguished from a tiger, or a leopard, or any other animal. But, besides these specific characters, the species lion (*Felis leo*) possesses another important attribute, namely, that of being found in a natural state only within a certain limited part of the world's surface. Over this district are distributed, in greater or less numbers, the various individuals which together make up the whole species. And this district is called the "range," "habitat," or "specific area" of the lion (*Felis leo*).

The existing "specific area" of the lion (*Felis leo*) comprehends Africa and South-western Asia up to Central India. I say *existing*, because we know that the areas of many animals have been materially altered, even during the historic period. Thus, the lion occurred in South-eastern Europe in the days of the Persian invasion, and in preceding geological epochs was abundant all over the continent, and even in England itself.

But although the lion and all other animals, especially the larger forms, which are least easily reconciled with man's presence, are continually altering their ranges or specific areas, this alteration is a slow, in many instances secular, process; so that for all practical purposes the "range" or "specific area" of an animal may be considered, like the rest of its specific characters, to be constant.

Let us now take other species of the larger and better-known cats:—

The tiger (*F. tigris*): Southern and Central Asia.

The wild-cat (*F. catus*): Northern and Central Europe.

The cheetah (*F. jubata*): Africa and S.W. Asia.

The serval (*Felis serval*): Africa.

The puma (*F. concolor*): Central and South America.

The jaguar (*F. onca*): Central and South America.

The pampas cat (*F. passerum*): pampas of South America.

Each species, it will be observed, has a distinct and definite

“range,” “habitat,” or “specific area,” and a naturalist would no more believe in a lion being found in America or a puma in Africa than in monkeys existing in the middle of the ocean or fishes on dry land.

Some of the species, you will remark, have a large range, some a small range, and such is the case throughout the animal kingdom. Some species are so widely distributed as to be almost cosmopolitan. But this is not often the case among mammals, except in the cases of such semi-domestic animals as the common rat and house-mouse; whereas among birds there are several instances, such as the osprey, peregrine-falcon, and sanderling, of almost universal distribution. On the other hand, many mammals are very local in their distribution, and confined to an extremely limited portion of the earth's surface. For example, the greater number of the species of lemurs are found only in certain parts in the Island of Madagascar: the moufflon sheep is met with only in Corsica and Sardinia; and the duckbill or ornithorhynchus is confined to the fresh waters of the colony of New South Wales. Amongst birds we have instances of still more restricted specific areas as in the case of the Pichincha and Chimborazo humming-birds, which are only found on the two mountains after which they are respectively named.

But to return to the various kinds of cats of which I was just now speaking. These, and the other known species of cats, make up altogether the genus *Felis* or cat, *genus* being the technical term used to denote an assemblage of nearly-allied species which have certain common structural characters. The genus *Felis*, then, comprehends all the different known kinds of cats, and is distinguished from all other genera of Carnivorous Mammals by a peculiar structure (arrangement of teeth, limbs, and internal organs), which structure is alike in all species of *Felis* or cat, but is not found in other Mammals. Now, just as we found in the case of each species of *Felis*, so in like manner the genus *Felis*, as a whole, has a certain definite range over the earth's surface, which is called its “generic area.” This area is made up of the sum of the specific areas of the various species which make up the genus, and within it alone the various species are met with. These “generic areas,” like “specific ones,” may be large or small. In the particular case of *Felis* or the cat-genus, the area is large, embracing nearly the whole world, except Australia and Madagascar. But in other cases, as we shall presently see, it is small. For example, the true kangaroos (genus *Macropus*) are confined to Australia; the tree-kangaroos (*Dendrolagus*) to New Guinea; the lemurs

(*Lemur*) to Madagascar ; the marmosets (*Hapale*) and the squirrel-monkeys (*Saimaris*) to certain portions of tropical America.

Proceeding a step higher in the usual plan of classification, we find nearly-allied genera united together into larger groups called "families." Thus, the cat family (or *Felidæ* of scientific naturalists) comprehends the genus *Felis* and other genera allied to it ; the dog family (*Canidæ*), the genus *Canis*, or dog, and other dog-like animals ; the bear family (*Ursidæ*), the genus *Ursus*, or bear, and other genera allied thereto. Just as is the case with genera or groups of species, each family or group of genera occupies a certain definite geographical area on the world's surface, which may be called the family area, and is made up of the area of the genera which compose the family.

