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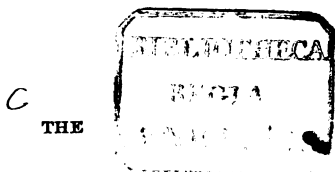
Zool. 20<sup>t</sup>

Baird





[FROM THE AMERICAN JOURNAL OF SCIENCE AND ARTS, VOL. XLI, JAN., 1866.]



DISTRIBUTION AND MIGRATIONS  
OF  
NORTH AMERICAN BIRDS.

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(Abstract of a memoir presented to the National Academy of Sciences, Jan., 1865.)

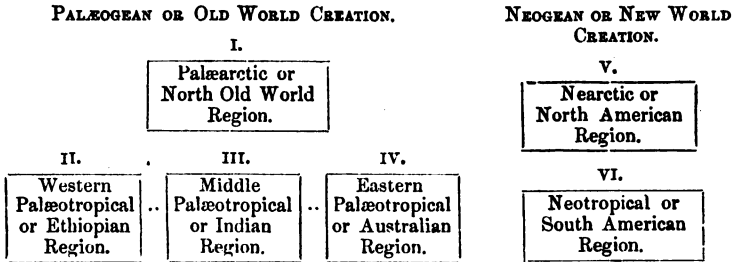
It is well known to all students of Natural History, that the zoology of America or the new world is very different from that of the old world, and that with these two grand divisions, there are in each various subdivisions of greater or less importance. To Dr. Sclater<sup>1</sup> is perhaps due the merit of having been the first clearly to define the "Regions" into which the animal life of the terrestrial globe, the birds especially, may be divided, and to point out approximately their relative magnitude and boundaries as well as their comparative richness in species of birds. Some of his details have been corrected and improved by Mr. Wallace,<sup>2</sup> but the conclusions of Dr. Sclater are in the main those which have received the support of most naturalists of the present day, and his details will ever mark an era in the science of zoological geography.

Dr. Sclater, in the article above alluded to, presents the follow-

<sup>1</sup> Journal of proceedings of the Linnæan Society: Zoology, ii, 1858, 180. (Read June 16, 1857.)

<sup>2</sup> Ibis, 1859.

ing scheme of the arrangement of "regions" as best illustrating their relationship.



The boundaries of these regions, as defined by Dr. Sclater with Mr. Wallace's corrections embrace the following countries.

I. *Palearctic Region*.—All Europe and Africa north of the Sahara, and all continental Asia north of about the parallel of 30° N. lat. including the whole mountainous country and plateaus of Central Asia, as well as Japan and the Kuriles. The Aleutians, assigned by Dr. Sclater to this region, appear to belong more to North America.

II. *Ethiopian Region*.—This embraces all of Africa south of the Sahara, and on the eastern side all south of about 30° N. lat., as well as most of Arabia, except the portion along the Indian ocean and the Persian gulf. It includes also Madagascar, and the adjacent islands as Mauritius, Bourbon, etc. The Sahara Mr. Wallace considers as belonging to neither the Palæarctic nor the African region, but to occupy the position of a sea, and to be essentially destitute of land species.

III. *The Indian Region*.—This includes the low lands of continental Asia, about south of 30° N. lat. and the portion of Arabia excluded from the Ethiopian region, as well as Ceylon, Sumatra, Java, Borneo, and the Philippines. It is the country washed by the Arabian Sea, the Persian Gulf and the China Seas, and its southeastern limit passes between the islands of Bali and Lombok, between Borneo and Celebes, and between the Philippines and the Moluccas.

IV. *The Australian Region*.—This includes Australia, New Guinea, Tasmania, New Zealand and Polynesia, also Lombok, Celebes, the Moluccas, and the Sandwich Islands. Mr. Wallace calls attention to the fact of the very great dissimilarity between the faunæ of Bali and Lombok, and of Borneo and Celebes, although geographically very near each other, while islands of the Indian region, as well as of the Australian, are respectively very closely allied, although much more remote from each other than those just contrasted. The explanation of this difference he finds in the comparatively slight depth of

water between islands of the same region, while the channel separating those of the different regions is almost unfathomable. By an elevation of 50 fathoms, all these islands of one region would almost become joined to the main land of their respective regions, while the channel separating the latter would still constitute a physical barrier. Hence he infers that subsequent to the original peopling of the Indian and Australian regions, a subsidence into the sea and the consequent production of islands, while it ultimately modified the minor characters of the faunæ, left the broad outlines unchanged.

V. *North American Region*.—Dr. Scater divides this from the South American somewhere in Mexico, the line reaching farther north on the coast, and more to the south in the central mountainous portion. Wallace draws the line about the parallel of 22°, or near the Tropic of Cancer. To the north it includes Greenland.

VI. *South American Region*.—This embraces, according to Scater and Wallace, the rest of continental America, the West Indies, the Galapagos, the Falklands, etc., while Wallace even includes (very erroneously, however,) the Sandwich Islands.

Of the regions thus sketched out, I propose to confine myself to the two last mentioned, or those of the new world, and more especially the portion included in the United States and north of it, and to point out the minor subdivisions and peculiarities of the ornithological faunæ of the same. Before proceeding however to this subject, I may premise that I cannot quite agree with Dr. Scater in referring the West Indies to the South American Region, but prefer to consider it as having independent rank as:

VII. *West Indian Region*.—In winter a large proportion of the inhabitants of the islands are visitors from North America, but the summer fauna is very distinct. The islands nearest to North and South America have of course an impress of the characteristics of these continental areas respectively, but as a general law it may be stated that of the species of land birds peculiar to the West Indies, exclusive of the diurnal Raptores and Columbidae, a large proportion belong to genera found equally in North and South America, as *Vireo*, *Turdus*, *Mimus*, *Polioptila*, *Dendroica*, *Tyrannus*, *Myiarchus*, *Contopus*, *Myiadestes*, *Progne*, *Petrochelidon*, *Icterus*, *Sturnella*, *Colaptes*, etc.: an almost equal proportion belong to genera peculiar to the West Indies, and characterizing several islands, as *Gymnoglaux*, *Mimocichla*, *Spindalis*, *Phonipara*, *Tachornis*, *Loxigilla*, *Saurothera*, *Blacicus*, *Todus*,<sup>2</sup> etc. or else more or less peculiar to one island respectively as *Teretristis*, *Melopyrrha*, etc., to Cuba, *Siphonorhis*, *Polytmus*, *Glossiptila*, *Hyetornis*, *Laetes*, etc., to Jamaica, *Dulus*, etc., to

<sup>2</sup> *Todus Mexicanus* of Lesson is a Porto-Rican species.



Hayti. Where the species belong to continental genera not represented in North America, they are more generally of Mexican and Central American forms and rarely of strictly South American.

The following table of resident land birds of Cuba and Jamaica, exclusive of diurnal Raptores and Columbidae, although approximately complete only, may serve to illustrate more fully the preceding remarks.

	Cuba.	Jamaica.
South American genera, - - - - -	..	1 <sup>4</sup>
Central American and Mexican, - - - - -	..	1 <sup>4</sup>
South and Central American, - - - - -	2	3
North and Central American, - - - - -	5	2
North, Central and South American, - - - - -	16	10
West Indian, - - - - -	8	6
Peculiar to the Island, - - - - -	3	6
Total,	<u>34</u>	<u>29</u>

The species of truly West Indian birds are remarkable for their local distribution, comparatively few being found on more than one of the larger islands, and, what is still more remarkable when the contrary is the case, an intervening island may be destitute of the species. Thus Cuba lacks several species common to the Bahamas and to Jamaica.

Professor Agassiz (Types of Mankind, 1854), has urged very strongly the recognition of an Arctic and an Antarctic region or "realm," a point in favor of which there is much to be said, but which cannot be discussed in the present article. He also anticipates Dr. Selater in regard to some of his views, but the facts at command at the time did not allow him to define the boundary lines of the regions with the same precision. Still more recently Dr. Pelzeln (Reise der Novara, 1865) insists likewise upon an Antarctic region.

Proceeding now to the especial subject of the present article, the mapping out of North America with reference to the geographical distribution and migrations of North American birds, it may be premised that in the article above referred to by Professor Agassiz, in Nott & Gliddon's Types of Mankind, we find the first attempt to mark off the zoological provinces of the New World—and very successful considering the insufficient data accessible at the time. In 1859<sup>6</sup> Dr. Leconte sketched out their

<sup>4</sup> Nyctibius.

<sup>5</sup> Phonipara.

<sup>6</sup> Coleoptera of Kansas and New Mexico, Dec. 1859, Smithsonian Contributions, vol. xi.

I may also refer to incidental mention of the same law in a paper by myself on the birds of Cape St. Lucas, in the Proceedings of the Philad. Academy for Nov. 8th, 1859, p. 299.

boundaries, in North America, with more precision, having particular reference to the distribution of Coleopterous insects.

The subdivisions by Dr. Leconte of these provinces, as based on the study of their Coleoptera, do not agree strictly with those of the ornithological faunæ, especially in the considerable number of local areas which he has adopted. This difference is, however, easily intelligible when we bear in mind the much superior power of flight and innate tendency to migration of the bird as compared with the insect; the distribution of reptiles agreeing much better with his outline than that of birds.

