# Article XIV.—THE GEOGRAPHICAL DISTRIBUTION OF NORTH AMERICAN MAMMALS.[1]

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(*With Four Maps, forming Plates V–VIII.*)

## INFLUENCES DETERMINING THE GEOGRAPHICAL DISTRIBUTION OF LIFE.

It has long been recognized that the influences determining the distribution of life over the earth's surface are climate and the interrelation of the principal land areas. It is questionable which of the two, all things considered, has been the more important factor in bringing about the present distribution of life, since the climate of any given area depends largely upon the relative distribution of land and water, and is further greatly modified by the topography of the principal land areas, the presence or absence of lofty mountain chains greatly modifying the climate of an entire continent.

CLIMATE.—Of strictly climatic influences, temperature is by far the most important, although moisture plays an influential part. Where a low temperature prevails life, both animal and vegetable, is represented by comparatively few forms; under a high temperature it is characterized by great diversity and luxuriance. Within the Arctic Circle the species of both plants and animals are not only few but they are widely distributed, being for the most part everywhere the same. Under the tropics they are a hundred fold more numerous and of comparatively restricted distribution, the general facies, as regards both the fauna and the flora, changing within short distances, with few elements in common when widely separated areas are compared.

The influence of temperature is perhaps most strikingly displayed in the distribution of life upon the slopes of a high mountain, especially if situated near the tropics. While its base may be clothed with palms and luxuriant tropical vegetation its sum-

[1] Read before the New York Academy of Sciences, January 26, 1891. In revising for publication some new matter has been added, chiefly in the last third of the paper and in the footnotes.

mit may be snow-capped and barren, or scantily covered with only a small variety of hardy alpine shrubs and plants. The animal life becomes likewise correspondingly changed, tropical forms of mammals, birds and insects of the lower slopes gradually giving place to such as are characteristic of arctic latitudes.[1]

The influence of moisture is most strikingly shown in the distribution of forest trees, where on the same continent, under corresponding parallels of latitude, and at nearly the same elevation, the country may be either heavily or only sparsely wooded, or even wholly devoid of a forest growth, in accordance with the abundance or scarcity of the rain-fall. We may thus have, on the same continent, immense areas of forest alternating with vast stretches of open prairies and plains, or even almost verdureless deserts. The effect of humidity upon plant life is thus obvious; but it is equally potent, though less evident, upon animal life. Many animals—mammals and birds as well as insects—are so fitted for a forest life, as regards both food and shelter, that their very existence depends upon such surroundings. Others are equally specially adapted for life on the open plains, or even in arid deserts. Thus moisture alone may determine the character of life over extensive regions, regardless of temperature, which under ordinary conditions is the ascendant controlling influence.

Interrelation of Land Areas.—The relation of the principal land areas to each other, in respect to continuity on the one hand and isolation on the other, is coëval and perhaps more than coördinate with climate in its influence upon the distribution of life, as it is also in the evolution of life. Palæontology teaches us that the present characteristics of the faunas and floras of the principal land areas are the results of a long period of evolution, during which there have been no very sudden transitions, but, in general, a gradual development from ancestral forms having about the same geographical distribution as their descendents. While some of the continents have unquestionably derived part of their life from neighboring continents, and islands from the mainland to which they are contiguous, these

[1] An excellent illustration of the influence of temperature upon the distribution of life on mountain slopes is afforded by Dr. C. Hart Merriam's thorough survey of the San Francisco Mountain region in Arizona, the life-zones of which he has defined and illustrated in detail. (See N. Am. Fauna, No. 3, Sept., 1890, pp. 5-20, pll. 1, 2, and maps 1-4.)

migrations are in the main of great antiquity, dating back at least nearly to the Miocene. At that early time, and also previously, there was not only a greater uniformity of climate, but a more uniform distribution of life. With the coming in of the Glacial Period a great change was wrought in respect to both, and the former equilibrium in neither has been restored. While it would lead me too far from the subject especially in hand to discuss at any length the probable geographical origin of the leading types of even the present mammalian life of North America, it seems well to recall, in the present connection, certain facts of general import. In the first place, the so-called Old World is admittedly the most advanced and the most specialized of the several continents, as regards both its physical features and its biology; and that probably many of its present leading types of mammalian life are of American origin; that North America is behind Eurasia in development, and South America behind North America; and that in reality Australia is the old continent in the sense of being behind all the others in its development, and thus the lowest, the least specialized, the most primitive.

In regard to the present distribution of the mammals of North America and their faunal relationship to the mammalia of the rest of the world, it is important to recall the present close proximity of North America at the northward to the northern portion of the Old World. Alaska is separated from Siberia by a shallow strait of less than forty miles in width, while in Tertiary times it is supposed they may have been united. Three-fourths of the land area is not only situated north of the equator, but is mainly massed about the northern pole, the only extensive stretch of sea being the few hundred miles between Iceland and Norway. If now we bear in mind the close similarity in climate and general physical conditions of the northern half of the northern hemisphere, its comparatively low temperature and meagre fauna and flora as compared with the tropics, and that continuity of land area tends to uniformity of life, and divergence and isolation tend to diversity of life, and increase of temperature to abundance and variety, the generalizations about to follow respecting the life regions of North America will, I trust, be recognized as resting on a sound basis.

## Importance of Mammals as a Basis for the Classification of Life Areas.

First, however, a word in reference to the class Mammalia as a basis for the distribution of the earth's surface into ontological divisions. On this point I cannot do better than to summarize the argument made by Mr. A. R. Wallace in his great work on 'The Geographical Distribution of Animals,' simply premising that his presentation of the case has my hearty approval.

The mammalia, he affirms, are pre-eminently of the greatest importance in determining zoölogical regions. Their dispersal is less dependent on fortuitous circumstances than that of the representatives of other classes; from their high organization they are less dependent upon other groups of animals, and have so much power of adaptation that they are able to exist in one form or another over the whole globe, as is certainly not the case with two of the lower classes of vertebrates, the reptilia and amphibia. Their distribution and dispersal are dependent on the distribution of the land areas, and are modified by such physical conditions as mountain barriers, areas of forest, and grassy or desert plateaus. Furthermore, their geological history, as well as their geographical range, is better known than that of most other classes, and there is also a greater unanimity of opinion respecting their natural affinities and the limitation of families and genera. "We should therefore," says Mr. Wallace, "construct our typical or standard Zoölogical Regions in the first place, from a consideration of the distribution of mammalia, only bringing to our aid the distribution of other groups to determine doubtful points. Regions so established will be most closely in accordance with these long-enduring features of physical geography, on which the distribution of all forms of life fundamentally depend; and all discrepancies in the distribution of other classes of animals must be capable of being explained, either by their exceptional means of dispersion or by special conditions affecting their perpetuation and increase in each locality. If these considerations are well founded, the objections of those who study insects or molluscs, for example,—that our regions are not true for their departments of nature—cannot be maintained. For they will find, that a careful consideration of the exceptional means of dispersal and conditions of existence of each

group, will explain most of the divergences from the normal distribution of higher animals."[1]

While the divisions of North America, as set forth in the present paper, are presented from the standpoint of mammals, it may be premised that many of them were first outlined on the basis of the distribution of birds, and that they have been found equally applicable to reptiles and bratracians, and also in a measure to insects and plants.[2]

## Systematic Classification of Life Areas.

In zoö-geography it is customary to recognize faunal areas belonging to several different categories, as regards their grade and extent, just as in zoölogy we divide animals into classes, orders, families, genera, and species. Unfortunately, however, the terms employed for their designation have not been used with the same precision as in zoölogical terminology. Identical terms have sometimes been used in diametrically opposite senses, in accordance with each writer's individual preferences, regardless of their prior use in a different sense by other authors. In view of this unfortunate state of affairs I attempted, in a paper on the distribution of North American birds, published in 1871,[3] to devise a system of terms that, while appropriate, should at the same time be in as close conformity as possible with current usage. Previously the terms *zone*, *realm*, *region*, *kingdom*, *province*, and even *fauna*, had been used more or less interchangeably for even the primary subdivisions, while some of these terms were also frequently employed in a narrower and more special sense. The scheme then proposed is as follows:

| | | | |
|---|---|---|---|
| For divisions of the | first | rank ..... | *Realm.* |
| " " | second | " ..... | *Region.* |
| " " | third | " ..... | *Province.* |
| " " | fourth | " ..... | *Subprovince or District.* |
| " " | fifth | " ..... | *Fauna, Flora.* |

[1] Geogr. Dist. Anim., Vol. I, pp. 56–58.

[2] Since this was written Dr. C. Hart Merriam, in his admirable presidential address, entitled 'The Geographic Distribution of Life in North America with Special Reference to the Mammalia,' read before the Biological Society of Washington, February 6, 1892 (Proc. Biol. Soc. Wash., Vol. VII, April, 1892, pp. 1–64), has given a 'Historical Synopsis of Faunal and Floral Divisions Proposed for North America' (l. c., pp. 6–21) which may be profitably consulted in the present connection.

[3] On the Mammals and Winter Birds of East Florida, with....a Sketch of the Bird Faunæ of Eastern North America. Bull. Mus. Comp. Zoöl., Vol. II, No. 3, April, 1871.

Their grade and order of sequence may be indicated by a comparison with the leading groups in zoölogy: thus *realm* would correspond in rank with *class; region* with *order; province* with *family; district* with *genus;* and *fauna* (or *flora*, as the case may be) with *species.* It sometimes becomes convenient, as we shall see later, to recognize other divisions intermediate to those above named—as in zoölogy we have suborder, subfamily, subgenus, etc., so we may have here subregions, subprovinces, and even subfaunæ. There may also be a subdivision of a continental or other large area into zones.

Temperate North America forms a *region* of the *North Temperate Realm*, and includes two *subregions*, one of which is divisible into two *provinces;* each *province* is separable into two *subprovinces* and these again into several lesser well-marked areas termed *faunæ*, as will be presently shown in detail. Realms are sometimes characterized by the presence of certain orders, commonly by the presence of certain families, which give to the region a particular impress, and by the absence of others which in a similar way characterize other realms. Regions are usually characterized by the prevalence over them of certain genera, or even by entire families; provinces by the presence or absence of prominent generic types. Faunæ, on the other hand, are seldom characterized by the presence or absence of particular genera or species but by the association, through the overlapping of their habitats, of a number of genera and species not elsewhere found together.

The transition between faunæ, between provinces, or between adjoining divisions of any grade is rarely abrupt; it is impossible to draw a hard-and-fast line between any of them; yet in a general way they may be limited with considerable definiteness. They depend upon climatic conditions, which, in a measure, are determined or modified by features of topography. They are of course limited and determined by the same conditions that govern the distribution of species. Hence we can seldom bound our faunal areas by geographical meridians or by parallels of latitude, and very rarely are they found to agree with any political boundaries; they do, however, closely coincide with certain isothermal lines, which are generally those of the season of reproduction, or, in

the northern hemisphere, those for the months of May, June and July. As temperature is influenced by altitude as well as by latitude, elevated plateaus and mountain ranges deflect the isotherms in the northern hemisphere far to the southward of their position over the contiguous low country, and furnish congenial habitats for northern forms of life under comparatively low latitudes. Thus in eastern North America the Appalachian Highlands carry the fauna of northern New England southward along the higher parts of the Alleghanies as far as northern Georgia. In the Rocky Mountains boreal types extend far down into Mexico, and along the Cascade and Sierra Nevada chain to southern California, with insular patches of northern life on the summits of detached peaks and ranges throughout the Plateau and Great Basin regions of the West. There is thus an interdigitation of the northern and southern life areas throughout the middle and southern portions of the North American continent.

The life of the globe is everywhere closely linked together. While the relationship at the northward is obviously intimate, and while in general the life of the intertropical zone is very different from that of the arctic or even of the temperate zones, and that of tropical America is very unlike that of tropical Africa or India, yet certain types are common to the whole. For example, the Cat family is represented throughout all countries except Australia, but there is a great difference between the Cats of the colder zones and those of the equatorial regions; yet the genus *Felis*, taken in a broad sense, is almost cosmopolitan. The Dog family, embracing the Wolves and Foxes, has an even wider distribution. The family Mustelidæ, embracing the Otters, Badgers, Skunks, Sables, Weasels, Minks and Martens, is more restricted, some of its leading forms, however, having a much wider and a very different distribution from others. Thus the Otters (subfamily Lutrinæ) are nearly cosmopolitan, while the true fur-bearing animals (subfamily Mustelinæ) are distinctively northern and circumpolar; the Skunks (subfamily Mephitinæ), on the other hand, are exclusively American, and range over the temperate and tropical portions of both continents. The order Insectivora has no representatives in either South America or Australia; the Hedghogs, forming a family of the order, are exclusively an Old

World type; the Shrews, forming a second family, have a circumpolar distribution, the genus *Sorex* ranging on both continents from the Arctic regions to within the tropics. The Moles, forming a third family of this order, are confined to the north temperate latitudes, and are represented by different and peculiar genera in Europe, Asia, Africa and North America, and in the latter continent are confined mainly to the United States east of the Great Plains. Among Rodentia the genus *Sciurus*, consisting of the true or arboreal Squirrels, the genus *Sciuropterus*, or the Flying Squirrels, and the genus *Lepus*, embracing the Hares and Rabbits, are other examples of wide-ranging genera, the arboreal Squirrels and the Hares occurring everywhere except in Australia, although both are sparingly represented in America south of the Isthmus of Panama, beyond which the Flying Squirrels wholly cease to exist. But the species are generally of local distribution, and to some extent different styles of Squirrels and Hares characterize different areas of the common habitat of the group. Northern North America has several genera of Field Mice which are also common to the northern parts of the Old World, but the great bulk of our native Rats and Mice belong to genera peculiar to America. Also our Jumping Mouse, the numerous species of Kangaroo Rats and Pocket Mice, all the Pocket Gophers and the Prairie Dogs are distinctively North American.

