

**PROCEEDINGS OF THE BIOLOGICAL
SOCIETY OF WASHINGTON, VOL. VII, PP.
1-64, APRIL 13, 1892:
THE GEOGRAPHIC DISTRIBUTION OF LIFE
IN NORTH AMERICA: WITH SPECIAL
REFERENCE TO THE MAMMALIA**

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* Annual Presidential Address, delivered at the Twelfth Anniversary Meeting of the Biological Society of Washington, February 6, 1892.

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INTRODUCTORY REMARKS.

Nine years ago the Biological Society listened to an address from its distinguished retiring President, Professor Gill, on "The Principles of Zoogeography," or the science of the geographical distribution of animals.* Professor Gill assembled the oceans of the globe, as well as the land areas, into primary divisions or

*Proc. Biological Society of Washington, vol. II, 1884, 1-39.

'zoological realms,' of which he recognized 9 for the land and 5 for the sea. It is not my purpose to discuss the zoological regions of the whole world, but to lay before you some of the facts concerned in the distribution of terrestrial animals and plants in North America with special reference to the number and boundaries of the sub-regions and minor life areas, and to touch upon the causes that have operated in their production.

No phenomenon in the whole realm of nature forced itself earlier upon the notice of man than certain facts of geographic distribution. The daily search for food, the first and principal occupation of savage man, directed his attention to the unequal distribution of animals and plants. He not only noticed that certain kinds were found in rivers, ponds, or the sea, and others on land, and that some terrestrial kinds were never seen except in forests, while others were as exclusively restricted to open prairies, but he observed further, when his excursions were extended to more distant localities or from the valleys and plains to the summits of neighboring mountains, that unfamiliar fruits and insects and birds and mammals were met with, while those he formerly knew disappeared.

Thus primeval man, and in truth the ancestors of primeval man, learned by observation the great fact of geographic distribution, the fact that particular kinds of animals and plants are not uniformly diffused over the earth, but are restricted to more or less circumscribed areas.

It will be observed that two classes of cases are here referred to, namely, (1) cases in which in the same general region certain species are restricted to swamps or lowlands, while others are confined to dense forests or rocky hillsides—differences of *station*, and (2) cases in which, regardless of *local peculiarities*, a general change takes place in the fauna and flora in passing from one region to another, or from low valleys or plains to high mountains—*geographic* differences. The latter class only is here considered.

Every intelligent schoolboy knows that elephants, lions, giraffes and chimpanzees inhabit Africa; that oranges and flying lemurs live in Borneo; kangaroos in Australia; the apteryx in New Zealand; the Royal Bengal tiger in India; llamas, chinchillas and sloths in South America; the yak in the high table lands of Thibet, and so on. In accordance with these facts naturalists long ago began to divide the surface of the globe into

zoological and botanical regions irrespective of the long recognized geographic and political divisions.* It was found that different degrees of relationship exist between the indigenous animals and plants of different countries, and that as a rule the more remote and isolated the region and the earlier in geologic time its separation took place, the more distinct were its inhabitants from those of other regions. Each of the larger islands lying near the equator and the continental masses of the southern hemisphere were found to possess not only peculiar species and genera, but even families and orders not found elsewhere; and it was discovered that insular areas of considerable magnitude that have had no land connection with other areas since very early times possess faunas and floras remarkable for the antiquity of their dominant types. In Australia, the most disconnected of all the continents, the entire mammalian fauna, though wonderfully diversified in appearance and habits, belongs to the primitive orders of monotremes and marsupials, whose best known representatives are the duck-billed platypus and the kangaroo. In the latter group Australia and neighboring islands contain no less than six families not found in any other part of the world.

Madagascar is the exclusive home of the remarkable aye-aye (*Chiromys*) and *Cryptoprocta*, the latter believed to be intermediate between the cats and civets.

Tropical America is alone in the possession of true ant-eaters (*Myrmecophagidae*), sloths (*Bradypodidae*), marmosets (*Hapalidae*), armadillos (*Dasypodidae*) and agouties (*Dasyproctidae*).

Africa is the home of many groups not known elsewhere. Among them are the giraffe, hippopotamus, *Orycteropus*, elephant shrews (*Macroscelididae*), *Potomogale*, and *Chrysochloridae*.