To present the general principles of distribution to which I have been led by an examination of the large collection of specimens in the museum of the Smithsonian Institution, I may say that as far as its ornithology, and to a considerable degree its vertebrate zoology in general is concerned, North America appears to be divided into two great regions, an eastern and a western, which in the United States are of approximately equal extent, but very unequal farther north. The eastern division extends from the Atlantic seaboard, westward across the Alleghanies (which affect the distribution of species but little) and over the valley of the Mississippi and its fertile prairies to about the 100th degree of longitude, or to the beginning of the sterile plains. Its western border is not sharply defined, nor strictly in a meridian line, but somewhat oblique, and interdigitates with the western division by extending westward along the river bottoms, some species, as *Galeoscoptes Carolinensis*, *Vireo olivaceus*, &c. occurring as far west as Fort Benton, or even Fort Colville.

The western division begins at the western border of the eastern, or along the sterile plains of the trans-Mississippi country and extends across to the Pacific ocean. The character of the ornithological fauna of this division is much the same through and beyond the Rocky Mountains to the eastern slope of the Sierra Nevada and Cascade Mountains of California and Oregon, but changes somewhat on the western slope and thence to the Pacific, and although to a considerable extent uniform, yet exhibits some modifications which may warrant a separation into a western and middle division, making three in all, which we may call provinces, of very unequal extent, and exhibiting further modifications or subdivisions with latitude, as I shall proceed to explain, taking into consideration the whole continent north of Mexico.

As previously remarked, the eastern province or division extends from the Atlantic ocean to about the meridian of 100° west from Greenwich, or 23° west from Washington. The line of division on the Gulf of Mexico, starts near the eastern border of Texas, perhaps between the Brazos and the Sabine, and fol-

lowing up the direction of the former river to the approaches of the Great Desert nearly on the meridian mentioned, proceeds northward, forced sometimes more or less westward, especially along the Platte, sometimes eastward. It crosses the Platte between Forts Kearney and Laramie and intersects the Missouri between Fort Randall and Fort Pierre, perhaps near Fort Look-out, as it is between the first mentioned two points that in ascending the river we find the change to take place in the ornithology of the country. Soon after crossing the northern boundary of the United States and to the western side of Lake Winnipeg, the line rapidly inclines westward, especially beyond the Saskatchewan, and extends to the Rocky Mountains, including the valleys of Athabasca and Great Slave Lakes, and both sides of the Mackenzie River, north to the Arctic ocean, even crossing the Rocky Mountains to the Porcupine river and into Russian America at least to  $145^{\circ}$ , or beyond the forks of the Yukon, where Mr. Kennicott found many of the most characteristic summer land birds to be almost identical with those of Slave Lake, Lake Winnipeg, and Northern Canada.

The western province occupies the western slope of the Cascade and Sierra Nevada ranges of mountains in the United States, although its extent southward along the peninsula of Lower California is not well determined. To the northwest it extends at least to the 140th meridian, beyond that probably replaced by a more Arctic fauna. We are not sufficiently familiar with the birds occurring between the northern Rocky Mountains and the coast, to tell how far inland in Stickin Territory or even in northern British Columbia, the coast fauna extends, perhaps not farther than in California or Oregon, although it is possible that, owing to the absence of a continuous longitudinal range of great height, the western and middle regions may there be more thoroughly blended into one.

The middle province, or that of the great plateau, occupies the space between the two just mentioned, probably not passing in its integrity, or as a peculiar province north of the valley of the Saskatchewan and is thus wedged in between the two. As already stated, it extends along the eastern slope of the Cascade and Sierra Nevada mountains, and apparently along the east side of Lower California to Cape St. Lucas, at least the birds of the Cape, as will hereafter be explained, belong much more emphatically to it than to the Western province. A break in the mountains opposite San Diego explains the appearance at that point on the coast of a few species like *Tyrannus vociferans*, *Sialia arctica*, *Poliophtila melanura*, &c., so characteristic of the middle province. The southern boundary of this province during the summer may be considered as occupying the valleys of the Rio Grande and Gila but along this line it is greatly mixed up with

the peculiar fauna of Northern Mexico, which as far as its summer birds indicate, is almost entitled to be considered as a fourth main province.

The eastern province to the north merges into the Arctic, and southward exhibits a very important subdivision in the hot region of the south Atlantic and Gulf States, which is bounded to the north by the isothermal of  $80^{\circ}$ , extending however up the coast to the Dismal Swamp of Virginia, or even to the James river. To the west it ranges along the isothermal of  $83^{\circ}$  or  $85^{\circ}$  following the line to the N.N.W. along the valleys of the Brazos, Red river, the Washita and the Canadian. Most of the species belonging to this subdivision reach along the valley of the Mississippi to a point far north of their limit on the Atlantic slope; the Swallow-tailed-Hawk, Parakeet, and other characteristic species, being well known visitors to Cairo, St. Louis, and even as far north as Wisconsin. This subdivision of the eastern province experiences a still further modification in the southern part of Florida in consequence of the proximity of the Bahamas and Cuba, which causes stragglers of the West India fauna to enter its limits, especially along the south eastern keys. Some of these are *Certhiola Bahamensis*, *Progne cryptoleuca?* *Vireo barbatula*, *Quiscalus aglaeus* (*Q. baritus*, Baird, B. N. A., 556), etc. The only really peculiar indigenous land bird in Florida is the Florida Jay (*Cyanocitta Floridana*), seldom, if ever, found out of that State. As far as is known, there is no corresponding southern subdivision on the west coast in the western province, although California and Washington Territory have each some peculiar species.

As in the eastern province, so in the middle, there is a subdivision along the southern border inhabited by species belonging more particularly to northern Mexico, and occupying the valleys of the Rio Grande and Gila, extending northward along the Rio Grande and Colorado far into the United States. It is the species of this subdivision, that, with those peculiar to Cape St. Lucas, characterize the summer fauna of the latter region. In winter, both there and along the Mexican boundary line, these species are mingled with others coming from the more northern portions of the middle province.

In addition, however, to possessing certain species of the boundary line fauna, Cape St. Lucas has other peculiarities which entitle it to especial consideration.<sup>7</sup>

It forms a distinct subdivision of the boundary sub-province even more peculiar in its relations than Florida, where the characteristic species (excepting the Florida Jay) are stragglers of the West Indian type from the Bahamas, while as shown by the

<sup>7</sup> See Baird, Pr. Acad. Nat. Sci., Nov. 8th, 1859.

indefatigable researches of Mr. Xantus,<sup>8</sup> there are at least twenty species found at Cape St. Lucas not known elsewhere.

Very few of the birds of the coast of California, or of the western province, winter at Cape St. Lucas, the species being almost entirely those of the middle province. The new and peculiar species in all cases belong to genera of the middle province, especially of its boundary subdivision, and no genera are peculiar to it. Furthermore, in no instance do we find species of the *Tierra Caliente* of Mexico not belonging to the United States, nor of any Mexican genera that do not possess representatives in the United States. The difference between the species of birds of Cape St. Lucas and of Mazatlan is very great, although separated only by the breadth of the Gulf of California.

From all these considerations we are legitimately entitled to claim Lower California, or at least its southern extremity, as belonging to temperate North America, even more positively than Florida itself.

Peculiarities in regard to the size of Cape St. Lucas birds will hereafter be referred to.

There is of course an Arctic province which melts gradually into those great provinces mentioned, and along the mountainous ranges extending far southward, in fact almost into Mexico, as shown by the occurrence in summer at Cantonment Burgwyn, near Lat. 37°, of *Lagopus leucurus*, *Pinicola Canadensis*, *Curvirostra Americana*, *Hesperiphona vespertina*, etc., while the two last mentioned species, with *Carpodacus cassini*, are even found in summer on the highlands about Orizaba, as shown by specimens transmitted to the Smithsonian Institution by Dr. Sartorius. Similar intrusions of species belonging to the North Mexican fauna take place up the valleys of the Colorado and the Rio Grande, and of those of the eastern province westward along the Missouri and along the Canadian, etc., but they do not affect the general plan. Although characteristic of the eastern province, as already stated, the Cat-bird, (*Galeoscoptes Carolinensis*), Red-eyed Vireo (*V. olivaceus*), and Wild-pigeon (*Ectopistes migratoria*), are found along the northern boundary of the United States to the Cascade Mountains, while specimens of *Dendroica coronata* have even been taken at Fort Steilacoom on Puget Sound. On the other hand, *Turdus naevius*<sup>9</sup> has been shot on Long Island and in New Jersey, *Helminthophaga celata* in the Atlantic states, and *Zonotrichia Gambelli*, and *Spizella pallida*,

<sup>8</sup> See Xantus, Pr. A. N. S., Nov. 1859.

<sup>9</sup> I am informed by Dr. Cabot that a third specimen has recently (Dec. 1864) been shot near Boston and presented to the Natural History Society. As it has been met with as far east as Fort Franklin, it may not improbably reach our eastern coast in company with some of our eastern species bred in the Mackenzie River valley and returning southward to the Atlantic.

are well known and constant visitors in the region of the Great Slave Lake.

Several species of water birds that belong to the winter fauna of the Pacific coast resort to the Slave Lake region and north of it to breed, crossing the Rocky Mountains for the purpose. Among them may be mentioned *Larus Californicus* and *brachyrhynchus*, *Colymbus Pacificus*, *Bernicla nigricans*, *Anser Rossii*, etc. This, however, may be in consequence of their migrations being along a meridian line, or north and south; the meridian of the westernmost point of California and even of Vancouver's Island passing east of the mouth of the Mackenzie River.