These few illustrations, from the many that might be given, will serve to indicate, in a general way, the basis on which the life areas of North America, and of the world at large, are founded.

## Primary Life Regions.

Seven primary life regions, speaking of the world as a whole, may be recognized, as follows:

1. An *Arctic Realm*, occupying the region north of the isotherm of 32° F., its southern boundary conforming very closely to the northern limit of trees. Its more characteristic terrestrial forms of both animal and vegetable life range nearly throughout its extent. It is thus so homogeneous in its ontological characters as not to require subdivision into regions and provinces, though embracing several slightly-marked areas of the rank of faunæ.

2. A *North Temperate Realm*, embracing the whole of that portion of the northern hemisphere embraced between the annual isotherms of 32° and 70° F.

3. An *American Tropical Realm*, consisting, as the name implies, of tropical America.

4. An *Indo-African Realm*, consisting of Africa (except the northern border), and tropical Asia and its outlying tropical islands.

5. A *South American Temperate Realm*, embracing extra-tropical South America.

6. An *Australian Realm*, including not only the continent of Australia but New Guinea, New Zealand, and the various groups of islands to the northward and eastward.

7. A *Lemurian Realm*, consisting of Madagascar.

An eighth or *Antarctic Realm* is also often recognized. It is almost wholly oceanic, and its fauna hence consists almost exclusively of marine or pelagic species, and is of course the Antarctic counterpart of the Arctic Realm, though perhaps less well characterized.

## North Temperate Realm.

The North Temperate Realm is divisible primarily into two Regions, namely, (1) a *North American Region*, occupying the whole of North America from the beginning of forest vegetation southward to about the northern limit of palms, or the area between the annual isotherms of 32° and 70° F.; and (2) an *Eurasiatic Region*, consisting of the corresponding portion of the Old World.

This region, and the Old World in general, lying outside of the special scope of the present paper, we will now pass to a detailed consideration of the mammalian fauna of North America, and the principal faunal subdivisions of the North American Continent, their distinctive characteristics, their relation to each other, and to the Eurasiatic Region.

Attention has already been directed to the intimate geographic relation of northern North America to northern Eurasia, and the

## *Genera of Land Mammals of the North Temperate Realm.*

[NOTE.—The names of circumpolar genera are in *italics;* those of genera peculiar respectively to the North American and Eurasiatic Regions are in SMALL CAPS.]

| NORTH AMERICAN REGION. | | | EURASIATIC REGION. | | |
|---|---|---|---|---|---|
| Genera. | Subregions. Cold Temp. | Subregions. Warm Temp. | Genera. | Subregions. Cold Temp. | Subregions. Warm Temp. |
| Didelphys | — | + | Sus | + | + |
| Dicotyles | — | + | CAMELUS | — | + |
| Cariacus | — | + | MOSCHUS | + | + |
| *Cervus* | + | — | *Cervus* | + | + |
| *Alces* | + | — | *Alces* | + | — |
| *Rangifer* | + | — | *Rangifer* | + | — |
| ANTILOCAPRA | — | + | DAMA | — | + |
| *Bison* | + | + | CAPREOLUS | + | + |
| *Ovis* | + | — | ELAPHODUS | — | + |
| MAZAMA | + | — | HYDROPOTES | — | + |
| *Arctomys* | + | + | *Bison* | + | — |
| CYNOMYS | — | + | POËPHAGUS | — | + |
| *Tamias* | + | + | ADDAX | — | + |
| *Spermophilus* | + | + | Oryx | — | + |
| *Sciurus* | + | + | Gazella | — | + |
| *Sciuropterus* | + | + | SAIGA | — | + |
| APLODONTIA | + | — | PANTHOLOPS | — | + |
| *Castor* | + | + | RUPICAPRA | + | — |
| FIBER | + | + | BUDORCAS | — | +? |
| *Cuniculus* | + | — | Nemorhœdus | + | + |
| *Myodes* | + | — | Capra | + | + |
| SYNAPTOMYS | + | + | *Ovis* | + | + |
| *Evotomys* | + | — | Equus | — | + |
| *Arvicola* | + | + | *Castor* | + | — |
| PHENACOMYS | + | — | *Sciurus* | + | + |
| ONYCHOMYS | — | + | *Sciuropterus* | + | + |
| Sitomys | + | + | Pteromys | — | + |
| Reithrodontomys | — | + | *Tamias* | + | — |
| Sigmodon | — | + | *Spermophilus* | + | — |
| Oryzomys | — | + | *Arctomys* | + | — |
| Neotoma | — | + | MYOXUS | — | + |
| THOMOMYS | — | + | ELIOMYS | + | + |
| GEOMYS | — | + | MUSCARDINUS | — | + |
| PEROGNATHUS | — | + | Mus | + | + |
| MICRODIPODOPS | — | + | Gerbillus | + | + |
| DIPODOMYS | — | + | CRICETUS | + | + |
| PERODIPUS | — | + | Meriones | — | + |
| ZAPUS | + | + | SMINTHUS | + | — |
| ERETHIZON | + | — | *Arvicola* | + | + |
| *Lagomys* | + | — | *Evotomys* | + | — |
| *Lepus* | + | + | *Cuniculus* | + | — |
| ANTROZOUS | — | + | *Myodes* | + | — |
| *Vesperugo* | + | + | ELLOBIUS | + | — |
| NYCTICEJUS | — | + | SIPHNEUS | + | — |

| North American Region. | | | Eurasiatic Region. | | |
|---|---|---|---|---|---|
| Genera. | Subregions. Cold Temp. | Warm Temp. | Genera. | Subregions. Cold Temp. | Warm Temp. |
| Atalapha | + | + | Spalax | + | — |
| *Plecotus* | — | + | Rhizomys | — | + |
| *Vespertilio* | + | + | Dipus | — | + |
| Euderma | — | + | Alactaga | + | + |
| Molossus | — | + | Platycercomys | + | — |
| Nyctinomus | — | + | Hystrix | — | + |
| Otopterus | — | + | *Lagomys* | + | — |
| *Sorex* | + | + | *Lepus* | + | + |
| Notiosorex | ? | + | Rhinolophus | — | + |
| Blarina | — | + | Triænops | — | + |
| Scalops | — | + | Synotus | — | + |
| Scapanus | — | + | *Plecotus* | — | + |
| Condylura | + | + | *Vesperugo* | + | + |
| *Urotrichus* | — | + | Harpiocephalus | — | + |
| *Ursus* | + | + | *Vespertilio* | + | + |
| Procyon | + | + | Miniopterus | — | + |
| Bassariscus | — | + | Rhinopoma | — | + |
| *Lutra* | + | + | *Nyctinomus* | — | + |
| Mephitis | + | + | Erinaceus | + | + |
| Conepatus | — | + | *Sorex* | + | + |
| Spilogale | — | + | Crossopus | + | — |
| Taxidea | + | + | Crocidura | — | + |
| *Gulo* | + | — | Anusorex | — | + |
| *Lutreola* | + | + | Diplomesodon | — | + |
| *Putorius* | + | + | Chimarrogale | — | + |
| *Mustela* | + | — | Nectogale | — | + |
| Urocyon | — | + | Myogale | — | + |
| *Vulpes* | + | + | *Urotrichus* | — | + |
| *Canis* | + | + | Uropsilus | — | + |
| *Lynx* | + | + | Scaptonyx | — | + |
| *Felis* | — | + | Talpa | — | + |
| | | | Scaptochirus | — | + |
| | | | *Ursus* | + | + |
| | | | Æluropus | — | + |
| | | | Ælurus | — | + |
| | | | Meles | + | + |
| | | | Mellivora | — | + |
| | | | Arctonyx | — | + |
| | | | *Lutra* | + | + |
| | | | *Gulo* | + | — |
| | | | *Lutreola* | + | + |
| | | | *Putorius* | + | + |
| | | | *Mustela* | + | — |
| | | | Nyctereutes | — | + |
| | | | *Vulpes* | + | + |
| | | | Cyon | — | + |
| | | | *Canis* | + | + |
| | | | Hyæna | — | + |
| | | | Genetta | — | + |
| | | | Herpestes | — | + |
| | | | *Lynx* | + | + |
| | | | *Felis* | + | + |
| | | | Macacus | — | + |

similarity of the climatic conditions of the two regions; and to the corresponding similarity in their mammalian life, as well as of their general faunal and floral facies.

In this connection it will be instructive to compare somewhat in detail the land mammals of the North American and Eurasiatic Regions, that is, omitting the Seals and the Sea Otter. We will also exclude the strictly Arctic genera—*Ovibos* and *Thalassarctos*. With these restrictions we have 75 genera for the North American Region and 97 for the Eurasiatic Region. These are enumerated in the accompanying table, where they are divided into four categories, as follows: (1) North American, subdivided into (*a*) Cold Temperate, (*b*) Warm Temperate; (2) Eurasiatic, subdivided into (*a*) Cold Temperate, and (*b*) Warm Temperate. By the use of distinctive type, the circumpolar genera and the genera peculiar respectively to the two Regions are distinguished from those having a more or less wide distribution to the southward of the North Temperate Realm. (See pp. 208, 209.)

The total number of genera tabulated is 140, a number of genera which barely enter the southern portion of the area under consideration being excluded as not properly pertaining to it. Of these 140 genera 75 are found in North America and 97 in Eurasia, the Eurasiatic Region, as would be expected from its much larger and more diversified area, having considerably the larger number. Of these 32 are circumpolar, and thus are common to the two regions, while quite a number of others are closely-allied representative genera. Thus nearly one-half of the North American genera are either identical with or closely related to Eurasiatic genera, while only a little more than one-third of the total number are respectively peculiar to one or the other of the two regions, namely: for the North American 27 out of 75, and for the Eurasiatic 40 out of 97, or 67 out of a total of 140.

If we compare, however, the Cold Temperate Subregions of the two Regions we find that out of 43 genera characteristic of the Cold Temperate Subregion in North America 32, or about three-fourths, are circumpolar, and that of the 49 genera of the Cold Temperate Subregion of the Eurasiatic Region 32 are also of course circumpolar. We find further that in the North American Region 17 out of the 27 peculiar genera do not extend north of

the Warm Temperate Subregion; that 6 are common to both subregions, while 4 are peculiar to the Cold Temperate Subregion. Also that in the Eurasiatic Region 30 of the 40 peculiar genera are confined to the Warm Temperate Subregion, that 4 are common to both subregions, while 6 only are peculiar to the Cold Temperate. Consequently the peculiar genera of the two Cold Temperate Subregions, taken together, number only 10 out of a total of 140. This shows that the chief difference between the Eurasiatic and North American Regions is confined respectively to their warm temperate subdivisions, less than one-third of their peculiar or distinctive genera occurring in their cold temperate subdivisions. It is also of interest to note that the peculiar genera of the North American Region belong mainly to two or three families of Rodents—particularly the Heteromyidæ and the Geomyidæ—while many of the peculiar Eurasiatic genera belong to the Talpidæ, and in each case are restricted to comparatively limited areas.

