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THE GEOGRAPHICAL ORIGIN AND DISTRIBUTION OF NORTH AMERICAN BIRDS, CONSIDERED IN RELATION TO FAUNAL AREAS OF NORTH AMERICA.[1]

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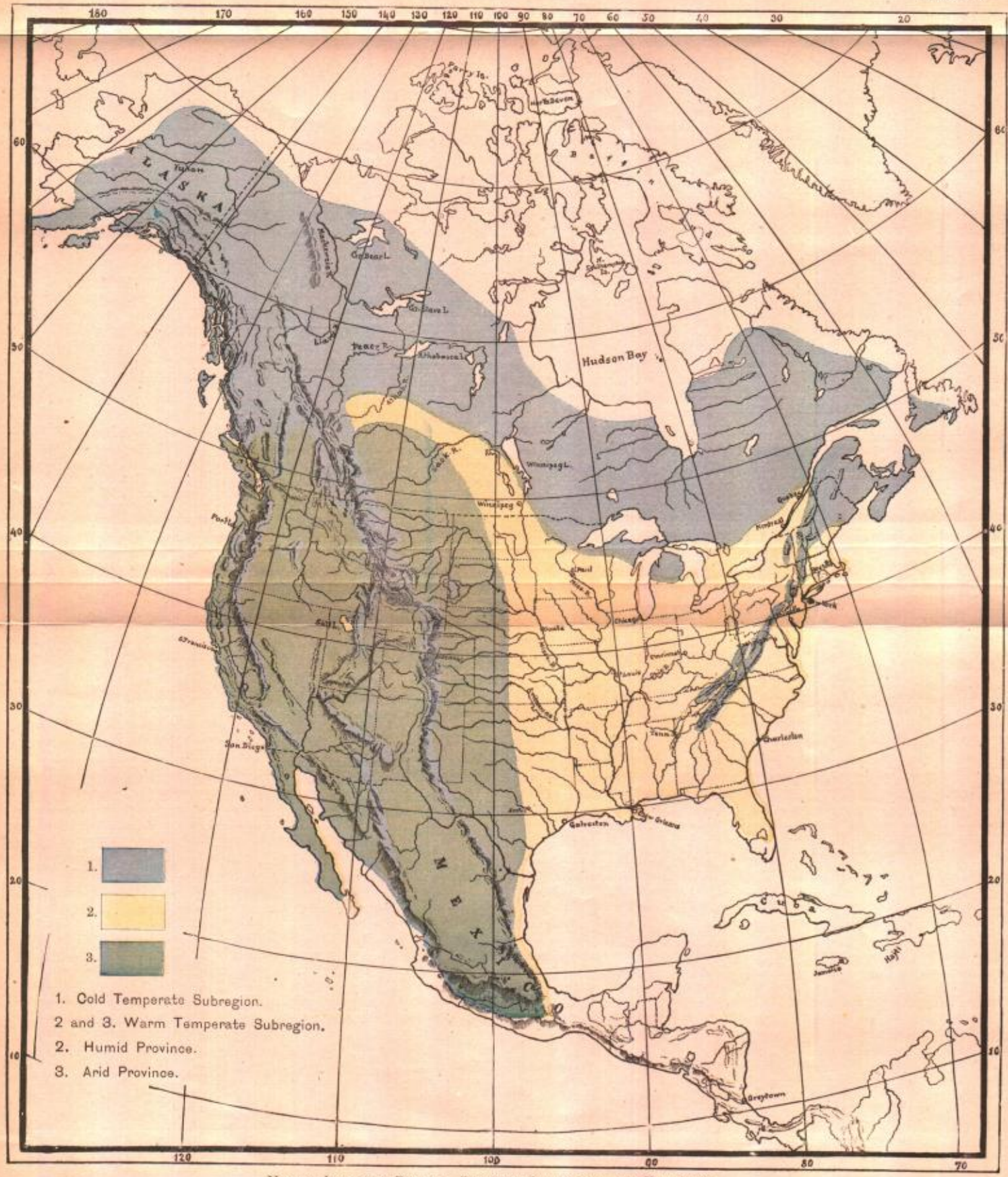
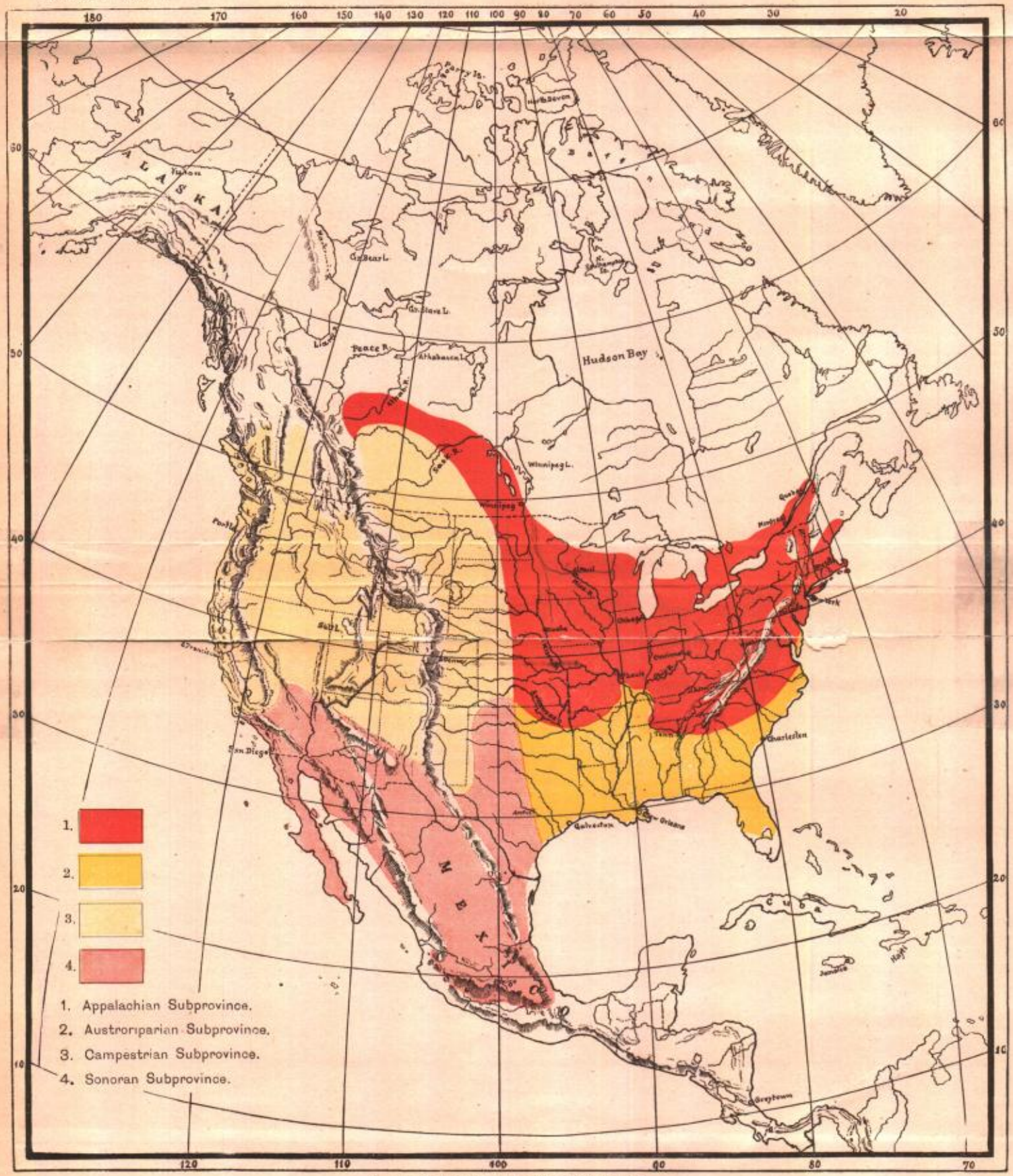
THE PRESENT paper consists essentially of two parts. The first treats of the probable geographical origin and present distribution of the genera of birds represented in North America, regardless of any inferences that may be drawn from this general presentation of the facts of the case; the second relates to the subdivision of the continent into faunal areas of various grades, with reference to their relationships, classification and nomenclature. No very novel views, nor many new facts are presented, the paper being in great measure a restatement of generally known facts in a new sequence, with a view to giving them greater emphasis in their bearing upon the special subject in hand. The leading ideas here embodied have already been set forth by the writer in other connections,[2] but the evidence is here for the first time presented

[1] Read before the Tenth Congress of the American Ornithologists' Union, held in Washington, D. C., Nov. 15–17, 1892.

[2] See the author's recent paper, 'The Geographical Distribution of North American Mammals' (Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, pp. 199-243, pll. v-viii), and the earlier papers there cited.



NORTH AMERICAN REGION—SHOWING SUBREGIONS AND PROVINCES.



SUBPROVINCES OF THE WARM TEMPERATE.

in detail from the standpoint of birds. As an introduction to Part I a few pages are devoted to questions having a more or less direct bearing upon the general subject.

I.—The Geographical Origin and Distribution of North American Birds.

It has long been recognized by nearly all writers on geographical biology that the two leading factors governing the distribution and dispersal of life over the globe are the land connections which now exist, or have formerly existed, between the principal land masses, and climate; and that by far the most potent of the climatic influences is temperature. In considering the faunal relations of North America to the Old World, it is important, therefore, to keep in mind the present slight separation of northern North America from Eurasia, and that, as currently believed by many geologists, the shallow basin now forming Bering Sea was at one time dry land, and thus formed a broad land connection between northwestern North America and northeastern Asia, during at least a portion of the Tertiary.

As is well known, a large proportion of the genera, and many of the species, of both animals and plants occurring in North America have a circumboreal distribution, even in many cases where their present habitats do not extend quite to the Arctic regions. Furthermore, that many genera, particularly of birds, which are at present limited to the warm temperate and tropical latitudes, are common to both the Old World and the two American continents. It is, in certain cases, hard to see how their present dispersion could have been brought about under the geographic and climatic conditions now existing. Geology here comes to our assistance, furnishing evidence that in earlier times the climate of the globe was not only more uniform, but also much warmer over the regions now buried half the year under snow and ice. It is well known that in Miocene times a warm temperate flora prevailed over the present Arctic regions, and that subtropical plants flourished in Central Europe and in corresponding latitudes in North America. Also that many types of mammals, now represented only in the tropics, formerly ranged over the greater part of the northern hemisphere, as shown by their fossil remains, long

since buried in the Tertiary deposits of both North America and Eurasia. Furthermore, there is abundant evidence of a considerable interchange of life between the two northern continents at a time when there was no climatic barrier, as now, to the northward extension of subtropic types; and that Eurasia was in part populated by types originating in North America; and also that North America has derived a portion of its life from the Old World. There is no reason to suppose that birds were then any less restricted in their means of dispersion than now, in comparison, for example, with mammals, insects, land mollusks and plants.

The past history of birds, while so defective in comparison with that of some other groups, affords proof of the former much wider dispersion of certain types than obtains at the present time. While for this class the geological record is so imperfect, it suffices to show that what are now strictly tropical genera, for example, formerly reached southern and central Europe. It also affords evidence that birds in Tertiary times were not so very different from the birds of to-day. The leading genera of the raptorial, gallinaceous, wading and swimming birds were much the same as now[1]; with them existed other genera which have since become extinct, while many of the now prevalent forms were absent, and have doubtless come later into existence. The

[1] Among the existing genera of birds found in the Tertiary of Europe and North America are the following, most of which date back to the Miocene, and some to the Eocene.

Struthio	Olor	Columba
Colymbus	Phœnicopterus	Buteo
Podiceps	Leptoptilus	Aquila
Podilymbus	Ibis	Falco
Uria	Ardea	Milvus
Larus	Grus	Strix
Sterna	Rallus	Bubo
Puffinus	Fulica	Psittacus
Phaëthon	Phalaropus	Picus
Sula	Scolopax	Leptosoma
Phalacrocorax	Tringa	Trogon
Pelecanus	Totanus	Callocalia
Merganser	Numenius	Corvus
Anas	Charadrius	Scolecophagus
Spatula	Coturnix	Passer
Anser	Phasianus	Sitta
Branta	Meleagris	Motacilla

fragile nature of most bird skeletons, and the small size of the greater part of the species, and the fact that only those of more or less aquatic habits would be liable to rapid entombment under conditions favorable for their preservation, are circumstances which render hopeless any expectation of the future discovery of the ancestral lines of the great bulk of our present avian fauna.