In any investigation into the reasons why the eastern province is of so much greater extent than the others, and exhibits such a trend westward in British America as to reach and even cross the Rocky Mountains, we will be greatly aided by the examination of Prof. Guyot's Wall Map of North America. On this map the country, not exceeding 800 feet in height, is colored green, and this portion is almost exactly coincident with the limits of the eastern province just defined; reaching west of the Mississippi, almost to the edge of the fertile plains (the true zoological boundary), passing up the Mississippi via St. Paul to the Winnipeg valley, involving the whole shores of Hudson's Bay, thence in a northwesterly direction, a little south of Slave Lake to the foot of the Rocky Mountains, and north to the Arctic ocean on both sides of the Mackenzie. Within this vast country are "islands" of more elevated land; the whole Appalachian range, from New Brunswick to Central Georgia and Alabama; the height of land between Hudson's Bay and the St. Lawrence system of waters (nearly parallel with the latter), the plateau of Iowa and Northern Wisconsin, and that east of Slave Lake,<sup>10</sup> etc, being more or less completely encircled by the lower level referred to. The highlands within this region have to a certain extent a peculiar fauna, characterized by the presence of such species to a considerable degree even in summer, as *Junco hyemalis*, *Perisoreus Canadensis*, *Chrysomitris pinus*, *Curvirostra Americana* (more rarely *leucoptera*), *Pinicola Canadensis*, etc., most of which are known to breed in the high mountain region of Georgia. These highlands do not, however, materially alter the summer distribution of our birds, especially in the interior, and there is no physical obstacle, not even that

<sup>10</sup> This region, bounded west by Coppermine river, Slave, Athabasca, and Wollaston lakes, and south by Churchill river, is known as the Barren Grounds of Arctic America, and is a great granitic or azoic region, more or less barren of vegetation, destitute of large trees, and having few inhabitants. It is, however, the especial home of the Musk Ox, the Barren Ground or Small Reindeer, the Barren Ground Bear, the Polar Hare, and other species.

of temperature, to interrupt or affect their passage by way of Rupert's land to the shores of the Arctic ocean."

The southern division of the eastern province is also quite well outlined by Prof. Guyot's limits of the cotton-producing region, although running much farther to the northwest in Arkansas and the Indian Territory than there indicated.

The much greater tendency of the southern birds, or those belonging to the cotton region, to go northward in the Mississippi valley than along the Atlantic slope is explained not only by the ascent there of the isothermal lines, but by the absence of any such obstacle to their journey as is furnished by the Appalachian range.

The great central plateau region of Prof. Guyot's map corresponds quite closely with the middle ornithological province, reaching north to the Saskatchewan and west to the Pacific slope. The close relationship of the western province to the middle is illustrated by the fact that the region of country exceeding 800 feet in height, extends quite to the Pacific in most places, leaving only a few narrow borders and perhaps the valley of the San Joaquin and the Tulare lakes below that level.

It is a fact not without its significance that the depressed lowland area of eastern America is characterized by the existence of certain genera of fishes and reptiles not found in its Appalachian "island." Thus we have *Amia*, *Lepidosteus*, *Micropterus* (*Grystes*), and various other forms of fishes throughout the Mississippi valley as far north as the Great Lakes, while in the Atlantic slope they do not pass the James or Lower Potomac except as stragglers. The soft shelled turtles, and the great mass of the

" The Appalachian Region towards the north and northeast passes into a well marked subdivision, called by Prof. Verrill in his paper on the birds of Norway, Maine, the "Canadian." This he correctly characterizes by the presence of certain species during the breeding season, replacing certain near allies, in what, with Prof. Agassiz, we may term the Alleghanian subdivision. Some of the characteristic and more or less parallel species of birds in these two subdivisions he considers to be the following :

*Alleghanian.*  
*Dendroica discolor*,  
*Pipilo erythrophthalmus*,  
*Spizella socialis*.

*Canadian.*  
*Dendroica striata*,  
*Chrysomitris pinus*,  
*Curvirostra leucoptera*,  
*Junco hyemalis*,  
*Perisoreus canadensis*,  
*Picoides arcticus*,  
*Tetrao canadensis*.

The Canadian sub-province includes especially the highlands between Hudson Bay and the St. Lawrence waters and across them into Northern Wisconsin, the higher portion of the Adirondack, Green, and White Mountains, Northern Maine, and, according to Prof. Verrill, the coast region from Mt. Desert to the southeastern part of New Brunswick, including the islands in the Bay of Fundy. Even far to the south, the high mountain regions of the Alleghanies to Georgia have the same fauna, their most characteristic species of bird being the common blue snow-bird, *Junco hyemalis*.

*Emydidae* belong to the same low region also, as well as most of the American Perennibranchiate Amphibia, *Menopoma* (more rarely *Menobranchus*) alone penetrating into the Appalachian region, while *Siredon* belongs exclusively to the high central plateau, being found from the Missouri plains to the Cascade mountains of Oregon and south to the city of Mexico.

The *Unionidae* and *Melaniidae* seem likewise to belong more especially to the depressed portion of eastern North America.

I may also mention in this same connection that as might be expected, the entire eastern province is characterized by its abundance of Chelonians and Amphibians; the middle and western, by their Saurians. Among fishes the Etheostomoids, Esoces, Siluridae, the fresh-water Ganoids, (*Amia*, *Lepidostei*, etc.), the fresh-water Percoids, etc., are peculiar to the eastern province, while the great abundance of unusual forms of the *Cyprinidae* is equally distinctive of the middle and western. As regards the fishes, however, the boundaries of the provinces are considerably changed, the eastern including all the waters emptying into the Missouri river and Gulf of Mexico, the middle embracing the region of the Great Basin and the drainage of the Colorado river, and the western, the waters discharging into the Pacific.

The following tables present the species of birds most characteristic of each province—the selection having been mainly confined to what may be considered as representative species, or those which would formerly have been considered as identical. The isolated species of each province have not been included.

<i>Western.</i>	<i>Middle.</i>	<i>Eastern.</i>
<i>Buteo montanus.</i>	<i>montanus.</i>	<i>borealis.</i>
<i>elegans.</i>	<i>elegans.</i>	<i>lineatus.</i>
<i>Athene cucularia.</i>	<i>hypogæa.</i>	
<i>Picus Harrisii.</i>	<i>Harrisii.</i>	<i>villosus.</i>
<i>Gairdneri.</i>	<i>Gairdneri.</i>	<i>pubescens.</i>
<i>Nuttalli.</i>	<i>scalaris.</i>	<i>borealis?</i>
<i>Sphyrapicus nuchalis.</i>	<i>nuchalis.</i>	<i>varius.</i>
<i>Colaptes Mexicanus.</i>	<i>Mexicanus.</i>	<i>auratus.</i>
<i>Trochilus Alexandri.</i>		<i>colubris.</i>
<i>Chætura Vauxii,</i>	<i>Vauxii?</i>	<i>pelasgia.</i>
<i>Chordeiles popetue.</i>	<i>Henryi.</i>	<i>popetue.</i>
<i>Myiarchus cinerascens.</i>	<i>cinerascens.</i>	<i>crintus.</i>
<i>Contopus Richardsonii.</i>	<i>Richardsonii.</i>	<i>virens.</i>
<i>Empidonax pusillus.</i>	<i>pusillus.</i>	<i>Trilli?</i>
<i>difficilis.</i>	<i>difficilis?</i>	<i>flaviventris.</i>
<i>Turdus nanus.</i>	<i>nanus.</i>	<i>Pallasii.</i>
<i>ustulatus.</i>	<i>ustulatus.</i>	<i>fuscescens.</i>
<i>Sialia Mexicana.</i>	<i>arctica.</i>	<i>sialis.</i>
<i>Geothlypis Macgillivrayi.</i>	<i>Macgillivrayi.</i>	<i>Philadelphia.</i>
<i>Icteria longicauda.</i>	<i>longicauda.</i>	<i>viridis.</i>
<i>Dendroica Audubonii.</i>	<i>Audubonii.</i>	<i>coronata.</i>
<i>Collyrio excubitoroides.</i>	<i>excubitoroides.</i>	<i>ludovicianus.</i>
<i>Vireo Swainsoni.</i>	<i>Swainsoni.</i>	<i>gilvus.</i>
<i>Minus var. caudatus.</i>	<i>caudatus.</i>	<i>polyglottus.</i>
<i>Harporhynchus redivivus.</i>	<i>crissalis.</i>	
	<i>Harporhynchus longiro-</i>	<i>rufus.</i>
	[ <i>tris.</i>	



Thryothorus spilurus.	Thryothorus Berlandieri.	ludovicianus.
Troglodytes Parkmanni.	leucogaster.	Bewickii.
Sitta aculeata.	Parkmanni.	aedon.
Lophophanes inornatus. <sup>11</sup>	aculeata.	carolinensis.
Parus occidentalis.	atricristatus.	bicolor.
Psaltriparus minimus.	septentrionalis.	atricapillus.
Carpodacus Californicus.	plumbeus.	
Zonotrichia Gambelii.	Cassini.	purpureus.
Junco Oregonus.	Oregonus.	leucophrys.
Spizella Breweri. <sup>12</sup>	pallida.	hyemalis.
Melospiza Heermanni.	fallax.	pusilla.
Peucea ruficeps.	Cassini.	melodia.
Passerella Townsendii.	schistacea. <sup>13</sup>	æstivalis.
Pipilo Oregonus.	arcticus.	iliaca.
“ fuscus.	mesoleucus.	erythrophthalmus.
Ageleus gubernator.	phœniceus.	
Sturnella neglecta.	neglecta.	phœniceus.
Scolecophagus cyanocephalus.	cyanocephalus.	magna.
Cyanura Stelleri. [lus.	macrolophus.	ferrugineus.
Cyanocitta Californica.	Woodhousii.	
	Meleagris Mexicana.	Floridana.
Callipepla Californica.	Gambelii.	gallopavo.
	Ortyx texensis.	
Tetrao Obscurus.	Richardsonii.	virginianus.
“	Franklinii.	
“ Sabini.	umbelloides.	canadensis.
Ibis guaruana.	guaruana.	umbellus.
Bernicla nigricans.		ordii. <sup>14</sup>
leucopareia.	Hutchinsii.	brenta.
Querquedula cyanoptera.	cyanoptera.	
Pelionetta Trowbridgii.		discors.
Larus occidentalis.	Chroicocephalus franklini.	perspicillata.
		Smithsonianus.
Sterna elegans.		atricilla.
Uria columba.		regia.
		grylle.