## The Sclaterian System.

While these and similar facts have been given due weight by the majority of writers on zoö-geography, there has been one notable exception to which it may not be out of place in the present connection to pointedly call attention. In 1858 Dr. P. L. Sclater, the eminent ornithologist and Secretary of the London Zoölogical Society, published a memoir on the geographical distribution of birds, in which he divided the earth's surface into two primary and four secondary zoölogical regions nearly in accordance with the principal land areas. His two primary regions are equivalent respectively to the eastern and the western hemispheres; or the Old World, termed 'Palæogæa,' and the New World, termed 'Neogæa.' These primary areas were divided on the same principle into (1) a Palæarctic Region, (2) a Nearctic Region, (3) a Palæotropical Region, (4) a Neotropical Region; thus entirely ignoring the close similarity of life throughout the cold temperate and arctic regions of the globe. These divisions, as has been urged recently in their favor,[1] are *convenient* and *easy to remember*, since they are approximately equal in size, are easily defined, and

[1] Wallace, Geogr. Distrib. Anim., Vol. I, pp. 63, 64.

avoid complicated boundaries. The names chosen for them have a classical appearance, are euphonius, and hence captivating. Moreover, this scheme of classification was based on a class of animals respecting which the proposer of the scheme is recognized as an eminent authority. At this time, and even for many years later, there were few special students in the field of zoölogical geography. Hence it was natural that the classification here laid down should meet with wide acceptance, particularly among English writers. Later its fallacies were exposed, and even several eminent English naturalists proposed much more rational schemes—as Huxley on the basis of birds, Günther of the British Museum on the basis of reptiles, and Blyth on general grounds, etc. Yet in 1876, Mr. A. R. Wallace, in his very useful and in many ways admirable work on the 'Geographical Distribution of Animals,' gave new life to the scheme by adopting it as the basis of his own classification, and attempting its defense. We may recognize this as a system based on continental areas, regardless of the actual distribution of life; and also as the Sclaterian method, in opposition to nearly all other systems, whether of botanists or zoölogists, who in general recognize that the distribution of life is in accordance with the climatic zones, in virtue of climatic influences, which the Sclaterian school consider as superficial and misleading. Like so many other misnomers, the terms 'Palæarctic' and 'Nearctic,' 'Palæotropical' and 'Neotropical,' have apparently become ineradicable, their convenience for the designation of particular geographic areas contributing to their adoption even by authors who protest against their use in their original sense.[1]

[1] Dr. Packard, in writing of the 'American Arctic Province' in 1883, speaks emphatically on this point as follows: "We reject the term 'Nearctic' proposed by Mr. P. L. Sclater, and adopted by Mr. A. R. Wallace, for America north of Central America, for the reason that it seems to us an unnatural and artificial term. The fauna is essentially American north temperate, while the Arctic regions of America and Europe-Asia form a realm by itself, of much less importance, it is true, than the north temperate realm (American and Europæo-Asiatic regions), when we consider the land plants and animals, but of nearly as much importance as regards marine life. To apply the term *Neurctic* to so vast a region as the American involves the idea that the region covers an area essentially arctic in its features. It is to be hoped that the term will not be adopted by American writers, as it is not by German and French writers, and we heartily endorse Mr. J. A. Allen's protest against the use of the term by American writers on this subject. The circumpolar or Arctic realm is a realm by itself, limited by the low degree of temperature and mainly bounded by the isothermal of 32°, and the adoption of this term will conduce, it appears to us, to clearer and more concise ideas of the geographical distribution of life on our continent."—*Twelfth Ann. Rep. U. S. Geol. and Geog. Surv.* (*Hayden*), pt. I, p. 363.

## The Mammals of North America Considered in Relation to the North American Region and its Subdivisions.

Having now compared the North American Region with the Eurasiatic Region, we may proceed to an analysis of the North American Region itself. As shown by the table of distribution already given (pp. 208, 209), the North American Region is divisible into two Subregions, namely, a Cold Temperate and a Warm Temperate.[1] The most natural boundary for separating the two Subregions seems to be, in a general way, the northern limit of the successful cultivation of wheat, rye, barley, maize, peas, beans, hops, tobacco, potatoes and tomatoes, and the apple, peach and plum, or about the isotheral line of 65° F. This is approximately the boundary line separating the Alleghanian and Canadian Faunæ, as commonly recognized. The mammalian life of one of these two subregions differs vastly more from that of the other than does the mammalian life of the boreal parts of North America from that of the corresponding portions of Eurasia. The transition is, however, somewhat gradual. New elements appear near the southern boundary of the Cold Temperate, and increase in a rapidly progressive ratio as we proceed southward, while northern types fade out, and the general aspect eventually becomes radically changed.

The mammalian fauna of the Warm Temperate subdivision is found to consist of three pretty distinct elements: first, a generally diffused and more or less modified northern element, forming about one-fourth of the whole; second, a southern element, forming about another fourth; and third, an indigenous element, comprising about the remaining half. This of course is exclusive of the southward extension of purely northern forms along the various mountain ranges, which in a measure masks or obscures the general character of the fauna throughout the Rocky Mountain Plateau region.[2]

[1] These subdivisions were recognized by me in 1878, but rather informally, and chiefly in a tabular way. See Bull. U. S. Geol. and Geogr. Surv., IV, pp. 339–343, and *passim* in the text at p. 337.

[2] Dr. Merriam has already called attention to the mixed origin of the fauna and flora of the middle temperate portion of North America is his discussion of the fauna and flora of San Francisco Mountain and the Painted Desert in Arizona (North American Fauna, No. 3, Sept., 1890, pp. 20–22).

To review briefly the leading characteristics of the region south of about the latitude of the Great Lakes, as compared with the area to the northward, we have as new elements among the Carnivores the Panther or Mountain Lion, the Bay Lynx instead of the Canada Lynx, the Gray Fox, the little Kit Fox and the Prairie Wolf, the Black-footed Ferret, the Raccoon, and the whole Skunk tribe represented by two genera and numerous species. Among the Ruminants the Prong-horned Antelope and the Bison; while the Caribou and the Moose of the north are replaced by an entirely different genus of the Deer tribe, represented by three species. Among the Rodents, we have an entirely new set of both Squirrels and Hares, and a greatly increased number of species of each; many new Field Mice, a ten-fold increase in the ground Squirrels and Spermophiles; also entirely new and numerously represented genera among the Field Mice, and three new families of other rodents, including some 20 to 30 species of Pocket Gophers, Kangaroo Rats and Pocket Mice. Among the Insectivores, in place of the single genus of small Shrews characterizing the northern region, we have not only new species but additional genera, and also the whole family of Moles, comprising several genera. In Bats, in place of a few straggling species which barely reach the milder parts of the high north, we have a very great increase in the number of both genera and species. We have further in the Opossum a distinctly tropical type.

Passing now down to near the southern border of this region we find still fewer northern types, but meet in their place a decidedly tropical element. In Texas, and along our southern border thence westward, we have the Armadillo, the Peccary, the Coati, the so-called Texas Civet-cat or Cacomistle, the Jaguar, the Ocelot, and leaf-nosed and big-eared Bats of several genera. Although the width of the continent along the 60th parallel is three times as great as it is along the 30th parallel, the number of species of mammals is probably ten times greater along the 30th parallel than it is along the 60th, and the life, so far as mammals are concerned, has become almost entirely changed, under the influence of the greatly altered climatic conditions.

As shown by the table of distribution already given (pp. 208, 209), 14 genera occur in the Cold Temperate which do not range to any extent into the Warm Temperate, namely:

| | | |
|---|---|---|
| Cervus, | Aplodontia, | Erethizon, |
| Alces, | Cuniculus, | Lagomys, |
| Rangifer, | Myodes, | Gulo, |
| Mazama, | Phenacomys, | Mustela. |
| Ovis, | Evotomys, | |

On the other hand, 33 genera found in the Warm Temperate do not occur in the Cold Temperate, namely:

| | | |
|---|---|---|
| Didelphys, | Geomys, | Otopterus, |
| Dicotyles, | Perognathus, | Notiosorex, |
| Cariacus, | Microdipodops, | Blarina, |
| Antilocapra, | Dipodomys, | Scalops, |
| Cynomys, | Perodipus, | Scapanus, |
| Onychomys, | Antrozous, | Urotrichus, |
| Reithrodontomys, | Nycticejus, | Bassariscus, |
| Sigmodon, | Plecotus, | Conepatus, |
| Oryzomys, | Euderma, | Spilogale, |
| Neotoma, | Molossus, | Urocyon, |
| Thomonys, | Nyctinomus, | Felis. |

The remaining 27 genera are to a greater or less extent common to both the Cold Temperate and the Warm Temperate. These genera are as follows:

| | | |
|---|---|---|
| Bison, | Arvicola, | Procyon, |
| Arctomys, | Sitomys, | Lutra, |
| Tamias, | Lepus, | Mephitis, |
| Spermophilus, | Vesperugo, | Taxidea, |
| Sciurus, | Atalapha, | Lutreola, |
| Sciuropterus, | Vespertilio, | Putorius, |
| Castor, | Sorex, | Vulpes, |
| Fiber, | Condylura, | Canis, |
| Synaptomys, | Ursus, | Lynx. |

Hence while the two Subregions have much in common, and are thus thoroughly bound together, their differential elements are strongly marked. The 42 genera occurring in the Cold Temperate are either obviously of boreal origin, or find their nearest relationships with boreal types. Of the 62 genera occurring in the Warm Temperate Subregion, about 14 are wide ranging southern or subcosmopolitan types (some of them disappear before reaching the southern third of the subregion), 24 may be regarded as indigenous, and about 13 as of southern (tropical or subtropical) origin.

Continuing the analysis in further detail, we find that the following 28 genera of the North American Region are of either circumpolar or subcosmopolitan distribution and hence not distinctively North American, namely:

| | | |
|---|---|---|
| Cervus, | Castor, | Gulo, |
| Alces, | Evotomys, | Lutreola, |
| Rangifer, | Arvicola, | Putorius, |
| Bison, | Lagomys, | Mustela, |
| Ovis, | Lepus, | Vulpes, |
| Arctomys, | Vesperugo, | Canis, |
| Tamias, | Vespertilio, | Lynx, |
| Spermophilus, | Sorex, | Felis. |
| Sciurus, | Ursus, | |
| Sciuropterus, | Lutra, | |

Only the remaining genera can therefore be considered as distinctively North American. These may be divided, according to their distribution, as follows :

Of general distribution, and thus distinctive of the North American region as a whole rather than of any particular subdivision :

| | |
|---|---|
| Fiber, | Atalapha, |
| Synaptomys, | Mephitis, |
| Sitomys, | Taxidea. |
| Zapus, | |

They are not, however, all evenly distributed throughout the region, *Taxidea*, for example, being absent from the southeastern States, while some of the others do not apparently extend northward beyond the middle of the Cold Temperate Subregion. On the other hand, *Mazama*, *Aplodontia*, *Latax*, and the subgenus *Neürotrichus* are of such local and peculiar distribution as not to be diagnostic of any of the lesser divisions, the first two being mountain forms and another (*Latax*) strictly littoral. *Erethizon* and *Phenacomys* are distinctive of the northern subregion ; *Synaptomys* and the subgenus *Tamiasciurus* occupy a middle position, though mainly northern ; *Condylura*, though of more local distribution, is not distinctively either northern or southern.

The remaining genera (with their subgenera, which it will be convenient to use in the present connection) do not range north of the Warm Temperate Subregion, though some of them extend far beyond it to the southward. Of these the following range over the subregion at large, and are consequently distinctive of the Warm Temperate Subregion as a whole :

| | |
|---|---|
| Cariacus, | Scapanus, |
| Neotoma, | Urocyon. |
| Neosciurus, | |

The remaining genera and subgenera are of comparatively limited distribution, and may be conveniently divided into four categories. First, however, may be eliminated a number of intrusive southern forms which are properly tropical and extend only a short distance over the southern border of the Warm Temperate Subregion. These are *Tatusia*, *Dicotyles*, *Heteromys*, *Molossus*, *Nyctinomus*, and *Nasua*; the first and the last (*Tatusia* and *Nasua*), and perhaps also *Heteromys*, though occurring north of the Rio Grande on the coast of Texas, appear to be really confined to the narrow northward extension of the American Tropical Realm along the lower coast of Texas, and thus really form no part of the proper fauna of the Warm Temperate Subregion. The four categories into which the remaining genera and subgenera may be divided are (1) *northern*, (2) *southern*, (3) *eastern*, and (4) *western*. The first two include the few types that range nearly across the continent from ocean to ocean as follows:

1. *Northern.*—Taken in a strict sense, the northern half of the Warm Temperate, has not a single genus, among those peculiar to the region, which ranges across the continent. By taking into consideration wide-ranging types, which reach this region (mainly) from the northward, we have the following as coming into the present category, namely: *Tamias*, *Lutreola*, *Zapus* and *Putorius*. *Tamias* (subgenus *Eutamias*), however, extends far southward in the West.

2. *Southern.*—The genera and subgenera that fall strictly into this category are few, even if we include besides those peculiar to the region, also those barely entering the region from the southward, as follows:

| | | |
|---|---|---|
| Didelphys, | Sigmodon, | Otopterus, |
| Dicotyles, | Oryzomys, | Corynorhinus, |
| Reithrodontomys, | Nyctinomus, | Spilogale. |

Thus the northern and southern divisions of this subregion are distinguished mainly, so far as genera having a transcontinental distribution are concerned, by the presence of a number of types in the southern which do not reach the northern, only six of which, however, are strictly transcontinental.

3. *Eastern.*—The distinctively eastern genera and subgenera are the following:

| | |
|---|---|
| Neofiber, | Nycticejus, |
| Blarina, | Parasciurus, |
| Scalops, | Tamias. |

The first of these is local and southern; the others have a more general range.

4. *Western.*—The following list of 20 genera and subgenera are distinctively western or southwestern, only one of them (*Ictidomys*) occurring east of the Mississippi River.

| | | |
|---|---|---|
| Antilocapra, | Perodipus, | Otospermophilus, |
| Cynomys, | Onychomys, | Ictidomys, |
| Thomomys, | Antrozous, | Xerospermophilus, |
| Perognathus, | Euderma, | Ammospermophilus, |
| Chætodipus, | Molossus, | Bassariscus, |
| Microdipodops, | Notiosorex, | Conepatus. |
| Dipodomys, | Eutamias, | |

All but two of these (*Molossus* and *Conepatus*) are indigenous to the region under consideration. *Geomys* may also be best placed here, though limited in its United States range to the plains and prairies east of the Rocky Mountains and to the coast region of the South Atlantic and Gulf States.

From the foregoing it is evident that the Cold Temperate and Warm Temperate Subregions differ greatly in respect to homogeneousness. No part of the Cold Temperate is very strongly differentiated from the rest of the subregion, whereas different parts of the Warm Temperate are found to be very unlike, even though situated under the same parallels of latitude. Hence the Warm Temperate admits of separation into two quite unlike parts, a western and an eastern, nearly on the line of the 100th meridian, while the Cold Temperate admits of no such subdivision.