Two hypotheses, however, may be hazarded regarding the present limited distribution of many groups now restricted within comparatively small areas. First, that they had not only a local origin, but that for some not very obvious reason they have always had a local distribution, as for example the Todies in the West Indies, and various South American and tropical Old World types. Second, that they have become specialized since the close of the Tertiary, with adaptations to a tropical or semi-tropical environment.

There is evidence that towards the close of the Tertiary a marked change in the earth's climate took place, culminating in the Glacial Period, during which the whole northern half of the northern hemisphere became covered with a heavy ice cap, lasting for possibly thousands of centuries, and extending its chilling influence nearly to the northern tropic. The rise of the glacial period was of course gradual, and the southward progress of the great ice cap drove before it all forms of life capable of any considerable power of locomotion, while those unable thus to escape must have perished from cold. There was hence a great crowding together of exiles from the north into the more favored regions to the southward, leading to an intense struggle for existence, and a weeding out on a grand scale of forms least fitted for the contest. This period must thus have been one of great activity in the evolution of new types. Opportunity was given for the gradual adaptation of many forms to a lower temperature than that to which they had been accustomed, and to an enforced change of food. The recession of the ice fields was accompanied by the gradual extension northward of habitable land. A broader area becoming available in summer than in winter an annual migration for a greater or less distance on the part of the pioneer life became a necessity. Finally the ice receded to its present limits and the whole north, under radically altered climatic conditions, became again available for occupation by the more or less modified descendants of the pre-glacial exiles. To some of

these a comparatively low temperature had doubtless become congenial, and from them may have been derived the distinctively arctic and subarctic birds of the present age. They belong mainly to our present circumboreal genera, and are unrestricted by climatic conditions in their dispersal throughout the arctic and subarctic regions.

Other forms proved less flexible, and remained in latitudes more nearly corresponding to the climatic conditions of preglacial times. They had, however, before the beginning of the Glacial Period, become broadly dispersed, and now are found in widely disconnected areas. We have thus a reasonable explanation of the disconnected distribution of congeneric species in such groups as the Tree Ducks, Egrets and Herons, Spoonbills, Flamingoes, Snakebirds, Gannets, Gallinules, Barn and Pigmy Owls, Kites (genus *Elanus*), Trogons, Barbets, Kingfishers, Swifts, Goatsuckers, Piculets, and a few Passerine birds. On the other hand, doubtless many of the peculiar tropical types of land birds were already restricted to somewhat near their present limits, and that they have never had a much wider dispersion than they have at the present day. Many of them are also possibly of comparatively modern origin. It is only on this supposition that we can account for the numerous peculiar types that at present characterize the subtropical and tropical areas of the several continents.

It is not probable, for example, that such exclusively tropical American families as the Formicariidæ, the Dendrocolaptidæ, the Galbulidæ, the Todidæ, the Toucans, the Motmots, the Cotingas, etc., have ever had a much wider range than now. It seems also probable that such distinctively American types as the Hummingbirds, the Icteridæ, the Tyrant Flycatchers, the Tanagers, the Vireos and the Mniotiltidæ, which for the most part have their centers of abundance in the tropics, with merely outlying members in temperate North America, have never had a wider range than at present, and that most of their outlying genera and species have, under the intense struggle for existence in the overcrowded tropics, become gradually somewhat modified to adapt them to slightly more boreal conditions, thus in course of time more or less extending the general habitat of the families to which they respectively belong. At the far north they are still cut off from further extension by an insuperable

climatic barrier, and have thus been unable to reach any part of the Eurasiatic continent.

The Glacial Period and the change of climate it produced has not only had a profound and permanent influence upon the distribution of life in the northern hemisphere, but proved a powerful agent in the evolution of new types, and in the extinction of old ones; it also left its impress upon the majority of northern birds through the development in them of the habit of migration: for it is now generally conceded that this habit must have originated in consequence of the great reduction of temperature beginning about the close of the Tertiary. Prior to this period, owing to the comparatively uniform climatic conditions then obtaining almost everywhere, there could have been no necessity for extended periodic movements. Later a nearly uniform temperature throughout the year gave place in northern latitudes to warm summers followed by winters of great severity. During the waning of the ice period the area offering a congenial summer home to a great multitude of birds became greatly extended, from which, however, they were driven by semi-arctic winters to seek favorable winter haunts further southward.

We have here what seems a natural and reasonable hypothesis for the origin of migration, and one now currently accepted by ornithologists. In this way, it is believed, the habit of migration not only originated but has become established as an irresistible hereditary impulse, as inherent and mandatory as the 'instinct' of reproduction.

In this connection, a few words may not be out of place respecting the question, Why do birds migrate? In considering this question, it should be borne in mind that there is everywhere, and has ever been, a constant and intense struggle for existence—that throughout nature the birth rate is far above the possibilities of permanent increase. Hence, in the bird world, as elsewhere, every station affording favorable conditions for existence must be occupied; there can be no unutilized areas. Many birds are organized to subsist only upon insects or soft fruits, or upon both combined; such food abounds in summer far to the northward of where it can be obtained in winter. Thus some of our Swifts, Swallows and Flycatchers range in summer almost to the borders of the Arctic Circle, where for a few weeks in summer they find abundance of food and a congenial temperature. Here they

bring forth their young, but are forced to retire at the approach of autumn, retreating gradually before the southward advance of colder weather, passing through the middle latitudes in September, and reaching the tropics in October or November, the time varying more or less with different species. Here they remain till the increased warmth of March or April, or the stimulus of the approaching breeding season admonishes them of the necessity of revisiting their breeding stations, when they begin to retrace the journey toward their summer haunts, keeping pace so exactly with the advance of the season as not to lose even a day of the brief interval available for their sojourn in their far northern home. They are thus wanderers—exiles, as it were,—for three fourths of the year. Evidently our northern-breeding insectivorous and berry-eating birds could not survive a winter at their breeding grounds. They might perhaps be able to pass the whole year in the tropics, or in the lower temperate latitudes,—at the risk, however, of over-crowding the regular occupants, and also of leaving a habitable area unoccupied. As a matter of fact, nature not only 'abhors a vacuum,' using the phrase in a strict sense, but allows no waste places; living space is always at a premium. Near relatives of our subarctic and cold temperate insectivorous birds are found in the tropics and throughout the temperate latitudes; while the tropical forms are non-migratory, those breeding in the temperate latitudes are less so than their more northern kin; they remain, owing to the longer summer, for a greater length of time at their breeding stations and have a shorter journey to reach their winter haunts.

This may serve as a general illustration, showing that the absence of proper food in the high north forces the summer insectivorous birds to leave these regions for warmer latitudes, where can be found the food their peculiar organization renders necessary. In short, as our knowledge of the habits and migrations of birds increases, it becomes more and more evident that the cause of the autumnal migration is failure of proper food at the breeding station.

Why migratory birds ever leave their winter haunts seems at first sight less obvious, since in most instances it can hardly be due to failure of the food supply, nor to any absolute incompatibility of climate. The return in spring is often attributed to strong home love, evidence of the existence of which is shown by the

return of birds to the same locality—even to the same nesting site—for many successive years. There is so much indubitable proof of this, that it is commonly assumed as the rule in most species. It is certainly beyond question that birds do not select their breeding stations in any hap-hazard way, journeying north along a vague course and stopping to nest wherever the proper conditions of season and other surroundings happen to prove favorable. Hence the impulse that governs their spring movements has been loosely termed the 'home instinct.'

If we consider that migration consists really of two movements—that is from the breeding station to the winter quarters and then back again—and that the one movement is the necessary complement of the other, it is hardly necessary to seek for a separate cause for the two movements; the two together constitute migration in a complete sense, which, as already explained, is an inherited habit,—an inherent, irresistible impulse, closely blended with the function of reproduction. The promptings which lead to the migratory movement, respectively in fall and spring, have unquestionably a different origin; the autumnal movement being doubtless prompted by a reduction of temperature and a failing food supply, while the spring movement is incited by the periodic activity of the reproductive organs, resulting in the necessity for the return of the species to the peculiar conditions and surroundings to which for long ages it has been undergoing special adaptation—in other words, to its home.

In the present paper, North America is considered in its faunal rather than its geographical sense, and in the synopsis here following the area covered by the A. O. U. Check-List and its Supplements is the region mainly considered, namely, North America north of Mexico, but including the peninsula of Lower California. The number of species now recognized in the A. O. U. Check-List as occurring within this area is about 795, with nearly 270 additional subspecies, making a total of about 1065 species and subspecies. These are arranged under 303 genera, with about 65 additional subgenera. Of these, however, 75 species and 25 genera occur merely as accidental stragglers from the Old World, the West Indies and Mexico. Deducting these as not valid components of the North American fauna, leaves about 720 species and 278 genera as legitimately North American, under the present restriction of the term. In the following

synopsis, subgenera will be in the main ignored, as their consideration is found to rarely modify the results derived from a consideration of the genera. Unless otherwise stated, the breeding range alone is taken into account.

The Pygopodes, as recognized in the A. O. U. Check-List, consist of three families, Podicipidæ, Urinatoridæ, and Alcidæ. The Podicipidæ constitute a small, well circumscribed group, of almost universal distribution, and of great antiquity, dating at least from the Miocene, with a closely related ancestral form in the Eocene. The number of genera recognized varies from two to half a dozen or more, according to the views of different systematists. Most of these so-called genera, however, are little more than subgenera, and as such are geographically limited to particular regions, some being tropical or austral, while others are confined to the temperate portions of the northern hemisphere, where they have a circumpolar distribution, as *Colymbus* and *Dytes* of the North American fauna. *Æchmophorus*, scarcely more than a well-defined subgenus, is confined to western temperate North America, though allied to a connectent form between *Æchmophorus* and *Colymbus* in South America. It is thus a distinctively American type. *Podilymbus*, consisting of a single species common to a large part of both North and South America, is quite sharply separated from the other members of the family, as a type peculiarly American, fossil remains of which, according to Dr. Shufeldt, occur in the Pliocene deposits of Oregon.

The Loons, forming the family Urinatoridæ, are distinctively northern, and to a large degree arctic or subarctic, though some of the species range in the breeding season throughout the cold temperate latitudes. It is a compact, sharply defined group, consisting of a single genus and less than half a dozen species; nearly all of them are circumboreal, none being distinctively American. The Loons form one of the early types, having survived with apparently little change from the close of the Eocene.

The Alcidæ, more numerous in genera and species than either the Grebes or Loons, are, like the Loons, a strictly northern type, several of the genera being among the most arctic of birds. With a superficial resemblance to the Penguins of the antarctic seas, but no close kinship, they may be regarded as their arctic repre-

sentatives in the rôle they fill in nature's economy. The Auks number 13 genera and about 24 species, displaying considerable diversity in size and form, and especially in the size and structure of the bill, and in the character of the nuptial ornaments. Considering their high northern range, one is struck with the greatly circumscribed distribution of many of the genera, only five out of the 13 being circumpolar, three being confined to the shores of the North Atlantic and Eastern Arctic Oceans, and five to the shores of the North Pacific and Bering Sea. Their limited distribution and diversity of structure indicate a plastic group of comparatively modern development. Being maritime species, none of even the non-circumpolar species can be claimed as distinctively either North American or Eurasiatic. In favor of their recent origin is the fact that, while almost arctic in habitat, few of the genera have acquired a circumpolar distribution, as they would in all probability have done had they existed in the same diversity in preglacial times. The locally restricted forms, moreover, occupy a region where food is exceptionally abundant.

Of the three families of Longipennes, — Stercorariidæ, Laridæ and Rynchopidæ, — the first is arctic, the second of world-wide distribution, and the third essentially tropical. Even the genera of the Longipennes are for the most part either circumpolar, cosmopolitan or tropicopolitan. Not a single genus is distinctively North American, and many of the species are either circumpolar or nearly cosmopolitan.

The Tubinares are so largely pelagic, so wide-ranging, and for the most part so little known as regards their breeding stations, that they will be dismissed without further consideration.

Of the six families of Steganopodes four — Phaëthontidæ, Sulidæ, Anhingidæ and Fregatidæ — are essentially tropical; another, Pelecanidæ, is semi-cosmopolitan, being found almost everywhere outside of the arctic and subarctic regions. The remaining family, the Cormorants (Phalacrocoracidæ), is universally distributed, though the species are largely maritime rather than inland, where they frequent only the larger rivers and lakes. Not a single genus of this whole order is distinctively North American. They are all birds of strong flight, and are apparently old types which have long had a wide distribution, the remains of Gannets, Cormorants and Pelicans occurring in deposits of Miocene age in both North America and Europe.