It should not be forgotten to mention that the areas of the different species of the same genus frequently overlap one another, as also the generic areas of the same family. Likewise that when, in certain cases, the species is of itself the only one of its genus, the specific and generic areas are of course identical ; and that, even in some cases where the form is of such peculiarity as to constitute a family of itself, the specific, generic, and family areas may be all the same.

When we come to divisions higher than families, the same rule of localisation, or restriction to a definite area, prevails. But in the case of the higher groups the area occupied is usually larger, and in some cases cosmopolitan. Thus, the order of bats, or *Chiroptera*, may be termed cosmopolitan, since bats are found in every part of the world except the polar regions. But of the two great divisions of this order, the insectivorous bats only are cosmopolitan, the frugivorous bats being entirely absent in the New World.

Again, the carnivora are universally distributed, except in Australia : the insectivora range over the whole world, except Australia and South America ; the marsupialia, on the contrary, are only to be met with in Australia and in the New World.

It is not necessary to pursue this particular branch of the subject further, but we may sum up the results arrived at in the following propositions :—

Every species occupies a definite area on the world's surface ; and in like manner every genus and family, or other higher assemblage of species, occupies a definite area on the earth's surface ; or, more shortly, locality or existence in a certain spot is quite as much an attribute of animals as structure or the possession of a certain form or shape.

We must now proceed to consider a further point in the distribution of animals, which is, however, to a certain extent involved in what has gone before, that is, that the areas occupied by natural groups of animals, whether these are species genera or families, are or formerly have been continuous. By the term "continuous" we mean that they do not contain two different parts of the earth's surface without extending over the intermediate space. This statement, however, must be taken with a certain degree of restriction. Animals are in many cases attached to certain descriptions of country. Some are entirely arboreal in their habits, others aquatic; some are only found in open prairies, others in sandy deserts. The sloth, for example, passes his whole life in trees in dense forests—we do not expect to find him in the intermediate open pampas. Larks and chats are desert-haunting forms, which will certainly not be found in the intervening woods.

The "continuity" of an animal's area must not therefore be considered to be interrupted by its non-occurrence in a district not suited to its habits. As a general rule, however, it may be undoubtedly stated that a specific generic or family area is continuous, or that if such be not the case we can show (or *ought* to be able to show) some good reason why it is not continuous. There are certainly exceptional cases, in which a gap of greater or less size is found. But it is the very unfrequency of these exceptions, and the trouble taken by naturalists to investigate them and to discover some explanation of how they have come to pass, that proves the stringency of the general rule.

When we come to genera and higher divisions, the exceptions to the present continuity of these natural groups are much more striking and obvious. For example, it may be said monkeys are found in the tropics of Asia, Africa, and America. They constitute, without doubt, a natural group; but how can it be said that their area is continuous? To this it must be answered that the area of the order Quadrumana is certainly *not* continuous in the present condition of the earth's surface. But if certain theories of naturalists (which I shall more particularise by-and-bye), are correct, we must hold that monkeys and all other natural groups originated in one area, although subsequent alterations of land and water may have taken place and broken up this area. When geologists have put together the fragments they are now engaged in collecting of the former history of our globe, they will, no doubt, come to a solution of this and many other at present almost inexplicable phenomena. For the present, we must be content

to take a little on trust, and to assume, as a general rule, that—*Specific generic and other areas occupied by natural groups are, or have been originally, continuous.*

Having now considered some of the principal facts and laws of distribution in general, we come to the part of this great and important subject immediately before us, namely, the geographical distribution of mammals.

Mammals constitute the first and highest class of vertebrated animals. They are of special interest to us, as, whatever views we may hold as to the moral and spiritual nature of man and as to his origin, there can be no doubt that, considered as regards his bodily structure, he must be classified simply as a mammal, not very far removed in all essential points from some of the higher monkeys.