## The Major Faunal Areas of the North American Continent.

We are thus led to adopt the following scheme for the division of the North American continent into major faunal areas, as illustrated in the accompanying maps. First, the Arctic portion of the continent, or the region beyond the limit of arboreal vegetation, is to be assigned to the *Arctic Realm.* Second, the region

south of the Mexican tableland, and also the low eastern coast region of Mexico north into Texas (about to Corpus Christi), and the low western coast region of Mexico north about to Mazatlan, may be assigned to the *American Tropical Realm*, with which also belong the extreme southern part of the Peninsulas of Lower California and Florida. Third, the remaining and by far the greater part of the continent belongs to the *North Temperate Realm*, of which it constitutes the *North American Region.*

The North American Region is divisible into two *Subregions*, namely, a *Cold Temperate* and a *Warm Temperate.* The latter comprises two *Provinces*, a *Humid* or Eastern, and an *Arid* or Western. The Humid Province is divisible into two *Subprovinces*, namely, an *Appalachian* or Northern, and an *Austroriparian* or Southern. The Arid Province is also divisible into two Subprovinces, namely, a *Campestrian* or Northern, and a *Sonoran* or Southern. The Campestrian Subprovince is susceptible of division into two or three *Districts*, as the *Great Plains District*, the *Great Basin District*, and a *Pacific Coast District.* Each of these areas usually consists of two or more minor divisions or *Faunæ.* (See accompanying maps, plates V–VIII.)

We will now pass in more formal review the faunal subdivisions of the North American Continent, from Region to Fauna, so far as the latter are at present clearly determinable.

## The American Arctic.

If North America were isolated from the rest of the world it would be quite proper to treat the American portion of the Arctic Realm as merely a subdivision of the North American *Region;* but in view of the fact that it is really a part of a homogeneous hyperborean fauna of circumpolar distribution it seems more in accordance with general facts to consider it as a part of the Arctic Realm. The propriety of this seems especially emphasized when we consider that the "animals and plants inhabiting the Arctic regions are usually specifically identical throughout Arctic America, Greenland, and the polar parts of Eurasia and outlying islands," the "types inhabiting the Arctic Zone being few in number and uniform in character throughout

their distribution."[1] The fauna of this Arctic Zone is thus no more American than it is Europæo-Asiatic, and differs far more from that of the adjoining region to the southward, both in North America and Eurasia, than does the American arctic from the Eurasian arctic. The Arctic Realm possesses only a small number of peculiar types in proportion to its area or in comparison with the other realms situated under more favorable conditions for the development of a diversified abundance of life; yet its peculiar types are quite numerous when considered in relation to the general meagreness of the fauna in these inclement latitudes. It is especially characterized by its poverty of life, and consequently largely by negative characters—by what it lacks rather than by a high ratio of peculiar forms.

The American Arctic[2] may be divided into two areas, which may take the rank of faunæ, or perhaps more properly of subfaunæ, in view of their slight inter-differentiation, namely: (1) the *Barren Ground Fauna*, and (2) the *Alaskan Arctic Fauna*.[3]

The Arctic American as a whole is characterized by being the home of the Eskimo, the Polar Bear, the Arctic Fox, the Arctic Hare, Parry's Marmot, the White Lemming, the Musk Ox, the Barren-ground Caribou, the Walrusses, and various species of Seals. Its southern boundary also forms the northern limit of nearly all of the characteristic species of the adjoining region southward, the greater part of which find their northern limit very near where the forest vegetation gives place to that of the Barren-grounds. The two faunæ into which this area appears separable are principally characterized by each having certain marine mammals along its coast not common to the other. The Alaskan Arctic has the Fur Seal, the Sea Lion, the Banded Seal, the Pacific Walrus, and the Sea Otter, neither of which occur in the region designated as the Barren Ground Fauna, which on the other hand has a few species, including the Musk Ox, not found in the Alaskan Arctic.

[1] Merriam, Proc. Biol. Soc. Wash., VII, pp. 39, 40.

[2] The American Arctic was ranked by me in 1871 (Bull. Mus. Comp. Zoöl., II, No. 2, p. 403) as a 'fauna' of the Arctic Realm, and termed the 'American Arctic Fauna.'

[3] The Alaskan Arctic Fauna is Mr. Edward W. Nelson's Alaskan Arctic District, characterized by him in his 'Report upon Natural History Collections made in Alaska,' 1887, pp. 27–32.

## The North American Region.

The North American Region forms two *Subregions*, namely: (1) a *Cold Temperate Subregion*, extending southward to about the mean latitude of the Great Lakes, with outlying portions extending further southward along the principal mountain systems of the continent; and (2) a *Warm Temperate Subregion*, occupying the remainder of the North American Region. The differential features of the two subregions have already been shown in the analysis of the mammalian fauna of North America (see pp. 213–215).

I. Cold Temperate Subregion.—The Cold Temperate Subregion extends across the continent from the Atlantic to the Pacific, and from about latitude 43° northward to the limit of forest vegetation, with, however, a narrow prolongation southward along the Appalachian Highlands as far as northern Georgia, another in the interior along the main chain of the Rocky Mountains south into Mexico, and a third along the Cascade and Sierra Nevada ranges. Its southern border also sweeps to the northward, in the region of the Great Plains, so as to exclude the plains of the Saskatchewan, which belong to the Warm Temperate. It is subdivisible into two transcontinental *zones*, termed respectively the *Hudsonian* and *Canadian Zones*,[1] named from the two principal faunæ of which this subregion mainly consists. These zones correspond respectively with the Subarctic and Cold Temperate Zones of physical geographers and botanists.

The *faunæ* of the Cold Temperate Subregion are the *Hudsonian* and *Carolinian* in the east, and the *Aleutian* and *Sitkan* on the northwest coast, with a series of closely-related mountain faunæ or subfaunæ in the Rocky Mountains and the Sierra Nevada, as yet not well defined.

1. *Hudsonian Fauna.*—The Hudsonian Fauna occupies a belt at the northern border of the Cold Temperate Subregion, extending from Newfoundland to and across Alaska nearly to Bering Sea. It is thus bounded on the north by the Barren Ground Fauna, and west and northwest by the Alaskan Arctic Fauna. Its southern limit may be tentatively given as the isotheral of 57° F.

[1] See Merriam, N. Am. Fauna, No. 5, 1891, pp. 10–12, and *ibid.*, Proc. Biol. Soc. Washington, VII, 1892, p. 24.

The Hudsonian, as thus defined, forms the northern limit of a comparatively large number of mammals dependent upon forests for food and shelter. These are apparently the Red Fox, the Timber Wolf, the Black Bear, the Canada Lynx, the Weasels, Mink, Marten, Fisher, Wolverine, and the Otter; also of the Red Squirrel, the Flying Squirrel, the Jumping and other Mice, and the Varying Hare. These all enter the Hudsonian Fauna from the southward, and range northward to about its northern border. The northern limit of these various species is not in each case coincident, some ranging more or less beyond certain others, the exact limit being determined by the peculiar needs and habits of the species, and somewhat with local conditions. Hence here, as at the boundaries of faunæ generally, the species limited by a given fauna do not all stop along one abrupt line, but gradually fade out, one after another, within, however, comparatively narrow and locally varying limits.

The Hudsonian Fauna is further characterized by forming the southern limit of several species of Seals, as the Gray, Hooded and Harp, the Barren-ground Caribou, the Tawny Lemming, and the Yellow-cheeked Meadow Mouse, which range southward over this fauna from the Arctic Realm. The Hudsonian Fauna is thus distinctively characterized by the assemblage of species just enumerated, which occur together nowhere else.

2. *Canadian Fauna.*—The Canadian Fauna, like the Hudsonian, forms a nearly transcontinental belt, with the southern border of the Hudsonian for its northern boundary. It apparently includes a small portion of southwestern Newfoundland, nearly all of the provinces of New Brunswick and Quebec, northern Ontario, the northern half of New England, northern Michigan, the northern border of Wisconsin, and northeastern Minnesota. West of Lake Superior it stretches northwestward in a broad belt to the Peace River and northern British Columbia districts of Canada. It thus extends across the Rocky Mountains nearly to the Pacific coast. Its southern border trends at first southward, reaching its most southern point in the interior in northern Michigan and northeastern Wisconsin; it then runs northwest along the border of the plains, till it nearly or quite reaches the 55th parallel, when it then descends, west of the Saskatchewan Plains, as a narrow belt

along the eastern base of the Rocky Mountains, as far as northeastern Montana, with a further southward extension in the mountains proper. West of the Rocky Mountains it appears not to descend below the southern boundary of British Columbia, but runs southward in the mountains to an as yet undetermined limit. To the westward it is cut off from the Pacific coast by a distinctively coast belt. It has outlying insular areas in the Adirondack region of New York and on the higher crests of the Appalachian Highlands; it also forms a zone in the Rocky Mountain chain and its outlying ranges.[1]

The Canadian Fauna forms the northern limit of the common Skunk, the Star-nosed Mole, the Hoary, Red and Brown Bats, the northern form of the common Striped Squirrel, the Woodchuck, and the Virginia Deer. It also forms the southern limit of the Canada Lynx, the Wolverene, Pine Marten, Moose, Caribou, Canada Porcupine, and various species of Short-tailed Meadow Mice of the genus *Phenacomys*, etc.

3. *Sitkan Fauna.*—This is the 'Sitkan District,' as defined by Mr. E. W. Nelson.[2] It is of limited area, being confined to a narrow strip along the Pacific coast of Alaska, extending from Bristol Bay to about the southern end of the Territory of Alaska. So far as mammals go it has very little to distinguish it from the Canadian Fauna, of which it is practically little more than a littoral district. It is characterized by a few local forms of wide-ranging species, particularly of birds, and probably of animal life in general. It is a region of heavy precipitation and overcast skies, the climatic effect of which is strongly shown in the great intensification of color which marks most of the species coming within its influence. For this reason it seems entitled to recognition as a distinct faunal area of low rank.

4. *Aleutian Fauna.*—This is the 'Aleutian District' of Mr. E. W. Nelson,[3] previously termed by me the 'Aleutian Fauna.'[4]

[1] On the southern boundary of the Canadian Fauna in the East, see Verrill, Proc. Bost. Soc. Nat. Hist., Vol. X, p. 260, and Allen, Bull. Mus. Comp. Zoöl., Vol. II, p. 398. See also Dr. Merriam's Map 5 in 'North American Fauna' No. 3, where the southern boundary of his Boreal Province may be taken as the southern boundary of the Canadian Fauna.

[2] Rep. Nat. Hist. Coll. made in Alaska, 1887, pp. 24-26.

[3] *Ibid.*, 1887, p. 26.

[4] Bull. Mus. Comp. Zoöl., II, 1871, p. 401.

It includes not only the Aleutian chain of islands, but also the western and southern portions of the Alaskan Peninsula and probably the island of Kadiak, although this may more properly belong to the Sitkan Fauna. So far as mammals are concerned there is very little to distinguish the Aleutian Fauna, but it is well characterized by its bird life.

Both the Hudsonian and the Canadian Faunæ are represented in the higher parts of the Cascades, and in the more northerly parts of the Rocky Mountains in the United States, including their outlying spurs in both Idaho and Montana. More to the southward, in Utah and Colorado, and thence further southward in New Mexico, Arizona, and in Mexico, and also in the mountains of California, a few new elements come in, the differentiation being progressive toward the southward. Our knowledge of the mammalian life of these subalpine regions is, however, still too limited to render practicable any attempt in the present connection to define or characterize these southern extensions of the Hudsonian and Canadian life zones. We are thus far indebted to Dr. C. Hart Merriam, Chief of the Division of Mammalogy and Ornithology of the Department of Agriculture, for most of the exact knowledge we at present possess on the subject, and for a very successful attempt to correlate the life zones of some of our western mountain areas with those of the northern part of the continent. In the San Francisco Mountain region in Arizona he has very clearly traced[1] seven life zones and in part correlated them with the corresponding life areas of the continent at large. He subsequently extended[2] his careful methods of field work to the mountains of South-Central Idaho, with like praiseworthy and satisfactory results. The zones recognized in the San Francisco Mountain region and their correlations may be indicated as follows:

| *Zone.* | *Fauna.* |
|---|---|
| Alpine | Arctic. |
| Subalpine or Timber-line | |
| Hudsonian or Spruce | Hudsonian. |
| Canadian or Fir | Canadian. |
| Neutral or Pine | Alleghanian. |
| Piñon or Cedar | [Carolinian]. |
| Desert | [Louisianian]. |

[1] N. Am. Fauna, No. 3, 1890, pp. 7–34 and maps 1–4.

[2] *Ibid.*, No. 5, 1891, pp. 9–12, 21–25.

II. Warm Temperate Subregion.—The Warm Temperate Subregion occupies middle North America, extending from the Cold Temperate Subregion on the north to the American Tropical Realm, as already defined, on the south. It thus includes the greater part of the United States, Lower California, and the Mexican tableland. It is cut into along the principal mountain systems by the southern prolongations of the Cold Temperate Subregion, and also extends northward over the Saskatchewan Plains. The extreme southern parts of the peninsulas of Florida and Lower California, however, are excluded, as also the lower coast region of Texas, these excluded districts, though of comparatively small extent, belonging to the Tropical Realm.