The Anseres are also a cosmopolitan group, containing many genera of very wide distribution. Particular styles of the Anserine type, however, have been developed over particular regions, as in South America, Australia, and in the Old World tropics. Of the 23 North American genera four only are peculiar to this continent, namely, *Lophodytes*, *Charitonetta*, *Camptolaimus*, and *Chen*, closely allied respectively to the circumpolar genera *Merganser*, *Glaucionetta*, *Somateria* and *Anser*, and are thus obviously derived from northern stock. *Histrionicus* is also almost wholly confined to the northern half of North America, while *Arctonetta* and *Philacte* occur only along the arctic coasts of Alaska and Siberia, like several of the genera of the Alcidæ. *Dendrocygna* is tropicopolitan, barely reaching the southern border of the area here under consideration. *Anas*, *Dafila*, *Spatula*, and *Erismatura* are nearly cosmopolitan. The remaining 14 genera of Ducks, Geese, and Swans are circumpolar, and most of them pass the breeding season in the cold temperate or subarctic regions. Thus of the Anseres only about one sixth of the genera are distinctively North American, and in every case are only slight modifications of circumpolar types, and hence of boreal origin, of probably comparatively recent date.

The Odontoglossæ, or the Flamingoes, are tropical,—a small, structurally widely isolated group, dating at least from the Miocene. A single species barely reaches our southern border, though in Pliocene and Post-Pliocene times Flamingoes ranged much farther north than now, both in Europe and North America, and were doubtless more numerous in species, the Flamingoes being a waning group.

Of the Herodiones, the Spoonbills, the Ibises, and the Storks are for the most part tropical, and hence do not enter prominently into the North American fauna. *Ajaja* and *Guara* are tropical American; *Plegadis* is subcosmopolitan and slightly more northern; *Tantalus* is also essentially tropical American, but has closely related forms in the Old World tropics. Our Herons all belong to nearly cosmopolitan genera and subgenera, many of the species being closely representative of Old World forms of corresponding latitudes. The North American Herodiones thus present no forms distinctively American.

The Paludicolæ afford us one form, *Aramus*, peculiar to America, but it barely reaches our southern border. Of the

other genera, *Grus* is common to the whole northern hemisphere; *Rallus* and *Porzana* are almost cosmopolitan, as are likewise *Gallinula* and *Fulica*, leaving only *Ionornis* as peculiar. This, however, is tropical American rather than North American, and has closely allied forms in the Old World tropics. The group is thus not only widely dispersed but of known great antiquity, the fossil remains of *Grus*, *Rallus* and *Fulica* having been found in the Eocene and Miocene deposits of Europe and in the Pliocene of North America.

The six families of the Limicolæ also afford very few peculiar North American genera, and these occur where, at first thought, they would be least expected, namely, among the Snipes and Sandpipers. Of the Phalaropes *Steganopus*, a subgenus of *Phalaropus*, is exclusively North American and the most southern in distribution of the three known species of the group, the others being both arctic and circumboreal. It is also of interest to note that, according to Dr. Shufeldt, its remains occur in the Post-Pliocene deposits of southeastern Oregon, rendering it certain that North America was within the pre-glacial range of the group.

The Stilts and Avocets, on the other hand, are of nearly world-wide distribution, being absent from only the cold temperate and arctic portions of the globe. The same is true also of the Oyster-catchers. The Surf-bird, genus *Aphriza*, is an isolated type of extended range on the Pacific coast of both North and South America during migration; its breeding haunts have as yet escaped discovery.

The two remaining families are the Scolopacidæ and the Charadriidæ. Of the former fifteen genera are represented in North America. One only, *Gallinago*, may be termed cosmopolitan. Of the other fourteen, six are circumpolar, and *eight* are distinctively North American, the North American genera being *Philohela*, *Macrorhamphus*, *Micropalama*, *Ereunetes*, *Symphemia*, *Bartramia* and *Tryngites*. Three of them breed from the cold temperate southward. Three of them are also restricted to eastern North America, while the other two—*Ereunetes* and *Macrorhamphus*, both monotypic—have each developed an eastern and a western subspecies. *Heteractitis* has a representative in Alaska and another in Eastern Siberia. Of the two genera of Charadriidæ, one, *Charadrius*, is arctic and circumboreal; the other, *Ægialitis*, is cosmopolitan.

We have now passed rapidly in review the Swimmers, Waders, and Shore-birds, with the following results: Total number of genera, 93; of which 74, or 80 per cent., are either cosmopolitan, tropicopolitan, circumpolar, or subcircumpolar, leaving 19, or 20 per cent., as American, of which only 11, or about 12 per cent., are distinctively North American; one half of these belong to the single family Scolopacidæ.

The North American Gallinæ number 12 genera, of which one, *Ortalis*, is tropical, while *Meleagris* is partly so. The remaining ten genera fall into the two subfamilies, Perdicinæ and Tetraoninæ. The four genera of the former are exclusively American; none reach the cold temperate zone, and all range to the southward of the United States; three of them are also exclusively western. Their metropolis is Mexico, where all occur, and where they have their greatest numerical representation. They have no representatives in South America, and no near relatives in any part of the Old World.

The Tetraoninæ are as emphatically northern as the Perdicinæ are southern. Of the six North American genera, three are circumboreal, one (*Tympanuchus*) is practically eastern, though formerly, in Post-Pliocene times, according to Dr. Shufeldt, ranging to Oregon; the remaining two, *Pediocætes* and *Centrocercus*, are western.

Of the eight genera of Pigeons, one, *Columba*, is subcosmopolitan; two, *Ectopistes* and *Zenaidura*, are North American, though the breeding range of the latter extends to the tropics; the remaining five are tropical American, of which four barely cross our southern border. The Columbine element in our fauna is thus obviously of tropical American origin.

Of the Birds of Prey, the three genera of Vultures are of course tropical American in origin, and still largely so in distribution, reaching only the warmer parts of North America. Of the sixteen genera of the Falconidæ, nine are either circumboreal or subcosmopolitan, and these all date back, with about the same distribution as now, to the Miocene, while some are known from the Eocene. The remaining seven genera must be ranked as tropical, five of them extending but a short distance into the United States. Hence not a single genus of this large family can be classified as distinctively North American. The same remarks are nearly true of the Owls, four of the twelve genera being cir-

cumboreal and mainly subarctic; six others are subcosmopolitan, while two only are American, namely, *Micropallas* and *Speotyto*, both of which have a rather restricted North American range. The latter doubtless reached North America from two sources, the West Indies, from which the Florida stock came, and Mexico, from which the western stock was derived.

Conurus, the only representative of the great order Psittaci, is of course only a northern outlier of the numerous group of tropical American Conures.

Our Cuckoos are all of tropical American origin, only the single genus *Coccyzus* having an extended North American distribution. *Geococcyx* is doubtless of Mexican origin. Our single genus of Kingfishers is subcosmopolitan.

Of our eight genera of Woodpeckers two, *Picoides* and *Dryobates*, are circumpolar, one being subarctic and the other of wide distribution; three are distinctively North American, while three others range at large over most of the two Americas.

Of the three genera of Swifts one, *Chætura*, is nearly cosmopolitan, one is exclusively North American, and one ranges over a large part of both the American continents.

All of the five genera of Goatsuckers, if *Antrostomus* be recognized as separable from *Caprimulgus*, are exclusively American; one only, *Phalænoptilus*, is restricted to North America, while *Nyctidromus* does not pass much beyond the Rio Grande.

Seven of the ten genera of Hummingbirds are essentially tropical, barely extending within our limits, while only one ranges over a very large part of the continent. Of the fourteen species, only one is eastern.

The Tyrannidæ, though preëminently a group of the American tropics, is represented by ten genera in North America; five of them, however, are scarcely entitled to rank as North American, and of the remaining five, only two, *Contopus* and *Empidonax*, reach the cold temperate latitudes.

The only American representative of the numerous Old World family Alaudidæ is the genus *Otocoris*, which ranges throughout the greater part of the northern hemisphere.

The Corvidæ are represented by eight genera, three of which are cosmopolitan and one, *Xanthoura*, is tropical. The other four are not only almost exclusively North American, but two of them are limited to the western half of the continent.

The Icteridæ are of course all American. Of the nine genera represented in North America, three (*Dolichonyx*, *Xanthocephalus*, and *Scolecophagus*) are exclusively North American. The six remaining genera range far into the tropics, two of them being mainly tropical; one of them (*Quiscalus*) is also mainly limited in North America to the eastern half of the continent.

The large cosmopolitan family Fringillidæ is represented in North America by thirty genera, twenty-one of which are strictly American and nine circumpolar. Of the twenty-one American, or twenty-three if we give generic rank to *Passerculus*, *Ammodramus* and *Coturniculus*, as I believe should be done, seventeen are exclusively North American; three others are mainly tropical, and three are shared in common by both North and South America. The Fringillidæ, although a cosmopolitan family, give a high ratio of forms peculiarly North American, amounting to fully 60 per cent. Furthermore, three of the North American genera are strictly western, and two strictly eastern, while five of the nine circumboreal genera are either arctic or subarctic.

The tropical American family Tanagridæ is represented by only two genera, namely, *Euphonia* and *Piranga*, only the latter extending over even the warm temperate portion of the continent, while the former barely reaches our border.

Of the six genera of Swallows none is essentially North American. *Tachycineta*, *Progne* and *Stelgidopteryx* range over both Americas; *Chelidon*, *Petrochelidon* and *Clivicola* are old World, each with a single species in North America.

Of the family Ampelidæ, the genus *Ampelis* is common to the colder parts of the northern hemisphere, but is most likely of American origin; the other genus, *Phainopepla*, is western and southern.

Lanius is the single representative of the very numerous and otherwise exclusively Old World family Laniidæ.

The Vireos range over both Americas, to which they are limited, with their metropolis in Middle America.

The Mniotiltidæ constitute the most characteristic family of North American birds, 70 per cent. of the twenty genera occurring in North America. Considering the family as a whole, three genera are exclusively West Indian; *Basileuterus*, which scarcely reaches our border, is continental and tropical; *Compsothlypis* and *Geothlypis* range throughout the warmer parts of

both continents, being tropical rather than North American, and nearly the same may be said of *Setophaga*. *Granatellus*, *Cardellina* and *Ergaticus* are Mexican and Central American, the two latter barely reaching our Mexican frontier. *Dendroica* is represented by about forty species, of which twenty-four, or about 60 per cent., may be considered as distinctively North American, while eleven, or 80 per cent., of the remaining species are West Indian; two are Central American and one occurs in the Galapagos Islands. Thus, in general terms, about one fourth of the species are West Indian and three fourths North American. The remaining eight genera are strictly North American, while three of them, *Helmitherus*, *Helinaia* and *Protonotaria*, are restricted to the eastern half of the United States, as is also *Compsothlypis*, so far as its United States distribution is concerned. *Mniotilta* is also eastern.

The large and widely dispersed Old World family Motacillidæ has only two genera in North America—*Budytes*, barely reaching Alaska, and the nearly cosmopolitan genus *Anthus*.

Cinclus is a mountain type, common to most of the higher mountain ranges of America and Eurasia.

The Troglodytidæ is almost exclusively an American family, represented in Eurasia by the subgenera *Anorthura* and *Elachura*. A few East-Indian genera are sometimes placed here, as *Sphenocichla*, *Pneopyga*, etc., but I think erroneously. The metropolis of the true Wrens is tropical America, where are found more than nine tenths of all the species of the group. The genera *Cistothorus*, *Thryothorus*, and *Campylorhynchus* extend into the warmer parts of the United States. *Salpinctes* and *Catherpes* are peculiar forms of the West and Southwest, of probably Mexican origin.

The subfamily Miminæ, of late associated with the Wrens, is exclusively American, and four out of the five North American genera doubtless originated near where they are now found. One of them, *Galeoscoptes*, is essentially eastern and one, *Oroscoptes*, is western. *Mimus* is tropical, with a single outlying species in North America.

Of the Paridæ, *Sitta* and *Parus* are found throughout the greater part of the northern hemisphere; *Chamæa*, *Psaltriparus*, and *Auriparus* are mainly limited to the northern border of Mexico and the adjoining tier of States to the northward, a

single species of *Psaltriparus* extending southward to the higher mountains of Guatemala, and another northward along the Pacific coast to Washington.

Certhia and *Regulus* belong to the northern hemisphere, ranging over its northern half; *Polioptila* is tropical American, with outlying species extending across the warm temperate.

The cosmopolitan family Turdidæ is represented by three genera—*Merula*, *Turdus* and *Saxicola*—of wide dispersion, and by two—*Hesperocichla* and *Sialia*—which may be considered as autocthonous; the sixth genus, *Myiadestes*, is tropical American, with a single species in the western United States.