Besides this class of cases, in which particular groups are restricted to particular countries, there is another class, in which the living representatives of single groups exist in isolated colonies in widely separated parts of the world. Illustrations of this kind are furnished by the tapirs, which inhabit tropical America and the Malay Peninsula, but do not exist in intermediate lands; by the family *Camelidae*, represented in South America by the llamas and in parts of Eurasia by the true camels; and by a group

*Among the many distinguished naturalists who have contributed to the literature of the subject may be mentioned Humboldt, Bonpland, Buffon, De Candolle, Schouw, Engler, Agassiz, Baird, Asa Gray, Grisebach, Huxley, Gill, Allen, Wallace, and Packard.

of insectivorous mammals in which all the genera but one are restricted to Madagascar, the one exception (*Solenodon*) living in Cuba and Haiti. Examples of this sort are known as cases of *discontinuous* distribution, and indicate that the ancestors of the animals in question formerly inhabited a vast extent of country; that some sort of land connection, however indirect, existed between the colonies now so widely separated, and that the surviving descendants of these groups are probably approaching extinction.

The examples thus far cited relate to the disconnected land areas in the neighborhood of the equator or in the southern hemisphere, and their explanation is to be sought in the history of the past. In the northern hemisphere animals and plants in general have a much more extended distribution than in the southern, the majority of the larger groups being common to North America, Europe, and Asia, and the limits of their distribution are encountered in traveling in a north and south direction and are evidently the result of causes now in operation. It is to this class of cases as presented on the North American continent that your attention is invited this evening.

In passing from the tropics to the Arctic pole on the eastern side of America a number of distinct zones are crossed, the most conspicuous features of which are well known. In the plant world the palms, mangroves, mahogany, mastic, Jamaica dogwood, and cassias of the tropical coast districts are succeeded by the magnolias, pawpaws, sweet-gums, hackberries, and persimmons of the Southern States. These give place gradually to the oaks, chestnuts, and hickories of the Middle States, and the latter to the groves of aspen, maple, and beech which reach the southern edge of the great coniferous forest of the north—a forest of spruces and firs that stretches completely across the continent from Labrador to Alaska. Beyond this forest is a treeless expanse whose distant shores are bathed in the icy waters of the Arctic Ocean.

Concurrently with these changes in vegetation from the south northward occur equally marked differences in the mammals, birds, reptiles, and insects. Among mammals the tapirs, monkeys, armadillos, nasuas, peccaries, and opossums of Central America and Mexico are replaced to the northward by woodrats, marmots, chipmunks, foxes, rabbits, short-tailed field-mice of several genera, shrews, wild-cats, lynxes, short-tailed porcu-

pinos, elk, moose, reindeer, sables, fishers, wolverines, lemmings, musk oxen, and polar bears.

The trogons, saw-bills, parrots, cotingas and other birds of tropical America give place in turn to the cardinals, blue grosbeaks, mocking birds, tufted tits, and gnatcatchers of the Southern States; the chewink, indigo bird, tanager, bluebird, and robin of the Middle and Northern States; the Canada jays, crossbills, white-throated sparrows, and hawk owls of the northern coniferous forests, and the ptarmigans, snowy owls, and snowflakes of the Arctic circle.

HISTORICAL SYNOPSIS OF FAUNAL AND FLORAL DIVISIONS PROPOSED FOR NORTH AMERICA.

The recognition of the above-mentioned facts early led to attempts to divide the surface of the land into faunal and floral regions or zones, and no less than 56 authors have proposed such divisions for North America. Of these, 31 were zoologists and 25 botanists. Of the zoologists, 10 aimed to show the distribution of animals in general, 8 of birds, 4 of terrestrial mollusks, 3 of mammals, 1 of reptiles and batrachians, and 4 of insects. Of the botanists, 22 aimed to show the distribution of plants in general and 3 of forest trees.

Of the writers who attempted to indicate the life areas of the New World prior to 1850, 68 percent were botanists, while during the next twenty years (1850-1870), 65 percent were zoologists. This striking oscillation of the biologic pendulum, first toward botany and then toward zoology, may be attributed in part at least to the influence of two great minds—Humboldt and Agassiz. Humboldt laid the corner-stone of the philosophic study of plant geography in 1805. Stimulated by his example and writings, botanists led the way and were almost the only occupants of the field until the middle of the present century, when the influence of the elder Agassiz gained the ascendancy and the botanists were replaced by zoologists, who have been in the lead ever since.

The accompanying table shows the various authors referred to, the dates of the earliest publication of their divisions, the branch of biology on which their conclusions were based, and states whether or not their articles were accompanied by maps.