Cultures of Collection in

Late Nineteenth Century American Natural History

by

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ABSTRACT

Natural history is, and was, dependent upon the collection of specimens. In the nineteenth century, American naturalists and institutions of natural history cultivated and maintained extensive collection networks comprised of numerous collectors that provided objects of natural history for study. Effective networks were collaborative in nature, with naturalists such as Spencer Baird of the Smithsonian trading their time and expertise for specimens. The incorporation of Darwinian and Neo-Lamarckian evolutionary theory into natural history in the middle of the century led to dramatic changes in the relationship between naturalists and collectors, as naturalists sought to reconcile their observations within the new evolutionary context.

This dissertation uses the careers of collectors Robert Kennicott, Frank Stephens, Edward W. Nelson, E.A. Goldman, and Edmund Heller as case studies in order to evaluate how the changes in the theoretical framework of late nineteenth century natural history led to advances in field practice by assessing how naturalists trained their collectors to meet new demands within the field. Research focused on the correspondence between naturalists and collectors, along with the field notes and applicable publications by collectors.

I argue that the changes in natural history necessitated naturalists training their collectors in the basics of biogeography – the study of geographic distribution of organisms, and systematics – the study of the diversity of life – leading to a collaborative relationship in which collectors played an active role in the formation of new biological knowledge. The project concludes that the

changes in natural history with regard to theory and practice gradually necessitated a more professional cadre of collectors. Collectors became active agents in the formation of biological knowledge, and instrumental in the formation of a truly systematic natural history. As a result, collectors became *de facto* field naturalists, the forerunners of the field biologists that dominated the practice of natural history in the early and middle twentieth century.

For my Family

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Introduction:

In a passionate essay in the spring of 1893, C. Hart Merriam lamented the lack of emphasis at the collegiate level of a unified, "more liberal" biology that included instruction in natural history.[1] Merriam was one of many naturalists who systematically recorded, catalogued, and collected biological specimens in America in the second half of the nineteenth century. His primary concern was that the lack of instruction in natural history would lead to a dearth of experienced and qualified specimen collectors, adversely affecting the study of natural history, which was predicated on the collection of specimens for study. As director of the Division of Economic Ornithology and Mammalogy (later the United States Biological Survey, [USBS]) within the United States Department of Agriculture, Merriam had a vested interest in the training of new collectors; he oversaw a vast collection network that included individual specimen collectors as well as more systematic collection surveys that crisscrossed the United States and into Mexico and Central America.[2] While certainly hyperbole – many effective collectors in the late nineteenth and early twentieth centuries, including Charles Camp (Museum of Vertebrate Zoology [MVZ], founded in 1908) and Edmund Heller

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[1] C. Hart Merriam, "Biology in Our Colleges: A Plea for a Broader and More Liberal Biology." *Science* 21 (1893): 352-355.

[2] "Economic" natural history refers to the study of the economic implications – both beneficial and harmful – of organisms on farming, ranching, and other economic endeavors. It was an important aspect of late nineteenth century natural history, especially with regard to receiving winning funding from state and national governments, because it demonstrated the "use" or "utility" of natural history.

(Field Museum, Museum of Vertebrate Zoology) were college educated and were active collectors prior to graduation, and both university students and "farm boys" required the same amount of on the job training with regards to how to collect effectively – it does demonstrate the importance of trained collectors to the pursuit of natural history in the late nineteenth century.

Merriam's role within both the federal government, and as a leading naturalist, represented an extraordinary growth with regard to science in the United States. The early American republic was a scientific backwater, due to the legacy of British colonialism and the dispersed nature of the colonial cultural elite.[3] Unlike Great Britain and France, government was not an active sponsor of science in the United States; apart from the Lewis and Clark expedition and the personal interests in science of Presidents Jefferson and John Quincy Adams, the federal government largely stayed out of scientific affairs until the late 1830s. As a result, the American naturalist community was quite small, centered in the intellectual capital of the early republic, Philadelphia. This community was dependent upon and knowledge attained and the practices pioneered by two