The Warm Temperate Subregion, regarded as a whole, is very unlike the comparatively homogeneous Cold Temperate Subregion, as already shown (pp. 213–218). It is vastly more varied in its physical features, is situated for the most part under climatic conditions more favorable to abundance and diversity of life, and thus presents a greater proportion of peculiar types, and also a larger number of more sharply contrasted faunal areas. Its life is largely indigenous, with, however, a strong infusion of both northern and southern elements. The indigenous elements appear to have had their origin in the Mexican plateau region, and are thus properly designated as Sonoran. The following list of mammalian genera and subgenera may be safely placed in this category:

| | | |
|---|---|---|
| Cariacus, | Thomomys, | Spilogale, |
| Antilocapra, | Dipodomys, | Notiosorex, |
| Cynomys, | Perodipus, | Scalops, |
| Xerospermophilus, | Microdipodops, | Scapanus, |
| Ammospermophilus, | Perognathus, | Corynorhinus, |
| Reithrodontomys, | Chætodipus, | Euderma, |
| Onychomys, | Bassariscus, | Antrozous. |
| Geomys, | Conepatus, | |

The genera of tropical origin are:

| | | |
|---|---|---|
| Didelphys, | Sigmodon, | Molossus, |
| Dicotyles, | Neotoma, | Nyctinomus, |
| Oryzomys, | Procyon, | Otopterus. |

Only two of these, *Neotoma* and *Procyon*, extend very far northward.

Besides the above, several genera of wide distribution beyond North America also occur, as

| | | |
|---|---|---|
| Lepus, | Spermophilus, | Vulpes, |
| Castor, | Lutra, | Lynx, |
| Sciurus, | Mustela, | Felis, |
| Sciuropterus, | Putorius, | Vesperugo, |
| Tamias, | Canis, | Vespertilio, etc. |

Several American genera of rather extended range to the northward also occur, as *Sitomys*, *Fiber*, *Atalapha*, *Mephitis*, *Taxidea*, etc.

*Nomenclature and History.*—Before passing to a detailed consideration of the subdivisions of the Warm Temperate Subregion, it may be proper to refer briefly to its nomenclature and history, as treated by previous authors. This region, as here defined, consists of the southern portion of Baird's Eastern Province, together with his Middle and Western Provinces. As early as 1878[1] I separated the 'North American Region' into two *Subregions*, namely, a *Cold Temperate Subregion* and a *Warm Temperate Subregion*, as is done in the present paper, using these terms as headings in tables giving the distribution of the genera of North American Mammals. Baird's 'Eastern,' 'Middle,' and 'Western' *Provinces* were recognized as "natural regions," with the designation of 'Provinces,' but with the Eastern Province modified so as to restrict it to the Warm Temperate Subregion, and all three reduced in grade to regions of the third rank[2] instead of the second rank, as regarded by Professor Baird.

In 1883 Dr. Packard[3] substantially adopted this classification in treating of the faunal regions of North America, with, however, a change of name for the 'Cold Temperate Subregion,' he adopting for it that of 'Boreal Province'—an unfortunate suggestion of my own made later in the paper above cited (l. c., p. 376, where, in some unaccountable way my former division of the 'North Temperate Realm' into 'Subregions' was wholly overlooked !). Dr. Packard, in his otherwise excellent 'Zoö-geographical Map of North America,' failed, however, to recognize the southward

[1] Bull. U. S. Geol. and Geogr. Survey (Hayden), IV, 1878, pp. 338–344.

[2] That is, of the North American Region; really of fourth rank, considered from the basis of the world as a whole.

[3] Twelth Ann. Rep. U. S. Geol. and Geogr. Survey (Hayden), pt. I, 1883, pp. 362–370, and map; the latter republished in the Third Rep. U. S. Entomol. Comm., 1883, map iv.

extension of the Cold Temperate Subregion along the principal mountain systems of the continent.

Dr. Merriam in 1890[1] again set off the Cold Temperate Subregion, under the name 'Boreal Province,' and mapped in detail its southern prolongations into the mountainous parts of the Warm Temperate. The Warm Temperate Subregion was also recognized as a contrasting region of coördinate rank, under the designation 'Sonoran Province,' while the old 'Eastern,' 'Middle,' and 'Western' Provinces were properly repudiated as having no basis in nature. Particularly is this the case in respect to the Central Province, of which Dr. Merriam observes: "The region almost universally recognized by recent writers as the 'Central Province' is made up of the Great Plains, the Rocky Mountains and the Great Basin. A critical study of the life of the Rocky Mountains has shown it to consist of a southward extension of the Boreal Province, with an admixture of southern forms resulting from an intrusion or overlapping of representatives of the Sonoran Province, some of which, from long residence in the region, have undergone enough modification to be recognized as distinct subspecies or even species. A similar analysis of the Great Plains and Great Basin has shown them to consist of northward extensions of the Sonoran Province, somewhat mixed with the southernmost fauna and flora of the Boreal Province. Thus the whole of the so-called 'Great Central Province' disappears.

"This explains a multitude of facts that are utterly incomprehensible under the commonly-accepted zoölogical divisions of the country. These facts relate particularly to the distribution of species about the northern boundaries of the supposed Central and Pacific Provinces, and to the dilemma we find ourselves in when attempting to account for the origin of so many primary life areas in a country where there are no impassable physical barriers to prevent the diffusion of animals and plants."[2]

Dr. Merriam's generalizations respecting the Central Province of authors mark an important advance in the study of North American bio-geography. Taking this region with its original boundaries and significance it is a highly artificial division, em-

[1] N. Am. Fauna, No. 3, Sept. 1890, pp. 24–26, and map 5; see also Proc. Biol. Soc. Washington, VII, 1892, pp. 21–40, and accompanying map.

[2] N. Am. Fauna, No. 3, pp. 22, 23.

bracing within its area very unlike faunal elements. Eliminating from it, however, the broad central arm of the 'Boreal' or Cold Temperate Subregion, which occupies so much of the great central plateau, relieves it of an extraneous element, and reduces it to a more natural and geographically quite different region.

As already seen, Dr. Merriam selected for his two primary divisions of the North American Region the terms 'Boreal' and 'Sonoran' *Provinces.* These regions, both as to grade and nomenclature, were at first apparently adopted provisionally, as he says, in speaking of the United States: "Indeed, the present investigation demonstrates that there are but two primary life provinces in this country: a northern, which may be termed *Boreal,* and a southern, which, for our purposes, may be termed *Sonoran,* since it comes to us from Mexico through Sonora."[1] Later, however, he has termed these divisions 'Regions' instead of 'Provinces,' but has continued the use of the terms 'Boreal' and 'Sonoran.' The term Sonoran is thus applied to a region identical in geographical extent with the Warm Temperate—a designation previously used for the same area—and hence includes the whole region east of the Mississippi (as well as that west of it), from the Great Lakes and southern New England south to Florida and the Gulf Coast. The terms 'Sonoran' and 'Sonoran Province' were used, however, as early as 1866 by Prof. Cope,[2] and also later by Cope, Heilprin, and others, for a region of comparatively small extent, consisting of Sonora and adjoining portions of Arizona and New Mexico. In 1887 Heilprin[3] extended the region to include "the peninsula of Lower California, the State of Sonora in Mexico, New Mexico, Arizona, and parts, not yet absolutely defined, of Nevada, California, Texas, and Florida," and modified its title by calling it the 'Sonoran Transition Region.' The Sonoran Province or Region of these authors is thus not at all the 'Sonoran Region' of Merriam, which is an area of much greater extent and of higher rank. The term Sonoran, used in this extended sense, seems at least inappropriate if not misleading, as there are few if any strictly 'Sonoran' types represented in that portion of the United States

[1] N. Am. Fauna, No. 3, p. 19.

[2] Proc. Acad. Nat. Sci. Phila., 1866, p. 300.

[3] The Geogr. and Geol. Distrib. of Anim., p. 106.

situated to the eastward of the Mississippi River. The more descriptive and appropriate designation of 'Warm Temperate' is therefore preferred for the region in question, since it not only has priority but is in harmony with the terms Arctic, Cold Temperate, and Tropical, used currently for other coördinate areas of the continent.

Dr. Merriam in his important contributions to North American bio-geography has evidently not attempted to devise a systematic scheme of terminology and classification for the various grades of faunal areas, but, at first at least, simply employed provisionally such terms as would suffice to clearly indicate the regions under consideration, his attention being mainly and most successfully given to an elucidation of the facts of distribution. In following out, in the present connection, a consistent scheme of nomenclature, first attempted many years ago, the aim is to fix definitely designations for areas of different grades, and to combine the whole into a consistent system of classification. The nomenclature of the subject has ever been in such a chaotic and inharmonious state that a strict 'rule of priority' cannot be enforced, the same terms having been used in widely different senses, while not unfrequently a number of different names have been given to the same area. As already explained (p. 204) the system here proposed in respect to the *rank* of areas of different grades, as from Realm to Fauna, is analagous to the systematic schemes of classification in biology, and also in stratigraphic geology. The selection of distinctive names for divisions of the higher grades has relation to the influences controlling the geographic distribution of life, namely, *climate*, and hence it is natural that the climatic zones and their principal subdivisions should suggest the names of many of the major ontological areas. This indeed has been the custom to a large extent with both botanists and physiographers, and has often been practiced by zoölogists. Thus 'Humid' and 'Arid' become appropriate and suggestive designations for the eastern and western subdivisions of the North American Warm Temperate Subregion. For the lesser regions geographical names, as 'Hudsonian,' etc., are admirably appropriate when suggestive of some characteristic portion of the region in question. Whenever feasible, names first given should of

course be retained in preference to later names. Furthermore, the terms indicative of grade should be used with the same uniformity and strictness as are the terms order, family, genus, etc., expressive of rank, in biology.

PROVINCES OF THE WARM TEMPERATE.—The Warm Temperate Subregion, considered as a whole, is primarily divisible into two *Provinces*, namely, (1) a *Humid Province*, extending from the Atlantic Coast to the vicinity of the 100th meridian, and (2) an *Arid Province*, extending from the western border of the Humid Province to the Pacific coast, excluding of course all the higher mountain ranges, which are more or less wooded and constitute southern extensions of the Cold Temperate Subregion.

The Humid Province, as the name implies, has a humid climate and is in general heavily forested; the Arid Province is a dry region, some of it excessively arid, and consists mainly of open plains and deserts. It is highly diversified in respect to its physiographic features, and presents consequently a more varied fauna than is met with in the Humid Province. As already shown (p. 218) these two provinces are distinguished by the occurrence in each of a few peculiar types not possessed by the other, the Arid Province, however, having by far the greater number of peculiar types, owing to the large continuous land area extending from its southern boundary southward, from which direction much of its life has been derived, while the Humid Province has for its southern boundary a wide expanse of sea, namely, the Gulf of Mexico.

These two provinces thus coincide with the two strongly-marked climatic divisions of the middle, or United States, portion of North America in respect to rain-fall. Unlike the major divisions heretofore characterized (realms, regions and subregions), and also unlike the transcontinental zones, they are not separated by isothermal lines, trending in an east and west direction, but by a north and south line determined by the amount of rain-fall. Thus, in the present instance, temperature as a climatic influence governing the distribution of animals and plants is subordinated to the other leading climatic influence, humidity, which varies greatly in these two contrasting regions, in consequence of the long-continued

peculiar physiographic and geographic conditions of the two regions. The many peculiar or indigenous types characterizing the Arid Province as compared with the Humid owe their existence, as already intimated, to the adjoining broad land area stretching far to the southward, whence they have been in large part derived, as contrasted with the absence of such a land area adjoining the Humid Province on its southern border. A large proportion of these peculiar types extend northward to the northern border of the Arid Province, or across the whole breadth of the Warm Temperate Subregion. The Warm Temperate Subregion is further subdivisible in a transcontinental direction into two zones, which might be termed a North Warm Temperate and a South Warm Temperate, as shown later on, but neither would be characterized by any considerable number of transcontinental genera. The northern belt would be characterized by less than half-a-dozen Cold Temperate genera which range a little way into the Warm Temperate, and the southern belt by about the same number of semi-tropical genera which extend into it from the southward. The remaining genera of the Warm Temperate are either wide-ranging transcontinental genera common to both belts, or else genera peculiar to either the Arid or the Humid Province.

The transition between the Humid and Arid Provinces is nowhere abrupt; they gradually merge into each other everywhere along their line of junction, as the prairies of the Mississippi Valley gradually become more arid and take on the characteristic aspect of the more arid plains. There is thus here the usual 'transition' belt occurring between contiguous faunal areas. It is, however, rather broader than between regions where temperature is primarily the limiting influence, as in the case of boundaries trending in a nearly east and west direction, the transition being first from a forested region to one of fertile prairies, and thence to arid plains and deserts. The dividing line may be considered as coincident with the isohyetal curve marking an annual rain-fall of 20 inches or less, as shown on rain-fall charts of the United States—hence, as above said, near the 100th meridian.

As already stated, the regions here designated as Humid and Arid 'Provinces' coincide with the 'humid' and 'arid' portions respectively of Dr. Merriam's 'Transition,' 'Upper Sonoran,' and

'Lower Sonoran' *Zones*;[1] he thus recognizing, but in a somewhat different way, the Humid and Arid areas here classified as *Provinces*.