In concluding our review of the land birds, the results may be summarized as follows: Total number of genera, 181; of these 55, or 30 per cent., are circumboreal or otherwise wide-ranging Old World forms; 126 genera, or 70 per cent., are American, of which 35, or 28 per cent., are essentially tropical, leaving 91 genera, or about 50 per cent., as distinctively North American.

Separating the Land Birds into the two categories of Passerine and non-Passerine, we find that of the 75 non-Passerine genera, 36 per cent. are wide ranging Old World forms, leaving 64 per cent. as American, of which latter 40 per cent. are tropical American, leaving 30 per cent. of the whole as strictly North American. Of the 106 genera of Passeres, only 25 per cent. are circumboreal or otherwise widely distributed in the Old World, leaving 75 per cent. as American, of which four fifths are strictly North American, or 60 per cent. of the Passerine genera.

The total number of genera represented in North America (as geographically restricted in the A. O. U. Check-List) of which account is here taken, is 274; of these 129, or 44 per cent., are either circumboreal or widely dispersed over the Old World, leaving 145, or 56 per cent., as American. Of the latter 102 genera, or about 40 per cent of the whole, are distinctively North American, and 43 genera, or about 12 per cent. of the whole, may be classed as tropical American.

Of the distinctively North American genera 57 per cent. have a general distribution over the continent, while of the remaining 43 per cent., 17 per cent. are eastern and 26 per cent. are western.

In order to bring still more closely into relief the extent and manner of the relationship of the North American avifauna to

that of the rest of the world, we will divide the non-tropical part of the continent into three belts, namely: (1) An Arctic, including that part of the continent and its adjacent islands north of about the limit of forest vegetation. (2) The Cold Temperate, limited on the north by the Arctic, and on the south by what is commonly recognized as the Canadian Fauna (see Pl. III). Its southern border thus coincides in a general way with the northern limit of the successful cultivation of the staple grains and fruits of the temperate zone. (3) The Warm Temperate, extending from the southern border of the Cold Temperate to about the edge of the palm belt, or to the hot lowlands of Mexico.

The Arctic belt is inhabited during the breeding season by about 65 genera of birds, of which only 5 are exclusively American; the remaining 60 have either a general circumarctic distribution or occur in Eastern Siberia or on the Arctic coast of Europe as well as in North America. None of the 5 American genera is strictly Arctic; they merely extend into the Arctic from the Cold Temperate, while quite a proportion of the circumpolar genera is strictly Arctic in their breeding range.

In the Cold Temperate belt 120 genera are represented, of which 98 are circumpolar and 22 American. Of these 46, or nearly half of the circumpolar genera, range also into the Warm Temperate belt, as do also 14 of the strictly American genera.

In the Warm Temperate belt 95 genera occur which do not range into the Cold Temperate, of which only 12 are Old World, 83 being exclusively American. In addition 60 genera are common to both the Cold Temperate and Warm Temperate, of which 46 are Old World and 14 American. This gives a total of 155 genera in the Warm Temperate, of which 58 are Old World and 97 exclusively American. Besides these, 50 essentially tropical genera reach or extend somewhat into the Warm Temperate, of which 43 are American and 7 tropicopolitan, increasing the total number of genera occurring in the Warm Temperate to about 205.

These statistics illustrate a number of important points: (1) the rapid increase of bird life in North America from the Arctic regions southward, notwithstanding the fact that the continent steadily and greatly decreases in breadth from the north southward, the number of genera in the Arctic belt being 65, in the

Cold Temperate 120, and in the Warm Temperate 205. (2) The decrease of Old World forms from the north southward, in the Arctic belt 91 per cent. of the genera being circumpolar, 82 per cent. in the Cold Temperate, and 37 to 23 per cent. in the Warm Temperate, according to whether the northern or the southern edge of the belt be considered. (3) As the distinctively American genera increase in passing southward, they became more or less differentiated into eastern and western types. Taking land birds alone, to the exclusion of pelagic and strictly maritime, the number of peculiarly eastern genera increases from two or three in the Cold Temperate to 17 in the Warm Temperate, and in the western from three or four in the Cold Temperate to 26 in the Warm Temperate, exclusive in each case of intrusive, essentially tropical forms which if taken into account would still further differentiate the two regions. Besides, as is well known, many genera which range across the continent are represented by different species on the two sides, while most of the continental species are differentiated into eastern and western subspecies, and frequently into a considerable number of local races.

We may now inquire, Whence was derived the present avifauna of North America? It is evident from the facts already presented that it is made up of four prominent elements. The first consists of types common to a large part of the northern hemisphere, which more and more prevail as we proceed from the south northward, till in subarctic and arctic America we meet with little else. The second consists of a rather strong infusion at the southward of types of almost universal distribution over the warmer temperate and intertropical latitudes. Third, a very prominent tropical American element, developed to the maximum just along our southern border and fading out gradually to the northward, little being left of it after we enter the Cold Temperate. Fourth, a very conspicuous autocthonous element, reaching its maximum in the Warm Temperate, and continuing prominent far into the Cold Temperate. This is made up partly of strongly modified Old World types, but mainly of peculiar genera, or at least peculiar species, derived obviously from tropical American stock, which entered our borders partly by way of the West Indies, but mainly by way of Central America and Mexico.

A large part of the distinctively American element in the North American avifauna seems almost obviously of tropical American origin; for example our Vultures, several genera of our Hawks and Owls, our Cuckoos, most of our Woodpeckers, our Nighthawks, Whippoorwills, Swifts, and all of our Hummingbirds; all of our Flycatchers, Orioles and Blackbirds, and our Vireos and Tanagers; many of our Sparrows and Grosbeaks; all of our Gnatcatchers, and the Mockingbirds, some of our Wrens, and a few of our more southern genera of Warblers, as the Yellowthroats and Redstarts.

It seems probable that another portion originated in Mexico, mainly on the great Mexican Plateau, as the Quails, the Turkeys, and some of our Pigeons; a number of our Woodpeckers; the greater part of our Jays, the Pipilos, the various species of *Peucæa*, *Amphispiza* and *Passerina;* the Titmice of the genera *Psaltriparus*, *Auriparus*, and *Chamæa;* our Wrens of the genera *Catherpes* and *Salpinctes;* the Solitaire, most of the Thrashers, and the Bluebirds.

Doubtless we may properly recognize as autochthonous or indigenous a half dozen genera of Sandpipers, our Prairie, Sharp-tailed and Sage Grouse, our Woodpeckers of the genera *Ceophlœus*, *Xenopicus* and *Sphyrapicus;* the Jays of the genera *Cyanocephalus* and *Cyanocitta* and probably *Aphelocoma;* the genera *Scolecophagus*, *Xanthocephalus*, and *Dolichonyx* among the Icteridæ, and among our Sparrows such genera and subgenera as *Passerella*, *Passerculus*, *Ammodramus*, *Spizella*, *Zonotrichia*, *Melospiza*, *Poocætes*, *Spiza*, and *Calamospiza;* of the Warblers the genera *Mniotilta*, *Protonotaria*, *Helinaia*, *Helmitherus*, *Helminthophila*, *Sylvania*, and *Seiurus*, and many of the species of *Dendroica;* also *Galeoscoptes*, *Oroscoptes*, *Hesperocichla*, and *Hylocichla*.

As modifications of Old World or circumpolar stock may be mentioned *Camptolaimus*, *Lophodytes*, and *Chen* among Ducks and Geese, and *Picicorvus*, *Rhynchophanes*, *Hesperiphona*, and *Leucosticte* among Passeres, with of course the hundred or more species and subspecies which belong to circumpolar genera.

Probably three fourths of the distinctively North American genera and species have reached their present habitats by way of Mexico, and perhaps one fourth or less by way of the West Indies. Many of the local genera and species, as those restricted

respectively to the eastern or western sides of the continent, have originated in some part of their present habitats, at a somewhat remote period, but most of them doubtless since the retreat of the glacial ice. In earlier times the barrier separating the ranges of species occupying respectively the eastern and western parts of the United States must have been much stronger than it is at present; and it will be less doubtless a few decades hence than it is now. There is good evidence that the eastern species are gradually extending their range westward, as I have already pointed out in the case of *Colaptes auratus*, and that western species are, in some cases at least, extending their range eastward. This is doubtless in great part due to, and is certainly aided by, the westward extension of agriculture, which is so rapidly transforming regions not long ago thought to be almost irreclaimable deserts. Irrigation and tree-planting, and the general pursuits of agriculture, cannot fail to extend westward the ranges of many eastern species, as the Bobwhite and various Sparrows, and probably of many of the smaller Passeres.

PART II.—THE FAUNAL SUBDIVISIONS OF NORTH AMERICA, CONSIDERED WITH REFERENCE TO THEIR RELATIONSHIPS, CLASSIFICATION AND NOMENCLATURE.[1]

1.—*Faunal Areas.*

In zoögeography it is necessary to recognize faunal areas varying in grade and importance, just as in zoölogy it is necessary to divide animals into groups differing in rank, as *classes*, *orders*, *families*, *genera* and *species*. The terms employed in zoögeography, however, have not been used with the same precision as the practically corresponding terms in zoölogy. Identical designations have sometimes been used in

[1] The classification and nomenclature here adopted is the same as in my recent paper on 'The Geographical Distribution of North American Mammals' (Bull. Am. Mus. Nat. Hist., Vol. IV, pp. 199–243, Dec. 1892). Also much of the matter, as regards the generalities of the subject, is the same in substance and often in phraseology. The accompanying maps are also reproduced, by permission, from the paper just cited. As that paper is not likely to be readily accessible to the majority of the readers of 'The Auk,' it is hoped that the reproduction of some matter previously published in another connection may not be considered reprehensible.

widely different senses, in accordance with the individual preferences of different writers. The terms *realm*, *region*, *kingdom*, *province*, *district*, and *fauna* have sometimes been applied by different writers to nearly the same geographical area, and each of them to divisions considered as of primary rank, while most of them have also been used for regions of secondary or still lower grade. In many cases they have been used merely in a quasi-technical sense, and there is hence difficulty in determining their claims to recognition by any rule of priority, or by frequency of use in any particular sense; so we are forced to choose mainly on grounds of appropriateness and convenience, the main thing being to secure uniformity of application. In view of this unfortunate state of affairs I attempted, in a paper on the geographical distribution of North American birds, published in 1871,[1] to devise a system of terms that should be not only appropriate, but in as close conformity as possible with previous usage. Finding that *realm* had been used by Agassiz and others for regions of the first rank, and that *region* and *province* had generally been employed for areas of secondary or lower rank, I proposed a scheme of nomenclature, which to some extent has been followed by others, but of course not fully or rigidly, since little attention has been paid to exact terminology in geographical biology. The scheme then proposed is as follows:—

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

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; fauna* (or *flora*, as the case may be) with *species*. It sometimes becomes convenient to recognize other divisions intermediate to these— as in zoölogy we have suborder, subfamily, subgenus, and sub-

[1] Bull. Mus. Comp. Zoöl., II, No. 3, April, 1871.

species, so we may have in zoögeography *subregions*, *subprovinces*, and even *subfaunæ*. In addition to and independent of these divisions we may also recognize *zones*. To illustrate by an example, temperate North America forms a *region* of a *realm* and includes two *subregions*, one of which is divisible into *provinces* and *subprovinces*, and some of these latter into *districts*, while each may contain several *faunæ*. It also proves desirable to subdivide the continent into a number of transcontinental belts or *zones*, which in a way coincide with the climatic zones of the physiographer.

The term *fauna* is unfortunately in current use both in a general sense and also in a restricted, taxonomic sense. In the first case it is employed to designate the animal life of a given area, geographical or political, varying in extent from a township to a continent, from a transient pool to a lake or an ocean, or in geology from a definite stratigraphic horizon to a geologic age, as the qualifying words may chance to indicate; in the second case it is a definite taxonomic term for the ultimate subdivisions of a realm, as is the term *species* for the ultimate divisions of a *class*. The term *flora* has also the same double use; and it would perhaps be futile to attempt to displace either by some specially coined substitute, to take the place of these terms when used in a specific sense for an ultimate faunal or floral area. Such an attempt, however, is perhaps unnecessary, since the qualifying prefix will rarely, if ever, leave one in doubt as to whether the term is used in a general or in a taxonomic sense.

Realms are sometimes characterized by the presence of certain orders, and usually by the presence of certain families which give to them 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 prevalence of particular genera or by the presence or absence of prominent species. Faunæ, on the other hand, are seldom characterized by having restricted to them any particular genera or species, but by the combination or overlapping of a number of genera and species not found elsewhere associated,—in other words, by a peculiar commingling of a considerable number of genera and species.