Mammals are divided by naturalists into about fourteen large groups, called "orders." As regards their distribution, however, these orders fall into two very different categories, according as they live on land or in the water—terrestrial and marine. For out of the fourteen orders, one of the principal divisions of the Carnivora—the Pinnipeds or seals, and two other orders in their entirety—the Cetacea or whales, and the Sirenia or herbivorous whales, are specially adapted for existence in water. Land is, therefore, a barrier to their extension, whereas, on the contrary, in the case of the ordinary terrestrial mammals, land is the means by which they extend their range, and ocean and rivers form their restraining boundaries.

We will for the present put aside the marine mammals, and address ourselves to the discussion of the distribution of the twelve terrestrial groups, namely :

- | | |
|-----------------|------------------|
| 1. Quadrumana. | 7. Proboscidea. |
| 2. Lemures. | 8. Hyraces. |
| 3. Chiroptera. | 9. Ungulata. |
| 4. Insectivora. | 10. Edentata. |
| 5. Carnivora. | 11. Marsupialia. |
| 6. Rodentia. | 12. Monotremata. |

But before we enter upon this, a few words may properly be said as to the general area of the earth's surface occupied to a greater or lesser extent by mammals generally. On the great continents of the old and new worlds mammals are everywhere to be met with, except on the tops of the highest mountains. We have not yet penetrated quite to the North Pole, so it is impossible to say whether that may prove to be an exception. But there is no reason

o

to suppose this, because at the highest northern latitudes to which man has yet penetrated, mammal-life has been found to be abundant. In the extreme north of Smith's Sound, in northern Greenland, in latitude $81^{\circ} 38'$, where the "Polaris" wintered in 1871-2, Captain Hall tells us that in the month of June "the plain was free from snow, and a creeping herbage covered the ground, on which numerous herds of musk-oxen found pasture, and rabbits and lemmings abounded." In the newly-discovered Franz-Joseph's Land, also, bears were found; and whales and seals occur abundantly in the highest latitudes yet visited.

In the case of the South Pole circumstances are very different, the complete isolation of the south-polar land having prevented the introduction of mammals, although birds and other forms of life are by no means absent.

The more remote oceanic islands in the Pacific and elsewhere are likewise mainly devoid of mammal-life, except such as is of a domestic nature, and the rats and mice which follow wherever civilised life penetrates. New Zealand also may be almost placed in this category, being, as regards mammals, only tenanted by two small species of insectivorous bats. There is indeed a vague tradition of a "native rat," but I have never heard of an actual specimen having been obtained. Our newly-acquired colony—the Fiji Islands—is, I believe, still worse off, only a single bat being known to occur there; and such is the case with most other islands removed from continents. But mammal-life extends throughout the chain of the West India Islands, and those of the East India Archipelago which connect Asia with Australia. Madagascar is also, as I shall presently point out to you, the seat of numerous and very peculiar forms of mammals.

Generally, therefore, it may be stated that terrestrial mammals are found all over the land-area of our earth, with the exception of the smaller oceanic islands far removed from any continent, and from the lowest plains and seaboard up to the perpetual snow-limit of the highest mountains.

We will now proceed to consider *after what manner* terrestrial mammals are distributed over the above-mentioned area, and what are the principal laws which seem to regulate this distribution.

Before we do this, however, I must call your attention to the fact that, general laws being only to be gathered from particulars, an exact knowledge of the range or area of every mammal should be obtained before we attempt to settle positively the general laws of distribution. Now this exact knowledge we are at present far

from possessing. In the first place knowledge of geographical distribution must be preceded by a perfect knowledge of classification. We must know what an animal really *is*, and what are its differences from allied forms, before its locality and range can become of any real value. To take the case of any island or other district of which it is required to ascertain the general character of the animal and vegetable life, every plant and every animal should be collected, examined, and determined before this problem can be satisfactorily answered, and even a few errors may be of serious importance. Now our knowledge of classification is at present very imperfect, even in the case of mammals, which have been more closely studied, and are, perhaps, better known to us than any other class of animals. It follows that our knowledge of their distribution is also by no means complete; in fact, the subject is nearly a new one, and, I may almost say, that it is only amongst the most advanced and enlightened students of nature that its true importance is even now appreciated. "Locality," which, as I have just pointed out, is quite as much an attribute of organised being as structure, has, until these last few years, been comparatively overlooked. Even in the best arranged public museums it is not uncommon to see gross errors in the localities affixed to specimens, or such vague indications as serve to give nothing but the most general idea of where the animal is to be found in its native state. And the same is the case, I regret to say, in many of the most common textbooks of Natural History—*e.g.*, "East Indies," "West Indies," "South Sea Islands," and such like, are localities often employed, which are utterly valueless for scientific purposes.