To sum up in brief the conclusions reached in the preceding remarks, it may be stated that the ornithological provinces of North America consist of two great divisions of nearly equal size in the United States, meeting in the vicinity of the 100th meridian, the western half divisible again into two, more closely related to each other than to the eastern, though each has special characters. These three sections form three great provinces to be known as the western, middle, and eastern; or those of the Pacific slope; of the great basin, the Rocky mountains and the adjacent plains; and of the fertile plains and region generally, east of the Missouri. A northern or sub-arctic fauna mixes with and melts into the three, extending far to the south (even into Mexico) along the Rocky mountains. The middle and eastern provinces have each a southern subdivision, the one bordering on Mexico, the other on the Gulf and the Atlantic, and each of these also exhibits a differentiation, the former having a special

<sup>11</sup> Found also in the middle province.

<sup>12</sup> Extends also to the Rocky Mts.

<sup>14</sup> Found all the way across to the Pacific.

<sup>13</sup> Found also at Fort Tejon ?

subdivision again into Cape St. Lucas, and the latter into Florida. Northward the eastern province extends more and more westward reaching the Rocky mountains and even westward of them towards the Yukon.

The southern boundary of the middle province of North America may be arbitrarily established as a straight line, drawn from the mouth of the Rio Grande to that of the Yaqui near Guaymas on the Gulf of California, thus throwing into North America the whole of Florida and Lower California.

[To be continued.]







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## The Distribution and Migrations of North American Birds.

BY SPENCER F. BAIRD,

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(Abstract of a memoir presented to the National Academy of Sciences, Jan., 1865.)

ATTENTION has already been called to the fact that certain species, characterizing the eastern province, make their appearance in the Rocky mountains. The following is a list of those collected by Mr. Drexler at Fort Bridger (about in lat.  $41^{\circ}$ , long.  $110^{\circ}$ ) in the center of the Rocky mountain range, nearly all of which have been found still farther to the northwest, toward Puget Sound. The birds found at Fort Bridger probably arrived there by way of the Platte, those of Washington Territory by both the Platte and upper Missouri.

Although thus extending westward, almost, if not quite, to

the Pacific, along the northern boundary, they appear to always return the way they went as none of the species have yet been met with in California.

I have added to each species the locality on the Missouri river up to which it was observed by Dr. Hayden in one of his early explorations.

*Species of Eastern birds found at Fort Bridger.*

Tyrannus Carolinensis,	Fort Union and Yellowstone.
Turdus fuscescens,	
T. Swainsoni,	
Seiurus Noveboracensis,	
Dendroica coronata, <sup>1</sup>	
Setophaga ruticilla,	Fort Pierre.
Vireo olivaceus,	" Union (Mr. Audubon).
Mimus Carolinensis,	" Lookout.
Zonotrichia leucophrys,	(not found farther west).
Quiscalus versicolor,	Fort Benton (Pearsall).

It will be sufficiently evident, as most birds change their residence from winter to summer, and *vice versa*, that unless we devote especial attention to their distribution during the breeding season, we shall not be able to mark their boundaries with precision. Species which go north to the Arctic circle to nest, return to mix in Mexico, Guatemala, or the West Indies, with species resident in those countries, or of short migration, and are followed part way in their southern flight by Arctic birds starting from localities still farther north. The case is quite different with reptiles, and most insects and mammals, of which a few species only change their residence or leave their place of birth, not in obedience to the instinct of reproduction, but of necessity caused by overcrowding, the search for suitable food, &c. A true parallel, however, is seen in the movements of fishes in search of a suitable place to deposit their spawn, which takes place with the same regularity as to date and direction that we find in birds.

It is only of late years that we have been enabled to determine, even with approximate precision, the winter quarters of our North American birds. Many of the species of the Eastern province are limited by the waters of the Atlantic or Gulf, crowding into Florida, Georgia, and other southern states. Comparatively few visit the West Indies; a much larger proportion reach Mexico and Guatemala, and the number of those passing farther south diminishes with the latitude. Very few of the land birds pass into South America, the following being a list of the principal species (and their southernmost mentioned limit) recorded as occurring in that portion of the continent, mostly as winter emigrants, although a few are resident.

<sup>1</sup> Found by Dr. Suckley on Puget Sound.

Cathartes aura, S. America.	Helminthophaga chrysoptera, Bogota.
“ atratus, “	Seiurus Noveboracensis, “
Falco columbarius, Ecuador.	Dendroica Blackburniæ, Ecuador.
“ femoralis, S. America.	“ cœrulea, Bogota.
“ sparverius, “	“ striata, “
Buteo Pennsylvanicus, Ecuador.	“ æstiva, “
Asturina nitida, “	Myiodytes Canadensis, Ecuador.
Nauclerus furcatus, Brazil.	Setophaga ruticilla, “
Rostrhamus sociabilis, Ecuador to La Plata.	Pyrranga rubra, “
Coccygus erythrophthalmus, Bogota.	“ æstiva, “
Turdus Swainsoni, Ecuador.	Dolichonyx oryzivorus, Gallapagos.
Mniotilta varia, Bogota.	Hirundo bicolor, Bolivia.
	Vireo olivaceus, Bogota.

25 species.

The following species are recorded as occurring on the Isthmus of Panama and Darien in addition to most of those just mentioned :

Anrostomus Carolinensis,	Hirundo lunifrons,
Ceryle alcyon,	Turdus fucescens,
Tyrannus Carolinensis,	Protonotaria citrea,
“ Dominicanis,	Geothlypis Philadelphia,
Myiarchus crinitus,	Oporornis formosus,
Empidonax Trailli,	Helminthophaga peregrina,
“ flaviventris,	Dendroica virens,
Dendroica coronata,	Chrysomitris Mexicanus,
“ castanea,	Euspiza Americana,
“ Pennsylvanica,	Guiraca Ludoviciana,
“ maculosa.	Icterus spurius,
Myiodytes mitratus,	“ Baltimore,
Hirundo horreorum,	Quiscalus macrourus.

27 species.

One circumstance will attract our attention in examining these lists of North American birds reaching the Isthmus of Panama or passing beyond it as far as Bogota and into Ecuador, namely : that they embrace absolutely none of the species characterizing the middle province, all belonging to the eastern. It would seem to be the case that the migratory birds of the Rocky Mountain region go only a comparatively short distance southward into Mexico, few of them even reaching Guatemala, but preponderating on the west coast. It has already been remarked that the birds strictly characteristic of the Pacific region of the United States scarcely appear to go into Mexico at all.

While the number of land birds reaching the gates of South America, and passing through them, principally along the Andes into central New Granada and Ecuador, is so small, the case is very different with the waders, a large proportion of which are during our winter spread over the entire continent, almost as far as Patagonia. Comparatively few, however, of the Natatores follow them in this journey.



The following list comprises the principal indications of the winter visitors to the West Indies from the United States, all of them, excepting *Nephocetes niger*, belonging to the eastern fauna.

	Bahamas.	Cuba.	Jamaica.	Other Islands.
<i>Cathartes aura</i> ,	*	*	* †	
“ <i>atratus</i> ,		*	*	
<i>Falco anatum</i> ,	*	*	*	
“ <i>columbarius</i> ,		*	*	Tobago.
<i>Buteo borealis</i> ,		*	*	
“ <i>Pennsylvanicus</i> ,		*		
<i>Rostrhamus sociabilis</i> ,		*		
<i>Circus Hudsonius</i> ,		*		
<i>Pandion Carolinensis</i> ,	*	*	*	Trinidad.
<i>Nauclerus furcatus</i> ,		*	*	
<i>Brachyotus Cassini</i> ,		*		
<i>Otus Wilsonianus</i> ,				Tobago †
<i>Coccygus</i> (uncertain),				
<i>Sphyrapicus varius</i> ,	*	*	*	St. Croix.
<i>Trochilus colubris</i> ,		*	*	
<i>Nephocetes niger</i> ,		*	*	
<i>Antrostomus Carolinensis</i> ,		*	*	St. Cruz, Tobago.
<i>Chordeiles popetue</i> ,	*	*	*	
<i>Ceryle alcyon</i> ,	*	*	*	
<i>Tyrannus Carolinensis</i> ,		*		
“ <i>Dominicensis</i> ,	*	*	*	St. Cruz, St. Thomas.
<i>Myiarchus crinitus</i> ,		*	* †	
<i>Contopus virens</i> ,		* †		
<i>Empidonax Acadicus</i> ,		*		
<i>Turdus mustelinus</i> ,		*		
“ <i>fuscescens</i> ,		*		
“ <i>Swainsoni</i> ,		*		
“ <i>Alicæ</i> ,		*		
“ <i>migratorius</i> ,		*		
<i>Sialia sialis</i> ,		*		
<i>Mniotilta varia</i> ,	*	*	*	St. Cruz.
<i>Parula Americana</i> ,	*	*	*	St. Thomas.
<i>Geothlypis trichas</i> ,	*	*	*	
<i>Oporornis formosus</i> ,		*	*	
<i>Helmitherus vermivorus</i> ,		*	*	
<i>Protonotaria citrea</i> ,		*	*	
<i>Helminthophaga Bachmani</i> ,		*	*	
“ <i>chrysoptera</i> ,		*	*	
“ <i>perigrina</i> ,		*	*	
<i>Seiurus aurocapillus</i> ,		*	*	St. Domingo, St. Cruz.
“ <i>Noveboracensis</i> ,		*	*	St. Cruz.
“ <i>Ludovicianus</i> ,		*	*	
<i>Dendroica virens</i> ,		*—		
“ <i>Canadensis</i> ,	*	*	*	
“ <i>coronata</i> ,	*	*	*	St. Domingo.
“ <i>Blackburniæ</i> ,	*			
“ <i>Pennsylvanica</i> ,	*			
“ <i>striata</i> ,	*	*		
“ <i>maculosa</i> ,	*	*		
“ <i>tigrina</i> ,	*	*	*	St. Cruz.
“ <i>palmarum</i> ,	*	*	*	St. Domingo.
“ <i>superciliosa</i> ,		*	*	St. Domingo.
“ <i>discolor</i> ,	*	*	*	St. Cruz.
“ <i>cœrulea</i> ,		*		
<i>Myiodyctes mitratus</i> ,		*		
<i>Setophaga ruticilla</i> ,	*	*	*	St. Domingo, St. Cruz.