The transition between faunæ, between provinces, or between adjoining divisions of any grade, is rarely abrupt; it is impossible to give them absolute boundaries; yet they may be limited, in a general way, with considerable definiteness. They depend upon climatic conditions, which are in a measure determined or modified by features of topography; in other words, they are determined by the same conditions that govern the distribution of species. Hence they can seldom be bounded by geographical meridians, or by parallels of latitude, or by political boundaries; they do, however, closely coincide with certain isothermal lines, which are generally those of the season of reproduction. As temperature is influenced by altitude as well as by latitude, elevated tablelands 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 homes for northern forms of animals and plants under comparatively low latitudes. Thus in the Appalachian Highlands we find northern types far to the southward of their range in the low country on either side; and the same is more strikingly apparent in the case of the Rocky Mountains, where northern types extend far down into Mexico, and in the Cascade and Sierra Nevada chain where northern types extend to southern California; isolated patches of northern life also occur on the summits of detached peaks and outlying ranges throughout the Plateau and Great Basin regions of the West. Northern and southern forms of life thus interdigitate according to elevation of the land.

While the life of the middle temperate latitudes, at ordinary levels, is so different from that of the high north on the one hand, and from that of the tropics on the other, the change is effected by a very gradual transition between the two extremes. If we suppose the life of either of the northern continents to be represented by a cube, and this cube to be composed of two blunt-edged wedges, and the two wedges so placed that one thin edge and one thick edge shall form respectively the base and the top of the cube, the two wedges would represent the fading out of the northern life southward and of the southern life northward; except that in nature the two elements are diffused through the mass instead of being segregated as in our supposed cube.

Furthermore, this northern life is largely circumpolar, so that

as we proceed northward, as in North America for example, the genera become in increasing ratio more and more those of wide distribution, till in the extreme north we meet with few that are not circumpolar. How gradually and completely this transition is made has already been shown (*antea*, p. 114), 47 per cent of the non-pelagic birds of North America occurring in corresponding latitudes in the Old World. Extra-tropical North America has, in fact, so much in common with extra-tropical Eurasia, that the two areas constitute merely two regions of a single realm.

To indicate my views in respect to the faunal relations of North America to the world at large, I will recapitulate briefly what I consider may be properly regarded as the primary life areas of the earth's surface, namely:—

(1) An *Arctic Realm*, occupying the region northward from about the limit of forest vegetation, or from about the isotherm of 32° F. It is characterized by its paucity of life and its homogeneousness, nearly all its forms of both animal and vegetable life ranging throughout its whole extent.

(2) A *North Temperate Realm*, extending from the northern limit of forest vegetation to the northern border of the palm belt, or 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 islands.

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

(6) An *Australian Realm*, including not only 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 sometimes recognized, as the Antarctic counterpart of the Arctic realm, though perhaps less well characterized, its fauna consisting almost exclusively of maritime and pelagic species.

The North Temperate Realm is divisible into two regions, (1) a *North American Region*, consisting of temperate North America, and (2) a *Eurasiatic Region*, consisting of temperate Eurasia.

Before proceeding to consider the North American Region and its faunal subdivisions, a few words may be devoted to the *American Arctic*, which is here set off from the rest of North America as a part of the Arctic Realm. If North America were entirely isolated from the rest of the world, it would be quite proper to treat the American Arctic as merely a subdivision of the North American Region; but in view of the fact that it is in reality a part of a homogeneous hyperborean fauna of circumpolar distribution, it seems more in accordance with general facts to consider it as forming part of an Arctic Realm. The propriety of this seems especially emphasized when we consider that (to quote the words of Dr. Merriam) "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 Eurasiatic, 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, yet its ratio of peculiar types, in comparison with its meagre fauna, is by no means low. It seems an eminently natural division from the fact that its southern boundary marks the termination of forest vegetation, with which necessarily stop all the mammals, birds and insects which depend upon forests for food, shelter and a congenial home. Of the 65 genera of birds occurring in the American Arctic 60 are, as already shown, circumpolar, and 5 are American water birds that reach it for a short stay during the breeding season.

The American Arctic may be divided into two areas which may take the rank of faunæ, namely: (1) *Barren Ground*, (2) *Alaskan-Arctic*. The last has been characterized by Mr. E. W. Nelson,[2] and the first by me in a recently published paper on 'The Distribution of North American Mammals' (l. c. p. 220).

[1] Proc. Biol. Soc. Wash., VII, 1892, pp. 39, 40.

[2] Rep. Nat. Hist. Coll. in Alaska, 1887, pp. 26-32.

The exact limits of the breeding ranges of our arctic and subarctic birds is still very imperfectly known. Of the following list of 80 species and subspecies, a few doubtless range in the breeding season somewhat below the southern boundary of the Arctic, but for the most part they may be considered as distinctively characteristic of the Arctic fauna. A large proportion of them are either strictly circumpolar, or are represented in Eurasia by closely allied species or subspecies.

Distinctively Arctic.

(Those marked with a * are apparently confined mainly or wholly to the Eastern Arctic or Barren Ground Fauna; those marked with a † are Western or Alaskan Arctic; those with no sign prefixed are of general distribution, by far the greater part being circumpolar.)

† Urinator adamsi
Urinator arcticus
† Urinator pacificus
Fratercula arctica glacialis
Cepphus mandtii
Stercorarius pomarinus
Stercorarius parasiticus
Stercorarius longicaudus
Gavia alba
† Rissa tridactyla pollicaris
† Rissa brevirostris
* Larus glaucus
† Larus barrovianus
Larus leucopterus
† Larus glaucescens
* Larus kumlieni
† Larus nelsoni
* Larus marinus
† Larus schistisagus
Rhodostethia rosea
Xema sabinii
† Sterna aleutica
Fulmarus glacialis
† Fulmarus g. glupischa
† Phalacrocorax pelagicus
† Phalacrocorax urile
† ? Eniconetta stelleri
† Arctonetta fischeri
* Somateria borealis
† Somateria v-nigra
Somateria spectabilis
Oidemia americana
Chen hyperborea
Chen rossii
Anser albifrons gambeli
† Philacte canagica
Olor columbianus
Crymophilus fulicarius
Phalaropus lobatus
Tringa canutus
* Tringa maritima
† Tringa couesi
† Tringa ptilocnemis
† Tringa acuminata
Tringa maculata
* Tringa fuscicollis
† Tringa bairdii
Tringa alpina pacifica
* Ereunetes pusillus
† Ereunetes occidentalis
Calidris arenaria
Limosa hæmastica
† Limosa lapponica baueri
† Heteractitis incanus
Numenius hudsonicus
Numenius borealis
Charadrius squatarola
Charadrius dominicus

† Charadrius d. fulvus
Ægialitis semipalmata
* Ægialitis hiaticula
Arenaria interpres
Arenaria melanocephalus
Lagopus lagopus
Lagopus rupestris
* Lagopus r. reinhardti
Falco islandus
Falco rusticolus gyrfalco
* Falco rusticolus obsoletus
Otocoris alpestris
Acanthis hornemanni exilipes
* Acanthis linaria rostrata
Acanthis linaria holbœlli
Plectrophenax nivalis
† Plectrophenax hyperboreus
Calcarius lapponicus
Calcarius pictus
Anthus pensilvanicus
Saxicola œnanthe

The following are arctic faunally, if not geographically, breeding mostly above timberline in the Rocky Mountains:—

Lagopus leucurus
Leucosticte tephrocotis
Leucosticte atrata
Leucosticte australis

Many other species, more properly Cold Temperate than Arctic, range into the Arctic so that the above list is by no means a complete enumeration of the American Arctic avifauna.

The North American Region (see Pl. III) consists of two *Subregions*, namely, (1) a *Cold Temperate Subregion* and (2) a *Warm Temperate Subregion.* The Cold Temperate Sub region extends across the continent from about the mean latitude of 43° northward to the limit of forests, with also 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 and its principal outliers south into Mexico; and a third along the Cascade and Sierra Nevada ranges. Its southern border also sweeps to the northward so as to exclude the great Saskatchewan Plains. In other words, the Cold Temperate coincides exactly with Dr. Merriam's 'Boreal Province' as laid down on his 'Provisional Biological Map of North America'.[1] As compared with the Arctic, it has 120 genera instead of 65, of which about 70 per cent. are circumpolar, and 30 per cent. American, showing the close connection of the life of the whole northern half of the northern hemisphere.

The following list of 213 species and subspecies includes only such as may be properly considered as distinctively characteristic of the Cold Temperate Subregion, as contrasted on the one hand

[1] N. Am. Fauna, No. 3, 1891, map 5.

with the American Arctic, and on the other with the Warm Temperate Subregion. Not all of them, however, are strictly limited to the Cold Temperate, a few ranging into the southern border of the Arctic, and a few others extending southward into the northern edge of the Warm Temperate; but their ranges, generally speaking, may be regarded as limited to the Cold Temperate. In scanning the list it should be borne in mind that this subregion extends very far southward along the principal mountain ranges of the continent.

Distinctively Cold Temperate.

Colymbus auritus
Colymbus holbœlli
Urinator imber
Urinator lumme
Fratercula arctica
Cyclorrhynchus psittaculus
Simorhynchus cristatellus
Simorhynchus pygmæus
Simorhynchus pusillus
Synthliborhamphus antiquus
Cepphus grylle
Alca torda
Plautus impennis
Larus argentatus smithsonianus
Larus delawarensis
Larus vegæ
Larus brachyrhynchus
Larus franklini
Larus philadelphia
Sterna paradisæa
Puffinus tenuirostris
Oceanodroma furcata
Oceanodroma leucorrhoa
Sula bassana
Phalacrocorax carbo
Phalacrocorax dilophus
Phalacrocorax d. cincinnatus
Phalacrocorax pelagicus robustus
Merganser americanus
Merganser serrator
Anas carolinensis
Anas discors
Dafila acuta
Aythya americana
Aythya vallisneria
Aythya marila nearctica
Aythya affinis
Aythya collaris
Glaucionetta clangula americana
Glaucionetta islandica
Charitonetta albeola
Histrionicus histrionicus
Camptolaimus labradorius
Oidemia deglandi
Oidemia perspicillata
Branta canadensis
Branta c. occidentalis
Branta bernicla
Olor buccinator
Porzana carolina
Porzana noveboracensis
Gallinago delicata
Macrorhamphus griseus
Macrorhamphus scolopaceus
Micropalama himantopus
Tringa minutilla
Limosa fedoa
Totanus melanoleucus
Totanus flavipes
Totanus solitarius
Totanus s. cinnamomeus
Tryngites subruficollis
Dendragapus obscurus
Dendragapus obscurus fuliginosus
Dendragapus obscurus richardsoni
Dendragapus canadensis

Dendragapus franklini
Bonasa umbellus togata
Bonasa u. umbelloides
Bonasa u. sabini
Lagopus welchi
Lagopus lagopus alleni
Lagopus rupestris nelsoni
Lagopus r. atkhensis
Pediocætes phasianellus
Accipiter atricapillus
Accipiter a. striatulus
Archibuteo sancti-johannis
Falco columbarius
Falco richardsoni
Scotiaptex cinerea
Bubo virginianus arcticus
Bubo virginianus saturatus
Nyctala tengmalmi richardsoni
Nyctea nyctea
Surnia ulula caparoch
Dryobates villosus leucomelas
Dryobates v. hyloscopus
Dryobates pubescens gairdneri
Dryobates pubescens orecœcus
Picoides arcticus
Picoides americanus
Picoides a. dorsalis
Picoides a. alascensis
Sphyrapicus varius
Sphyrapicus v. nuchalis
Sphyrapicus thyroideus
Contopus borealis
Empidonax flaviventris
Empidonax difficilis
Empidonax pusillus
Empidonax minimus
Empidonax hammondi
Otocoris alpestris leucolæma
Pica pica hudsonius
Cyanocitta stelleri
Cyanocitta s. frontalis
Cyanocitta s. macrolopha
Cyanocitta s. annectens
Perisoreus canadensis
Perisoreus c. capitalis
Perisoreus c. fumifrons
Perisoreus c. nigricapillus
Perisoreus obscurus
Picicorvus columbianus
Cyanocephalus cyanocephalus
Corvus corax principalis
Scolecophagus carolinus
Coccothraustes vespertinus
Coccothraustes v. montanus
Pinicola enucleator
Leucosticte griseonucha
Carpodacus purpureus
Carpodacus p. californicus
Carpodacus cassini
Loxia leucoptera
Spinus pinus
Ammodramus princeps
Ammodramus sandwichensis
Ammodramus s. savanna
Ammodramus s. alaudinus
Zonotrichia querula
Zonotrichia leucophrys
Zonotrichia l. intermedia
Zonotrichia l. gambeli
Zonotrichia coronata
Zonotrichia albicollis
Spizella monticola
Spizella m. ochracea
Junco aikeni
Junco hyemalis
Junco h. oregonus
Junco h. shufeldti
Junco h. carolinensis
Junco h. thurberi
Junco annectens
Junco cinereus dorsalis
Junco cinereus palliatus
Melospiza cinerea
Melospiza lincolni
Passerella iliaca
Passerella iliaca unalaschcensis
Passerella iliaca megarhyncha
Passerella iliaca schistacea
Tachycineta bicolor
Tachycineta thalassina
Ampelis garrulus
Lanius borealis

