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**NATIONAL ACADEMY OF SCIENCES**

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**Volume XXI**  
**FIRST MEMOIR**

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**BIOGRAPHICAL MEMOIR JOEL ASAPH ALLEN**

**1838-1921**

**BY**

**FRANK M. CHAPMAN**

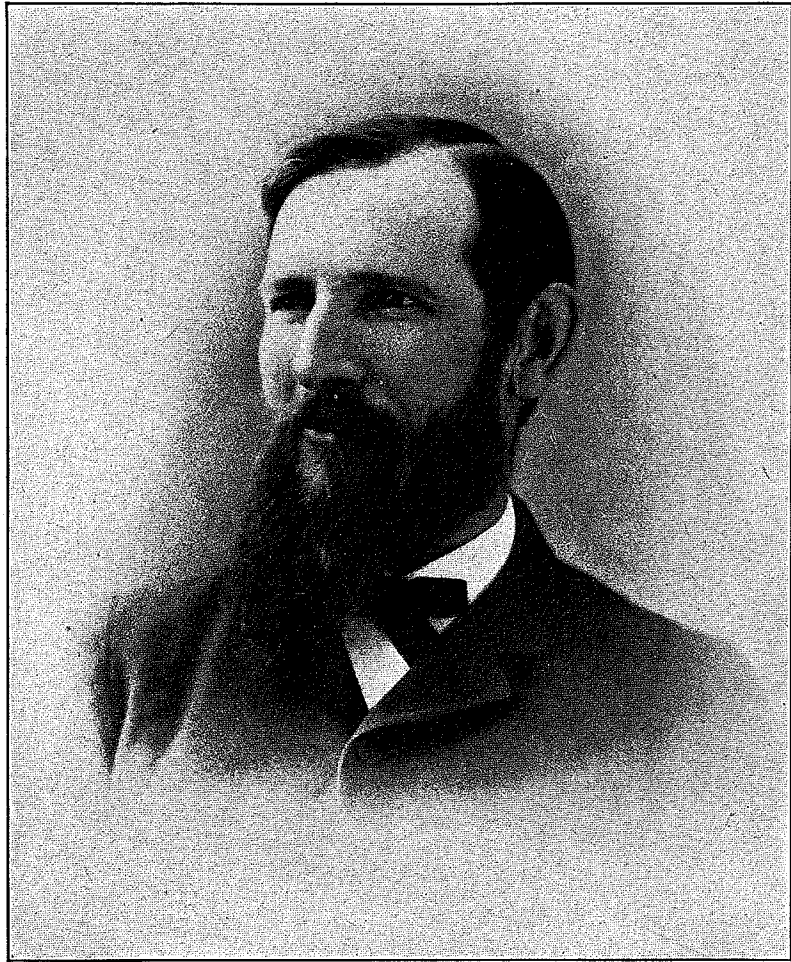
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*J. A. Allen*

# JOEL ASAPH ALLEN<sup>1</sup>

By FRANK M. CHAPMAN

## ANCESTRY AND BOYHOOD

There is nothing in the immediate ancestry, the early environment, or associations of Joel Asaph Allen to account for his obviously instinctive characteristics as a student of nature. One can only say that he was born a naturalist and that the definite, pronounced interest which at an early age he evinced in natural phenomena and in plant and animal life developed spontaneously.

Doctor Allen was born at Springfield, Mass., July 19, 1838, and died at Cornwall-on-Hudson, N. Y., on August 29, 1921. He came of good New England stock. On his father's side he was a descendant in the eighth generation of Samuel Allen, who settled at Windsor, Conn., in 1640, and who came to this country from England, it is believed, in 1630 with the Dorchester Company in the ship *Mary and John*.

On the maternal side, Doctor Allen was descended from John Trumbull, great-grandfather of Gov. Jonathan Trumbull (said to have been the original "Brother Jonathan" and familiar friend of Washington), who was born in Newcastle-on-Tyne, England, and settled in Roxbury, Mass., in 1639.

Doctor Allen's immediate progenitors were farmers. His father, however, was a carpenter in his earlier days, but later bought a farm on which he passed the greater part of his life. A man of excellent judgment and sterling integrity whose advice was often sought by his neighbors, he had, however, little appreciation of his son's desire to study nature, and evidently expected him to succeed him in the care of the farm. Doctor Allen's mother, on the other hand, had much sympathy with his yearnings for a knowledge of flora and fauna, and often used her influence to secure for him opportunities to study. Possibly tastes latent in her may have found expression in her son. They were not, however, possessed by Doctor Allen's two brothers, one of whom became a molder, while the other remained on the parental farm.

Doctor Allen's early training was rigidly puritanical. Both of his parents were members of the Congregational Church and strict in their religious observances. His home was half a mile from that of the nearest neighbor; but in thus being removed from external influences, he evinced while still a toddling youngster so marked an interest in wild flowers that he was dubbed "Doctor Sykes," in allusion to an herb doctor of local reputation.

With no training or contact with the outside world, other than that to be gained by attendance during the winter session at the conventional little red schoolhouse, distant a mile from his home, the young farmer developed a desire to know more of the soil and rocks, the animal and plant life, the ever-changing phenomena of sky and air which formed his environment.

At the age of 13, after much pleading, his father presented him with a gun. At first used for sport, it soon became a means of acquiring specimens. No books were available; there was no one to turn to for advice; and without instruction of any kind the tastes, not merely of the "nature lover," common in varying degrees to most men, but the deeper, rarer instincts of the student naturalist, were manifested. The birds shot were measured, weighed, described, and named. Attempts were even made to make colored drawings of them. A new world was opening to the boy, and so far as he knew he was the only naturalist in it.

His joy may be imagined, when, a little later, he made the acquaintance of one Bradford Horsford, a teacher of drawing, who was also an amateur taxidermist and ornithologist. From

<sup>1</sup>The biographical and bibliographical portions of this memoir are based on "Autobiographical Notes and a Bibliography of the Scientific Publications," prepared by Doctor Allen, and published by the American Museum of Natural History in 1916. The more strictly historical portion is taken from the memorial address on Doctor Allen presented by the writer before the American Ornithologists' Union, at its Thirty-ninth Congress, held in Philadelphia, November 9, 1921, and subsequently published in "The Auk" for January, 1922.

him young Allen borrowed, and afterward bought, a copy of the Brewer edition of Wilson's American Ornithology. Subsequently Nuttall's and Audubon's works on North American birds were discovered in the Springfield Public Library, and the boy naturalist was launched upon the career which, with never-ceasing pleasure to himself and increasing profit to science, he followed for the succeeding 70 years.

#### EDUCATION

When one considers his comparative isolation and the general lack of interest in natural phenomena of the period, Doctor Allen was singularly fortunate in finding men who could give him the assistance he so eagerly sought.

Shortly after meeting Horsford, a teacher took charge of the district school who possessed a broader education than anyone with whom young Allen had come in contact. A nature lover himself, he could appreciate his pupil's aspirations, and he not only assisted him in his studies, but gave him a copy of Blythe's Cuvier's Animal Kingdom. This work greatly enlarged the boy's horizon and showed his potential broadness as a naturalist. His interest in nature did not, as often happens, begin and end with birds, but plants, mammals, reptiles, fishes, insects—in short, the living world—equally appealed to him, and for years he kept a detailed record of meteorological phenomena. His first publication, indeed, was a summary from his journal of weather conditions, which appeared in the *New England Farmer* for 1858.

Prof. Oliver Marcy followed the donor of "Cuvier" as the boy naturalist's friend and teacher. Later he became dean of the faculty of Northwestern University, but at that time he was the teacher of natural sciences at Wilbraham Academy, which Allen attended during the winter from 1858 to 1862. This was a productive period in his development. Under the sympathetic guidance of Professor Marcy he selected his own studies, including physiology, astronomy, chemistry, Latin, French, and German. His summers were still spent on the farm, but with Humboldt's *Cosmos*, Lyell's *Principles of Geology*, and Dana's *Mineralogy* for companions, it is clear that his horizon was not restricted to the hayfields. To demonstrate, however, his value as a farm hand, the far from strong boy unduly exerted himself and this, with demands made by a desire to gratify his passion for collection and study, told heavily on his health. To these long periods of overwork, Doctor Allen attributed much of the semi-invalidism from which he suffered in after years.

Much of his spare time was now devoted to the study of botany, with the aid of Gray's *Manual*, and to the making of a collection of plants. These, however, formed only a part of the future curator's "museum." During the years 1859–1861 he collected and mounted some 300 birds, representing nearly 100 species, numerous mammals, reptiles, fishes, amphibians, some mollusks, and several hundred insects. Local minerals and rocks also found a place on the shelves of the room which did duty for a museum. These specimens indicated not a boyish desire to acquire; they were named and catalogued as part of a naturalist's equipment.

"The whole," Doctor Allen writes, "was amateurish in the extreme, and represented merely a superficial acquaintance with a wide range of subjects, but enough to add immensely to the pleasure of living, giving, as it did, the sense of being in touch with the plant and animal life and the geological features of my immediate environment."

Few local collections have done better service than the one which inaugurated Doctor Allen's career in museum work. It not only directly increased its owner's knowledge, but by its sale to Wilbraham Academy he was enabled to pay his tuition in that institution, where future students could profit by his industry.

The balance of the fund received for his beloved specimens enabled Doctor Allen to take the most important step in his life as a naturalist. While at Wilbraham Academy he found a congenial spirit in a fellow pupil, William Harmon Niles, a nephew of Professor Marcy, and who subsequently became professor of geology and physical geography in the Massachusetts Institute of Technology.

Niles planned to enter the Lawrence Scientific School as a pupil of Agassiz, and Allen decided to join him. The necessary preliminaries having been arranged, they arrived in Cam-

bridge early in February, 1862. They were cordially greeted by Agassiz; and plans were at once made for laboratory work and for courses of lectures in the Lawrence Scientific School under Agassiz, Jeffries Wyman, Joseph Lovering, Josiah P. Cook, and Asa Gray. Thus, as by the workings of a special Providence, the young naturalist's eager inquiries for directions on the road he was destined to follow were answered by the village taxidermist, the public schoolmaster, and the academy professor, each of whom assisted him on his way to the greatest teacher of his time. How fortunate it was for the future of science in America that Agassiz should have attracted to him students of the caliber of Allen, Alpheus Hyatt, Edward S. Morse, A. S. Packard, and A. E. Verrill, and others whose subsequent labors have exerted an incalculable influence on the development of zoological research in this country!