[3] See John C. Greene, "Science, Learning, and Utility: Patterns of Organization in the Early American Republic," in *The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War*, ed. by Alexandra Oleson and Sanborn C Brown (Baltimore: Johns Hopkins University Press, 1976); Sally Gregory Kohlstedt, *The Formation of the American Scientific Community*. Urbana: University of Illinois Press, 1976; Sally Gregory Kohlstedt, Michael M, Sokal, & Bruce V. Lewenstein (eds.), *The Establishment of Science in America: 150 Years of the American Association for the Advancement of Science* (New Brunswick: Rutgers University Press: 1999); Robert V Bruce, *The Launching of American Science: 1846-1876* (New York: Alfred A. Knopf, 1987).

centuries of European naturalists, and was well aware of its limitations in resources for the traditional work of naturalists: collecting, and then identifying, describing, and classifying organisms. This task was not even close to completion for the relatively known Atlantic region, let alone the vast American hinterland. Those institutions interested in natural history, such as the Academy of Natural Sciences in Philadelphia, local natural history societies in Boston and New York, as well as Harvard University and a few other eastern universities, did not have the financial wherewithal to sponsor large collection efforts. Naturalists in the first half of the nineteenth century had to supplement their own collection efforts with those of amateur nature enthusiasts, actively soliciting for specimen donation. This was an extremely haphazard process, more often than not leading to nothing new of significance, but resulted in the development of correspondence and collection networks centered on these naturalists. These networks would later form the basis of much of late nineteenth century specimen collection.

As the republic expanded, so too did collection efforts. In the second quarter of the nineteenth century, much of the North American continent was scientific *terra incognita*. While the first specimen collections from the far west were taken by Lewis and Clark in the first decade of the nineteenth century, the first substantial collections from the Pacific coast were taken as part of the United States Exploring Expedition (US Ex. Ex.) in the early 1840s. These collections were supplemented by specimens collected by surgeon naturalists such as Joseph G. Cooper on the government sponsored (and Army run) railroad surveys of the

1850s, as well as Asian specimens from the North Pacific Exploring Expedition that accompanied Commodore Perry to East Asia in the early 1850s. While these early expeditions expanded the reach of the American natural history establishment, specimen collection was of secondary importance to mapping the oceanic and continental hinterland. Thus, at the time of the Civil War, American naturalists were dependent upon government surveys and their own correspondence networks for material, and the science remained centered in the eastern cities of Philadelphia, Boston, and Washington, D.C.

The Smithsonian Institution (founded in 1846), in particular became a major place for natural historical research due to primacy of government-backed surveys and the efforts of Assistant Secretary Spencer F. Baird. Baird was a master of diplomacy in contentious Washington, and a firm believer in the necessity of research collections for the national scientific museum. He was also very well connected politically, coming from Pennsylvania's social elite, and was able to suggest naturalists for government surveys through his father-in-law, Brigadier General Sylvester Churchill, quartermaster of the Army.[4] Baird soon oversaw one of the most extensive collection networks in the United States, not only amassing and overseeing collections from rail surveys, coordinating Ferdinand V. Hayden's explorations in the western territories with Joseph Leidy of the Academy of Natural Sciences in Philadelphia, as well as promoting the collection (and later publishing) efforts of numerous young colleagues, including

[4] E.F. Rivinus and E. M. Youseff, *Spencer Baird of the Smithsonian* (Washington: Smithsonian Institution Press, 1992), 61.

Robert Kennicott, C.B.R. Kennerly, William Stimpson, Henry Bryant, and Edward Drinker Cope. Due to his extensive collection network, Baird, like Asa Gray and Louis Agassiz of Harvard, became an expert in biogeography. While the Smithsonian had little space of its own for the display of specimens until the opening of the National Museum in 1881, the Institution itself was used as a model for other societies and institutions of natural history. Kennicott, for example, was one of the main proponents for the development of a Chicago Academy of Sciences, and modeled the motto of the Chicago society on that of the Smithsonian.[5] Baird also served as a sounding board for enthusiastic prospective naturalists, offering encouragement and advice to Hayden and a very young Clinton Hart Merriam with regard to natural history in general and natural history in particular.