HUMID PROVINCE.—The Humid Province corresponds to the warm temperate part of Prof. Baird's 'Eastern Province,' and is exactly coincident with Dr. Merriam's 'Humid Sonoran' and 'Humid Transition.'[2] It comprises the United States east of the Great Plains, including also southeastern Ontario and the upper St. Lawrence Valley, but excluding northern New England, a portion of northern New York, northern Michigan and northern Wisconsin, and the higher crests of the Alleghanies. It contains a few genera and subgenera which do not occur in the Arid Province, as *Nycticejus*, *Blarina*, *Scalops*, *Condylura*, *Neofiber*, *Parasciurus* and *Tamias* (restricted subgenus). It lacks about 20 genera and subgenera that are confined in their eastward range to the Arid Province.

The Humid Province is separable into two *subprovinces*, namely, (1) an *Appalachian Subprovince*, and (2) an *Austroriparian Subprovince*.

*Appalachian Subprovince.*—The Appalachian Subprovince consists of the Alleghanian and Carolinian Faunæ, with the boundaries as long recognized by ornithologists and mammalogists, and as recently revised and mapped by Dr. Merriam.[3] It is characterized by the presence of a number of somewhat northern genera and subgenera which do not extend south of the southern boundary of the Carolinian Fauna, namely:

| | | |
|---|---|---|
| Arctomys, | Mynomes, | Synaptomys, |
| Tamias, | Pitymys, | Condylura. |
| Tamiasciurus, | | |

It is further characterized by the absence of a considerably greater number of southern genera and subgenera which do not pass north of its southern border, as enumerated in the next paragraph.

[1] Proc. Biol. Soc. Washington, VII, pp. 27–31, and accompanying map.

[2] *Ibid.*, pp. 27 and 30, and accompanying map.

[3] North Am. Fauna, No. 3, Map 5.

*Austroriparian Subprovince.*—The Austroriparian Subprovince consists of the long-recognized Louisianian Fauna, or 'Austroriparian' Fauna, as sometimes termed. Its fauna differs so much from that of the Appalachian Subprovince that they form two strongly-contrasted faunal areas. It is reached by few northern types, southern forms prevailing, to which are added genera of wide general distribution, like *Lutra*, *Canis*, *Vulpes*, *Sciurus*, *Sciuropterus*, *Lepus*, etc. It is characterized by the absence of the genera tabulated in the preceding paragraph, and by the presence of a larger number of others which do not extend north of its northern boundary, namely :

| | | |
|---|---|---|
| Reithrodontomys, | Neotoma, | Spilogale, |
| Oryzomys, | Neofiber, | Corynorhinus, |
| Sigmodon, | Geomys,[1] | Nyctinomus. |

FAUNÆ OF THE HUMID PROVINCE.—The Humid Province, as here limited, has long been divided into three *Faunæ*, as follows : (1) *Alleghanian Fauna ;* (2) *Carolinian Fauna ;* (3) *Louisianian Fauna.* They have been so long recognized, and of late so clearly defined, that their boundaries have become well known.[2]

1. *Alleghanian Fauna.*—The northern border of the Alleghanian Fauna forms about the northern limit of the Panther, the Bay Lynx, the Raccoon, the Mole Shrew, the common and Brewer's Moles, the Gray Squirrel, and the Wood Hare. Its southern border forms about the southern limit of the Fisher, the Ermines, the Harbor Seal, the Elk (in former times), the Northern Striped Squirrel, several species of Field Mice (genera *Evotomys* and *Synaptomys*), the varying Hare, etc. It also forms the northern limit of the Cat and Fox Squirrels (subgenus *Parasciurus*), the Opossum, and various other species soon to be mentioned in characterizing the Carolinian Fauna. The Alleghanian Fauna is thus characterized by the overlapping and commingling of a particular set of species not found elsewhere associated. It is bounded on the north by the Canadian Fauna, on the south by the Carolinian Fauna, and extends westward to the edge of the Great Plains.

[1] So far as its distribution east of the Mississippi River is concerned.

[2] See Allen, Bull. Mus. Comp. Zoöl., II, pp. 395–397 ; Merriam, North. Am. Fauna, No. 3, map No. 5. Respecting especially the southern boundary of the Alleghanian Fauna, see Bicknell, Bull. Nutt. Orn. Club, III, p. 128 ; Allen, *ibid.*, p. 149 ; Chapman, Auk, VI, p. 179.

2. *Carolinian Fauna.*—The northern boundary of this fauna forms in a general way the northern limit of the Gray Fox, the Northern Fox Squirrels, the Pine Mouse, the Opossum, and a Bat of the genus *Nycticejus.* It also forms the southern limit of the Star-nosed Mole, the common Red Squirrel, the Southern Chipmunk, the Woodchuck, the Muskrat, and the common Meadow Mouse (*Arvicola riparius*).

3. *Louisianian Fauna.*—The Louisianian Fauna joins the Carolinian Fauna on the south, and occupies the rest of the Eastern United States to the southward, excepting the extreme southern portion of the peninsula of Florida, which has long been recognized as a *Floridian Fauna*, and as belonging to the Antillean Subregion of the American Tropical Realm. The Louisianian Fauna is characterized by the possession of a number of both genera and species not found north of its limits, although most of the Louisianian genera have a wide distribution southward in Mexico, and westward and northwestward, where, however, they are commonly represented by different species. The characteristic elements of the Louisianian Fauna are the Wood Rat, Cotton Rat, Cotton Mouse, Golden Mouse, Rice-field Mouse, Harvest Mouse, Pocket Gopher, the Southern Gray and Southern Fox Squirrels, the Marsh Hare, Swamp Hare, Little Striped Skunk, and a species each of Big-eared and Leaf-nosed Bats. These represent eight genera not found in the Carolinian Fauna, as follows: *Neotoma*, *Sigmodon*, *Oryzomys*, *Reithrodontomys*, *Geomys*, *Spilogale*, *Corynorhinus* and *Nyctinomus.*

Several interesting facts may be here noted in relation to the faunæ of the Humid Province of the Warm Temperate Subregion as compared with the eastern tier of faunæ in the Cold Temperate Subregion. While the Alleghanian, Carolinian and Louisianian Faunæ terminate at the eastern border of the Great Plains, and hence extend over less than half the width of the continent, the Canadian and Hudsonian sweep across nearly its whole breadth, from the Atlantic coast nearly to the Pacific, and this too at a point where the continent presents its greatest breadth. The mammals and birds found from about the latitude of 43° northward extend as a rule uninterruptedly northwestward from the

eastern seaboard over the comparatively low, generally forested interior to the Rocky Mountains and across Alaska almost to the Pacific coast. They also pass over the depressed portions of the Rockies in about latitude 57° to 59°, and follow the Peace and Liard Rivers to the sources of the Yukon, spreading thence northward and westward to the coast ranges of southern Alaska. In fact, the Rocky Mountains, as is well known, present too many points of depression to form much of a barrier to the dispersion of species, so that from southwestern British Columbia northward, except along the coast, the fauna is nearly identical with that of eastern Canada and northern New England. The arid, treeless plains of the interior thus form a greater barrier to the extension westward of eastern forms than do the Rocky Mountains themselves.

ARID PROVINCE.—The Arid Province extends from the eastern border of the Great Plains to the Pacific, and northward over the Saskatchewan Plains, the Plains of the Columbia, and thence north into southern British Columbia. It thus includes the so-called 'Central' and 'Pacific' Provinces of Baird and most subsequent writers, excepting of course the more elevated parts of the Rocky Mountain plateau. It is thus coëxtensive with Dr. Merriam's 'Arid Sonoran.' While it is true that a narrow belt along the Pacific coast from Southern California northward to the Alaskan Peninsula possesses a few peculiar types, and lacks a few of those occurring in the region immediately to the eastward, the differentiation is on the whole too slight to give to this Pacific coast district the rank of a region coördinate in grade with Baird's so-called Middle and Eastern Provinces.[1] These differences serve at best merely to mark off from the interior region at large a tier of narrow coast faunæ of the same grade as those bordering the Atlantic coast,

[1] In writing in 1871 of the 'Natural Provinces of the North American Temperate Region,' from the standpoint of Ornithology, I adopted the present classification, as shown by the following: "Within this Region may be recognized two Provinces—an Eastern and a Western—quite distinct from each other in their general features as well as in many special characteristics. The Eastern Province is characterized by the uniformity of its geographical and climatic features, and by a corresponding uniformity in its faunal and floral aspects. The Western Province, on the other hand, is characterized by the diversity of its geographical and climatic features—different areas situated under the same parallels differing greatly in these respects—and by the number and small extent of its zoölogical and botanical areas, and its comparatively numerous restricted floræ and faunæ.... The Western Region [*lege* Province] commences at the western border of the Eastern and extends thence to the Pacific coast."—*Bull. Mus. Comp. Zoöl.*, Vol. II, pp. 384, 385.

although the latter, owing to the widely different physiography of the eastern and western borders of the continent, have a much greater east and west extent.

The Arid Province is characterized by the presence of about 20 genera not found in the Humid Province, and by lacking a few occurring in the latter. The 20 genera and subgenera of the Arid Province not found in the Humid Province are the following:

| | | |
|---|---|---|
| Antilocapra, | Perodipus, | Otospermophilus, |
| Cynomys, | Onychomys, | Ictidomys, |
| Thomomys, | Antrozous, | Xerospermophilus, |
| Perognathus, | Euderma, | Ammospermophilus, |
| Chætodipus, | Molossus, | Bassariscus, |
| Microdipodops, | Notiosorex, | Conepatus. |
| Dipodomys, | Eutamias, | |

Among its characteristic mammals are the Badger, Coyote, Kit Fox, Black-footed Ferret, Texas Civet Cat, the Mule and Black-tailed Deer, the Prong-horned Antelope, all of the numerous species and subspecies of the genus *Thomomys* and nearly all the species of *Geomys*, four genera and some thirty species of Kangaroo Rats and Pocket Mice, all of the several species of Prairie Dog, eight or ten species of Spermophiles, a dozen species of Ground Squirrels, including the whole subgenus *Eutamias*, all of the several species of Jackass Hares, all of the Grasshopper Mice (*Onychomys*), and numerous species of Bats, Shrews and Arboreal Squirrels.

*Subprovinces of the Arid Province.*—The Arid Province, like the Humid, is divisible into two subprovinces, namely, (1) a northern or *Campestrian Subprovince*, and (2) a southern or *Sonoran Subprovince*. These two regions correspond respectively with Dr. Merriam's 'Arid Upper Sonoran' and 'Arid Lower Sonoran'; just as the two subprovinces of the Eastern Province correspond with his 'Humid Upper Sonoran' and 'Humid Lower Sonoran,' as laid down on his 'Second Provisional Bio-geographic Map of North America,' except that the 'humid' and 'arid' portions of his 'Transition Zone' are also included respectively in the Alleghanian and Campestrian Subprovinces. The Sonoran Subprovince is equal to Dr. Merriam's restricted "Arid or Sonoran subregion proper" plus his "Lower Californian subregion," while the Campestrian Subprovince includes his "Great Basin subregion" and

his "Great Plains subregion."[1] The name 'Campestrian' has reference to the fact that this subprovince is largely made up of plains, including as it does the greater part of the Great Plains, the Plains of the Saskatchewan, and the Plains of the Columbia and Snake Rivers. (See map, pl. VII.)

Many species are limited in their southward distribution by the southern border of the Campestrian Subprovince, but few genera appear to be thus restricted. This boundary also forms about the northern limit of many species and genera of the Sonoran Subprovince. These two subprovinces are hence characterized mainly by the presence of a large number of forms found in the Sonoran which are absent from the Campestrian, which is thus characterized, like many northern divisions when compared with adjoining southern ones of coördinate rank, from the Arctic southward, by what it lacks rather than by the possession of any peculiar types.

*Districts of the Campestrian Subprovince.*—The Arid Province is further divisible into a number of areas intermediate in rank between faunæ and subprovinces, which may be called *Districts*. Thus the Campestrian Subprovince is separated by the main chain of the Rocky Mountains into two areas each of which includes two or more faunæ, equivalent to and representative of the Alleghanian and Carolinian Faunæ of the Atlantic coast. These two areas are (1) the *Great Plains District*, consisting of the Great Plains region east of the Rocky Mountains from northern Texas to and including the Saskatchewan Plains; and (2) the *Great Basin District*, including the Great Basin region at large, from southern New Mexico, southern Utah, and southern Nevada north to the Plains of the Columbia and Snake Rivers, and thence northward over the more open and arid portions of eastern British Columbia. It encloses outlying spurs and insular areas of the Cold Temperate Subregion. These two districts possess few distinctive genera and but few distinctive species, though physiographically so well separated. A narrow Pacific Coast belt, situated mainly west of the Sierra Nevada and Cascade Ranges, may be recognized as (3) a *Pacific Coast District*,

[1] *Cf.* N. Am. Fauna, No. 3, p. 25.

characterized by the presence of a few species and a considerable number of subspecies mainly restricted to it. (See map, pl. VII.)

The *Sonoran Subprovince* is apparently not so distinctly separable into Districts of very marked distinctness, even the Peninsula of Lower California presenting few peculiar forms of higher grade than subspecies. Apparently, however, the main continental divide serves to separate a well-marked eastern from a well-marked western subdivision, each characterized by many species and subspecies not found in the other.