Allen expected to specialize in ornithology and was somewhat disappointed to be given, with Niles, a collection of corals and told to find their methods of growth and laws of development. Neither books nor instructions were given them, and equipped only with a hand lens they were instructed to use their powers of observation and report the result. Weeks were devoted to this task, but eventually the problems were solved and the young students given other work. With interruptions occasioned by ill health, when he devoted himself to fieldwork, Doctor Allen continued to work at Cambridge until the spring of 1865.

#### FIELD EXPLORATIONS

In March, 1865, Allen was invited by Agassiz to accompany him on an expedition to Brazil. The party contained seven official members, including Charles Frederick Hartt, and six volunteers, among whom was William James, later to become eminent as a psychologist. They sailed from New York on March 26 and arrived at Rio Janeiro April 22.

After collecting in the vicinity of that city for some weeks Doctor Allen was detailed to join a smaller party which left June 9 for the northern Provinces of Brazil. A difficult journey of somewhat over six months brought him to Bahia. Although so far from well during this period that he was obliged to abandon the plan to reach the coast at Ceara, Doctor Allen's collections included several cases of birds, mammals, mollusks, and zoological specimens, besides six or eight barrels of fishes, reptiles, and other vertebrates in alcohol; and his notebooks contained many pages of detailed observations on the country through which he had passed, its flora and fauna.

On December 15 Doctor Allen sailed from Bahia on a 300-ton brigantine, and, after a trying voyage, during which they were blown from Cape Hatteras back to St. Thomas, they dropped anchor off Woods Hole, Mass., 90 days out from Bahia.

Chronic indigestion now forced Doctor Allen to abandon museum work and return to the farm; but he had experienced the joy of exploration and, as soon as his health permitted, he took the field again, collecting in June, 1867, on Sodus Bay, Lake Ontario, and during the summer in Illinois, Indiana, and southern Michigan. At the end of this time he was physically so greatly improved that in October, 1867, he returned to the Museum of Comparative Zoology to act as curator of birds and mammals in that institution.

After a year in the study, the winter of 1868-69 was devoted to zoological exploration on the headwaters of the St. John's River, then a primeval part of Florida.

The results of the Florida expedition having been reported, Doctor Allen started in April, 1871, on a nine months' collecting trip to the Great Plains and Rocky Mountains in the interests of the Cambridge Museum. General collections were made at intervals from the Missouri River to the Great Salt Lake, the selection of locality being largely dependent upon the movements of hostile Indians. At Fort Hays, Kans., the arrival of a military escort being delayed, Doctor Allen and his two assistants went buffalo hunting, accompanied by only a single hunter, securing and preparing in 8 days, of which 36 hours were occupied in traveling, 14 complete skeletons and 5 young calves. This collection was supplemented the following January by the skins of 8 buffalo in winter pelage.

July and part of August were passed in Colorado, where *Leucosticte australis* was discovered on the summit of Mount Lincoln, and after 10 days at Cheyenne Doctor Allen went to Ogden,

Utah, which became his base for the ensuing 7 weeks. In October he worked at Green River and Fort Fred Steele, and from October 20 to December 18 at Percy. Here he secured the assistance of two native hunters, and the collections, chiefly of big game, shipped from this point nearly filled a freight car. December 19 he started eastward and, after a short stop in Kansas to secure buffalo, reached Cambridge on January 22, 1872. The collection made on this expedition included 200 skins, 60 skeletons, and 240 additional skulls of mammals (mostly large species), 1,500 birds' skins, over 100 birds in alcohol, a large number of birds' nests and eggs, recent and fossil fishes, mollusks, insects, and crustaceans.

The following year Doctor Allen, representing both the Cambridge Museum and the Smithsonian Institution, again went to our western frontier, on this occasion as chief of the scientific staff attached to the survey of the Northern Pacific Railroad. Railhead on this road was then at Fargo, N. Dak., beyond which construction trains ran as far as Bismarck.

The work of the expedition lay in the country between Bismarck and a point on the Mussellshell River, about 50 miles northwest of Pompey's Pillar on the Yellowstone, a distance of about 550 miles. The journey occupied some three months from June 20.

The region was infested by actively hostile Indians who had so interfered with the survey for the railroad route that an escort of 1,400 troops under General Custer accompanied the expedition. It was only three years later that this officer and his entire command were killed some 60 miles south of the most western point reached by Doctor Allen.

After passing the mouth of the Powder River the expedition was in daily contact with Indians and twice was attacked in force; orders were given forbidding the naturalists to use firearms or to leave the line of march, and, Doctor Allen writes, "The opportunities for natural-history collecting and field research on this expedition were far from ideal," but some specimens and much valuable data were secured which later formed the basis of a report of some 60 pages. With the exception of a visit to Colorado with William Brewster, in 1882, made chiefly to regain his greatly impaired health, Doctor Allen did not again enter the field. His collecting days, therefore, were ended before those of most of his colleagues were well under way, and few who knew him only in the study realized the extent of his travels, the dangers on sea and land to which he had been exposed, and the amount of material he had secured. The present-day naturalist, who travels in palatial steamers or follows well-worn trails, has but faint conception of the discomforts of a 90-day voyage in a small sailing vessel and has perhaps never experienced the risk of being himself collected.

From 1876 to 1882 Doctor Allen gave his time wholly to research, producing his monographs on the American Bison, Living and Extinct, and North American Pinnipeds, the latter a volume of 800 pages. The intensity with which he applied himself to these and other tasks during this period overtaxed his always limited reserve powers and for long periods he was able to do little or no work.

#### ASSOCIATION WITH THE MUSEUM OF COMPARATIVE ZOOLOGY

Doctor Allen's association with the Museum of Comparative Zoology began when as a student under Agassiz, he acted as an assistant in routine work, and received a monthly allowance sufficient for his living expenses, together with a furnished room in the museum dormitory.

He was not, however, made a member of the museum's scientific staff until 1871, when he became "assistant in ornithology." He continued to act as curator of birds and mammals until 1885, when he resigned to accept a similar position in the American Museum of Natural History.

Practically all Doctor Allen's field work after boyhood was done for or under the auspices of the Museum of Comparative Zoology, and he thus laid the foundation for the valuable collections of birds and mammals contained in that institution. The care of this material fortunately did not prevent Doctor Allen from making the philosophical researches which soon distinguished him, and some of his most important contributions to science were produced while he was associated with the Museum of Comparative Zoology. Chiefly through his influence and that of William Brewster, Cambridge became the center of ornithological activity



in this country. In 1876 this interest in the study of birds found expression in the formation of the Nuttall Ornithological Club, which, after giving birth to the American Ornithologists' Union, in 1883, has continued its career as a prosperous local organization.

For eight years Doctor Allen served as corresponding secretary of the Nuttall Club, and as editor of its *Bulletin*, the latter position leading naturally to his editorship of *The Auk*, which, with the founding of the American Ornithologists' Union, logically succeeded the *Bulletin*.

While in Cambridge, in addition to his curatorial duties, Doctor Allen served as lecturer on ornithology at Harvard College (1871-1873), as curator of reptiles at the Boston Society of Natural History (1868-1871), and as curator of birds and mammals in the same institution (1870-1880).

#### ASSOCIATION WITH THE AMERICAN MUSEUM OF NATURAL HISTORY

When the trustees of the American Museum, under the presidency of Morris K. Jesup, decided to make research as well as exhibition the function of that institution, their choice fell upon Doctor Allen as the head of the department of birds and mammals, a post which Doctor Allen entered on May 1, 1885.

This was the beginning of a new period in his life as well as that of the museum. Although the museum's exhibition halls had a fair representation of the leading types of birds and mammals, there was no study collection of the latter, and only about 3,000 study specimens of the former. The 50,000 skins and skulls of mammals at present in the museum were all, therefore, acquired during the period of Doctor Allen's curatorship, and to him in large measure is due the size and importance of the study collection of birds. Two years after Doctor Allen came to the museum, the Lawrence collection of 12,000 specimens was purchased, and this was followed by the Herbert Smith collection of 4,000 birds from southwestern Brazil, the Scott collection from Arizona, and the collections of Arizona birds presented by Dr. E. A. Mearns, and of humming birds by D. G. Elliot. At this time also the invaluable ornithological library of Doctor Elliot was acquired. The first three years of his connection with the museum Doctor Allen worked alone, but on March 1, 1888, the writer was appointed his assistant, and to-day the combined staffs of the now separate departments of birds and mammals number 17.

Relieved now of the actual care of the growing collections, Doctor Allen devoted himself to their study, and the publications of the museum during the succeeding third of a century bear testimony to his industry and productiveness. During this period he published 37 papers on birds and 150 on mammals, based wholly or largely on museum material. To his duties as curator were soon added those of editor, a post which his natural qualifications and experience especially fitted him to occupy. For 32 years all the zoological publications of the museum, including 37 volumes of the *Bulletin* and 22 of the *Memoirs*, passed through his hands, and a large part of his time was consumed by the preparation of copy for the press and the reading of proof.

Doctor Allen was eagerly welcomed to New York by the resident naturalists of the city. He was at once placed on the council of the Academy of Sciences, and later was made president of the Linnaean Society, but he soon found that the duties of each day demanded all his strength and he was able to take only a small part in the scientific activities of the city. He, however, was one of the organizers of the original Audubon Society, and to the end was an active director of this society and its virtual successor in New York, the National Association of Audubon Societies.

#### ASSOCIATION WITH THE AMERICAN ORNITHOLOGISTS' UNION

But by far the greater part of the time Doctor Allen could spare from his curatorial labors was given to the American Ornithologists' Union, in the welfare of which he was as much concerned as a father in the well-being of his first born. Indeed, to Doctor Allen might well be applied the title "Father of the American Ornithologists' Union." He played a leading part in its organization, served as its president during the first eight years of its existence, and was a member of its council until the day of his death. He edited 3 volumes of the Union's Check-List of North American Birds and for 28 years was editor of its official organ, *The Auk*, during which period he contributed 643 papers, reviews, and obituary notices to that publication.