	Bahamas.	Cuba.	Jamaica.	Other Islands.
<i>Pyrranga rubra</i> ,		*	*	
" <i>æstiva</i> ,		*	* †	
<i>Hirundo horreorum</i> ,		*		St. Cruz.
" <i>bicolor</i> ,		*		
<i>Cotyle riparia</i> ,		*	*	
<i>Ampelis cedrorum</i> ,		*	*	
<i>Vireo olivaceus</i> ,		* †		
" <i>barbatula</i> ,	*	*		
" <i>Noveboracensis</i> ,		*		
" <i>solitarius</i> ,		*		
" <i>flavifrons</i> ,		*		
<i>Galeoscoptes Carolinensis</i> ,		*		
<i>Polioptila cærulea</i> ,		*		
<i>Certhiola Bahamensis</i> ,	*			
<i>Passerculus savanna</i> ,		*		
<i>Coturniculus passerinus</i> ,		*	* †	
<i>Spizella socialis</i> ,		*		
<i>Guiraca Ludoviciana</i> ,		*		
" <i>cærulea</i> ,		*		
<i>Cyanospiza cyanea</i> ,		*		
" <i>ciris</i> ,		*		
<i>Dolichonyx oryzivorus</i> ,	*	*	*	
<i>Agelæus phœniceus</i> ,	*			
<i>Xanthocephalus icterocephalus</i> ,		* †		
<i>Icterus cucullatus</i> ,		*		
" <i>Baltimore</i> ,		*		
" <i>spurius</i> ,				
<i>Columba leucocephala</i> ,	*	*	*	St. Cruz, Porto Rico.
<i>Ectopistes migratoria</i> ,		*		
<i>Zenaidura Carolinensis</i> ,		*		
<i>Melopelia leucoptera</i> ,		*	*	
<i>Chamæpelia passerina</i> ,	*	*	*	

87 species.

From an examination of this list it will be seen that, with but few exceptions, the species that reach Panama and pass into South America occur also in Cuba as winter visitors, the principal exceptions being *Empidonax Trailli* and *flaviventris*, *Geothlypis Philadelphica*, *Dendroica castanea* and *æstiva*, *Myiodioctes Edna-densis*, *Euspiza Americana*, and one or two species belonging to the middle province. It will also be remarked how many more of our species are recorded as visiting Cuba than Jamaica, 80 species instead of 36, the number becoming still less as we proceed eastward in the group. The Bahama winter fauna will probably exhibit as many continental species as Cuba, or even more when we are better acquainted with it. The comparative superiority of numbers in Cuba, is probably owing to the fact that the island, the western end especially, with the Tortugas, is a stepping stone or resting place for our species passing from Florida to Yucatan and Guatemala. This is probably the route by which most species of the Eastern province reach middle America, rather than along the coast of Texas and Mexico, many species being recorded in Guatemala and Honduras, not noted in Mexico north of Yucatan. It is the species of the Middle province that characterize more especially the winter fauna of Central Mexico, particularly its western slope and Cape St. Lucas, and it is an interesting fact that very few of the birds pecu-

liar to the Western province are known to occur in Mexico at all. The North American winter birds of Western Mexico, as stated, belong almost entirely to the Middle fauna, the most notable exceptions being the occurrence at Colima and Manzanillo of *Dendroica superciliosa*, *Sterna Antillarum*, and *Chroicocephala atricilla*, and at Mazatlan of *D. superciliosa*, *Mniotilta varia*, and *Seiurus atrocapillus*, none of them being found in California. The birds of Eastern Mexico are likewise in large proportion from the Eastern province of North America.

It may perhaps be proper to recall attention to the fact that, in defining the southern boundary of the Middle province and at the same time that of North America as a zoological region, I drew the line from the mouth of the Rio Grande of Texas to that of the Yaqui River at Guaymas on the Gulf of California. The space embraced between this line and the continental portion of South America, including Mexico, Central America, the Isthmus of Panama and of Darien, and the entire West Indies, I term Middle America; all south of this, South America. Trinidad alone, of the West Indies, belongs rather to South America, most of its species being common to the adjacent main land, though some are, perhaps, peculiar to it. Tobago, farther north, though with some South American species, has yet a considerable number peculiar to itself.

In concluding this part of my remarks I may state that the present lists and generalizations in regard to the distribution of our birds are to be considered merely as provisional, and that investigations at present in progress by myself and others will, it is hoped, impart much greater precision to the knowledge of the subject. In many instances I have omitted species which might have been considered as entitled to a place in one or the other tables, but this has been in most cases the result of recent determinations and different identifications than those of other authors.

Having thus briefly indicated the boundaries of the principal provinces of the North American ornithological fauna, I propose to call attention to some generalizations that have suggested themselves in reference to certain influences exerted upon species by their distribution according to latitude, longitude, and elevation, and by their association with each other. The most important of these, is the law that North American birds of wide distribution in latitude, whether migrant, or residents, will be found to be larger the higher the latitude of their place of birth.

It is well known to zoölogists that of all animals, birds are the most constant in their dimensions, so much so indeed, that size is generally considered as a most important specific character. The comparison of many specimens of the same species from widely remote localities has shown me, however, that there is a certain variation in size, dependent on the extension northward

and southward of the limits of distribution during the breeding season, the more northern being the larger, the more southern the smaller. Nor does this depend upon a greater development of body by more constant use of the muscular system in flight, as suggested by Gloger, who observed the same fact in Europe (but confined it especially to the increase in length of wings and tail), or upon a greater variety or amount of food, since the difference is as strongly marked in species constantly resident, as in those which migrate over great distances, and the development extends to the bill, feet, and all parts of the body. And in fact birds most remarkable for their great range show the least variation in size, while the variation is most evident in certain species of woodpeckers as *Picus villosus* and *Hylotomus pileatus*, which have a very wide distribution in latitude, without any special migration at all. In these woodpeckers the difference between specimens from Florida and from Canada is so great as to have given rise to the impression of there being several species of each, differing in size.

In nearly every instance where I have compared summer specimens from localities widely remote in latitude, I have found the difference referred to. A similar law prevails in regard to mammals as shown very clearly in the American deer, *Cervus Virginianus* and in the gray Squirrel, *Sciurus Carolinensis*, which are much larger in the north than in the south and larger in the mountains than in the lowlands. In mammals, if not in birds, a second law comes into play: that in the same latitudes in North America the specimens from the greater altitudes are the larger, this law appearing to extend even to man, as shown by the greater size of the inhabitants of the Appalachian region, than in those of the lowlands.

If we assume the parallel of  $40^{\circ}$  as an average line, while the specimens born farther north are larger, those born in the most southern localities are even disproportionately smaller. This is very evident in species from Cape St. Lucas, the extreme southern limit of the Middle province, where, almost without exception, the indigenous birds are so much smaller than specimens of the same species inhabiting the United States, as readily to convey the impression of being distinct new species. The same is the case, although to a less degree, in Florida, where there appears to be a tendency (found to some extent also at Cape St. Lucas) to absolute increase of the size of the bill, even with diminution in general bulk, seen especially in *Corvus Americanus*, and *Ortyx Virginianus*.<sup>2</sup>

While some Florida birds are thus characterized by larger bills than their more northern brethren, several of the birds of the Middle and Western provinces have an increase in the length of the tail as compared with the same or allied species in the east.

<sup>2</sup> This disproportionate difference of size at Cape St. Lucas and South Florida is probably connected with the limited range of the species in those regions which have thus an insular rather than continental relationship.

Thus *Icteria longicauda* of the Western and Middle provinces is only to be distinguished from *I. viridis* of the Eastern by the longer tail, while *Mimus polyglottus*, and *Harporhynchus rufus* have each a long tailed Western variety.

Both these generalizations in regard to varieties of size and proportion, have been used with advantage in testing the claim of supposed species to this rank, and have aided in materially diminishing the accepted number of species of both mammals and birds.

Another fact which may be mentioned in reference to birds of the different provinces, is that specimens from the Pacific coast are apt to be darker in color than those from the interior, the latter frequently exhibiting a bleached or weather-beaten appearance, possibly the result of greater exposure to the elements and less protection by dense forests.