I repeat, therefore, that to trace out the general laws of distribution, we must have an exact knowledge of its particular facts. To discover the general laws of the distribution of mammals, we must first know the distribution of every species of mammal exactly. Not only do we not yet know this, but we are not yet acquainted with all the species of mammals, even in the case of the most conspicuous and most important groups. Within these last few years most important additions have been made to the list of known mammals, such as new tapir and a new rhinoceros, new deer, and new forms among the larger carnivora and quadrumana. *Tapirus bairdi* of Central America, *Rhinoceros lasiotis* of Chittagong, *Cervus alfredi* of the Philippine Islands, *Æluropus melanoleucus* of Chinese Thibet, and *Rhinopithecus roxellana* of the same district, are examples of such discoveries.

Again, errors in distribution and wrong deductions are often

caused by false classification. If an animal really belonging to one natural family is wrongly referred to another, a serious error in the range assigned to each group is likely to follow. For example, it was until lately supposed that, as regards the *Viverridæ* or civet-family of the carnivora, there was a singular anomaly in the fact that they were all confined to the Old World except a single genus (*Bassaris*) which occurs in Mexico. But Professor Flower has recently shown that *Bassaris* belongs really to the *Procyonidæ* or racoon family of the New World; so that this apparent anomaly has no real existence.

Again, the musk-deer (*Moschidæ*) have been supposed until lately to be distributed over India and Africa. But it has now been shown by Alphonse Milne-Edwards that the supposed Indian and African members of the group constitute a very different family of the Ungulata—the Chevrotains or Tragulidæ. The musk-deer, therefore, now consists only of a single form (*Moschus*), of Central Asia. This is another instance of how much our knowledge of distribution depends on classification.

I have said thus much by way of caution before entering upon the next branch of my subject, which is—taking the facts as regards the distribution of terrestrial mammals, so far as they are known to us, as our guide—how the world may be best divided into zoological regions.

This problem is, of course, only a subordinate part of a much larger one, namely, how the earth may be most naturally divided to correspond with the distribution of the whole of organic life—that is, all the animals and plants known to exist on it. To solve this larger problem, the range and distribution of every group of terrestrial animals and plants must be separately discussed and carefully investigated. That is, we should require to know the exact distribution of each of such groups, as—

- | | |
|------------------------|-----------------------------|
| 1. Mammals. | 6. Land-shells. |
| 2. Birds. | 7. Insects. |
| 3. Reptiles. | 8. Fresh-water Crustaceans. |
| 4. Batrachians. | 9. Plants, &c. |
| 5. Fresh-water Fishes. | |

Now, if there is still so much wanting to be known, even in the much-studied class of mammals, before we can attain a complete knowledge of their distribution, you may judge what an enormous number of facts have still to be ascertained before the whole subject of the general distribution of animal and vegetable life can be completely investigated.

At the same time, we must recollect that nature is, above all things, harmonious. Her laws cannot be discordant, though our interpretation of them may seem to indicate a want of harmony. If, therefore, we can correctly interpret the known facts of the geographical distribution of mammals, and deduce certain laws from them, we may be sure that these deductions will be ultimately reconcilable with what is discovered upon the examination of other classes of animals and plants—due allowance being made for the various peculiarities of each class.

So much being premised on both sides of the question, we will now proceed to discuss the problem—

Given the facts of the distribution of terrestrial mammals so far as they are known to us, how to divide the land surface of the globe into its most natural divisions.

The ordinary geographer's division of Europe, Asia, Africa, America, and Australia may be easily shown to be incorrect, and will not answer for naturalists. In the first place, Europe is but a mere fragment of Northern Asia, and belongs to the same division zoologically. Again, Africa north of the Atlas is peopled by the same forms as inhabit the northern shores of the Mediterranean; whereas the animals of the great mass of that continent are wholly distinct. Moreover, as can be easily shown, a considerable part of the land north of the isthmus of Panama belongs zoologically to South America.