Vireo philadelphicus
Helminthophila ruficapilla
Helminthophila r. gutturalis
Helminthophila celata
Helminthophila c. lutescens
Helminthophila peregrina
Dendroica tigrina
Dendroica cærulescens
Dendroica coronata
Dendroica auduboni
Dendroica maculosa
Dendroica castanea
Dendroica striata
Dendroica blackburniæ
Dendroica virens
Dendroica townsendi
Dendroica palmarum
Dendroica p. hypochrysea
Seiurus noveboracensis
Seiurus n. notabilis
Geothlypis agilis
Geothlypis philadelphia
Geothlypis macgillivrayi
Sylvania pusilla
Sylvania p. pileolata
Sylvania canadensis
Cinclus mexicanus
Troglodytes hiemalis
Troglodytes h. pacificus
Troglodytes alascensis
Certhia familiaris americana
Certhia familiaris montana
Certhia familiaris occidentalis
Sitta canadensis
Sitta pygmæa
Parus atricapillus
Parus a. septentrionalis
Parus a. occidentalis
Parus gambeli
Parus cinctus obtectus
Parus hudsonicus
Parus h. stoneyi
Parus rufescens
Regulus satrapa
Regulus s. olivaceus
Regulus calendula
Turdus aliciæ
Turdus aliciæ bicknelli
Turdus ustulatus
Turdus u. swainsonii
Turdus aonalaschkæ
Turdus a. auduboni
Turdus a. pallasii
Hesperocichla nævia
Sialia arctica

Of the above list of 213 species and subspecies, about 20 are maritime, about 60 range across the continent, and about 130 have a more limited range. Of these a small number is limited to the immediate vicinity of the Northwest Coast, a few to the Upper Missouri region, and a large number to the Rocky Mountain plateau and the various mountain ranges of the western half of the continent.

The Cold Temperate Subregion has been divided into four *faunæ*, as follows: (1) *Hudsonian*, (2) *Canadian*, (3) *Aleutian*, (4) *Sitkan*. The first two have been long recognized, and their boundaries are well known. They were first mapped by Dr. Merriam[1] in 1890, and more recently by the

[1] North American Fauna, No. 3, map 5.

present writer,[1] on practically the same lines. The last two were first defined by Mr. E. W. Nelson[2] as respectively the 'Sitkan District' and the 'Aleutian District,' and re-defined and mapped in my recent paper on the 'Geographical Distribution of North American Mammals.'[3] As noted later in the present paper (p. 139), there remain to be defined, when our knowledge of the subject becomes sufficiently detailed, a series of local mountain faunæ in the Rocky Mountains and other principal mountain chains in the West.

The *Warm Temperate Subregion* occupies middle North America, extending from the southern boundary of the Cold Temperate Subregion, as defined above, to the northern edge of the American Tropical Realm (see Pl. III). It is thus geographically the same as Dr. Merriam's 'Sonoran Province.' It 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 contrasts strongly with the Cold Temperate in respect to its topographic and climatic features, as well as in its faunal aspects. Aside from the very marked difference of temperature between the two, the Cold Temperate is a homogeneous region, covered almost continuously with principally coniferous forests; and aside from its southern extension along the mountain ranges, presents little diversity in topography. The Warm Temperate, on the other hand, is highly diversified topographically, and consequently in climate, especially in respect to rainfall, which of course greatly modifies the distribution of forests, and of plants in general, which in turn exerts a marked influence upon the distribution of animal life. We have hence conditions favorable for the development of

[1] Bull. Am. Mus. Nat. Hist., IV, 1892, pl. viii.
[2] Rep. Nat. Hist. Coll. made in Alaska, 1887, pp. 24--27.
[3] Bull. Am. Mus. Nat. Hist., IV, 1892, pp. 223, 224, pl. viii.

locally restricted types, including families as well as genera and species, to say nothing of merely geographical races or subspecies. Consequently it is divisible into a larger number of faunal areas, varying to a much greater extent as regards their relative taxonomic rank, and much more strongly contrasted in respect to their faunal characteristics.

The Warm Temperate Subregion may be considered as primarily divisible along a nearly north and south line into two *Provinces*, namely (1) an eastern or *Humid Province* and (2) a western or *Arid Province*. The Humid Province extends from the Atlantic coast westward to about the 100th meridian, or to the eastern border of the Great Plains, exclusive, of course, of the Appalachian Highlands; the Arid Province extends thence westward to the Pacific coast, exclusive, of course, of the southward extensions of the Cold Temperate along the mountain systems. These regions thus correspond respectively with Dr. Merriam's 'Humid Sonoran' and his 'Arid Sonoran,' as he originally defined them. The Humid Province, as the name implies, has a rather moist climate and is (or was a century ago) in most parts heavily forested; the Arid Province is, on the other hand, a region of open plains and deserts, with, in general, an excessively arid climate.

These two provinces thus coincide with the two strongly marked regions of the middle portion of North America in respect to climate as modified by rainfall. The line of separation is thus meridional instead of transcontinental as are the faunal boundaries determined by temperature. In this case temperature, as a controling influence in the distribution of animals and plants, is subordinated to the usually less powerful agent, humidity.

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 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 rainfall of 20 inches or less, as shown on the rainfall charts of the United States, — in other words, as already stated, near the 100th meridian.

The contrasting climatic conditions of these two regions are due to peculiar physiographic and geographic conditions which extend back to a comparatively remote period — so remote as to have given time for the development of many generic forms limited almost entirely to one or the other of these two regions. Thus, in respect to birds, we have 17 genera in the Humid Province which do not range to any great extent into the Arid Province, and 28 genera in the Arid Province which are not found to any extent in the Humid. The distinctively eastern or Humid Province genera are :—

Philohela	Ictinia	Protonotaria
Bartramia	Dolichonyx	Helinaia
Colinus	Quiscalus	Helmitherus
Tympanuchus	Ammodramus[1]	Compsothlypis
Catharista	Spiza	Galeoscoptes
Elanoides	Mniotilta	

A few of these genera range into the eastern border of the Plains, and sometimes, as in the case of *Galeoscoptes*, occur locally westward to the Pacific coast. They are nevertheless to be regarded as distinctively characteristic of the eastern side of the continent. *Colinus* is more difficult to locate, as southern forms of the genus occur in the Sonoran Subprovince of the Arid, while its northern form, *C. virginianus*, is distinctively an eastern form characteristic of the Humid Province.

On the other hand, the following genera may in like manner be considered as distinctively characteristic of the Arid Province, although some of them range northward into the Cold Temperate :—

Æchmophorus	Pediocætes	Micropallas
Oreortyx	Centrocercus	Geococcyx
Callipepla	Pseudogryphus	Xenopicus
Cyrtonyx	Glaucidium	Phalænoptilus

[1] Subgenus.

Cypseloides	Amphispiza	Chamæa
Aëronautes	Calamospiza	Psaltriparus
Selasphorus	Phainopepla	Auriparus
Xanthocephalus	Salpinctes	Myiadestes
Calcarius	Catherpes	
Rhyncophanes	Oroscoptes	

Were we to include in this connection some 38 additional tropical genera which range only a short distance into the Warm Temperate, as here defined, we should have to add 7 genera to the eastern list and about 30 to the western list. In other words, out of a total of about 150 genera distinctive of the Warm Temperate,[1] about 65, or 43 per cent., have a transcontinental distribution, and about 85, or 57 per cent., are either eastern or western.

The higher ratio of peculiar types in the Arid Province as compared with the Humid Province is obviously due to geographic conditions, the Arid Province adjoining at the southward a broad tropical land area, while the southern boundary of the Humid Province is formed by the Gulf of Mexico. A large proportion of the genera peculiar to either the Humid or Arid Provinces range across the whole north and south breadth of the Warm Temperate Subregion.

The northern half of the Warm Temperate, however, also differs faunally quite markedly from the southern half, in consequence of the extension southward of a few northern genera over most of its northern half, and the extension northward of many tropical genera over a portion of its southern half. As regards birds, while a considerable list of species would fall respectively into one or the other of these two categories, the number of genera is small, owing to the fact that if we take them on the basis of their transcontinental range their representation is often very different in the two provinces, as regards both their geographical distribution and the species which represent them. The northern list would include perhaps such genera as *Botaurus* (excluding *Butorides*), *Bonasa*, *Passerculus* (subgenus), and perhaps *Tachycineta* and *Ampelis*, and in the East *Carpodacus* and *Merula;* although most of these are really Cold

[1] Cosmopolitan and other wide-ranging genera are not included in this connection, but only such as are distinctively American.

Temperate rather than Warm Temperate forms. The southern list would include a large number of tropical genera which range into the southern part of the Warm Temperate—such for instance as *Columbigallina*, *Scardafella*, *Urubitinga*, *Asturina*, *Geococcyx*, *Conurus*, *Nyctidromus*, various genera of Hummingbirds, *Milvulus*, *Pyrocephalus*, *Campylorhynchus*, *Catherpes*, etc.; but they are nearly all limited to the Arid division of the Warm Temperate, and thus serve to emphasize the differences distinguishing the Arid from the Humid Province quite as much as a northern and southern division along a transcontinental line. The differentiation of the Warm Temperate into two transcontinental belts—a northern and a southern—is thus due to the increase of tropical forms near the southern border, in accordance with the law of general increase of the forms of life from the north southward.

In respect to species and subspecies, the following lists may serve to indicate the forms characteristic respectively of the Humid and Arid Provinces. As the transition between the two is gradual, with many interdigitations, through the extension of forest or tree-loving species up the partially wooded river valleys into the Plains, the lists are to some degree open to the criticism that many species classified as eastern are not sharply limited at the eastern edge of the Plains, and that a few of the properly Arid Province species range eastward to the prairies east of the Mississippi River, yet in general terms the distribution is as implied in the headings of the two lists. The straggling of Catbirds and Kingbirds to the Great Basin, and even to the Pacific coast, does not weigh heavily against the propriety of including them in the Humid Province list since they are here such characteristic elements of the fauna. The lists, furthermore, are not intended to be complete; to save space subspecies are in many instances omitted; the more tropical forms, and generally also those of local distribution, as well as the maritime water birds, are excluded.

Humid Province.

Ajaja ajaja
Guara alba
Ardea rufescens
Ardea tricolor ruficollis
Ardea cœrulea
Nycticorax violaceus
Rallus elegans
Ionornis martinica

Philohela minor
Symphemia semipalmata
Ægialitis meloda
Colinus virginianus
Tympanuchus cupido
Tympanuchus americanus
Meleagris gallopavo
Columbigallina passerina
Catharista atrata
Elanoides forficatus
Ictinia mississippiensis
Buteo lineatus
Buteo latissimus
Syrnium nebulosum
Megascops asio
Conurus carolinensis
Dryobates villosus
Dryobates borealis
Melanerpes erythrocephalus
Melanerpes carolinus
Antrostomus vociferus
Antrostomus carolinensis
Tyrannus tyrannus
Tyrannus dominicensis
Myiarchus crinitus
Sayornis phœbe
Contopus virens
Empidonax acadicus
Otocoris alpestris praticola
Cyanocitta cristata
Aphelocoma floridana
Corvus ossifragus
Dolichonyx oryzivorus
Molothrus ater
Sturnella magna
Agelaius phœniceus
Quiscalus major
Quiscalus quiscula
Ammodramus savannarum
Chondestes grammacus
Spizella pusilla
Peucæa æstivalis
Melospiza fasciata
Pipilo erythrophthalmus
Cardinalis cardinalis
Guiraca cærulea
Habia ludoviciana
Passerina cyanea
Passerina ciris
Piranga rubra
Piranga erythromelas
Lanius ludovicianus
Vireo flavifrons
Vireo solitarius
Vireo noveboracensis
Protonotaria citrea
Helinaia swainsonii
Helmitherus vermivorus
Helminthophila pinus
Helminthophila chrysoptera
Helminthophila bachmani
Dendroica cærulea
Dendroica pensylvanica
Dendroica dominica
Dendroica kirtlandi
Dendroica vigorsii
Dendroica discolor
Seiurus aurocapillus
Seiurus motacilla
Geothlypis trichas
Geothlypis formosa
Icteria virens
Sylvania mitrata
Galeoscoptes carolinensis
Harporhynchus rufus
Thryothorus ludovicianus
Thryothorus bewickii
Troglodytes aëdon
Cistothorus palustris
Cistothorus stellaris
Sitta carolinensis
Sitta pusilla
Parus bicolor
Parus carolinensis
Polioptila cærulea
Turdus mustelinus
Turdus fuscescens
Sialia sialis

Arid Province.