In a careful study of large series of birds of any two representative species collected near the line of junction of their respective provinces, a combination of characters of both species will often be met with, explicable only on the supposition of the hybridization of the two. Whether such hybrids are themselves fertile, or whether the cross is kept up by the constantly recurring union of individuals of pure breed of either species, I am not prepared to say, but the general facts appear to be as stated. A notable instance of this is seen in the two northern species of *Colaptes*, one, *Mexicanus*, characterizing the Western and Middle provinces, the other, *auratus*, the Eastern. The lines of distribution of the two intersect on the upper Missouri near the mouth of the Yellowstone River, and all along that portion of its course we find *Colaptes* of every possible grade of transition, or combination of the several characters of the two species; scarcely any two exactly alike, and the same individual not even agreeing in the markings of opposite sides.\* A similar combination of characters of *Cyanura Stelleri* and *macrolopha* is met with on the headwaters of the Columbia, and on the Yukon, of *Junco hyemalis* and *Oregonus*, and of *Helminthophaga celata* and *peregrina*. Other instances can be adduced, but these will be sufficient to illustrate the facts.

The possibility of hybridity as referred to, is another element to be taken into consideration in discussing the claim of a supposed new species to that rank.

Having thus discussed the laws of distribution and migration of the birds of North America on the continent itself, and the influence of region upon the development of the individual, I proceed to consider the subject of their movement eastward toward Greenland and Europe; that of European birds toward North America, and the several causes that appear to influence such migrations; and to present various tables of geographical distribution bearing upon the question introduced.

\* See Baird. Birds of North America, 1858, 122.

## The Distribution and Migrations of North American Birds.

BY SPENCER F. BAIRD,  
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(Abstract of a memoir presented to the National Academy of Sciences, Jan., 1866.)

A COMPARISON of the carefully prepared lists of Greenland birds by Reinhardt in the *Ibis* for 1861, and of Iceland birds by Newton, published in "Iceland, its Scenes and Sagas," by Sabine Baring-Gould, in 1863, will show that all the land birds mentioned as abundant in Iceland are, with few exceptions, more or less common in Greenland; and it is therefore very probable that the additions to the lists of European birds found in Greenland are to be looked for among the remainder of the Icelandic species. The following list, compiled from the above sources, of all land birds of Iceland and of the European species occurring in Greenland, will illustrate the relationship in this respect.

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## European land birds found in Iceland and Greenland.

	Iceland.	Greenland.	North America.
<i>Haliaetus albicilla</i> (Linn.)	Common.	Very common.	? Very rare.
<i>Falco Canadensis</i> , Gmel.,	Rather rare.	Common.	Quite common.
“ <i>Islandicus</i> , “	Very common.	Rare.	Rare.
“ <i>peregrinus</i> , L.	Problematical.	Not common.	Very rare.
“ <i>æsalon</i> , L.	Very common.		
<i>Nyctea nivea</i> , H.	Rather rare.	Very common.	Very common.
<i>Otus brachyotus</i> ,	Rare.	Very rare.	“ “
“ <i>vulgaris</i> ,	One specimen.		
<i>Chelidon urbica</i> (Linn.),	Rare.		
<i>Hirundo rustica</i> , L.	“		
<i>Troglodytes borealis</i> , Fischer,	“		
<i>Turdus merula</i> , L.	Seen twice.	[killed.]	
“ <i>iliacus</i> , L.	Common.	Two specimens	
“ <i>pilaris</i> , L.	Doubtful.		
<i>Ruticilla tithys</i> (Scop.).	Seen once.		
<i>Saxicola œnanthe</i> , Linn.	Common.	Common.	Rare.
<i>Motacilla alba</i> , L.	“	Two specimens.	
<i>Anthus pratensis</i> ,	“	One specimen.	
<i>Plectrophanes Lapponica</i> , L.	Very rare.	Common.	Very common.
“ <i>nivalis</i> , L.	Very common.	Very common.	“ “
<i>Aegiothus linaria</i> , L.	Rare.	Common.	Common.
“ <i>cancescens</i> , Gld.		“	
<i>Sturnus vulgaris</i> , L.	Rare.	One specimen.	
<i>Corvus corax</i> , L.	Common.	!	
“ <i>cornix</i> , L.	Rare.		
<i>Lagopus Islandorum</i> , Fabr.	Common.	Common.	Common.

From an examination of the above list it will be seen that the only land bird abundant in Iceland and not noticed in Greenland is *Falco æsalon*. The European species to be looked for in Greenland as occurring in Iceland are only the *F. æsalon*, *Chelidon urbica*, *Hirundo rustica*, *Troglodytes borealis*, *Turdus merula*, *Ruticilla tithys*, *Corvus corax*?, and *Corvus cornix*. It will also be noticed that all the European land birds common in Greenland have also been found in continental North America.<sup>1</sup> The Ptarmigans of the three regions will quite probably be found identical.

The following is a table of the water birds of Greenland and Iceland belonging to the European fauna, from which it will be seen that two species, *Crex pratensis* and *Ortygometra porzana*, are found in Greenland and are not yet recorded from Iceland; eleven or twelve species in Iceland and not in Greenland; one in Newfoundland, *Scolopax rusticola*, and neither in Greenland or in Iceland; eleven in both Greenland and Iceland. There are in Greenland proportionally fewer water birds than land birds of the European fauna that occur in continental North America.

<sup>1</sup> *Haliaetus albicilla* was noticed by Sclater as found in Newfoundland and Nova Scotia; although now he considers the evidence rather uncertain. The Smithsonian Institution possesses specimens of true *Falco peregrinus* as distinguished from *anatum* from Moose Factory, Hudson's Bay.

	Iceland.	Greenland.	North America.
<i>Vanellus cristatus</i> (Meyer),	Occasional.	Two specimens.	
<i>Charadrius hiaticula</i> (L.),	Not rare.	Not rare.	
" <i>pluvialis</i> (L.),	Very common.		
<i>Hæmatopus ostralegus</i> (L.),	Common.	Three specimens.	
<i>Ardea cinerea</i> (L.),	Occasional.	Two specimens.	
<i>Falcinellus igneus</i> ,	Very rare.		
<i>Numenius phæopus</i> (L.),	Very common.	Not rare.	
" <i>arquatus</i> (Linn.),	Rare.		
<i>Philomachus pugnax</i> (L.),	One specimen.		Several specimens.
<i>Limosa algocephala</i> (L.),	Common.	One specimen.	
<i>Gallinago media</i> (Leach),	"	Common.	Bermuda.
<i>Scolopax rusticola</i> (L.),			Newfoundland.
<i>Fulica atra</i> (L.),	Rare.		
<i>Crex pratensis</i> (Bechst.),		Very rare.	Occasional.
<i>Ortygometra porzana</i> (L.),		"	
<i>Rallus aquaticus</i> (L.),	Rare.		
<i>Bernicla leucopsis</i> (Temm.),	Common.	Common. †	Doubtful
<i>Anser ferus</i> (L.),	Rare.		
" <i>segetum</i> (Bechst.),	Rare.		
" <i>brachyrhynchus</i> (Baill.),	Rare.		
<i>Cygnus ferus</i> (Leach),	Common.	Not rare.	
<i>Nettion crecca</i> (L.),	Very common.	Common.	Not rare.
<i>Mareca penelope</i> (L.),	Quite common.	Not rare.	"
<i>Querquedula querquedula</i> (L.),	Problematical.		
<i>Fuligula ferina</i> (L.),	One specimen.		
<i>Oidemia nigra</i> (L.),	Rare.		
<i>Larus canus</i> (L.),	Very rare.		

The following list embraces the strictly North American birds which are recorded by Reinhardt as occurring in Greenland.

<i>Falco candicans.</i>	<i>Eremophila cornuta.</i> †
<i>Hirundo horreorum.</i>	<i>Sphyrapicus varius.</i>
<i>Cistothorus palustris.</i>	<i>Colaptes auratus.</i>
<i>Regulus calendula.</i>	<i>Charadrius Virginicus.</i>
<i>Dendroica coronata.</i>	<i>Numenius Hudsonicus.</i>
" <i>virens.</i>	" <i>borealis.</i>
" <i>striata.</i>	<i>Actodromas maculata.</i>
<i>Parula Americana.</i>	<i>Gambetta flavipes.</i>
<i>Helminthophaga ruficapilla.</i>	<i>Macrorhamphus griseus.</i>
<i>Geothlypis Philadelphia.</i>	<i>Porzana Carolina.</i>
<i>Anthus Ludovicianus</i> (breeds).	<i>Fulica Americana.</i>
<i>Turdus minor.</i> <sup>2</sup>	<i>Nettion Carolinensis.</i>
<i>Tyrannula pusilla.</i> <sup>2</sup>	<i>Bucephala albeola.</i>
<i>Contopus borealis.</i>	<i>Pelionetta perspicillata.</i>
<i>Vireo olivaceus.</i>	<i>Podiceps Holbölli.</i>
<i>Xanthocephalus icterocephalus.</i>	<i>Rhodostethia rosea.</i>
<i>Zonotrichia leucophrys.</i> <sup>4</sup>	<i>Xema Sabini.</i>
<i>Loxia leucoptera.</i>	

While therefore it appears that Iceland in all probability furnishes a considerable number of species of European birds to Greenland, the latter supplies very few American birds in return. This is owing to the fact that Iceland lies east of the southwestern extremity of Greenland, and in part south of its

<sup>2</sup> It is difficult to say which of the three allied species of North American thrush is meant here.

<sup>3</sup> This species is also indeterminable.