Only one in daily contact with Doctor Allen can realize the extent of the demands upon his time and strength made by his duties for the Union and the loving attention he gave to its affairs. It occupied a place in his affections second only to that held by members of his family, and he never spared himself in advancing its aims.

Doctor Allen was chiefly responsible for the formulation of the Union's Code of Nomenclature, a subject in which he took a deep interest and on which he was an authority. For years he served as chairman of the Union's committee on classification and nomenclature, and for the last 10 years of his life he was a member of the International Commission on Zoological Nomenclature.

#### PERSONAL CHARACTERISTICS

Doctor Allen's distinguishing characteristics as a man were modesty, sincerity, unselfishness, gentleness, consideration for others, and a purity of mind and purpose which made it difficult for him to believe that anyone was not actuated by the same direct, guileless motives which ever animated him. I do not recall ever hearing him speak ill of another, but he was unsparing in his condemnation of careless work, and particularly of generalizations based on insufficient data. But so impersonal was his attitude, so impossible was it for him to cherish resentment, that while for an author he would show only helpful consideration, for his work honesty would compel him to be merciless. I have seen him treat with fatherly kindness a man whose theories he had subjected to fatally destructive criticism.

As a student Doctor Allen was inspired by love of truth for truth's sake and by an intense absorbing interest in his work. "All I aspired to," he wrote (Autobiographical Notes, p. 42), "was opportunity for scientific research, believing that diligence, singleness of purpose, and honest work would bring its own reward. I was content to follow my own lines of dominating interest to such limit as the circumstances of earning a living would permit. I have never had any desire for money as such, nor any interest whatever in financial projects, nor any longing for honors beyond those my colleagues in science saw fit to impose." His powers of application and concentration were phenomenal; his enthusiasm for research so unlimited that he constantly overtaxed his physical resources and the end of the day often found him on the verge of complete exhaustion. But so vitalizing was his love for his profession that, in spite of a frail physique and the fact that he never rested from his labors when it was a possible thing to pursue them, he was actively engaged in research to within a few weeks of his death.

But he was never too absorbed in his work to be interested in that of others; an appeal to him for advice or assistance received his whole-hearted attention and he made your problem his. The writer owes him a debt which accumulated during 34 years of almost daily association. Coming to the museum in March, 1888, as an inexperienced assistant, he found in Doctor Allen not only a friend but a teacher to whom he might turn for instruction in even the most trivial matters with the assurance that he would meet with a sympathetic response. Doctor Allen's counsel was always based on a logical consideration of the facts at issue; for, as far as was humanly possible, he eliminated the personal equation in reaching conclusions. The inestimable privilege of securing Doctor Allen's advice was sought, therefore, not only by members of his staff but by workers in other departments of the museum and in other institutions.

#### HOME LIFE

In 1879, after five years of wedded life, Doctor Allen's first wife, Mary Manning Cleveland, of Cambridge, died, leaving him his only child, Cleveland Allen, now in business in New York City.

Seven years later, and a year after coming to the American Museum, Doctor Allen married Susan Augusta Taft, of Cornwall-on-Hudson, who survived him. "I owe to her deep love and sympathy," Doctor Allen writes, "to her supreme optimism and constant watchfulness over my health, and to her inspiration, the greater part of the little I may have achieved in these last thirty years, and doubtless many years of activity beyond those I otherwise would have attained."

## CONTRIBUTIONS TO SCIENCE

Doctor Allen's first publication of major importance appeared in 1871, when he was 32 years of age. It was issued, unfortunately, under the superheading "On the Mammals and Winter Birds of East Florida" (an excellent faunal paper based chiefly on a winter's work in that State), but that portion of the paper which at once brought Doctor Allen to the attention of philosophic naturalists is contained under the subheading "With an examination of certain assumed specific characters in birds and a sketch of the bird-faunæ of eastern North America."

The subject of individual and geographic or climatic variation in the size and colors of birds was here given more serious consideration, based on detailed studies, than it had previously received.

Trinomials had not then been adopted as tools of the taxonomist, and Doctor Allen, conservative by nature, protested against the recognition as species of intergrading forms, a procedure which is now unquestioned. He argued that "whenever two forms which have both received names are found to intergrade, the more recent name shall become a synonym of the other. Some, however, still urge that every recognizable form, closely allied to others, and even intergrading, should be recognized by a binominal epithet, and that whether we call them species, or varieties, or races, or simply *forms*, that such names are none the less convenient expressions of facts."

Doctor Allen did not indorse this view, and although subspecific "splitting" was then in its infancy, he added with a prophetic foresight which indicated the thought he had given to the subject: "... Only experts can distinguish the forms, and frequently they only by actual comparison of specimens. . . . The names alone give us no clue to their real character, and are hence in a great measure meaningless when separated from the most explicit diagnoses, and whose affinities can frequently only be settled by the arbitrary criterion of locality."

It is a tribute to Doctor Allen's open-mindedness to follow his gradually changing point of view as with increasing experience, gained through the study of constantly growing collections and a characteristically unprejudiced estimate of the labors of his colleagues, he finally became convinced of the importance of recognizing the slightest constant geographic variation by name.

In 1883 and 1884 he published several articles or reviews advocating the use of trinomials as a convenient means of recognizing geographic forms in our systems of nomenclature. "Instead of doing violence to the 'Stricklandian Code,'" he wrote, "the trinomial system is a device, as we have stated on other occasions, to meet simply and completely a condition of things unknown and unexpected when that, in most respects, admirable system of nomenclatural rules was conceived, and is in accordance with the spirit if not the letter of that 'Code.' It is in no sense a lapse toward polynomialism." (Auk I, 1884, p. 103.)

Six years later, under the title "To what extent is it profitable to recognize geographical forms among North American birds?" he wrote: "Conscious of my own changed tendencies, it has seemed to me well to raise the above question for brief consideration, since it can do no harm to survey the field calmly and take note of the present drift in respect to a very important subject.

"Recent investigations have taken me over fields I worked, with some care, ten to fifteen years ago. In the meantime material has greatly increased; series of specimens have been obtained from localities then unknown; thus I find myself looking at things in a new light, but from, I trust, a more advanced position. My former tendencies, in common with those of others at that time, were in the direction of reducing doubtful forms to synonyms and closely related species to geographical forms. Now, with much additional experience, some increase of knowledge in respect to particular points at issue, and much more abundant material, some of my former conclusions seem open to revision, as I now realize that the resources then at command were far less adequate for the settlement of questions at issue than I then supposed them to be."

He still, however, urged caution in the use of trinomials "in order to guard against drawing too fine distinctions"; and added, "very little is to be gained by naming races distinguishable only by experts . . ." (l. c., p. 7). But a dozen years later we find him wholly committed to the recognition by name of geographic variations which are appreciable only to the experienced

systematist. Replying to an article in *Science* by Mr. Hubert Lyman Clark on the advisability of naming these slightly differentiated forms, he said: "We submit that the 'layman' who is naturally so troubled and confused by the modern ways of finding out how and to what extent animals are modified by their environment, is not the proper arbiter to determine the value and bearing of expert knowledge. If in other fields of scientific research it is not demanded that the investigator stop his work at the point where his results are within the comprehension of the lay mind, why should the student of birds and mammals be expected to refrain from extending his researches beyond the point of convenience for the layman?"

As an indication of this gradually changing estimate of the nature and importance of geographic variations, as well as of the increasingly great amount of material that passed through his hands, it is interesting to observe that while from the beginning of his systematic studies in 1870 to 1890 Doctor Allen described only 16 species and subspecies of mammals, during the 20 years following 1890 he described 415.

After treating at length of individual and climatic variations and illustrating his remarks with many specific instances<sup>2</sup> which up to that time had escaped the attention of systematic ornithologists, Doctor Allen presented an exposition of the "Causes of climatic variation," to which, after 50 years, we can add but little. After calling attention to the fact that increase in color is coincident with increase in humidity, and that the darker representatives of a species occur "where the annual rainfall is greatest, and the palest where it is least," he added: "This coincidence is clearly illustrated in the birds of the United States, when the darkest representatives of a species, as a general rule (indeed without exception so far as known to me), come from regions of maximum annual rainfall, and the palest from those of minimum annual rainfall."

Part V of this classic work, "On the geographical distribution of the birds of eastern North America, with special reference to the number and circumscription of the ornithological faunæ," has in reality a wider scope than the title implies, since it includes also a general discussion of the laws governing the distribution of life, an outline of the primary natural history divisions of the globe, and of the provinces of the North American temperate region.

When we consider the comparatively limited, and often inaccurate, data which were available 50 years ago, the soundness of the conclusions reached by Doctor Allen in his study of these problems is a tribute to the breadth of his vision, the thoroughness of his methods, and the excellence of his judgment.

"I am aware," he writes, "of the diversity of opinions still prevalent among naturalists in regard to the influence climate exerts on determining the geographical distribution of species and that many writers on this subject attribute to it only a slight importance, or altogether ignore it." That he, himself, did not share this view is evident when he adds: "That temperature is a powerful limiting influence affecting the range of species, especially in respect to their northward and southward extension, is so easily demonstrable that I am surprised to see it still questioned. I have myself subjected this principle to a rigid examination in studying the distribution of the animals and plants of eastern North America, and have been surprised at the exact coincidence I have almost constantly met with between their northern and southern limits of distribution and isothermal lines, they following them in all their numerous undulations, sweeping northward in the valleys and southward along the sides of mountain ranges. The occurrence on isolated alpine summits of species existing at a lower level only far to the northward, is of itself suggestive of the powerful influence temperature has on the distribution of animals and plants. In the Northern Hemisphere a northern fauna and flora everywhere extends along the mountains hundreds of miles to the southward of their respective limits in the adjoining plains and valleys. Various other causes have, of course, a greater or less influence in determining the range of species, but none other, on the land areas, humidity perhaps alone excepted, is nearly so potent. The want of conformity of isothermal lines with parallels of latitude has doubtless led to confusion in regard to this subject, since vain attempts have often been made to circumscribe the botanical and zoological zones by the latter. . . . The iso-

<sup>2</sup> E. g., birds which subsequently were described as *Pipilo erythrophthalmus alleni* Coues, *Ortyx virginianus floridanus* Coues, *Buteo lineatus alleni* Ridgw., *Sturnella magna argutula* Bangs, etc.

therms of the continents are widely deflected by the irregularities of the surface of the land, running nearly straight and parallel across level areas; but in mountainous districts they bend abruptly northward or southward, following along the sides of mountains instead of crossing them. In the same manner are species, and faunæ and floræ, limited—a coincidence clearly indicative of the strong influence climates exert in determining their geographical limits."