The ultimate faunal areas, or the *Faunæ*, of the Arid Province have not as yet been outlined, and their detailed treatment is beyond the scope of the present paper.

ZONES OF THE WARM TEMPERATE SUBREGION.—In addition to the subdivisions of the Warm Temperate already recognized, and independent of them, this subregion may be divided also into several *zones* or *belts* of transcontinental extent, namely, (1) *Alleghanian Zone*, (2) *Carolinian Zone*, and (3) *Louisianian Zone*—these names being based respectively on those of the long-known Atlantic coast faunæ, of which they respectively in part consist, just as 'Canadian' and 'Hudsonian' have been adopted for the transcontinental zones of the Cold Temperate.

The *Alleghanian Zone*, east of the Great Plains, consists of the Alleghanian Fauna; from the eastern edge of the Plains westward it consists of a succession of faunæ—one in the Great Plains District, another in the Great Basin District, and a third in the Pacific Coast District, as yet not clearly defined—equivalent in faunal character to and representative of the Alleghanian Fauna of the East. This zone has already been traced across the continent and mapped by Dr. Merriam under the name '*Neutral* or Transition Zone.'[1] It was first recognized by him in his exploration of the San Francisco Mountain region in Arizona, under the name of 'Neutral or Pine Zone,'[2] and later

[1] Proc. Biol. Soc. Washington, VII, 1892, pp. 30–33, and accompanying map.
[2] N. Am. Fauna, No. 3, 1890, p. 11.

in Idaho.[1] In his later treatment of the subject he has strangely separated this zone as an independent region of minor grade, interposed between his two primary divisions of the continent! He says: "Interposed between the Boreal and Sonoran Regions throughout their numerous windings and interdigitations, is the Neutral or Transition Zone. The humid division of this zone, known as the Alleghanian Fauna, covers the greater part of New England....and extends westerly over the greater part of New York, southern Ontario and Pennsylvania, and sends an arm south along the Alleghanies all the way across the Virginias, Carolinas, and eastern Tennessee, to northern Georgia and Alabama. In the Great Lake region this zone continues westerly across southern Michigan and Wisconsin, and then curves northward over the prairie region of Minnesota, covering the greater parts of North Dakota, Manitoba, and the plains of the Saskatchewan; thence bending abruptly south it crosses eastern Montana and Wyoming, including parts of western South Dakota and Nebraska, and forms a belt along the eastern base of the Rocky Mountains in Colorado and northern New Mexico, here as elsewhere occupying the interval between the Upper Sonoran and Boreal Zones."[2]

The Alleghanian Zone is beyond question a transition belt, being necessarily so from its geographical position; its affinities, however, are decidedly with the Warm Temperate division of the continent rather than with the Cold Temperate, as the case was first interpreted by Dr. Merriam,[3] since its northern boundary coincides closely with the northern limit of distribution of a large number of southern genera of both plants and animals, including most of the staple grains and fruits of the Warm Temperate Zone.

As is well known, there is always a belt of neutral territory along the common boundary line of two adjoining areas, varying in breadth with the rank of the two areas; and the present case of the Alleghanian Zone is thus not exceptional. All things considered it therefore seems best to regard it as the northern transcontinental belt of the Warm Temperate rather than to give it the

[1] N. Am. Fauna, No. 5, 1891, p. 24.

[2] Proc. Biol. Soc. Washington, VII, 1892, pp. 30, 31.

[3] N. Am. Fauna, No. 3, p. 20, and *ibid.*, No. 5, pp. 21 and 25.

anomalous position of a minor faunal area interposed between and completely separating two areas of a higher grade.[1]

The *Carolinian Zone* consists of the Carolinian Fauna, with its several western equivalents. It correlates with the 'Piñon Zone' of Dr. Merriam, as recognized by him in the San Francisco Mountain Region,[2] and later in Idaho, under the designation of 'Arid Upper Sonoran Zone.'[3] Taken as a whole it corresponds to what he has denominated Upper Sonoran.

The *Louisianian Zone* includes the Louisianian Fauna and its equivalent faunæ in the West. It may be correlated with Dr. Merriam's 'Desert Zone or Area' in Arizona,[4] which became later[5] his 'Arid Lower Sonoran Zone,' and is, as a whole, the same as his 'Lower Sonoran.'

It thus appears that extra-tropical North America may be separated into about six transcontinental belts or zones, for the purpose of conveniently correlating the numerous faunæ of the continent, as follows:

(1) An Arctic or Hyperborean Zone, coëxtensive with the American portion of the Arctic Realm.

(2) A Subarctic, Hudsonian or 'Spruce' Zone.

(3) A Cold Temperate, Canadian, or 'Douglass Fir' Zone.

(4) A Temperate or Alleghanian Zone.

(5) A Warm Temperate or Carolianian Zone.

(6) A Subtropical or Louisianian Zone.

## Tropical North America.

It has long been recognized that the extreme southern portion of the Peninsula of Florida, the lower portion of the Rio Grande Valley, and a narrow belt extending thence northward for a

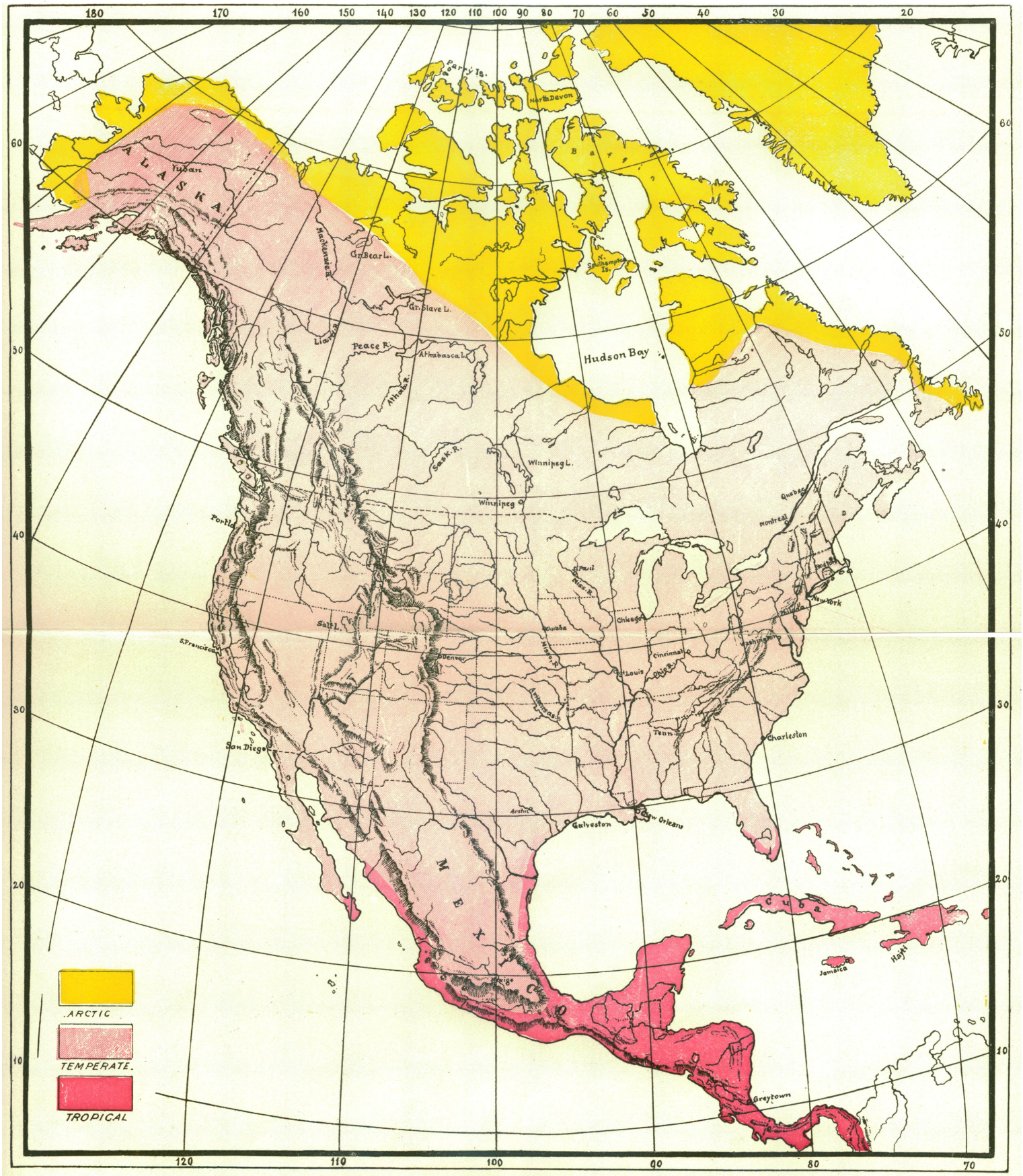
[1] In biology 'aberrant,' 'transition' or intermediate genera are frequently met with, and in some cases it is difficult to refer them to one of the two subfamilies to which they are allied rather than to the other. Yet we feel compelled to refer them to one or the other, or else to make a new subfamily for the aberrant genus, in case it shows sufficient differentiation, rather than to leave it as an isolated genus, with the rank of a genus, to be interposed between two subfamilies, or families, as the case may be.

[2] N. Am. Fauna, No. 3, pp. 12 and 20.

[3] *Ibid.*, No. 5, p. 25, and Proc. Biol. Soc. Washington, VII, p. 27.

[4] *Ibid.*, No. 3, pp. 13 and 20.

[5] Proc. Biol. Soc. Washington, VII, p. 28.

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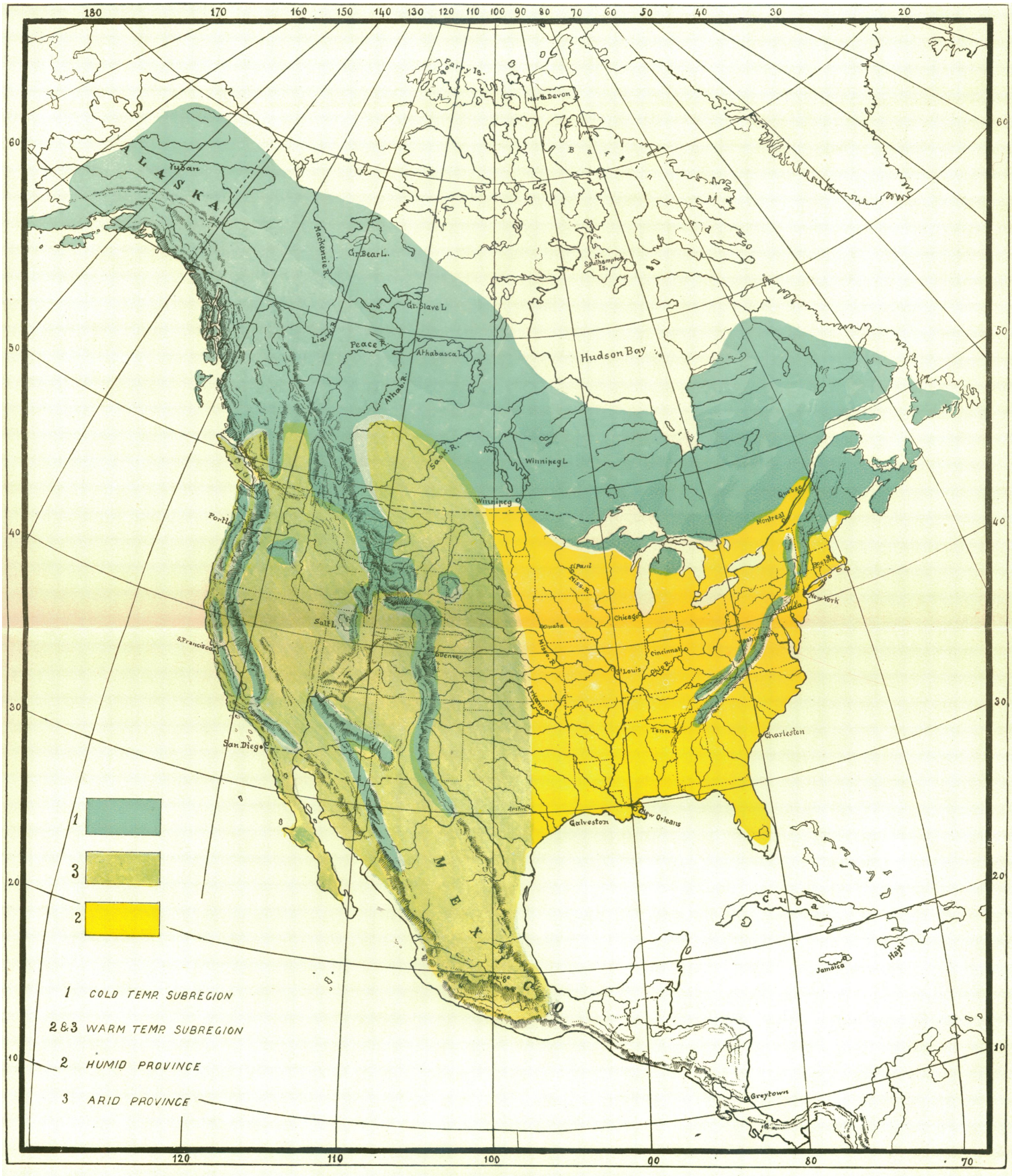
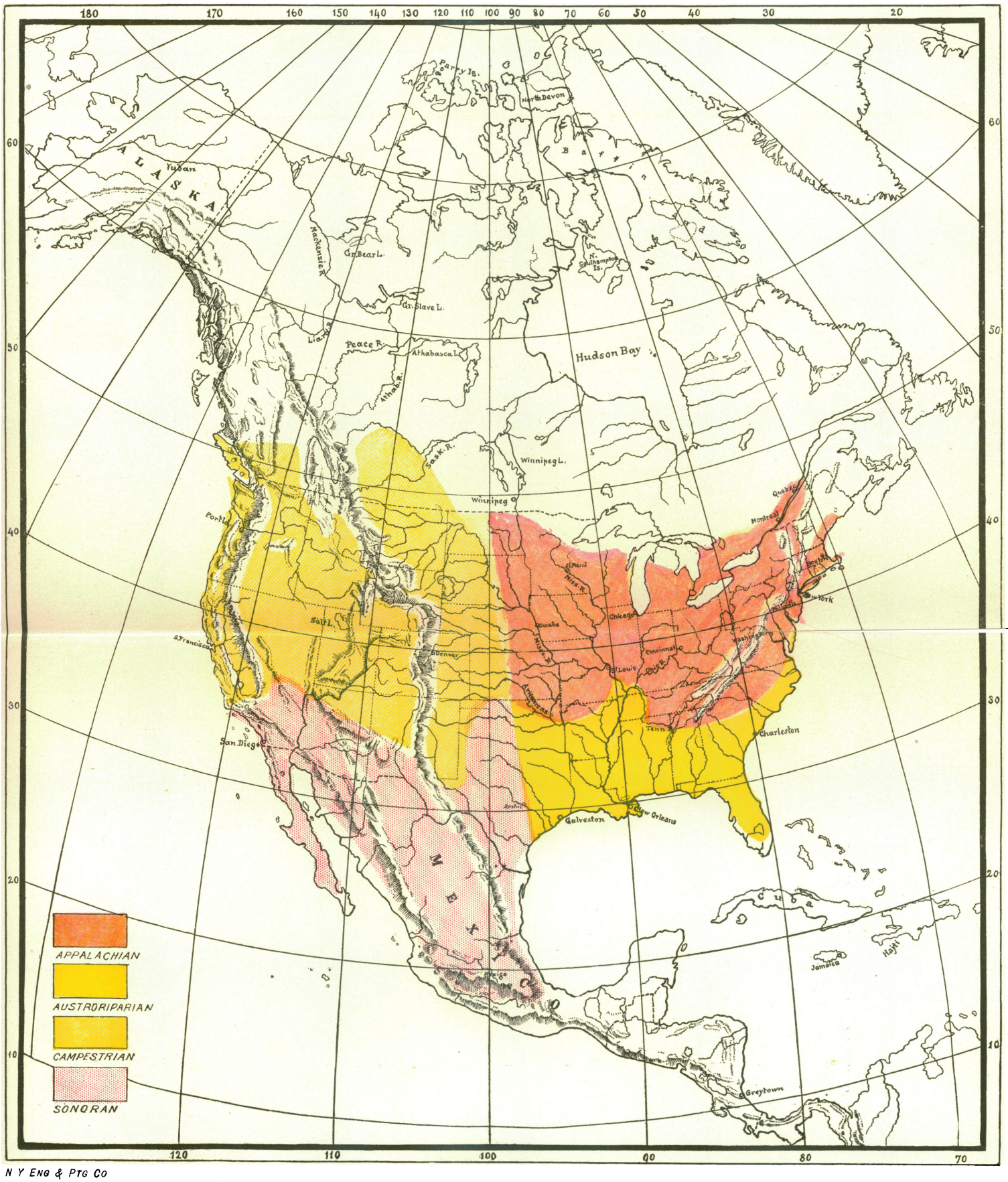
REALMS.