<sup>4</sup> Quite as likely to be *Z. Gambelii*.



eastern coast, so that the visitors from the continent of North America in their northward or northeastern movement and corresponding return would not come near Iceland at all, while on the other hand a migration to the north and northwest from Iceland would necessarily soon strike Greenland at a distance of only a few hundred miles, especially aided by the prevalent aerial currents, of which mention will be made hereafter. The following are the only peculiarly North American or Greenland species noted in Mr. Newton's list: *Falco candicans* Gmel., *Numenius Hudsonicus* Lath., *Histrionicus torquatus* Bon.

It is difficult to say whether the Iceland Golden Eye (*Clangula Islandica*) is a gift from Iceland to Greenland and North America, or *vice versa*. While abundant in Iceland, it is by no means rare in North America, being some years quite common as far south as the St. Croix river.

The British island of Heligoland in the North Sea, off the coast of Denmark, is of special interest in an ornithological point of view, from its furnishing more species of European birds than any other locality of its extent (400 out of about 500 species admitted by Blasius), as well as several Asiatic and North American species not recorded as having occurred elsewhere in Europe. To the labors of Herr Gätke, a resident of the island, extended over more than twenty years, we are indebted for the curious and remarkable facts referred to (Naumannia, 1858, 419). The North American birds observed by him are—

Anthus Ludovicianus,	Nov. 6, 1851.	Tryngites rufescens,	May 9, 1847.
Dendroica virens,	Oct. 19, 1858.	Pelionetta perspicillata,	Oct. 9, 1851.
Harporhynchus rufus,	Oct. —, 1857.	Xema Sabinii,	Oct. 25, 1847.
Galeoscoptes Carolinensis,	Oct. 28, 1840.	Rhodostethia rosea,	Feb. 5, 1858.
Charadrius Virginicus,	Dec. 20, 1847.		

The following North American birds are recorded in Prof. Blasius's "List of the Birds of Europe, 1862," edited by Newton, in the British Museum Catalogue of British birds, and in other authorities, as occurring in Europe:—

Falco candicans,		† Lanius excubitoroides,	(England.)
Nauclerus furcatus,	(England.)	Turdus Pallasii,	(Germany.)
Nyctale Acadica,	"	" Swainsoni,	(Belgium; Italy.)
Scops asio,	"	" migratorius,	(Germany.)
Colaptes auratus,	"	Anthus Ludovicianus,	(Heligoland.)
Picus villosus,	"	Vireo olivaceus,*	(Chillaston, near Derby,
" pubescens,	"	Eng., May, 1859.)	
Coccyzus Americanus,	"	Regulus Calendula,	(England.)
" erythrophthalmus,	(Lucca.)	Ampelis cedrorum,	"
Ceryle alcyon,	(Ireland.)	Loxia Americana.	
Progne purpurea,	(England.)	" leucoptera,	"
Hirundo bicolor,	"	† Aegiothus canescens,	(Belgium.)
Dendroica virens,	(Heligoland.)	Spiza ciris,	(England; cage bird †)
Harporhynchus rufus,	"	Agelæus phœniceus,*	(England.)
Galeoscoptes Carolinensis,	"		

\* Ibis, 1864, 394.

\* Ibis, 1861, 177.

Sturnella magna, (England; March and October.)	Bernicla Canadensis, (England.)
Ectopistes migratoria, (England.)	Querquedula discors, (Northern France.)
Charadrius Virginicus, (Heligoland.)	Mareca Americana, (England.)
" vociferus, (England.)	Cygnus Americanus, "
Gambetta flavipes, "	Fulix affinis, "
Symphemia semipalmata, (Sweden.)	" collaris, "
Actiturus Bartramius, (Germany; Eng- land.)	Bucephala albeola, "
Tringoides macularius, (Eng.; Germ.)	Pelionetta perspicillata, (Heligoland.)
Tryngites rufescens, (Eng.; Heligoland.)	Lophodytes cucullatus, (England.)
Macrorhamphus griseus, (England.)	Plotus unbinga, "
Actodromas maculata, "	Tachypetes aquilus, (Weser.)
" minutilla, "	Sterna fuliginosa, (Engl.; Magdeburg)
" Bonapartii, (England; France.)	Anous stolidus, (England; France.)
Numenius Hudsonicus, (Iceland.)	Rhodostethia rosea, (Heligoland; Eng- land.)
" borealis, (Scotland.)	Xema Sabini, (Heligoland; England.)
Porphyrio martinica, (England.)	Chroicocephalus atricilla, (England.)
Porzana Carolina, (England: Newbury, Oct. 1864; Zoologist, 9540.)	" Philadelphia, (Ireland.)
Botaurus lentiginosus, (England.)	Oceanites oceanica, (England.)
Nycticorax violaceus, "	Puffinus fuliginosus, (France; England.)
Anser hyperboreus, (Germany.)	" obscurus, (England.)
	Podiceps Holböllii, (Holland.)

Of the 69 species of the above list, all but 19 occurred in Great Britain and Ireland.

*List of birds supposed to be identical in Europe and North America, or not satisfactorily separated.*

Archibuteo lagopus.	Fulix marila.
Aquila chrysaetos.	Histrionicus torquatus.
Pandion haliaetus.	Bucephala clangula.
Brachiotus vulgaris.	" Islandica.
Nyctea nivea.	Harelda glacialis.
Surnia ulula.	Polysticta Stelleri.
Cotyle riparia.	Somateria mollissima. †
Ampelis garrulus.	" spectabilis †
† Pinicola enucleator.	Mergus serrator.
Aegiothus linaria.	Sula bassana.
Plectrophanes Lapponicus.	Graculus carbo.
" " nivalis.	Stercorarius (all species).
† Corvus corax.	Larus glaucus.
† Lagopus albus.	" leucopterus.
† " mutus.	" marinus.
Squatarola Helvetica.	Rissa tridactyla.
Strepsilas interpres.	Pagophila eburnea.
Phalaropus hyperboreus.	Rhodostethia rosea.
" fulicarius.	Sterna Anglica.
Tringa canutus.	" Caspia.
" maritima.	" Hirundo.
" subarquata.	" macrura.
Calidris arenaria.	" Paradisea.
Bernicla brenia.	Hydrochelidon fisisipes.
Anas boschas.	Colymbus torquatus.
Dafila acuta.	" septentrionalis.
Spatula clypeata.	Podiceps cristatus.
Chaulelasmus streperus.	

I have omitted the strictly Pelagic or ocean-wandering birds and those belonging to both coasts of the North Atlantic.

No North American birds have yet been found in Spitzbergen—indeed there are there but about 26 species in all, according to Malmgren. The only land birds recorded are *Falco gyrfalco*, *Nyctea nivea*, *Plectrophanes nivalis*, and *Lagopus* var. *hyperboreus*. Of the birds of Jan Mayen's Land, which lies in a direct line between Iceland and Spitzbergen, and nearer to Greenland than to either, I have seen no catalogue; but they probably have some relationship to Greenland species.

Bermuda,\* in lat. 32° 15' and long. 64° 51', is about 700 miles off the coast of the Carolinas, Cape Hatteras being the nearest land. It is nearly on the same parallel with Charleston, and about 900 miles south of Nova Scotia, nearly midway between the latter and the Virgin Islands of the West Indies. The entire group to which it belongs is about fourteen miles in length by about three or four in width. There are no indigenous Vertebrates, with the exception of a lizard (*Plestiodon longirostris* Cope, Pr. Acad. Nat. Sci., 1861, 315), and the birds are entirely North American in character, much like those of the middle United States. The fauna is especially characterized by the existence throughout the year, and the breeding, of the following birds: *Vireo noveboracensis*, *Galeoscoptes carolinensis*, *Sialia sialis*, *Cardinalis virginianus*, *Corvus americanus* (said to have been introduced), *Chamaepelia passerina*, ? *Gallinula galeata*.

In addition to these the following species are supposed to breed occasionally in the islands: *Sphyrapicus varius*, *Ardea herodias*.

All the other species appear to be accidental visitors, noted for a day or two one year, and not seen again perhaps for several. By far the greater number make their appearance in autumn only, very few occurring in spring.

There are no West Indian birds, properly so called, in the Bermudas; and the occurrence of *Milvulus tyrannus*, a South American species, is very questionable.

A few species of European birds have been noted in the Bermudas, consisting of *Saxicola œnanthe*, *Alauda arvensis*, and *Gallinago media*.

It will be noticed that the first and the last of these have been found in Greenland, the *Saxicola* on the continent only.

As out of the line of migration of our land birds, it is not likely that there are any regular visitors to the Bermudas, *en route* for other regions, the great majority of the species detected there having, in all probability in most cases, been driven out of their course by storms. They certainly do not all stop *en route* to the West Indies, as many of the species are not found in the latter islands.

\* See "Ornithology of the Bermudas," "Jardine's Contributions to Ornithology," 1849 and 1850, and "The Naturalist in Bermuda," by J. M. Jones, London, 1859.

The water birds seem to appear more regularly, owing to the fact that many of the species apparently take their flight southward from Nova Scotia and Newfoundland straight for the West Indies, and pass directly over the Bermudas.

In the following list of the birds recorded as occurring in the Bermudas, it will be seen that the greater portion of the insectivorous birds and many of the Raptores occur also in the West Indies; rather more than half of the number visit the latter group.