In defining the boundaries of faunal areas and in the nomenclature adopted for them Doctor Allen exhibited characteristic common sense and independence of thought: "The boundaries of realms and provinces," he wrote, "have often been arbitrarily fixed, inasmuch as they have been frequently limited and named in conformity to the continental areas, regardless of the fundamental law of the distribution of life in circumpolar zones." He protested against "the arbitrary partitioning of an almost homogeneous Arctic Realm between two implied totally distinct life regions, and also a similar division of the two slightly differentiated regions of the North Temperate Realm. For nearly all the species, and hence of course the genera and families, of the Arctic Realm, and a considerable percentage of the species, a large proportion of the genera, and nearly all the families of the Temperate Realm, occur in the northern parts of both the so-called 'Neogean' and 'Palaeogean Creations.'" These terms, he added in a footnote, together with "Palaeartic," "Nearctic," etc., "like those of 'Old World' and 'New World,' have been given with reference solely to the length of time the different land areas of the earth's surface have been known to the dominant race of mankind, and hence regardless of the zoological history of these different land areas. Modern science has taught us that the latest discovered continent (Australia) is peopled with the most ancient types of animals and plants now in existence, and that it is, zoologically considered, the ancient continent. Also that North and South America are behind Europe, Asia, and Africa in their zoological and geological development, while they are far in advance of Australia. To apply the term 'ancient' to what is really the most recent and 'modern' to what is mediæval, is evidently too great a misuse of language to be allowable in scientific nomenclature. The sciences of geographical zoology and geographical botany concern not merely the geographical distribution of the animals and plants now living, but also those of the past. If such descriptive terms as the above are to be employed, it is evidently important that they should be used in their legitimate sense. In the present paper it has hence been considered advisable to altogether discard these terms, since to use them properly would necessitate their adoption in a manner directly opposite to their original and generally accepted application."

"Neotropical," as applied to southern Mexico, Central and South America, is also shown to be misleading, since it includes also the South American Temperate Realm.

The terms employed by Doctor Allen for the eight major faunal areas, or "realms," call for no explanation and are, therefore, far more preferable than those which disguise an old fact under a new name. They are:

I, an Arctic Realm; II, a North Temperate Realm; III, an American Tropical Realm; IV, an Indo-African Tropical Realm; V, a South American Temperate Realm; VI, an African Temperate Realm; VII, an Ant-arctic Realm; VIII, an Australian Realm.

Doctor Allen followed Baird in recognizing two provinces, an eastern and a western, within the limits of the American portion of the North Temperate Realm, and he then treated of the faunas, or minor divisions of his eastern province, in so adequate a manner that the lines he laid down have not been essentially changed, and this treatise remains to-day an authoritative exposition on the causes governing the distribution of life in eastern North America.

This publication won for its author the Humboldt scholarship of the Lawrence Scientific School and at once placed him in the first rank of American naturalists. It was characterized by Coues (Bibliography of North American Ornithology, p. 686) as "a highly important philosophic treatise upon the general subject, which is discussed at length with force and logical consistency; the author's broad views upon this subject had at once a marked influence upon ornithological thought."

The subject of geographic variation continued actively to hold Doctor Allen's attention and, five years after the appearance of the Museum of Comparative Zoology essay, he published a paper on "Geographical variation among North American mammals, especially in respect to size," in which the following laws in regard to fissiped carnivora were enunciated:

(1) *The maximum physical development of the individual is attained where the conditions of environment are most favorable to the life of the species.* Species being primarily limited in their distribution by climatic conditions, their representatives living at or near either of their respective latitudinal boundaries are more or less unfavorably affected by the influences that finally limit the range of the species. . . .

(2) *The largest species of a group (genus, subfamily, or family, as the case may be) are found where the group in which they severally belong reaches its highest development, or where it has what may be termed its center of distribution.* In other words, species of a given group attain their maximum size where the conditions of existence for the group in question are the most favorable, just as the largest representatives of a species are found where the conditions are most favorable for the existence of the species.

(3) *The most 'typical' or most generalized representatives of a group are found also near its center of distribution, outlying forms being generally more or less 'aberrant' or specialized.* Thus the Cervidæ, though nearly cosmopolitan in their distribution, attain their greatest development, both as respects the size and the number of the species, in the temperate portions of the northern hemisphere. The tropical species of this group are the smallest of its representatives. Those of the temperate and cold temperate regions are the largest, where, too, the species are the most numerous. . . . The possession of large, branching, deciduous antlers forms one of the marked features of the family. These appendages attain their greatest development in the northern species, the tropical forms having them reduced almost to mere spikes, which in some species never pass beyond a rudimentary state.

A year later he contributed to the *Radical Review* (May, 1877, pp. 108-140) an article on "The influence of physical conditions in the genesis of species," which is fundamentally so sound and logical that 29 years later the Smithsonian Institution requested permission to republish it (*Ann. Rep. for 1905*, pp. 375-402).

Doctor Allen here contended that the direct modifying influences of environment are more potent factors in evolution than natural selection, taken in the narrow sense of the "survival of the fittest." Climate is shown to be the most active agent in promoting variations in size and in color, but habits and food and the geological character of the country are considered to play their part. Of the action of climatic influences he wrote:

That varieties may and do arise by the action of climatic influences, and pass on to become species, and that species become, in like manner, differentiated into genera, is abundantly indicated by the facts of geographical distribution and the obvious relation of local forms to the conditions of environment. The present more or less unstable condition of the circumstances surrounding organic beings, together with the known mutations of climate our planet has undergone in past geological ages, points clearly to the agency of physical conditions as one of the chief factors in the evolution of new forms of life. So long as the enviroing conditions remain stable, just so long will permanency of character be maintained; but let changes occur, however gradual or minute, and differentiation begins. If too sudden or too great, extinction of many forms may result, giving rise to breaks in the chain of genetically connected organisms.

Due allowance, however, he states must be made for relative plasticity or susceptibility to the influences of environment shown by closely allied species.

He also considers the possibility of species arising through what has since become known as mutation; writing:

But it is supposed, again, that new forms are not always thus gradually evolved from minute beginnings, but sometimes—perhaps not infrequently—arise by a *saltus*; that individuals may be born widely different from their parents, differing so widely and persistently as not to be so readily absorbed by the parental stock. In proof of this, instances are cited of new species apparently appearing suddenly, and of varieties thus originating under artificial conditions resulting from domestication. Granting that new forms may thus arise, although as yet few facts have been adduced in its support, they are necessarily at first local, and in no way accord with the observed geographical differences that characterize particular regions, and which affect similarly many species belonging to widely different groups.

Meanwhile, Doctor Allen was pursuing on a larger scale the studies in distribution, of which the earlier results were announced in the fifth part of the *Mammals and Winter Birds of East Florida*, and in 1878 there appeared his paper on "The geographical distribution of mammals, considered in relation to the principal ontological regions of the earth and the laws that govern the distribution of animal life." (*Bull. U. S. Geol. Surv.* IV, No. 2, pp. 313-377.)

The fact that Wallace in his classic, *Geographical Distribution of Animals* (1876), adopted the faunal regions proposed by Sclater, gave Doctor Allen an additional incentive to prove the incorrectness of faunal boundaries which are not based primarily on climatic zones. "One of the reasons given by Mr. Wallace for adopting Doctor Sclater's regions," he writes, "is that 'it is a positive, and by no means unimportant advantage to have our regions approximately equal in size and with easily defined, and therefore easily remembered boundaries,'" to which Doctor Allen adds: "These arguments can be scarcely characterized as otherwise than trivial, since they imply that truth, at least to a certain degree, should be regarded as secondary to convenience."

Wallace, commenting on the criticism of Sclater's faunal regions made by Doctor Allen in 1871, said: "The author continually refers to the '*law of the distribution of life in circumpolar zones*,' as if it were one generally accepted and that admits of no dispute. But this supposed 'law' only applies to the smallest details of distribution—to the range and increasing or decreasing numbers of *species* as we pass from north to south, or the reverse; while it has little bearing on the great features of zoological geography—the limitation of groups of *genera* and *families* to certain areas. It is analogous to the '*law of adaptation*' in the organization of animals, by which members of various groups are suited for an aerial, an aquatic, a desert, or an arboreal life; are herbivorous, carnivorous, or insectivorous; are fitted to live underground, or in fresh waters, or on polar ice. It was once thought that these adaptive peculiarities were suitable foundations for a classification,—that whales were fishes, and bats birds; and even to this day there are naturalists who cannot recognize the essential diversity of structure in such groups as swifts and swallows, sun-birds and hummingbirds. under the superficial disguise caused by adaptation to a similar mode of life."

Doctor Allen was not slow to accept this challenge of the correctness of his fundamental principles, replying:

I unblushingly claim, in answer to the main point, that the geographical distribution of life is *by necessity* in accordance with a "*law of adaptation*," namely, of *climatic adaptation*; that such a law is legitimate in this connection, and that the reference to the "superficial disguise" adapting essentially widely different organisms to similar modes of life is wholly irrelevant to the point at issue—a comparison of things that are in any true sense incomparable; furthermore, that the "law of distribution of life in circumpolar zones" does apply as well in a general sense as to details—"to groups of genera and families" as well as to species.