Let us, therefore, cast geographers' notions aside for a minute, and begin at the other end. The twelve orders of terrestrial mammals are, according to the best authorities, arrangeable under three very distinct heads—

- I. Monotremes, or Ornithodelphs.
- II. Marsupials, or Didelphs.
- III. Typical mammals, or Monodelphs.

Now, when we come to examine the distribution of these three groups on the map, we shall find that the Monotremes are wholly confined to Australia; that the Marsupials predominate in Australia, and are only met with elsewhere in South America (one or two species of opossum (*Didelphys*) occur in North America, but are probably only recent intruders from the south); and that the main part of the typical mammals is distributed over the rest of the world.

Again, after examining the distribution of the ten orders of typical mammals, we remark the following significant facts:—

- I. The absence of insectivora in South America.

2. The prevalence of Edentata in the same country; the sloths, armadilloes, and ant-eaters, three out of the five known families of this Order, being entirely confined to South and Central America.

Taking these main facts, we may divide our earth, as follows, into four divisions:—

- I. Land where monodelphs only occur; no marsupials nor monotremes { Europe, Asia, Africa, Asiatic Islands down to Wallace's Line, and North America down to the Isthmus of Tehuantepec.

Arctogæa—North-land.

- II. Land where monodelphs and marsupials occur; no monotremes { America, south of the Isthmus of Tehuantepec.

Dendrogæa—Tree-land.

- III. Land where marsupials prevail; no other monodelphs but rodents and bats; monotremes { Australia.

Antarctogæa—South-land.

- IV. Land without mammals (except bats). { New Zealand and Pacific Islands.

Ornithogæa—Bird-land.

The fault of this division is that it leaves the great mass of land in the northern hemisphere undivided and rather unmanageable. But this *Arctogæa* or northern land is easily separable into four sections, although it must be understood that these sections are not really equivalent in value to the two remaining undivided primary divisions. Thus leaving out the fourth primary division, where no mammals are found, we obtain a division of the land-area of the globe for mammals into six areas, which may be called REGIONS, and defined and named as follows:—

- | | | | | |
|---|-----------|---|---|------------------------------|
| { | ARCTOGÆA. | I. Europe: Africa north of Atlas: and Northern Asia. | { | <i>I. Palæarctic Region.</i> |
| | | II. Africa, south of Atlas, and Madagascar. | | <i>II. Ethiopian Region.</i> |
| | | III. S. Asia, Philippines and Islands of Indian Archipelago down to Wallace's line. | | <i>III. Indian Region.</i> |
| | | IV. N. America, down to Isthmus of Tehuantepec. | | <i>IV. Nearctic Region.</i> |

DENDROGÆA.	V. Central America, south of the Isthmus of Tehuantepec, and South America.	V. <i>Neotropical Region.</i>
ANTARCTOGÆA.	VI. Australia, N. Guinea, and islands up to Wallace's line.	VI. <i>Australian Region.</i>

We will now take a brief survey of the principal features of these six regions—as shown in the accompanying chart—and their most characteristic mammal-forms.

1.—PALÆARCTIC REGION.

Name.—*παλαιὸς* ancient, and *ἄρκτος* north, as embracing the whole northern area of the old world.

Boundaries.—Land north of a line south of the Atlas, and running eastward through south of Palestine and Persia, along the Himalayas, through Central Asia and the centre of China to the Pacific.

Characteristics.—Absence of monkeys, lemurs, and frugivorous bats; abundance of *Carnivores*—ounce, lynx, wolves, foxes, bears, weasels, glutton; *Rodents*—marmots, beavers, pikas; no elephants nor hyrax: *Ungulates*—sheep, deer, chamois, and musk-deer.

2.—ETHIOPIAN REGION.

Name.—*Ἰθίοπες*, ancient name for negroes.

Boundaries.—Africa, south of the Atlas; probably Arabia up to Persian Gulf, and Madagascar.