*List of birds recorded as occurring in the Bermudas.\**

- Cathartes aura (W). No. of specimens 1, December.  
 Falco anatum (W). 2, January, February.  
 " columbarius (W). Through year, especially in September.  
 " sparverius. 1, December.  
 Circus Hudsonicus (W). Occasional in autumn.  
 Haliaetus leucocephalus. Seen.  
 Pandion Carolinensis (W). Abundant.  
 Otus Wilsonianus (W). 3.  
 Syrniun nebulosum. 1, April.  
 Nyctale Acadica. 1, January.  
 Nyctea nivea. 3, Autumn.  
 Coccyzus Americanus. "Thousands," Oct. 1849; a few in April.  
 Sphyrapicus varius (W). Perhaps breeds; December to April.  
 Trochilus colubris (W). At one time common; April.  
 Chætura pelasgia. Several; Sept. 1849.  
 Chordeiles popetue (W). Sometimes very common; April to Sept. 1864.  
 Ceryle alcyon (W). Common; September to April; regular visitor.  
 Milvulus tyrannus.?? One; March, 1847.  
 Tyrannus Carolinensis (W). Abundant; April.  
 " Dominicensis (W). March and April.  
 Contopus virens (W). One; April.  
 Turdus mustelinus (W). Several.  
 " Swainsoni (W). Two; October.  
 " migratorius (W). Several; February and March.  
 Saxicola œnanthe. One each; October, March.  
 Sialia sialis (W). Common; resident.  
 Anthus Ludovicianus. One; November.  
 Mniotilta varia (W). Three; October.  
 Parula Americana (W). One; April.  
 Geothlypis trichas (W). One; October.  
 Seiurus Noveboracensis (W). Abundant in autumn; regular visitor.  
 Dendroica coronata (W). One; January; several in April.  
 " pinus. Common in September; several seasons.  
 " palmarum (W). Two; December.  
 " discolor (W). One; October.  
 Myiodioctes mitratus (W). One; March.  
 Pyrranga rubra (W). Several; April.  
 " œstiva (W). "  
 Hirundo horreorum (W). Rare in spring; common Aug. to Sept.; great flight in Sept. 1849.  
 " bicolor (W). Sept. 1849.  
 Cotyle riparia (W). August and September.  
 Progne purpurea. Great flight Sept. 22, 1849.  
 Ampelis cedrorum (W). Abundant October to December.  
 Collyrio borealis. One; March.

\* Species with (W) are found also in the West Indies.

- Vireo noveboracensis* (W). Common; resident.  
*Mimus carolinensis* (W). " "  
*Eremophila cornuta*. Three; October and February.  
 (*Alauda arvensis*.) One; June 12.  
*Chrysomitris tristis*. Several; March.  
*Curvirostra americana*. January to May.  
 " *leucoptera*. March to May.  
*Plectrophenax nivalis*. January to February.  
*Passerculus savana* (W). One; April.  
*Poœcetes gramineus*. One; Oct. 25.  
*Coturniculus henslowi*. Small flock; December.  
*Melospiza palustris*. One; December.  
*Guiraca ludoviciana* (W). Two; October and April.  
*Cardinalis virginianus*. Common; resident.  
*Dolichonyx oryzivorus* (W). Nearly every autumn; October.  
*Icterus baltimore* (W). Two; October.  
*Corvus americanus*. A few every year; perhaps breeds.  
*Zenaidura carolinensis* (W). One; March, 1850.  
*Chamæpelia passerina* (W). Common; resident.

Also most of the waders and a considerable number of the swimming birds.

*Conclusion.*—From a careful consideration of the facts mentioned in the preceding pages, we are, I think, entitled to derive the following generalizations in regard to the interchange of birds between America and Europe.

European birds, especially the land species, reach Greenland and return to the continent by way of Iceland, the Faroe Islands forming a stepping-stone from Great Britain and Scandinavia. In very rare instances species seem to proceed direct to Greenland, without stopping in Iceland, although this may be due to the fact that while visiting Iceland they have not yet been noted there by any naturalist.

The European birds found on the continent of North America reach it by autumnal movement from Greenland in company with strictly North American species.

Birds of North America rarely, if ever, reach England from Greenland by direct spontaneous migration by way of Iceland, as shown by the fact that only three of the American birds occurring in Greenland are found in Iceland, and that few of the American species observed in Europe are found in Greenland at all.

Most specimens of American birds recorded as found in Europe were taken in England (about 50 out of 69), some of them in Heligoland; very few on the continent (land birds in only five instances).

In nearly all cases these specimens belonged to species abundant during summer in New England and the eastern provinces of British America.

In a great majority of cases the occurrence of American birds in England, Heligoland, and the Bermudas, has been in the autumnal months.

The clue to these peculiarities attending the interchange of species of the two continents will be found in the study of the laws of the winds of the northern hemisphere, as developed by Prof. Henry and Prof. Coffin. These gentlemen have shown (see Prof. Henry's articles on Meteorology, "Report of Commissioner of Patents for 1856," page 489) that "the resultant motion of the surface atmosphere, between latitudes  $32^{\circ}$  and  $58^{\circ}$  in North America, is from the west, the belt being twenty degrees wide, and its greatest intensity in the latitude of  $45^{\circ}$ . This, however, must oscillate north and south at different seasons of the year with the varying declination of the sun. South of this belt, in Georgia, Louisiana, etc., the country is influenced, at certain seasons of the year, by the northeast trade-winds; and north of the same belt by the polar winds, which on account of the rotation of the earth, tend to take a direction toward the west. It must be recollected that the westerly direction of the belt here spoken of is principally the resultant of the southwesterly and northwesterly winds alternately predominating during the year."

From these considerations and facts, therefore, we are entitled to conclude that the transfer of American birds to Europe, is principally, if not entirely, by the agency of the winds, in seizing them during the period of their migration, (the autumnal especially) when they follow the coast, or cross its curves, often at a considerable distance from land, or a great height above it. Carried off, away out to sea, mainly from about the latitude of  $45^{\circ}$  (the line of greatest intensity of the winds) the first land they can make is that of England, whence the fact that most of the species have occurred in the British Islands as well as Heligoland, equally well fitted to attract stragglers and furnish them a resting place. It is probable that, apart from its few permanent residents, the Bermudas are supplied in the same manner.

Iceland being in the latitude of the reverse current, from east to west, such of its species as are caught up by the winds and carried off would soon reach Greenland, only a few hundred miles distant. This may be the principal agency of supply from Europe to Greenland, as most European land birds are only met with there at rare intervals, although as Greenland lies north of Iceland, there may be a regular migration to some extent.

As remarked, the prevailing direction of the winds, whether violent or moderate throughout the year, as well as during the period in which our birds are on either their spring or autumnal migration, is from America toward Europe. Even should their direction be reversed and that rare phenomenon, a summer "northeaster," occur, it would merely have the effect of bringing the birds back upon our own coast, or into the interior, the

line of the storm being in fact about parallel with the eastern shore line of the United States, and its influence extending only a short distance from the coast, and not involving the vicinity of Europe at all. That such storms do affect the movements of our birds is shown in the case of the golden plover. It is well known that this species breeds in immense numbers in the northern regions of America, and that the southward migration in summer and autumn, is principally confined to the region along or near the Atlantic coast. Generally, large flights would seem to start directly from Newfoundland and Nova Scotia for the West Indies, where they are met with every autumn passing still southward into South America, and reaching almost to Patagonia. Usually it is but a comparatively small number that touch and rest along the Atlantic states; but it is well known to the sportsmen of New England that, should a violent northeast storm occur off the coast toward the end of August, unusual flights of plover and curlew may be looked for.\* This was the case in 1863, when the islands of Nantucket, Martha's Vineyard, and other localities along the coast of Massachusetts, swarmed with incredible flights of these birds. On similar occasions immense numbers have been carried far into the interior of the Atlantic states, furnishing the occasion of a regular carnival for gunners, much as in the case of great flights of the wild pigeon.

Another instance of the influence of northeast storms is in the occurrence of the Stormy Petrel, (Mother Carey's Chickens) and other oceanic birds far in the interior, and even across the Alleghanies, during and after such storms. The collections of the Smithsonian Institution embrace specimens of *Thalassidroma Leuchii* killed about Washington in August, 1842, with hundreds of others. I myself obtained at Harrisburgh, Penn., a fine adult Pomerine Jager, *Cataractes pomarinus*, killed on the Susquehanna, near that city, in September, 1839. Adults of the species mentioned are rarely seen within the limits of the United States at all, and in summer the latter would hardly be likely to occur south of Newfoundland.

The present is not the occasion to discuss the nature of that impulse which causes the bird or the fish to retrace its steps in spring so unerringly; the fact is a well established one and of much importance in reference to the multiplication or diminution of species. A region deprived of its spring birds or fishes by extermination will only be filled up again in the course of a long period of time. The result, however, can be greatly accelerated by artificial propagation in the places to be supplied.

\* Mr. G. N. Lawrence mentions (Annals N. Y. Lyceum, viii, 1864, 100.) that the Golden Plover is always found at Montauk Point on the 28th of August, should a northeast storm occur.

It may be considered as established that the migrations of birds are generally more or less in a north and south direction, influenced very materially by river courses, mountain chains, forests, conditions of moisture, mean temperature, altitude, etc. Middendorf (Die Isepiptesen Russlands) suggests that birds migrate in the direction of the magnetic pole; a suggestion not at all borne out by the facts in North America.

It may be further remarked that while birds proceed generally in the spring to the very spot of birth, and by a definite route, their return in autumn is not necessarily in the same line. Many birds are familiar visitors in abundance, in certain localities in either spring or autumn, and are not known there in the other season. This is a fact well known to the diligent collector, and I have been inclined to think that, in very many instances, birds proceed northward along the valley of the Mississippi, to return along the coast of the Atlantic.

In general the northward vernal movement is performed much more rapidly, and with fewer stops by the way, than the autumnal.

Birds generally make their appearance in given localities with wonderful regularity in the spring, the *Sylvicolidae* especially; a difference of a few days in successive years attracting the notice of the careful observer; this difference is generally influenced by the season. The time of autumnal return is, perhaps, less definite.