It was in the last forty years of the nineteenth century that American natural history really came of age. Two important reasons for this are the increase in institutions dedicated to natural history in the United States, and the opportunity for naturalists to explore and examine the biota of relatively unexplored regions, such as the western United States and south Florida. These institutions were considered culturally fashionable and were part of a conscious attempt by Americans to rival the scientific standing of Europe. By 1900, the United States was home to 250 natural history museums, the same number as

[5] Robert Kennicott to Spencer Fullerton Baird, March 8, 1857, Spencer Fullerton Baird Correspondence, Smithsonian Institution Archives (hereafter SIA) Record Unit (hereafter RU) 7002, Box, 26, Folder 30.

Great Britain and 100 more than Germany.[6] This explosion of institutions dedicated to natural history notably included the opening of large museums in New York (the American Museum of Natural History [AMNH]) in 1868 and Chicago (the Columbian Field Museum) a quarter century later. These two new museums, with private backing, were able to allocate resources to collecting that smaller and government-supported institutions could not. Even the federally funded Smithsonian saw an increase in its ability to partake in research due to Spencer Baird becoming the Secretary of the Institution in 1878, and the opening of the National Museum three years later. Public interest in natural history was fueled by this increase in museums, a corresponding increase in the number of zoological and botanical parks, the discovery of large mammal and dinosaur fossil remains in the American West, and the purchase of the elephant "Jumbo" by P.T Barnum.[7] Another aspect of natural history's cultural relevance was the uniquely American focus on "economic" natural history – the study of how biological organisms affected U.S. business, especially agricultural business interests, leading to the founding of the Division of Economic Mammalogy and Ornithology in the U.S. Department of Agriculture under C.H. Merriam. As a result of the sum of these developments, tens of thousands of specimens were collected as older institutions sought to update their collections, and newer

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[6] Paul Farber, *Finding Order in Nature: The Naturalist Tradition from Linnaeus to E.O. Wilson* (Baltimore: Johns Hopkins University Press, 2000), 91.

[7] Ibid, Chapter 7

institutions attempted to replicate or surpass the exhibits and research series of established museums and societies.

Darwin's discovery of natural selection played a pivotal role in the expansion of American natural history. C.H. Merriam, for example, argued that only an understanding of natural history would allow oneself to "form a sound judgment on the questions involved in the action of the law of natural selection."[8] Further, North America's climatic and geographical diversity gave American naturalists a unique opportunity to evaluate Darwin's theory. Most of America's leading naturalists, with Louis Agassiz the notable exception, embraced the idea of evolution shortly after the *Origin* was published, even as they disagreed with certain aspects of his theory.[9] Gray, who was privy to Darwin's ideas prior to the publishing of the *Origin*, had already staked his scientific claim on the distribution of plants in Asia and North America based on Darwin's ideas. Joseph Leidy saw evolution as the central explanation of his previous twenty years of zoological and paleontological efforts, and Baird was a firm (but silent) supporter at the Smithsonian. Perhaps the overriding reason why evolution was accepted by

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[8] C. Hart Merriam. "Biology in Our Colleges:" 353.

[9] See Peter Bowler, *The Non-Darwinian Revolution: Reinterpreting a Historical Myth* (Baltimore: Johns Hopkins University Press, 1988); A. Hunter Dupree, *Asa Gray: American Botanist, Friend of* Darwin (Baltimore: Johns Hopkins University Press, 1959); Thomas Glick, *The Comparative Reception of Darwinism* (Chicago: University of Chicago Press, 1988); J. David Hoeveler, *The Evolutionists: American Thinkers Confront Charles Darwin, 1860-1920* (Lanham: Rowman and Littlefield, 2007); Mary Winsor, *Reading the Shape of Nature: Comparative Zoology at the Agassiz Museum* **(**Chicago: University of Chicago Press, 1991).

America's leading naturalists was that it dovetailed with their findings with regards to the geographic distribution of organisms in North America.[10] For a younger generation of naturalists – E. D. Cope, C. H. Merriam, Henry F. Osborn, J. A. Allen, Charles Bessey, and William Osgood – evolutionary theory was central to their understanding of the relationships between extinct and extant biota, and formed the backbone of their research and scholarly work.