He then advances the theory of dispersal of life southward from the arctic which has since been so ably developed by Matthew, writing:

In this connection it may be well to recall certain general facts previously referred to respecting the geographical relations of the lands of the northern hemisphere and their past history. Of first importance is their present close connection about the northern pole and their former still closer union at a comparatively recent date in their geological history; furthermore, that at this time of former, more intimate relationship, the climatic conditions of the globe were far more uniform than at present, a mild or warm-temperate climate prevailing where now are regions of perpetual ice, and that many groups of animals whose existing representatives are found now only in tropical or semitropical regions lived formerly along our present Arctic coast. We have, hence, an easy explanation of the present distribution of such groups as Tapirs, Manatees, many genera of Bats, etc., in the tropics of the two hemispheres, on the wholly tenable assumption of a southward migration from a common wide-spread northern habitat, to say nothing of the numerous existing arctopolitan and semi-cosmopolitan genera. . . . The succeeding epochs of cold caused extensive migrations of some groups and the extinction of others; with the diverse climatic conditions subsequently characterizing high and low altitudes came the more pronounced differentiation of faunae, and the development, doubtless, of many new types adapted to the changed conditions of life—the development of boreal types from a warm-temperate or semi-tropical stock. The accepted theories respecting the modification of type with change in conditions of environment—changes necessarily due mainly to climatic influences—render it certain that if animals are so far under the control of circumstances dependent upon climate, and emphatically upon temperature, as to be either exterminated or greatly modified by them, the same influences must govern their geographical distribution.

Further study induced Doctor Allen to modify somewhat the views advanced in his *Museum of Comparative Zoology* essay of 1871, "especially in relation to the divisions of the Australian Realm, and to unite the South African Temperate with the Indo-African, as a division of the latter, and also to recognize Madagascar and the Mascarene Islands as forming together an independent primary region, in accordance with the view of Sclater, Wallace, and others."

He then presents in detail the evidence on which his conclusions are based, including a treatment of the regions and provinces contained in his realms, and after a general summary of the data supporting the belief that temperature is the most potent factor governing the distribution of life adds:

Hence, given: 1. Arctic and cold-temperate conditions of climate, and we have a fauna only slightly or moderately diversified; 2. A moderate increase of temperature, giving warm-temperate conditions of climate, and we have the addition of many new types of life; 3. A high increase of temperature, giving tropical conditions of climate, and we have a rapid multiplication of new forms and a maximum of differentiation. Again, given: 1. A long-continued continuity of land surface, and we have an essential identity of fauna; 2. A divergence and partial isolation of land-areas, and we find a moderate but decided differentiation of faunae; 3. A total isolation of land-areas, and we have a thorough and radical differentiation of faunae, proportioned to the length of time the isolation has continued. Hence, the present diversity of life is correlated with two fundamental conditions: 1. Continuity or isolation, past as well as present, of land surface; and, 2. Climatic conditions, as determined mainly by temperature.<sup>3</sup>

In accordance with these principles, which rest on incontrovertible facts of distribution, it follows that the nearly united lands of the North present a continuous, almost homogeneous, arctopolitan fauna; that farther southward, in the warmer temperate latitudes, we begin to find a marked differentiation on the two continents; that this differentiation is still further developed in the tropical continuations of these same land-areas, till an almost total want of resemblance is reached, except that there is what may be termed, in contrast with the more northern regions, a "tropical *facies*" common to the two. The small amount of land surface belonging to these primary land regions south of the tropics have no more in common (a few marine species excepted) than have these two tropical areas, but it is hardly possible for them to have much less. The Antarctic (mainly oceanic) region has a fauna strongly recalling the marine fauna of the Arctic, but has no resemblance to that of the intervening area.

The northern circumpolar lands may be looked upon as the base or centre from which have spread all the more recently developed forms of mammalian life, as it is still the bond that unites the whole.

Subsequently published papers on distribution treated in detail of the mammals and birds of North America and were in the main elaborations of his earlier contributions to zoogeography.

It was natural that Doctor Allen's faunistic studies should arouse his interest in the closely allied subject of migration and, in 1880, he published a brief paper on the "Origin of the instinct of migration in birds," in which he developed the theory that the seasonal movements of birds are, primarily, due to climatic changes occasioned by glaciation. He said:

Nothing is doubtless more thoroughly established than that a warm-temperate or subtropical climate prevailed down to the close of the Tertiary epoch, nearly to the Northern Pole, and that climate was previously everywhere so far equable that the necessity of migration can hardly be supposed to have existed. With the later refrigeration of the Northern regions, bird life must have been crowded thence toward the tropics, and the struggle for life thereby greatly intensified. The less yielding forms may have become extinct; those less sensitive to climatic change would seek to extend the boundaries of their range by a slight removal northward during the milder intervals of summer, only, however, to be forced back again by the recurrence of winter. Such migration must have been at first "incipient and gradual," extending and strengthening as the cold wave receded and opened up a wider area within which existence in summer became possible. What was at first a forced migration would become habitual, and through the heredity of habit give rise to that wonderful faculty we term the instinct of migration.

The explanation here offered of the origin of bird migration remains to-day an accepted theory among students of this phenomenon.

While prosecuting these more philosophical researches, Doctor Allen was also devoting much time to the production of his classic memoir on *The American Bisons, Living and Extinct*, a quarto of some 250 pages, published in 1876, to his monographs of *North American Rodentia* (with Elliot Coues), and to his notable *History of North American Pinnipeds*, an octavo of some 800 pages which appeared in 1880.

After accepting the post of curator of birds and mammals in the American Museum of Natural History, the character of Doctor Allen's work of necessity changed. Curatorial, administrative, and editorial duties now demanded all of his time and strength. His thought

<sup>3</sup> In illustration of the above, it may be added that the circumpolar lands north of the mean annual of 36° F., or, in general terms, north of the fiftieth parallel, with approximately an area of about 12,500,000 square miles, have representatives of about 54 genera of mammals; tropical America, with an approximate area of about 5,000,000 square miles, has about 90 genera; the Indo-African Realm, with an approximate area of about 15,000,000 square miles, has about 250 genera. Hence the tropical lands are four to five times richer in genera, in proportion to area, than those of the cold-temperate and Arctic regions.



and energy were devoted to laying the foundation of the great research collections which will forever remain monuments to his power to impress the museum authorities with the need of acquiring specimens for study as well as for exhibition.

For the first few years of his curatorship he had no assistance and was himself forced to perform the clerical tasks of cataloguing and labeling specimens. But as material accumulated, he was relieved of these duties in order that he might prepare reports on the rapidly growing collections.

Thus his work became largely that of a systematist and during the succeeding 35 years a constant stream of authoritative papers, at first on birds and mammals but later exclusively on mammals, poured from his pen. This included monographic as well as faunal papers to the number of 165 on mammals and 37 on birds.

The nomenclatural questions involved in work of this nature had a growing attraction for Doctor Allen, and his genius for unraveling the tangles of synonymy and allied problems soon made him a recognized authority in this thankless field of labor and resulted in his election, in 1910, as a member of the Commission on Zoological Nomenclature of the International Congress of Zoology.

A regrettably large part of his time was devoted to the preparation of copy for the press and the reading of proofs, and, while the high standard of museum publications, both in matter and appearance, owes much to his expert care and sound judgment, one can not but feel that this editorial supervision might have been secured at less cost to his time.

The Auk made similar demands upon him, but his rare ability as a discriminating, broadly informed, fair-minded, unprejudiced critic was given opportunity for expression in the often elaborate reviews of current literature which he prepared during the 36 years of his editorship of the Nuttall Bulletin and its successor, The Auk.

The wide influence exerted by these reviews is convincingly stated in a letter to Henry Fairfield Osborn, president of the American Museum of Natural History, by Dr. Joseph Grinnell, who writes:

Of all the eastern ornithologists active during the past thirty-five years I believe that Dr. Allen wielded the greatest influence in the field of serious scientific ornithology out here on the Pacific Coast. It was through the columns of "The Auk," especially in the review department of that journal, that Dr. Allen exercised this influence. I think others of the younger bird students here in the West would agree with me that our conceptions in systematic zoology and geographical distribution were molded more importantly by reason of Dr. Allen's sane criticisms and comments in his various reviews than through what we read in other articles and in books covering the same ground. I know that this was true in my own case.

#### HONORS

Doctor Allen's retiring disposition made it difficult for him even to appear before his scientific colleagues with justice to himself or to the paper he presented. The recognition, therefore, which his work received was due to its inherent scientific value.

He was awarded the Humboldt scholarship by the Lawrence Scientific School in 1871, the Walker grand prize by the Boston Society of Natural History in 1903, and the medal of the Linnaean Society of New York City in 1916, and in 1886 he was given an honorary Ph. D. by the University of Indiana.

He was elected to membership in the National Academy of Sciences in 1876, was a founder of the American Ornithologists' Union in 1883, and was annually reelected to its presidency from that date until 1891; he was an honorary fellow of the London Zoological Society (1901), an honorary member of the British Ornithologists' Union (1907), an honorary member of the New York Zoological Society (1897), to mention only the more important of the societies on whose roll his name appears, and always, he wrote, these honors came to him as a "surprise."

From a bibliography of over 1,400 titles covering the period from August, 1860, to August, 1916, which was issued with Doctor Allen's Autobiographical Notes,<sup>4</sup> the more important titles have been selected for republication here. To these there have been added references to all Doctor Allen's scientific publications which have appeared since August, 1916, thus completing his bibliography.

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On the Eared Seals (Otariadæ), with detailed descriptions of the North Pacific Species, by J. A. Allen. Together with an Account of the Habits of the Northern Fur Seal (*Callorhinus ursinus*), by Charles Bryant. <Bull. Mus. Comp. Zool., II, No. 1, pp. 1-108, pll. i-iii, August, 1870.

I. (1) Résumé of recent contributions to the natural history of the Otariadæ, pp. 4-19; (2) affinities, distinctive characters and synonymy, with remarks on sexual, age and individual variation, and a conspectus of the genera and species, pp. 19-45; (3) on the North Pacific species, pp. 45-89. II. Habits of the Northern Fur Seal, etc., by Charles Bryant, with notes by J. A. Allen, pp. 89-103. *Oulophocinæ*, p. 44, and *Trichiphocinæ*, p. 44, subfam. nov. of Otariadæ; subsequently abandoned.

On the Mammals and Winter Birds of East Florida, with an examination of certain assumed specific characters in Birds, and a sketch of the Bird-faunæ of Eastern North America. <Bull. Mus. Comp. Zool., II, No. 3, pp. 161-450, pll. 4-8, April, 1871.