Characteristics.—Chimpanzee and other monkeys: no bears; lion; African elephant; hyrax; rhinoceros; hippopotamus; warthog—numerous antelopes, but no deer; giraffe; manis; ant-bear—generally rich in large and highly-organised mammals.

2A.—LEMURIAN SUB-REGION.

Name.—Derived from *Lemur*, the prevalent type.

Boundaries.—Madagascar and Mascarene Islands.

Characteristics.—Home of the lemurs, few being found elsewhere; absence of cats and ruminants; tenrecs.

3.—INDIAN REGION.

Boundaries.—Southern Asia, south of the Palæarctic Region, and Islands of Indian Archipelago, down to Wallace's line.

Characteristics.—Orang and other peculiar monkeys; flying-lemur; tiger, leopard, and other cats; Indian elephant; rhinoceros; Malayan tapir; manis.

Generally it may be said that peculiar groups are fewer than in the Ethiopian region, and that the Indian has bear, deer, and tapir, which are wanting in the latter.

4.—NEARCTIC REGION.

Name.—*νέος* new and *ἀρκτος*, *i.e.*, northern district of New World.

Boundaries.—America, down to Isthmus of Tehuantepec.

Characteristics.—General mammal-fauna very like that of the Palæarctic region, and probably of recent origin from the west. Bears, beavers, sheep, and deer similar; prong-buck, pouched mice and musquash peculiar; racoon and opossum, probably derived from the south.

5.—NEOTROPICAL REGION.

Name.—*νέος* new and *τροπικος*, *i.e.*, southern land of the New World.

Boundaries.—America, south of Isthmus of Tehuantepec.

Characteristics.—Monkeys of the family Cebidæ and Hapalidæ; absence of frugivorous bats, and presence of vampires; abundance of porcupine family; absence of insectivores and civets; also of elephants; tapirs; no ruminants except deer and lamas; sloths, ant-eaters, and armadilloes; opossums.

5a.—ANTILLEAN SUB-REGION.

Mammals few but several peculiar: *Solenodon*, *Capromys*, and *Plagiodontia*.

6.—AUSTRALIAN REGION.

Boundaries.—Australia, New Guinea, and Moluccas, up to Wallace's line.

Characteristics.—Absence of monodelphic mammals, except a few rodents and bats; presence of six distinct families of Marsupials with 100 species, and the only two known Monotremes.

I have now put before you (or endeavoured to do so), a few of the principal known facts relating to the geographical distribution of terrestrial mammals. I have also shown you how the present land surface of the globe may be approximately divided into

zoological regions, so far as regards its mammals. We now come to the question, *What* is the meaning of all this? *Why* are animals distributed in the way in which we find them to be? *Why* has each country its particular set of animals, and *why* are species and other natural aggregations of animals confined to particular areas? To these important questions two very different answers have been given. The one view—that of Agassiz and his school, though not even by them carried out, I believe, to its utmost extremity—maintains that species are invariable; they were created, or came into being, in and over the area in which we now find them existing. The other—that of Darwin and his followers—maintains that species are ever slowly varying, that they are related by natural descent to each other, and that the present animal population of the earth is simply the modified offspring of what has been there ever since the beginning of time.

Now as regards the phenomena of distribution—if they are to be allowed any weight in the matter—there can be no question, I think, on which side of the balance they must be placed. Under the former hypothesis it may still be an interesting question to work out the area of every species, and the range of every natural group, but no sort of answer is given to the intelligent inquirer who demands why are these things so? We must simply reply because they *are*, and have been made so, and there is nothing more to be said on the subject.

On the other hand, if we adopt the Darwinian hypothesis of the derivative origin of species as a working principle, we shall find it a key which will unlock nearly all the most perplexing phenomena of distribution. For example, it explains why the individuals of each species are confined to a certain definite locality. They are simply the remote descendants of pre-existing species which occupied the same or a nearly contiguous area. Why do we so often find cases of “representative species,” as they are termed, or of a series of different species taking each others places in adjoining areas, and evidently fulfilling corresponding functions in the system of nature? They are simply children of the same parents who have migrated from a common centre. Why are the animals of two distant parts of the world almost entirely different? Because of the length of time which it has taken their ancestors to travel from the common point of origin. Why are the animals of two near countries almost always identical? Because they have not yet had time to acquire differences. The philosophic view of *species*, and that which is now adopted by all our leading and most thinking naturalists, is, that