Anas cyanoptera
Dendrocygna fulva
Dendrocygna autumnalis
Plegadis guarauna
Symphemia s. inornata
Ægialitis meloda circumcincta
Ægialitis nivosa
Ægialitis montana
Callipepla squamata
Callipepla gambeli
Callipepla californica
Oreortyx pictus
Colinus virginianus texensis
Pediocætes phas. columbianus
Pediocætes phas. campestris
Tympanuchus pallidicinctus
Meleagris gallopavo ellioti
Meleagris gallopavo mexicanus
Columba fasciata
Columbigallina p. pallescens
Pseudogryphus californianus
Buteo borealis calurus
Buteo borealis harlani
Buteo lineatus elegans
Archibuteo ferrugineus
Falco mexicanus
Syrnium occidentale
Megascops asio (subsps.)
Megascops flammeolus
Speotyto cunicularia hypogæa
Glaucidium gnoma
Micropallas whitneyi
Geococcyx californianus
Dryobates villosus (subsps.)
Dryobates nuttalli
Dryobates scalaris
Dryobates arizonæ
Xenopicus albolarvatus
Melanerpes torquatus
Melanerpes formicivorus bairdi
Melanerpes uropygialis
Colaptes cafer
Colaptes chrysoides
Phalænoptilus nuttalli
Antrostomus vociferus arizonæ
Chordeiles virginianus henryi
Chordeiles acutipennis texensis
Cypseloides niger
Chætura vauxi
Aëronautes melanoleucus
Trochilus alexandri
Selasphorus rufus
Selasphorus alleni
Selasphorus platycercus
Calypte anna
Tyrannus verticalis
Tyrannus vociferans
Myiarchus mexicanus
Myiarchus cinerascens
Sayornis saya
Sayornis nigricans
Contopus richardsonii
Contopus pertinax
Empidonax wrightii
Empidonax fulvifrons
Otocoris alpestris (subsps.)
Aphelocoma woodhousei
Aphelocoma californica
Aphelocoma sieberi arizonæ
Corvus caurinus
Molothrus ater obscurus
Xanthocephalus xanthocephalus
Sturnella magna neglecta
Agelaius phœniceus sonoriensis
Agelaius gubernator
Agelaius tricolor
Icterus bullocki
Icterus cucullatus (subsp.)
Icterus parisorum
Scolecophagus cyanocephalus
Carpodacus mexicanus frontalis
Spinus psaltria
Calcarius ornatus
Rhyncophanes mccownii
Poocætes gramineus confinis
Ammodramus s. perpallidus
Ammodramus h. occidentalis
Chondestes grammacus strigatus
Spizella pusilla arenacea
Spizella pallida

Spizella breweri
Spizella atrigularis
Amphispiza bilineata
Amphispiza belli
Peucæa cassini
Peucæa carpalis
Peucæa ruficeps
Melospiza fasciata (subsps.)
Pipilo maculatus (subsps.)
Pipilo fuscus
Pipilo aberti
Pipilo chlorurus
Cardinalis cardinalis (subsps.)
Pyrrhuloxia sinuata
Guiraca cærulea eurhyncha
Habia melanocephala
Passerina amœna
Passerina versicolor
Calamospiza melanocorys
Piranga rubra cooperi
Piranga ludoviciana
Phainopepla nitens
Lanius ludovicianus (subsps.)
Vireo solitarius (subsps.)
Vireo atricapillus
Vireo belli
Vireo huttoni
Vireo vicinior
Helminthophila luciæ
Helminthophila virginiæ
Dendroica graciæ
Dendroica chrysoparia
Dendroica nigrescens
Dendroica occidentalis
Geothlypis trichas occidentalis
Icteria virens longicauda
Oroscoptes montanus
Harporhynchus longirostris
Harporhynchus curvirostris
Harporhynchus bendirei
Harporhynchus lecontei
Harporhynchus crissalis
Salpinctes obsoletus
Catherpes mexicanus
Campylorhynchus brunneicapillus
Thryothorus ludovicianus (subsp.)
Thryothorus bewickii (subsps.)
Troglodytes aëdon (subsps.)
Cistothorus palustris paludicola
Sitta carolinensis aculeata
Sitta pygmæa
Parus bicolor texensis
Parus inornatus
Parus atricristatus
Parus wollweberi
Parus carolinensis agilis
Chamæa fasciata
Psaltriparus lloydi
Psaltriparus minimus
Psaltriparus plumbeus
Psaltriparus santaritæ
Auriparus flaviceps
Polioptila cærulea obscura
Polioptila plumbea
Polioptila californica
Myiadestes townsendi
Turdus fuscescens (subsp.)
Sialia mexicana

A careful tabulation of the thousand or more species and subspecies of North American birds shows that about 400 occur in the Warm Temperate Subregion that do not extend much to the northward of its northern border, and which may be hence termed distinctively Warm Temperate species. This excludes about 75 essentially tropical species and subspecies which range into the southern border of the United States, and also about 86 wide-ranging species whose habitats either broadly overlap both subregions or have even a much greater distribution and are thus not properly distinctive of either the Cold Temperate or the Warm Temperate.

Of the 400 essentially Warm Temperate forms only about 6 per cent. have a transcontinental range; about 25 per cent. may be considered as having a more or less general dispersion over the Humid Province, to which they are restricted, and about 44 per cent. range more or less at large over the Arid Province, to which they are practically confined. The remaining 25 per cent. are of more or less local distribution, part being water birds confined to certain portions of the Atlantic, Pacific or Gulf coasts; part are more or less maritime land birds, while a few are limited to particular areas of comparatively small extent in the interior, or to a narrow belt along the Pacific coast. As will be noted later, some 28 species and 24 subspecies are confined to Lower California and its outlying islands.

The northern and southern differentiation of the Warm Temperate noted above serves, however, as a basis for primary subdivisions (secondary divisions of the Warm Temperate) of both the Humid and Arid provinces, each being separable into two *Subprovinces* (see Pl. IV). Thus the Humid Province is divisible into (1) an *Appalachian Subprovince*, consisting of the long recognized Alleghanian and Carolinian Faunæ, and (2) an *Austroriparian Subprovince*, consisting of the Louisianian Fauna, as commonly recognized. The Austroriparian Subprovince is Dr. Merriam's 'Louisianian or Austroriparian subregion' of his 'Sonoran' region; the Appalachian Subprovince is the northeastern part of his 'Sonoran,' left by him as an unnamed remainder after setting off and naming as 'subregions' all the other parts of his 'Sonoran Region.' The line separating these two subprovinces marks the southern limit of several northern genera and many northern species, and the northern limit of a still greater number of southern genera and species.

The Humid Province comprises three *faunæ*, as follows: (1) *Alleghanian*, (2) *Carolinian*, (3) *Louisianian*. These faunæ have been so long recognized, and have recently been so well mapped by Dr. Merriam,[1] that a detailed account of them may be here omitted.

The Arid Province not only extends, as already stated, from the eastern edge of the Great Plains to the Pacific coast, but also northward over the Saskatchewan Plains, the Plains of the Colum-

[1] N. Am. Fauna, No. 3, map 5.

bia, and thence northward 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 the Pacific coast district the rank of a region coördinate in grade with the formerly so-called Middle and Eastern Provinces. 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, 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, like the Humid, is divisible into two *subprovinces*, namely, (1) a northern or *Campestrian Subprovince*, and (2) a southern or *Sonoran Subprovince* (see Pl. IV). These two regions correspond respectively with Dr. Merriam's 'Arid Upper Sonoran' and his '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'[1] 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 Sub-province includes his 'Great Basin subregion' and his 'Great Plains subregion.'[2] 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.

Many species are limited in their southward distribution by the southern border of the Campestrian Subprovince, but few genera

[1] *Cf.* Proc. Biol. Soc. Washington, VII, 1892, pp. 26-33, and accompanying map.

[2] *Cf.* N. Am. Fauna, No. 3, 1890, p. 25.

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, and are thus distinguished, like many northern divisions when compared with adjoining southern ones of coördinate rank, from the Arctic southward, by what they lack rather than by the posession of any peculiar types.

The Campestrian Subprovince itself may be divided into three areas which may be termed *districts*, namely (1) the *Great Plains District*, (2) the *Great Basin District*, and (3) the *Pacific Coast District*. (See Pl. IV.) The first two are respectively the 'Great Plains subregion' and the 'Great Basin subregion' of Dr. Merriam's first 'Biological Map of North America.'[1] Although these two districts are separated by the main chain of the Rocky Mountains, they are faunally but slightly differentiated. But few genera occur in the one that do not occur in the other; a few species, and a larger number of subspecies are restricted to one or the other during the breeding season, but they often become more or less mixed during winter, when they meet on common ground in the Sonoran Subprovince. Thus the Rocky Mountains, while forming so imposing a feature in the configuration of the continent, fail to be by any means an impassable barrier to the dispersal of species, owing to their numerous comparatively low depressions, and to their meridional trend.

The Pacific Coast District consists of a narrow belt situated mainly west of the Sierra Nevada and Cascade Ranges, and is characterized by the presence of a few species and a considerable number of subspecies mainly restricted to it.

The Sonoran Subprovince consists of Dr. Merriam's restricted 'Sonoran subregion,'[1] with the addition of Lower California, which Dr. Merriam gave the rank of a 'subregion.' A careful synopsis of the bird life of Lower California and its outlying islands shows that it has 28 species and 24 subspecies which are not found in the United States. Of the 29 species 10 are confined exclusively to the outlying islands, and 9 others are either strictly

[1] N. Am. Fauna, No. 3, 1890, p. 25, and map 5.

maritime or pelagic. Of the 10 peculiar land birds, all but one are congeneric with and for the most part closely allied to North American species. Of the 24 subspecies, 23 are merely local races of North American species. A number of these peculiar species and subspecies are confined to the subtropical portions of the region below La Paz, which belongs to the American Tropical Realm rather than to the Temperate Realm, thus leaving very little of distinctive importance for the non-tropical portion of the Peninsula.

It is at present impracticable to attempt to define in detail the numerous faunæ of the Arid Province. While certain portions might be thus treated, our knowledge of the region as a whole is too defective to warrant even a provisional subdivision into faunæ. The same is true also of the southern prolongations of the Cold Temperate along the mountain ranges of the western half of the continent. It is evident, without going into a detailed analysis, that many of the wide-ranging species that prevail over and give character to the Arctic, Hudsonian, and Canadian Faunæ, respectively, are absent from the Rocky, the Cascade, and the Sierra Nevada ranges and their outlying spurs; also that many eastern forms are here replaced by more or less closely related western forms, and that quite a number of peculiar mountain types are superimposed upon this new combination. The case is obviously quite different from the conditions met with in the Alleghanies, where merely a small percentage of Canadian forms occur far to the southward of where they are found in the contiguous lowlands. To give due expression to the faunal conditions met with, for example, in the Rocky Mountains south of the Canadian Pacific Railroad, it evidently will be necessary to recognize a succession of mountain faunæ as we go southward, as well as in descending from timber-line at any given point to the foot-hills. Dr. Merriam, in defining the life zones at high elevations in Arizona, Idaho, and California, has made an excellent beginning in this comparatively new line of work, and we may confidently look forward to still more important results from the great mass of unpublished data he has so industriously brought together. The proper collation of our mountain areas, from the British boundary across the United States into Mexico, will be a work of exceptional interest and importance, and will require much additional field research.

As already noted, the extreme southern portions of North America belong to the American Tropical Realm, which consists of tropical America at large. It thus includes not only a large part of South America, Central America and the West Indies, but the lowlands of Mexico, including the low eastern coast region to some distance north of the mouth of the Rio Grande, and the low western coast to some distance north of Mazatlan. To the Tropical Realm belong also the extreme southern portion of the peninsula of Lower California, and the extreme southern portion of the peninsula of Florida. There are thus three small portions of 'North America,' as defined in the A. O. U. Check-List, which belong with the Tropical rather than to the North Temperate Realm.[1]

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,[2] 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. The tropical portion of Lower California also belongs to the Central American Region.