Annotated list of the mammals, 35 species, pp. 168-185. *Trichechus manatus* Linné employed as the name of the Manatee (p. 171).

Notes on the Mammals of portions of Kansas, Colorado, Wyoming, and Utah. <Bull. Essex Inst., VI, pp. 43-66, May, 1874.

Four distinct lists of mammals observed in the region named in the title, with notes on their habits, distribution, etc. I. Mammals of Middle and Western Kansas, 23 species, with three pages on *Cynomys ludovicianus*, pp. 45-52. II. Mammals of Park County, Colorado, 37 species, pp. 53-58. III. Mammals of Carbon County, Wyoming, 32 species, pp. 58-61. IV. Mammals of Great Salt Lake Valley, Utah, 42 species, pp. 61-66.

Notes on the Natural History of portions of Dakota and Montana Territories, being the substance of a report to the Secretary of War, on the collections made by the North Pacific Railroad Expedition of 1873, Gen. D. S. Stanley, commander. <Proc. Boston Soc. Nat. Hist., XVII, pp. 33-91, June, 1874. (Also as a separate pamphlet of 61 pp., 1874.)

Mammals, pp. 36-45 (pp. 6-13 of the reprint), 31 species; notes on habits, distribution, etc.

<sup>1</sup> These titles are additions to the original bibliography, the numbers preceding them continue its system of enumeration.

On Geographical Variation in Color among North American Squirrels; with a list of the Species and Varieties of the American Sciuridæ occurring north of Mexico. <Proc. Boston Soc. Nat. Hist., XVI, pp. 276-294, June, 1874.

Variation in color, pp. 276-286; list of species and varieties, pp. 286-294. Genera: *Sciurus*, *Sciuropterus*, *Tamias*, *Spermophilus*, *Cynomys*, *Arctomys*. Species, 25, with 19 additional varieties=44 forms. Vars. nov.: (1) *Tamias quadrivittatus* var. *pallidus*, p. 289, (2) *Spermophilus tridecem-lineatus* var. *pallidus*, p. 291; (3) *Spermophilus parryi* var. *kodiacensis*, p. 292. ]

Geographical Variation among North American Mammals, especially in respect to size. <Bull. U. S. Geol. Surv. Terr., II, No. 4, pp. 309-344, July 1, 1876.

Memoirs of the Geological Survey of Kentucky. | N. S. Shaler, director. | Vol. I, Part ii. | - | The American bison, living and extinct. | By J. A. Allen. | With twelve plates and map. | - | University press, Cambridge: | Welch, Bigelow & Co. | 1876. Also:

Memoirs of the Museum of Comparative Zoölogy, at Harvard College, Cambridge, Mass. | Vol. IV, No. 10. | - | The American bison, living and extinct: | By J. A. Allen | Published by permission of N. S. Shaler, director of the Kentucky | Geological Survey. With 12 plates and a map. | University press, Cambridge: | Welch, Bigelow & Co. | 1876.

4°, pp. i-ix, 1-246, 1 col. map, 12 pll. 13ll., 2 woodcuts in text. Edition of 500 copies.

These two publications were simultaneous, and only differ in the titles. The following are the contents:

Title, p. i.

Preliminary note (by N. S. Shaler), p. iii.

Introduction, pp. v-ix.

## PART I

1. Distinctive characteristics and affinities of the bison, pp. 1-3.
2. General historical account of the remains of extinct bison hitherto found in North America, pp. 3-7.
3. Description of the extinct species, pp. 7-31.
4. Geographical distribution and geological position of the remains of the extinct bison of North America, pp. 32-35.
5. Relation of the existing species of bison to the extinct species, pp. 35-36.
6. Description of the existing species, pp. 36-70.

## PART II

1. Geographical distribution, past and present, of *Bison americanus*, pp. 71-191.
2. Products of the buffalo, pp. 191-201.
3. The chase, pp. 202-215.
4. Domestication of the buffalo, pp. 215-221.

Monographs of North American Rodentia. By Elliott Coues and Joel Asaph Allen.=Report of the U. S. Geol. Survey of the Territories (F. V. Hayden).

The Geographical Distribution of the Mammals, considered in relation to the principal ontological regions of the earth, and the laws that govern the distribution of animal life. <Bull. U. S. Geol. and Geogr. Surv. Terr., IV, No. 2, pp. 313-377, May, 1878.

Contents: I. Distribution of mammalian life in the Northern Hemisphere, considered in relation to laws of geographical distribution, pp. 313-329.—Historical résumé, with critical analysis of views of Selater and Wallace.

II.—Mammalian regions of the Globe, pp. 329-373.—(1) Arctic Realm; (2) North Temperate Realm; (3) Tropical Realm; (4) South American Temperate Realm; (5) Indo-African Realm; (6) Australian Realm; (7) Lemurian Realm; (8) Antarctic Realm.

The realms are divided into regions and provinces.

III.—General Summary, pp. 373-377, with diagram of realms, regions, and provinces.

History of North American Pinnipeds: A Monograph of the Walruses, Sealions, Sea-bears and Seals of North America. Washington: Govern. Printing Office, 1880.=U. S. Geol. and Geogr. Surv. Territories (F. V. Hayden, U. S. Geol.-in-Charge), Misc. Publ. No. 11. 8°, pp. i-xvi, 1-785, 60 woodcuts.

Family Odobenidæ, pp. 5-186. *Odobenus* Brisson (1762) the proper generic name for the walruses, and *Odobænida* the proper name for the family—not *Trichechus* (auct. non Linné), nor *Trichechida*, which are, respectively, the proper names of the Manatees; two species of walrus established, *O. rosmarus* (Linn.) and *O. obesus* (Illiger), with figures of skulls, and full history of each species, including the nomenclature, osteology and dentition, geographical distribution, chase, and commercial products.

Family Otariidæ, pp. 187-411. Technical and commercial history, with synopsis, characters, and geographic distribution of the extra-limital species, recent and fossil, as well as the North American.

Family Phocidæ, pp. 412-756. Technical history of the family, classification, synonymic list of the genera and species, geographical distribution, fossil remains, milk-dentition, habits, migrations, locomotion on land, the seal-hunting industry and sealing-grounds, methods of capture, species hunted, products, decrease of seals from injudicious hunting, etc., pp. 412-557; systematic treatment of the North American species, pp. 557-756; Appendix: a, material examined (pp. 757-764); b, additions and corrections (pp. 765-773); index (pp. 775-785).

"A most valuable and complete history of these animals, especially of those found in North America, of their distribution and pursuit, with full synonymy, and copious tables and references. The history of the species of the group generally is also discussed, with remarks on their synonymy and distribution."—Zool. Rec. for 1880, Mamm. p. 2.

Preliminary List of Works and Papers relating to the Mammalian Orders Cete and Sirenia. <Bull. U. S. Geol. and Geogr. Surv., VI, No. 3, pp. 399-562, Aug. 30, 1882.

Covers the period from Albertus Magnus (1495) to the year 1840, and numbers 1013 annotated titles, the annotations in many cases amounting to a full statement of contents, so far as pertinent to the present subject, including names of species and genera and nature of treatment. All thus far published. The cause of the discontinuance of publication is explained in an insert, as follows:

"Owing to the illness of the author, which prevented his revision of the proof-sheets, it was necessary to stop the printing of the 'List' at the end of the year 1840. The present instalment comprises only a little more than one-third of the article; the remainder will be published as soon as the author's health renders it practicable.—J. A. ALLEN, Cambridge, Sept., 1882."

See further, a "Personal Note" in *Bull. Amer. Mus. Nat. Hist.*, XXIV, 1903, pp. 279-280.

The West Indian Seal (*Monachus tropicalis*). <Bull. Amer. Mus. Nat. Hist., II, pp. 1-34, pls. i-iv, April 25, 1887.

Introduction, pp. 1-3; external characters, pp. 4-6; osteological characters, pp. 6-19; sexual differences, pp. 20-21; affinities of the genus *Monachus*, pp. 22-23; general history, pp. 23-26; geographical distribution, pp. 27-29; habits, pp. 29-34.

A Review of some of the North American ground Squirrels of the genus *Tamias*. <*Bull. Amer. Mus. Nat. Hist.*, III, pp. 45-116, June, 1890.

24 species and subspecies are recognized, of which 13 are here first described, as follows: (1) *Tamias obscurus*, p. 70; (2) *T. senex*, p. 83; (3) *T. speciosus* (Merriam, ined. MS.), p. 86; (4) *T. frater*, p. 88; (5) *T. amoenus*, p. 90; (6) *T. cinereicollis*, p. 94; (7) *T. umbrinus*, p. 96; (8) *T. quadrivittatus gracilis*, p. 99; (9) *T. q. luteiventris*, p. 101; (10) *T. q. affinis*, p. 103; (11) *T. q. neglectus*, p. 106; (12) *T. minimus consobrinus*, p. 112; (13) *T. m. pictus*, p. 115.

The Geographical Distribution of North American Mammals. <*Bull. Amer. Mus. Nat. Hist.*, IV, pp. 199-244, pls. v-viii (maps), 1892.

Influences determining the geographic distribution of life (climatic), pp. 199-200; interrelation of land areas, pp. 200-201; mammals as the basis for the classification of life areas, pp. 202-203; systematic classification of life areas, pp. 203-211; the Sclaterian system, pp. 211-212; the mammals of North America considered in relation to the North American Region and its subdivisions, pp. 213-240, with 3 maps.

A synopsis of the Pinnipeds, or Seals and Walruses, in relation to their commercial history and products. <*Fur-seal Arbitration. Appendix to the case of the United States before the Tribunal of Arbitration, etc.*, I, 1892, pp. 367-391.

Revision of the Chickarees, or North American Red Squirrels (subgenus *Tamiasciurus*). <*Bull. Amer. Mus. Nat. Hist.*, X, pp. 249-298, August 31, 1898.

Monographic revision. Subsp. nov.: (1) *Sciurus hudsonicus baileyi*, p. 261; (2) *Sciurus hudsonicus ventorum*, p. 263; (3) *Sciurus hudsonicus streator*, p. 267; (4) *Sciurus douglasii cascadenis*, p. 277; (5) *Sciurus fremonti neomezicanus*, p. 291. *Sciurus douglasii mollipilosus* Aud. & Bachm. revived to replace *Sciurus hudsonicus orarius* Bangs, 1897, p. 277.