so far from being fixed in their characters, they are *ever slowly changing*. If we take any particular animal that has a wide range, we shall find that specimens obtained from the extreme parts of its area are almost always sufficiently different to be recognised on comparison. We know that Great Britain has not long been separated from the rest of Europe—that is, not long geographically speaking—and yet we find that many of our common birds have acquired certain peculiarities, even to such an extent as to cause them to be regarded by some naturalists as belonging to different species.

Now let us suppose an island occupied by a species of animal and in which individuals from the two extremities of the island already present appreciable differences. The island becomes divided by a broad channel into two islands. The two forms can no longer interbreed, and thus delay the rate of variation. On the contrary, the variation is intensified by those possessing the same peculiarities breeding *inter se*, and two “*representative species*” quickly result. There are numberless cases in the West India Islands, the Moluccas, the Pacific Islands, and all over the world, in fact, in which specific differences may have arisen in this way.

But the same result may take place, and does continually take place, on continents, without the intervention of aquatic disturbances. The area in the middle of the range of a species becomes deserted from some cause, and the result is the growth of an allied representative species in each of the two divided areas. There can be no doubt that the origin of numerous species has taken place somewhat after this fashion. In short, by the aid of the theory of the gradual variation of species, we can explain *most* of the phenomena of distribution; taking the opposite view—that of the fixity of species—we can explain *none* of them.

Let us now, therefore, assume the derivative origin of species: let us take for granted that the greater or less resemblances of animals are simply a manifestation of their farther or nearer relationship by descent. Now, let us again look at the leading features of the general distribution of terrestrial mammal-life over the earth, which I have already set before you, and see whether we can make out at all how they have come about.

Australia (or *Antarctogæa*) is the most unlike all other countries in its mammal life; it has therefore been isolated the longest period. The probability is, indeed, that the few non-marsupial forms met with in it (bats, rodents, and the native dog) are all comparatively of recent introduction, and that its original mammal-

life consisted entirely of marsupials and monotremes. In the earlier part of what is called the secondary epoch of geologists, the only existing form of mammal-life was marsupial, and marsupials then existed in this country, and probably all over the land area of the earth. In those days Australia was joined to the then Arctic continent: since then it has remained separate, and has for some reasons, at present unknown to us, retained its marsupial features of mammal-life, which have perished or become superseded by higher forms in the rest of the world.

Again, we see that after Australia the Neotropical Region (*Dendrogæa*) presents the most strongly marked features of individuality as regards its mammals. Observe its strange forms of edentates, and its peculiar group of marsupials. There can be no doubt, therefore, that the Neotropical Region, or the greater part of it, was until recently, and for a long period, separated from the northern portion of the New World, to which it is now joined, and that it contains land that was formerly part of the great "*terra marsupialium*," since we find marsupials still lingering there.

More recently it has been united to North America, and has received a certain number of immigrants from the north, such as *Ursus*, *Mustela* and *Lutra*, and has parted with one or two opossums, which have intruded themselves into the Nearctic Region.

The higher or Monodelphic type of mammal life must have originated in a great tertiary continent, situate somewhere in the northern hemisphere, whence it has diffused itself into every part of Arctogæa, perhaps exterminating the marsupials, which prevailed there before it. Of the constituent regions of Arctogæa, as I have arranged them, the Ethiopian and its Lemurian neighbour appear to have been first separated off, since they possess most individuality. The Nearctic region possesses a few peculiar types (such as *Antilocapra*, *Condylura*, and the *Sacomylidæ*, and was probably separated and again rejoined, when it was overrun by Palæarctic forms.

But I must cease my speculations, which can be deemed little more than conjectures, until we know much more than has been yet ascertained of the geological structure of the globe, as well as of the animals that now inhabit it and have inhabited it in former ages. I trust, however, that the facts I have put before you, and the deductions I have endeavoured to draw from them, may have induced some of you to take more interest in that somewhat neglected branch of Biology—the geographical distribution of plants and animals.