This emphasis on evolutionary theory, coupled with the traditional importance of taxonomy and biogeography, led to a revolution in systematics. Ernst Mayr has defined systematics as "the scientific study of the kinds and diversity of organisms and any and all relationships among them" and noted that the late nineteenth century, naturalists actively looked for signs of variation within populations, and re-evaluated earlier work on biogeography in an attempt to put the puzzle of life together within the new evolutionary context.[11] This was not a seamless process, and naturalists quarreled over whether Darwinian, Lamarckian, or a hybridization of the two, provided the best explanation for natural phenomena, and therefore how best to attempt to explain speciation.[12] Merriam attempted to develop an all-encompassing "life-zone" theory that reconciled the variation and geographic distribution of species with climate, but even after two

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[10] See A. Hunter Dupree, *Asa Gray*; Leonard Warren, *Joseph Leidy: The Last Man Who Knew Everything.* New Haven: Yale University Press, 1998; and E.F Rivinus and E.M. Youssef, *Spencer Baird of the Smithsonian*.

[11] Ernst Mayr, *Principles of Systematic Zoology* (New York: McGraw Hill, 1969), 2; 60-64.

[12] See Peter Bowler, *The Non-Darwinian Revolution*.

decades of revisions, it could not adequately describe observations from the eastern United States. Another example of the importance of systematics to late nineteenth century natural history was the American Ornithologists Union's adoption of the subspecies as a taxonomic group to refer to variations in species in accordance to contemporary understandings of Darwin's theory.[13] Coupled with contemporary debates over the significance and validity of the taxonomic groups "species" and "variety," naturalists grappled with the question of how much variation could be found within a particular taxonomic group, extending a debate that had been a part of natural history since the work of Carl von Linné, only imbuing it with an evolutionary twist. Some naturalists, characterized as "lumpers," felt that species and genera should include as much variation as possible to highlight Darwin's emphasis on a spectrum of variation, where "splitters" sought to distinguish variation by identifying the same subset of organisms into more specific taxonomic groups. These questions are still

[13] Subspecies is the most specific recognized taxonomic group. At the time, they were occasionally used to denote potential incipient – that is emerging – species. Most ornithologists then used trinomials to classify birds, and the usage spread to the classification of mammals. The Latin trinomial was used prior to and contemporary to Darwin's findings occasionally to denote a "variety" of a species. Earlier debates over subspecies and species with respect to varieties had mostly been resolved by the late nineteenth century, and subspecies were designated to show portions of populations that were differentiated enough to be 'on the way' to becoming completely different species. See R.V. Melville, *Towards Stability in the Names of Animals: A History of the International Commission on Zoological Nomenclature, 1895-1995* (London: International Commission on Zoological Nomenclature, 1995) and Harriet Ritvo, The *Platypus and the Mermaid and Other Figments of the Classifying Imagination* (Cambridge: Harvard University Press, 1997), Chapter 3.

pertinent today given the rise of molecular biology and the use of DNA within evolutionary classification.

This revolution in systematics and the explosion of institutions of natural history occurred as innovations in transportation, instrumentation, and communication allowed increased access to heretofore scientific *terra incognita*. The influx of specimens from these areas reinforced challenges to the existing ideas of classification, and heightened the need for naturalists to obtain large research collections.[14] Thus, there was clearly a nexus between increased natural historical research, access to specimens, and the increased influence of both systematics and evolutionary theory in late nineteenth century American natural history, leading to what historian of science Paul Farber has aptly termed the "Golden Age of Natural History."[15]

This dissertation seeks to answer the following question: "How did the changes in the theoretical framework of late nineteenth century natural history lead to changes in field collection practice in the United States?" A second, and related question, is "did this theoretical change lead to a change in the way biological knowledge was produced viz. specimen collectors?" I argue that the

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[14] Robert Kohler, *All Creatures: Naturalists, Collectors, and Biodiversity, 1850-1950* (Princeton: Princeton University Press, 2006), Chapter 6; Kingsland, Sharon, *The Evolution of American Ecology, 1890-2000* (Baltimore: Johns Hopkins University Press, 2005), chapters 1 and 2