The Floridian Fauna has recently been treated in much detail by Dr. Merriam,[3] and hence need not be considered at length here. The following birds, however, may be mentioned as among those distinctively characteristic of this limited area, though having generally a very extended range into tropical America.

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[1] See maps, plates III and IV, where the uncolored portions to the south of the colored areas belong to the Tropical Realm. The uncolored portion at the top of plate III may be taken as representing that portion of the continent belonging to the Arctic.

[2] *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.)

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

Sula sula
Fregata aquila
Phœnicopterus ruber
Ardea occidentalis
Aramus giganteus
Columba leucocephalus
Zenaida zenaida
Rostrhamus sociabilis
Buteo brachyurus
Polyborus cheriway
Speotyto cunicularia floridana
Crotophaga ani
Coccyzus minor maynardi
Euetheia bicolor
Ammodramus nigrescens
Vireo altiloquus barbatulus
Cœreba bahamensis

The semi-tropical area occupying the extreme lower portion of the Rio Grande Valley and extending as a narrow belt thence northward for a short distance along the Texas coast, and also southward along the Mexican coast to the neighborhood of Tampico, I have recently designated[1] as the *Tamaulipan Fauna*. Among the birds that extend northward from the tropics to find here about their northern limit are the following:—

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

The extreme southern portion of Lower California, from about La Paz southward, may be considered as fairly subtropical, but contains, on the whole, comparatively few distinctively tropical types of birds. Among such may perhaps be placed the following:—

[1] Bull. Am. Mus. Nat. Hist. IV, p. 241, Dec. 1892.

Glaucidium hoskinsi
Crotophaga sulcirostris
Dryobates scalaris lucasanus
Basilinna xantusi
Empidonax cineritius
Empidonax griseus
Dendroica bryanti
Geothlypis beldingi
Harporhynchus cinereus
Campylorhynchus affinis
Merula confinis

A few additional subspecies of northern forms also characterize the subtropical portion of the peninsula, which may perhaps well bear the name *Saint Lucas Fauna.*

Independently of the subdivisions already enumerated, and in addition to them, North America may be divided into a number of transcontinental belts or *Zones* in accordance with the climatic conditions prevailing over the different parts of the continent. Several of these zones have been repeatedly recognized by various writers on the distribution of animals and plants. A division of extra-tropical North America into about seven zones will greatly facilitate the correlation of the faunæ of different regions. These are, (1) the Arctic or Hyperborean Zone, equivalent to the American portion of the Arctic Realm; (2) the Subarctic or Hudsonian Zone; (3) the Cold Temperate or Canadian Zone; (4) the North Warm Temperate or Alleghanian Zone; (5) the Middle Warm Temperate or Carolinian Zone: (6) the South Warm Temperate or Louisianian Zone; (7) the Subtropical or Floridian Zone.[1] Dr. Merriam has already in his recent papers on the distribution of North American mammals distinguished these zones more or less definitely in treating of the life zones of the San Francisco Mountain region in Arizona and in Idaho. He has done much also toward correlating the life zones of mountain faunas with the long recognized faunæ of the Atlantic Coast. Much further information is required before these zones can be geographically defined over the western half of the continent.

In selecting names for their designation several alternatives present themselves, as for example, names derived from the climatic zones, or from some leading characteristic, as 'Spruce

[1] This is a modification of my recently published classification (Bull. Am. Mus. Nat. Hist., IV, p. 240), rendered necessary from the evident desirability of reserving the term 'Subtropical Zone' for the designation of the most northern belt of the Tropical Realm, instead of applying it to the lowest or most southern belt of the Temperate Realm, as is done when it is used for the Louisianian Zone.

Zone' for the Hudsonian, 'Arctic-alpine' for treeless mountain summits equivalent in character to the Arctic, etc., or from those of the Atlantic coast faunæ. This latter method has the merit of at once suggesting a well-known standard of comparison when applied to belts in the interior or on the Pacific coast, representative of the commonly recognized faunæ of the Atlantic coast.

Dr. Merriam has already recognized the equivalents of the Arctic, Hudsonian, Canadian, Alleghanian, etc., in portions of the mountainous districts of the West, and has presented in substance the following correlations.[1]

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].

2. *Classification and Nomenclature.*

A few words in regard to the names chosen for the several major divisions of the North American Region, and the choice of names in general in bio-geography. It is natural that the influences controlling the geographical distribution of life, namely, climate, and hence the principal climatic zones, should suggest the names of many of the larger ontological regions; and we find that to a large extent such names have been chosen, as by Dana, in 1852, in discussing the distribution of marine life, and by botanists generally, and notably by German writers. 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 be retained in preference to later names.

In concluding this paper a few words of explanation are necessary in relation to various points of nomenclature and classification. In comparing the present scheme of faunal areas of North

[1] N. Am. Fauna, No. 3, 1890, pp. 7–34, and maps 1–4; *ibid*, No. 5, 1891, pp. 9–12, 21–25.

America with those employed by Dr. Merriam in his recent well-known admirable papers on the geographical distribution of North American mammals, so frequently cited in the preceding pages, it will be noticed that there is a striking agreement in their number and boundaries, although a few new minor divisions have here been introduced; yet the terms employed for their designation are to a great extent different. As already intimated, the present system of classification and nomenclature is a further development of that first instituted by me in 1871, and used later in 1878, and now carried out in greater detail and extended to the whole North American Continent. The present revision of the subject is therefore not to be looked upon as unfriendly criticism of Dr. Merriam's classification and nomenclature, which he evidently adopted provisionally,[1] selecting such terms as would suffice to clearly indicate the areas under discussion; his attention was given mainly and most successfully to an elucidation of the facts of distribution; a detailed consideration of the nomenclature of the subject was outside of his special field.

In attempting to establish a consistent scheme of classification and terminology, the aim is to assign definite terms for areas of similar taxonomic grade. Many of the terms in more or less current use have been employed so loosely, and used in so many different senses by different writers, that, as already said, a strict 'rule of priority' cannot be enforced, at least without leading in many instances to very unsatisfactory and inharmonious results. As already explained, the system here adopted is analogous to the schemes followed in systematic biology and stratigraphic geology. In the selection of names for the higher divisions, reference has been had to the influences controling the geographic distribution of life, namely, *climate*, and the climatic zones have been allowed to suggest the names of many of the major ontological areas. Indeed, such names have been employed before in nearly the same sense, not only by physical geographers, but by many botanists and some 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

[1] This is not only apparent from his papers, but I am informed by him that this was intentionally the case.

names, as 'Hudsonian,' etc., are admirably appropriate when suggestive of some characteristic portion of the region in question. Terms designating grade should, of course, be used with the same strictness as the corresponding terms,—order, family, genus, etc., expressive of rank,—in biology.

Realm is employed as a designation for primary regions, taking the world at large, and Fauna for the ultimate subdivisions. Region, the term selected for divisions of the second rank, has been used by different writers for areas of various grades, but it is proposed to limit its application in a technical sense to the primary divisions of Realms. Below this, in successively descending order, we have Subregions, Provinces, Subprovinces, Districts and Faunæ; faunæ being subdivisions of districts (in cases when it seems desirable to recognize districts), while districts are the primary subdivisions of the subprovinces. In the Arctic Realm the only subdivisions it seems necessary to recognize are faunæ; in the Cold Temperate, possibly both districts and faunæ; in the Warm Temperate, at least so far as North America is concerned, it seems desirable to recognize (1) provinces, (2) subprovinces, (3) districts, and (4) faunæ.

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

[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.

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 'Zoögeographical Map of North America,' failed, however, to recognize the southward 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

[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.

life areas in a country where there are no impassable physical barriers to prevent the diffusion of animals and plants." [1]

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, embracing 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.

The first discrepancy between Dr. Merriam's classification and my own that requires notice is in respect to the primary divisions of the North American Region, which he first termed 'Provinces'[2] and later 'Regions,'[3] with the prefixes 'Boreal' and 'Sonoran' respectively for the 'Cold Temperate' and 'Warm Temperate' *Subregions* of the present writer. The use of Boreal, however, as shown above, was not an innovation; but the term 'Sonoran' was used in a new and greatly extended sense, the term Sonoran being applied to a region identical in geographical extent with the Warm Temperate,—a designation previously used for the same area,—and hence including the 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 as early as 1866 by Prof. Cope,[4] 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[5] 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.

[1] N. Am. Fauna, No. 3, pp. 22, 23.
[2] N. Am. Fauna, No. 3, p. 19, 20.
[3] Proc. Biol. Soc. Washington, VII, 1892, pp. 22, 26.
[4] Proc. Acad. Nat. Sci. Phila., 1866, p. 300.
[5] The Geogr. and Geol. Distrib. of Anim., p. 106.

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 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 coödinate areas of the continent.

Another, and perhaps the only other, important discrepancy between Dr. Merriam and myself is in respect to the primary subdivisions of the Warm Temperate or 'Sonoran' Subregion. Here the difference is in respect to classification, Dr. Merriam dividing the Warm Temperate into two transcontinental divisions which he terms respectively 'Upper' and 'Lower Sonoran'; while according to my best judgment the primary division is in a meridional line into an eastern and a western division, which I have termed respectively Humid and Arid Provinces, borrowing the terms from Dr. Merriam, who has used them in the same geographical sense but not in the same nomenclatural relation, as already shown in preceding pages. As the evidence, pro and con, has already been submitted (see *antea*, pp. 128–131, and Bull. Am. Mus. Nat. Hist., IV, pp. 230–232), it is unnecessary to rediscuss the matter here.

In respect to the subdivisions respectively of the Humid and Arid Provinces, my subprovinces correspond to his secondary divisions of the 'Sonoran' (with slight modifications, as already explained), my Appalachian Subprovince being essentially his 'Humid Upper Sonoran,' my Austroriparian Subprovince his 'Humid Lower Sonoran,' my Campestrian Subprovince his 'Arid Upper Sonoran,' and my Sonoran Subprovince his 'Arid Lower Sonoran.' My division of the Campestrian Subprovince into Districts conforms nearly with Dr Merriam's division of the same geographical area,[1] and I have adopted for these areas the same descriptive appellations.

Taking Dr. Merriam's latest paper on the faunal areas of North America and accompanying map,[2] one other point of difference calls for notice, namely, his recognition of a 'Transition

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

[2] Proc. Biol. Soc. Wash., VII, pp. 1–64, April, 1892.

Zone,' interposed between and separating the Cold Temperate, or 'Boreal,' from the Warm Temperate, or 'Sonoran' (l. c. pp. 30–33). This is equivalent to what is termed in this paper the Alleghanian Zone, and forms the northern transcontinental belt of the Warm Temperate. This zone was first recognized by Dr. Merriam in the West as the 'Neutral or Pine Zone,'[1] and correlated later with the Alleghanian Fauna of the East, as the 'Neutral or Transition Zone.'

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,[2] 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 anomalous position of a minor faunal area interposed between and completely separating two areas of a higher grade.[3] Besides, the term 'transition,' for reasons already given, is not a distinctive designation for a faunal area of any grade, although it has been repeatedly used in this way by different writers; its proper function is that of a descriptive term—not a designation to be used in a taxonomic sense.

The various faunal areas recognized in the present paper may be tabulated as follows:—

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[1] N. Am. Fauna, No. 3, 1890, p. 11, map 5.

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

[3] 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.

Tabular Synopsis of the Faunal Areas of North America.

REALMS { Arctic. / North Temperate. / American Tropical.

REGIONS { North American < *North Temperate Realm.* / Central American, Antillean } < *American Tropical Realm.*

SUBREGIONS { Cold Temperate, Warm Temperate } = *North American Region.*

PROVINCES { Humid, Arid } = *Warm Temperate Subregion.*

SUBPROVINCES { Appalachian, Austroriparian } = *Humid Province.* / { Campestrian, Sonoran } = *Arid Province.*

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

FAUNÆ[1] { Barren Ground, Alaskan-Arctic } *Arctic.* / { Aleutian, Hudsonian, Canadian, Sitkan } *Cold Temperate.* / { Alleghanian, Carolinian, Louisianian } *Humid Warm Temperate.* / { Floridian, Tamaulipan, Saint Lucas } *Tropical.*

ZONES { Arctic or Hyperborean. / Subarctic or Hudsonian. / Cold Temperate or Canadian. / North Warm Temperate or Alleghanian. / Middle Warm Temperate or Carolinian. / South Warm Temperate or Louisianian. / Subtropical or Floridian.

[1] Mainly those of Eastern North America only.