The Musk-oxen of Arctic America and Greenland. <*Bull. Amer. Mus. Nat. Hist.*, XIV, pp. 69-86, pls. xiii-xvii, and 7 text figures, March 27, 1901.

Principally on the Ellesmere Land form, here referred to *Ovibos wardi* Lydekker (= *O. pearyi* Allen, Ms.).

A Preliminary Study of the South American Opossums of the Genus *Didelphis*. <*Bull. Amer. Mus. Nat. Hist.*, XVI, pp. 249-279, Aug. 18, 1902.

A monographic revision, with copious tables of measurements. Subsp. nov.: (1) *Didelphis marsupialis insularis*, p. 259; (2) *D. m. etensis*, p. 262; (3) *D. paraguayensis andina*, p. 272; (4) *D. p. meridensis*, p. 274. *D. paraguayensis* Oken (1816) replaces *D. aurita* Temminck (1825).

The Hair Seals (Family Phocidae) of the North Pacific Ocean and Bering Sea. <*Bull. Amer. Mus. Nat. Hist.*, XVI, pp. 459-499, with 10 text figures, Dec. 12, 1902.

Nomenclature; sexual differences in dentition; revision of the North Pacific species (11 species and subspecies are recognized), the following new; (1) *Phoca hispida gichigensis*, p. 488; (2) *Phoca ochotensis macrodens*, p. 483; (3) *Phoca stejnegeri*, p. 485; (4) *Phoca richardii pribilofensis*; (5) *Phoca richardii geronimensis*, p. 495.

*Phoca nigra* Pallas (p. 483 footnote) suggested as apparently available for *Callorhinus curtilensis* (see *infra*, No. 192).

Mammalia of Southern Patagonia. Reports of the Princeton University Expeditions to Patagonia, 1896-1899, Vol. III, 1905, Part I, pp. 1-120, pls. i-xxix.

Detailed treatment of 55 species, with special reference to nomenclature, that of the genera as well as the species discussed historically; full tables of references under the genera and species, and an annotated bibliography (pp. 192-210) of 65 titles.

*Eunothocyon*, gen. nov., p. 153 (in text); *Carcinocyon*, gen. nov., p. 153 (in text); *Otenomys osgoodi*, nom. nov., to replace *C. robustus* Allen, preoccupied, p. 191; *Canis sclateri* nom. nov. (p. 153) to replace *Canis microtis* Sclater, preoccupied.

Species figured: *Zaedyus ciliatus*, Pls. i-iii (animal, skeleton, and three skulls); *Kerodon australis* and *Otenomys osgoodi*, pl. vii (skulls); *Otenomys sericeus* and *C. colburni*, pl. viii (skulls); *Eligmodontia*, *Oryzomys* and *Ozomycterus*, pls. ix and x (skulls and dentition of various species); *Akodon*, pls. xi and xii (skulls and dentition of 6 species); *Phyllotis*, *Eumecomys*, and *Reithrodontomys*, pls. xiii and xiv (skulls and dentition); *Arctocephalus australis* and *A. philippii*, pls. xv-xvii (skulls, three views of each); *Arctocephalus townsendi*, pls. xviii-xx (skull, three views); *Otaria byronia*, pl. xxi (skeleton); *Conepatus humboldti*, pl. xxii (skulls and dentition); *Cerdocyon griseus*, pl. xxiii (skull, three views); *Lynchailurus pajeros crucina*, pl. xxiv (skull and dentition); *Puma pearsoni*, pls. xxv and xxvi (colored figures of animal, red and gray phases); *Puma pearsoni*, pls. xxvii-xxix (three views of skull).

The North Atlantic Right Whale and its near Allies. <*Bull. Amer. Mus. Nat. Hist.*, XXIV, pp. 277-329, pls. xix-xxiv, and 1 text figure, April 8, 1908.

History, relationships, nomenclature, geographical distribution, and external and osteological characters of *Eubalena glacialis* (Bonaterre).

Ontogenetic and other Variations in Muskoxen, with a systematic Review of the Muskox Group, recent and extinct. <*Mem. Amer. Mus. Nat. Hist.*, New Series, I, Pt. 4, 1913, pp. 101-226, pls. xi-xviii, 1 map, and 45 text figs., March, 1913.

Ontogenesis of the horns, teeth, skull and pelage, pp. 107-143; individual differentiation as indicated by the skull, pp. 143-157; systematic review, including historical summary, pp. 157-160; geographic distribution, past and present, pp. 160-164; classification and relationship, 164-171; *Ovibos*, characters, alleged species and subspecies, pp. 171-179; geographic variation, pp. 179-180; synopsis of species and subspecies, pp. 180-182; systematic description, habits, and distribution: *Ovibos moschatus moschatus*, pp. 183-189; *O. m. niphæcus*, pp. 189-191; *O. m. wardi*, pp. 191-201; *O. yukonensis* (extinct), pp. 201-203; *O. pallantis* (extinct), pp. 203-205; extermination, pp. 205-207; Muskoxen in Zoological Gardens, pp. 207-208; *Bootherium*, pp. 209-213; *Symbos*, pp. 213-215; *Liops*, p. 216; bibliography, pp. 221-226.

Plates xi-xv, *O. m. wardi* as follows: pl. xi, horncores; pl. xii, transverse sections of horncores; pl. xiii, longitudinal sections of horncores; pl. xiv, sections of horncores; pl. xv, maxillary tooththrow at different ages; pl. xvi, mandibular tooththrow at different ages. Plates xvii and xviii, skull of *Symbos cavifrons*.

Text figures 1-26, skulls and dentition of *O. m. wardi* from foetal age to senescence; text fig. 27, map of distribution, present and recent, of Muskoxen in North America and Greenland, text figs. 28-31, skulls of *O. m. moschatus* and *O. m. wardi*; text figs. 32-36, mounted specimens of same; text figs. 38-44, photographs of calves of *O. m. wardi* in New York Zoological Park; text fig. 45, type skull of *Bootherium bombifrons*.

- Review of the South American Sciuridæ. *Bull. Amer. Mus. Nat. Hist.*, XXXIV, pp. 147-309, pls. i-xiv, and 25 text figs., May 17, 1915.  
Historical outline, pp. 151-158; general considerations, pp. 158-168; genera and subgenera of American squirrels, pp. 169-186; systematic review of the South American squirrels.
271. <sup>2</sup> The Whalebone Whales of New England. *Science*, XLV, pp. 89-90, Jan. 26, 1917.  
Review of Glover M. Allen's paper of this title (*Mem. Boston Soc. Nat. Hist.*, VIII, No. 2, pp. 107-322, pls. 8-15, text figs. 1-12, Sept., 1916).
272. The American Museum Congo Expedition Collection of Bats. (With Herbert Lang and James P. Chapin.) *Bull. Amer. Mus. Nat. Hist.*, XXXVII, pp. 405-563, pls. xlv-iv, text figs. 1-26, and 1 map, Sept. 29, 1917.  
Systematic list, 68 species and subspecies, with much technical comment, pp. 405-478; notes on the distribution and ecology of Central African Chiroptera, by Herbert Lang and James P. Chapin, pp. 479-496; field notes by Herbert Lang and James P. Chapin, on 68 species, pp. 497-560.  
Subgen. nov.: *Lophomops*, p. 460; *Allomops*, p. 470; spp. and subsp. nov.: (1) *Nycteris pallida*, p. 425; (2) *Nycteris awakubia*, p. 426; (3) *Rhinolophus abæ*, p. 428; (4) *Rhinolophus axillaris*, p. 429; (5) *Hipposideros caffer niapu*, p. 431; (6) *Hipposideros abæ*, p. 432; (7) *Hipposideros nanus*, p. 434; (8) *Hipposideros langi*, p. 434; (9) *Hipposideros gigas niangaræ*, p. 438; (10) *Pipistrellus abaensis*, p. 442; (11) *Eptesicus ater*, p. 443; (12) *Eptesicus faradjus*, p. 444; (13) *Eptesicus garambæ*, p. 445; (14) *Glauconycteris humeralis*, p. 448; (15) *Glauconycteris alboquittatus*, p. 449; (16) *Miniopterus breyeri vicinior*, p. 450; (17) *Nyctinomus ochraceus*, p. 455; (18) *Chærephon frater*, p. 456; (19) *Chærephon russatus*, p. 458; (20) *Chærephon (Lophomops) chapini*, p. 461; (21) *Chærephon (Lophomops) cristatus*, p. 463; (22) *Chærephon (Lophomops) abæ*, p. 464; (23) *Mops conzigus*, p. 467; (24) *Mops niangaræ*, p. 468; (25) *Mops trevori*, p. 468; (26) *Mops (Allomops) osborni*, p. 473; (27) *Mops (Allomops) occipitalis*, p. 474; (28) *Mops (Allomops) faradjus*, p. 476; (29) *Mops (Allomops) nanulus*, p. 477.
273. The Skeletal Characters of *Scutisorex* Thomas. *Bull. Amer. Mus. Nat. Hist.*, XXXVII, pp. 769-784, pls. lxxxix-xciii, text figs. 1-8, Nov. 26, 1917.  
The extraordinary skeletal characters of *Scutisorex conzigus* serve as a basis for raising the *Scutisorex* group to the rank of a subfamily of the Soricidæ under the name Scutisoricinae, p. 781; with field notes by Herbert Lang, pp. 781-783.
274. The Laysan Seal. *Natural History*, Journ. Amer. Mus. Nat. Hist., XVIII, pp. 399-400, May, 1918.  
Remarks on *Monachus schauinslandi* Matschie from Laysan Island and on the widely interrupted distribution of the genus *Monachus* in warm temperate and subtropical latitudes, now known only from the leeward group of Hawaiian Islands, and the Caribbean and Mediterranean seas.
275. Nelson's Wild Animals of North America. A Review. *Natural History*, Journ. Amer. Mus. Nat. Hist., XIX, pp. 331-333, 2 photographs, March, 1919.  
Review of the paper of this title (Published by National Geographic Society, Washington, D. C., 1918).
276. Severtzow's Classification of the Felidæ. *Bull. Amer. Mus. Nat. Hist.*, XLI, pp. 335-340, Sept. 22, 1919.  
A critical review of Severtzow's classification, with an annotated list of his genera and subgenera and comment on their validity.
277. Notes on the Synonymy and Nomenclature of the Smaller Spotted Cats of Tropical America. *Bull. Amer. Mus. Nat. Hist.*, XLI, pp. 341-419, figs. 1-31, Oct. 3, 1919.  
Introduction, p. 343; list of currently recognized forms of smaller cats of Tropical America arranged in groups according to their obvious alliances, pp. 345-384; 37 forms recognized, of which 12 are rated as species and (excluding the typical races) 25 as subspecies, referred to 7 superspecific groups.  
Gen. nov.: *Oncilla*, p. 358; subsp. nov.: *Margay glaucula nicaraguzæ*, p. 357.
278. Preliminary Notes on African Carnivora. *Journ. Mammalogy*, I, pp. 23-31, Nov., 1919.  
Preliminary report on some 600 specimens collected by The American Museum Congo Expedition, 1909-1915. Discussion of the generic names *Mungos* and *Herpestes*.  
Nomen nov.: *Micraonyx* (for *Leptonyx*, preoccupied), p. 24; gen. and spp. nov.: *Osbornictis*, p. 25; *Osbornictis piscivora*, p. 25; *Xenogale*, p. 26; *Xenogale microdon*, p. 27.
279. Note on Gueldenstaedt's Names of Certain Species of Felidæ. *Journ. Mammalogy*, I, pp. 90-91, Feb., 1920.  
Comments on the nomenclature of the North American bay lynx, whose correct technical name should be *Lynx rufa* Schreber.
280. The Technical Names of Two *Colobus* Monkeys. *Journ. Mammalogy*, I, pp. 96-97, Feb., 1920.  
Reference to *Simia polycomos* Schreber as the genotype of *Colobus* Illiger and designation of *Simia badius* Kerr as the genotype of *Ptilocolobus* Roehbrune.
281. Mammals of Panama. *Journ. Mammalogy*, I, pp. 188-189, August, 1920.  
Review of Edward A. Goldman's work of that title (*Smithsonian Misc. Coll.*, LXIX, No. 5, pp. 1-309, pls. 1-39, text figs. 1-24, 1920).
- POSTHUMOUS PUBLICATIONS
282. The American Museum Congo Expedition Collection of Insectivora. *Bull. Amer. Mus. Nat. Hist.*, XLVII, Art. 1, pp. 1-38, pls. 1-4, text fig. 1, July 20, 1922.  
Deals with the Potamogalidæ, Erinacoidæ, Macroscelididæ, and Soricidæ collected by the Congo Expedition. Twenty-one species and subspecies are listed, with much technical comment. Based on a collection of 377 specimens.
283. Sciuridæ, Anomaluridæ and Idiuridæ Collected by The American Museum Congo Expedition. *Bull. Amer. Mus. Nat. Hist.*, XLVII, Art. 2, pp. 39-71, pl. 5, Oct. 27, 1922.  
These three families are represented by 480 specimens belonging to 20 forms, all discussed with considerable detail.
284. Carnivora Collected by The American Museum Congo Expedition. *Bull. Amer. Mus. Nat. Hist.*, XLVII, Art. 3, pp. 73-281, pls. 6-78, text figs. 1-67, 1 map, April 11, 1924.  
The collection consists of 588 specimens representing 24 genera and 33 species distributed among the Canidæ, Mustelidæ, Viverridæ, Hyænidæ, and Felidæ. Much technical comment renders the report one of the most valuable contributions to African mammalogy.