NORTH AMERICAN REGION.

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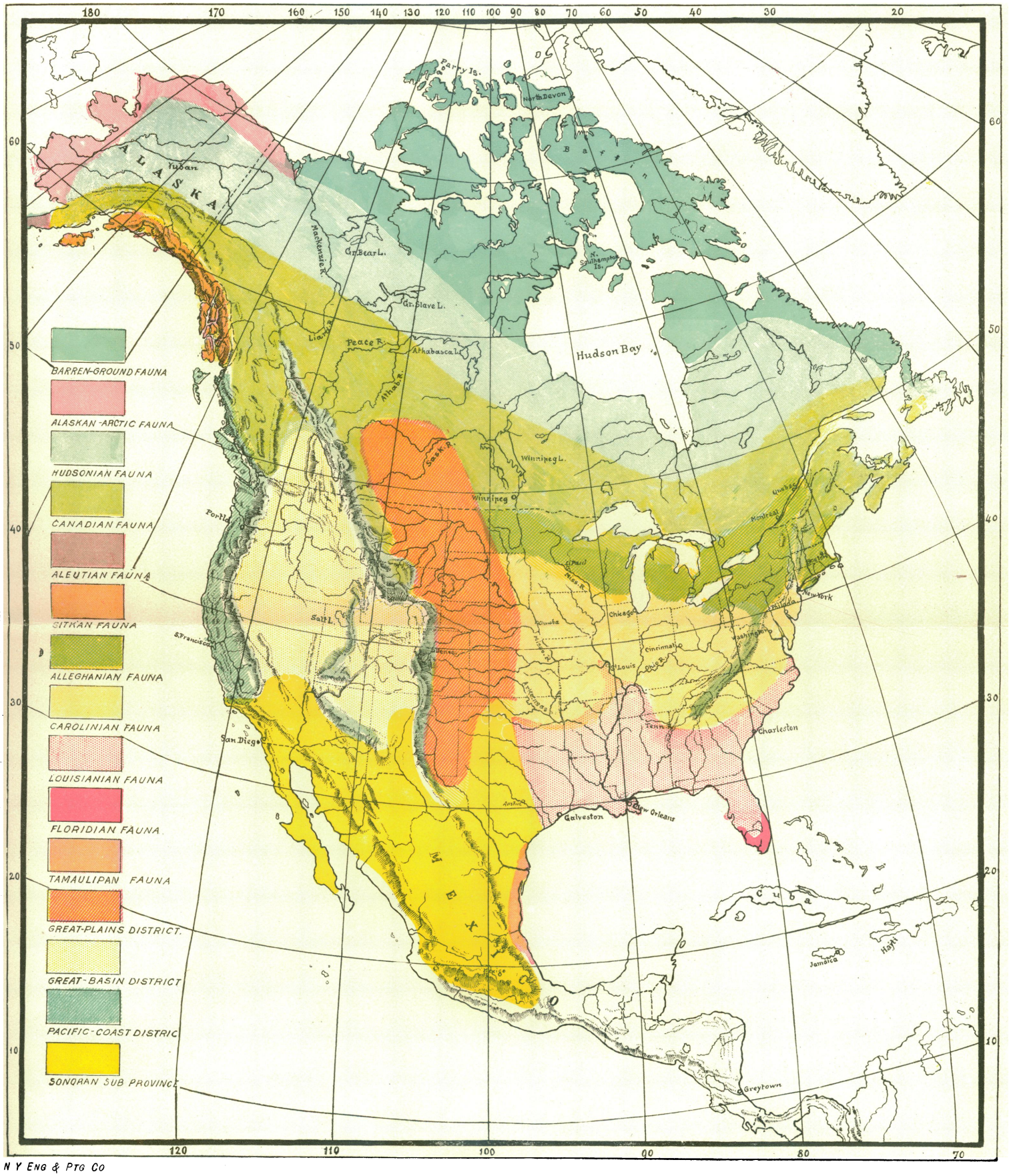
SUBPROVINCES.

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DISTRICTS AND FAUNAS.

short distance along the Texas coast contain such a strong infusion of tropical types as to render these limited areas properly referable to the Tropical Realm, to which belong also all of the lowland of Mexico, including a narrow coast belt extending from the Rio Grande southward on the eastern coast and from Mazatlan southward on the western coast.

The fauna of neither of the tropical areas within the United States is typically tropical, but the infusion of tropical elements is so great as to render them tropical rather than temperate. They have also little in common with each other, as would be naturally anticipated from their wide geographical separation through the interposition of the Gulf of Mexico, thus preventing a tropical land connection. Consequently the Floridian area, or the *Floridian Fauna*, as it has long been technically known,[1] belongs to the Antillean Region of the American Tropical, while the Texan area is an outlying arm of the Central American Region of the American Tropical.

*Floridian Fauna.*—So far as mammals are concerned the Floridian Fauna has few distinctive elements. It has, however, a peculiar subspecies of the Wood Hare, and also of the Cotton Rat, and several species of Field Mice of the genus *Sitomys;* and the Manatee is a characteristic animal of the coast lagoons and rivers. From the standpoint of birds, insects, mollusks and plants, the Floridian Fauna is strongly characterized, not less than a dozen distinctly tropical genera of birds being represented, with a much larger infusion of tropical insects and mollusks.[2] Among the tropical birds which occur more or less regularly may be mentioned the Man-o'-War Bird, the Flamingo, the Florida Burrowing Owl, four West Indian species of Pigeons, the Ani, the Mangrove Cuckoo, the Dusky Seaside Sparrow, the Grassquit, the Black-whiskered Vireo, the Bahaman Honey Creeper, and various peculiar subspecies of northern birds.

*Tamaulipan Fauna.*—This semitropical area occupies the extreme lower portion of the Rio Grande Valley, probably not extend-

[1] *Cf.* Bull. Mus. Comp. Zoöl., II, 1871, p. 391.—The general provisional northern limit here given—"near the latitude of Lake George"—proves to have been carried a little too far north, its limits as now recognized being Cape Malabar on the east coast and Tampa Bay on the west coast. (*Cf. Merriam*, Proc. Biol. Soc. Washington, VII, 1892, p. 33.)

[2] *Cf.* Merriam, Proc. Biol. Soc. Washington, VII, 1892, pp. 52–54.

ing much above Hidalgo, and thus limited to within about the 100-foot contour line. It extends along the coast, mainly within the same contour line, northward to about the mouth of the Nuesces River, thence gradually fading out northward, a few tropical forms extending as far north as the mouth of the Colorado River, where a number of Louisianian forms gradually disappear. South of the Rio Grande it occupies the low coast region of Mexico southward nearly to Tampico. It thus includes the greater part of the State of Tamaulipas, and the southeastern part of the State of Nuevo Leon. Among mammals the following distinctively tropical forms are either limited in their northward range by the Tamaulipan Fauna, or extend but a little way beyond it:

Tatusia novemcinctus,
Heteromys alleni,
Dipodomys phillipsii,
Sigmodon hispidus texianus,
Oryzomys aquaticus,
Sitomys mearnsii,[1]
Atalapha intermedia,
Nasua narica,
? Putorius brasiliensis frenatus,
Felis eyra,
" yaguarandi,
" onca,
" pardalis.

The last two have been reported from as far north along the Texas coast as the Brazos River, but they are tropical rather than warm temperate species. *Dicotyles tajacu* also properly belongs here, though ranging a little further to the northward than do the others.

Among tropical birds that here reach their northern limit are the following:

Podiceps dominicus,
Ortalis vetula maccalli,
Engyptila albifrons,
Buteo albicaudatus,
Crotophaga sulcirostris,
Trogon ambiguus,
Nyctidromus albicollis merrilli,
Amazilia fuscicaudata,
" cerviniventris,
Pitangus derbianus,
Myiozetetes texensis,
Xanthoura luxuosa,
Embernagra rufivirgata,
Sporophila morelleti sharpei,
Euphonia elegantissima,
Vireo flavoviridis,
Compsothlypis nigrilora,
Geothlypis poliocephala palpebralis,
Basileuterus culicivorus,
Harporhynchus longirostris sennetti.

The Tamaulipan Fauna has fewer distinctively tropical types than would be expected from its low altitude and geographical position. This is doubtless due to the extreme aridity of the

[1] = *Vesperimus mearnsii* Allen, Bull. Am. Mus. Nat. Hist., III, p. 300.

country, since in the forest regions further inland under the same parallels Trogons, Motmots and Parrots occur to a much greater extent than in the arid, nearly treeless coast region.

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*Tabular Synopsis of the Faunal Areas of North America.*

REALMS.
- Arctic.
- North Temperate.
- American Tropical.

REGIONS.
- North American. < *North Temperate Realm.*
- Central American. } < *American Tropical Realm.*
- Antillean. }

SUBREGIONS.
- Cold Temperate. } = *North American Region.*
- Warm Temperate. }

PROVINCES.
- Humid. } = *Warm Temperate Subregion.*
- Arid. }

SUBPROVINCES.
- Appalachian. } = *Humid Province.*
- Austroriparian. }
- Campestrian. } = *Arid Province.*
- Sonoran. }

DISTRICTS.
- Great Plains. }
- Great Basin. } = *Campestrian Subprovince.*
- Pacific Coast. }

FAUNÆ.
- Barren Ground. } *Arctic.*
- Alaskan-Arctic. }
- Aleutian. }
- Hudsonian. } *Cold Temperate.*
- Canadian. }
- Sitkan. }
- Alleghanian. }
- Carolinian. } *Humid Warm Temperate.*
- Louisianian. }
- Floridian. } *Tropical.*
- Tamaulipan. }