<sup>2</sup> The following titles are additions to the original Bibliography. The numbers preceding them continue its system of enumeration.

285. Primates Collected by The American Museum Congo Expedition. *Bull. Amer. Mus. Nat. Hist.*, XLVII, Art. 4, pp. 283-499, pls. 79-167, text figs. 1-3, 1 map, Feb. 6, 1925.

The specimens number 645, of which 66 represent the Lemuridae, 549 the Lasiopygidae, and 30 the Pongidae. Among them are 28 forms with one species new to science. There is one new genus, and one new generic name is proposed. A critical discussion of nomenclature, and other remarks give the report an authoritative place among papers on this group.

#### IV. ZOOGEOGRAPHY

On the Mammals and Winter Birds of East Florida . . . and a Sketch of the Bird Faunæ of Eastern North America. <*Bull. Mus. Comp. Zool.*, II, No. 3, April, 1871, pp. 161-450.

Part V. On the Geographical Distribution of the Birds of Eastern North America, with special reference to the Number and Circumscription of the Ornithological Faunæ, pp. 375-425; List of Authorities, pp. 426-450.

"In accordance with the facts stated above respecting the mode of the distribution of animals and plants over the earth's surface, and the zoölogical and botanical laws of the differentiation and mutual relations of the different regions, the following primary natural history divisions may be recognized: I, an Arctic Realm; II, a North Temperate Realm; III, an American Tropical Realm; IV, an Indo-African Tropical Realm; V, a South American Temperate Realm; VI, an African Temperate Realm; VII, an Antarctic Realm; VIII, an Australian Realm" (p. 380).

For eastern North America are recognized the following seven faunæ: (1) Floridian, (2) Louisianian, (3) Carolinian, (4) Alleghanian, (5) Canadian, (6) Hudsonian, (7) American Arctic. Their boundaries and their characteristic species of birds are given (pp. 387-404), and they are further considered with reference to mammals and reptiles (pp. 404-406).

The species of North American birds are considered and tabulated with reference to their geographical ranges (pp. 407-418). General remarks on the distribution and migration of the birds of the Eastern Province (pp. 418-425). A Bibliography of ornithological works and papers, or "List of Authorities," relating to North America occupies pages 426-450, geographically arranged by States and countries and numbering 346 titles—much the largest list of papers relating to North American ornithology that appeared prior to 1878.

The Geographical Distribution of the Mammalia, considered in relation to the principal Ontological Regions of the Earth, and the Laws that govern the Distribution of Animal Life. <*Bull. U. S. Geol. and Geogr. Surv. Terr.*, IV, No. 2, pp. 313-377, May 3, 1878.

I. General considerations, with criticism of the life-regions proposed by Dr. P. L. Selater and supported by Mr. Alfred R. Wallace, pp. 313-329; II. Mammalian Regions of the Globe; pp. 329-373; III. General Summary, pp. 373-377.

The primary divisions are essentially as laid down in 1871 (see above), except that a South African Temperate Realm is admitted, and Madagascar is recognized as an additional Realm, designated as the Lemurian Realm. Under these are defined regions of secondary and tertiary rank where such subdivisions seemed to be required.

The Geographical Distribution of North American Mammals. <*Bull. Amer. Mus. Nat. Hist.*, IV, pp. 199-243, pls. v-viii (colored maps), Dec. 29, 1892.

Influences determining the Geographical Distribution of Life, pp. 199-203; Systematic Classification of Life Areas, pp. 203-206; Primary Life Regions, pp. 206-207 (same as in No. 2 *supra*); North Temperate Realm, pp. 207-211; The Selaterian System, pp. 211-212; The Mammals of North America considered in relation to the North American Region and its Subdivisions, pp. 213-240; Tropical North America, pp. 240-243; Tabular Synopsis, p. 243.

The Geographical Origin and Distribution of North American Birds, considered in relation to Faunal Areas of North America. <*Auk*, X, pp. 97-150, pls. iii, iv (colored maps), July, 1893.

I. The Geographical Origin and Distribution of North American Birds, pp. 98-117; II. The Faunal Subdivisions of North America, considered with reference to their Relationships, Classification, and Nomenclature, pp. 117-150 (tabular synopsis, p. 150).

The classification adopted is essentially the same as that recognized in 1892 (see *supra*, No. 5).

#### V. EVOLUTION

Mammals and Winter Birds of East Florida, etc. <*Bull. Mus. Comp. Zool.*, II, No. 3, pp. 161-450, April, 1871.

Part III. On Individual and Geographical Variation among Birds, considered in respect to its bearing upon the Value of certain assumed Specific Characters, pp. 186-250.

Wide range of individual variation shown to occur in a considerable number of species, with extensive tables of measurements, pp. 186-226; correlation of variations in general size, size of bill, etc., and in coloration, with differences in climatic and geographic conditions, pp. 229-242; species, varieties, and geographical races, pp. 242-250. A presentation of facts, without discussion of any theories of evolution, which appeared later.

Geographical Variation in North American Birds. <*Proc. Boston, Soc. Nat. Hist.*, XV, pp. 212-219, Dec., 1872.

A general résumé of the author's studies of the subject, to that date. (Republished in *Amer. Nat.*, VIII, pp. 534-541, Sept., 1874.)

Geographical Variation among North American Mammals. <*Bull. Geogr. and Geol. Surv. Terr.*, II, No. 4, July 1, 1876, pp. 309-344.

The correlation of size with geographical variation is formulated (p. 310) under the three propositions:

"(1) Maximum physical development of the individual is attained where the conditions of environment are most favorable to the life of the species . . ."

The influence of Physical Conditions in the Genesis of Species. <*Radical Review*, I, No. 1, pp. 108-140, May, 1877. (Republished by request, in the Ann. Report of the Smithsonian Institution for 1905 (1906), pp. 375-402.)

"The doctrine of natural selection, or the survival of the fittest, has recently been brought forward as the key to this complex problem and is upheld by a large class of enthusiastic adherents, who accept it as the full solution of the whole question. By others the conditions of environment are believed to be far more influential in effecting a certain class of modifications, at least, than the necessarily precarious influence of natural selection," etc.

The direct modifying influence of environment as a factor in evolution is regarded as more potent than natural selection taken in the narrow sense of the "survival of the fittest."

Sexual Selection and the Nesting of Birds. <*Auk*, II, pp. 129-139, April, 1885.

In reference to Wallace's "Theory of Birds' Nests" (*Intellectual Observer*, July, 1867), and Dixon's "On the Protective Colour of Eggs" (in Seebohm's *Hist. Brit. Birds*, Introd., pp. x-xxxvii).