[15]Paul Farber. *Finding Order in Nature*, chapter 7. See also Philip Pauly, *Biologists and the Promise of American Life*. (Princeton: Princeton University Press, 2000), Chapter 2; Lynn Nyhart "Natural History and the "New Biology," in *Cultures of Natural History*, ed. N. Jardine, A. Secord, and E.C. Spray (Cambridge: Cambridge University Press, 1996), 441-442.

changes within the epistemology and practice of natural history in the late nineteenth century necessitated an increasingly professionalized cadre of collectors. A central goal of the study is to reconstruct the daily interactions that typified research in natural history, especially with regard to work in the field. Effective institutional naturalists, such as Joseph Grinnell and Spencer F. Baird encouraged individual collectors and attempted to educate them so as to be more "scientific" collectors. This training was *ad hoc* and was usually done via correspondence, unless the collector could join the naturalist on an expedition or at their institution for in-person training. Much of this training was extra-institutional in nature, though naturalists did occasionally bring their collectors to work for the institution in an official capacity. Collection of specimens in the late nineteenth century was done by collectors that were scientifically literate, and they were trained by naturalists to become *de facto* field naturalists – a clear contrast to the more amateurish collecting that typified American natural history prior to 1850. Tellingly, collectors often incorporated an understanding of evolution and systematics in their notes as well as their correspondence to naturalists. While it would be inappropriate to label many of these collectors, such as Tracey Storer, Frank Stephens, and Joseph Dixon, who all collected for the MVZ, as scientifically trained professionals, this training led to a gradual professionalization of collection which resulted in a more collaborative relationship between collectors and naturalists. This collaborative framework allowed collectors to actively participate in the formation of new natural historical knowledge.

These changes in the structure of natural history led to changes in the practice of collection of specimens. This was not due to a paradigmatic shift, but rather a gradual change in emphasis that resulted in more educated and scientific collectors. Many of these developments had already been implemented in limited scale in natural history, such as the collection of series of a species or variety of organism, rather than the earlier emphasis collecting individual specimens that matched the type specimen's characteristics. Over the nineteenth century, these series became increasingly important as institutions of natural history sought to attain larger research collections of specimens, first for studies of biogeography, and later for attempting to identify any potential variations that could be evolutionarily advantageous. Series of birds and small mammals at the end of the century could number a dozen or so from each locality visited by collectors, leading to an enormous increase in the number of specimens required by naturalists for "scientific" study. Collectors were aided in their duties by improvements in traps and firearms, as well as specimen preparation techniques, provided to them in person or via post by naturalists. Collectors increasingly were encouraged to record as much data as possible on the locality from which they collected specimens, such as physical geography and what other organisms lived in the area.

Another innovation in late nineteenth century natural history was the development of natural history surveys. These expeditions were undertaken by research institutions as well as individual states, and were an attempt to systematically identify and collect the biota in a given area. Professional naturalists directed these collection efforts and were the face of natural history, but could often not be in the field for extended periods of time, having other obligations to museums, the government, or to universities. It fell to collectors to perform the acts necessary to the growth of the science. While not universally practiced, the survey did become the ideal method for collection, and increased in relative importance to other collection strategies over time. However, this method of collecting only supplemented, and did not supplant, the traditional model of collectors collecting individually or in small groups. It should be noted that even in Merriam's United States Biological Survey (née the Division of Economic Ornithology and Mammalogy), extensive survey trips were exceptionally rare, with collectors usually working in pairs or small groups.[16] E.W. Nelson and Alphonso Goldman, for example, collected together in Mexico from 1892-1906, usually accompanied only by locally hired men to work as porters, packers, or cooks.

[16] The United States Biological Survey was originally known as the Division of Economic Ornithology and Mammalogy when founded in 1885. Its name was changed to the Biological Survey in 1896 so that its name better fit its mission. Merriam's outfit was raised to Bureau status in the Department of Agriculture in 1905. See Jenks Cameron, *The Bureau of the Biological Survey: its History, Activities, and Organization* (Baltimore: Lord Baltimore Press, 1929), Chapter 1.

Large expeditions, such as the USBS's Death Valley Expedition in 1891, or the MVZ's Colorado River Survey in 1910, were fairly rare, as they required considerable planning, logistics, and funding. The larger, privately funded escapades of E.D. Cope and O.C. Marsh in the 1870s were dependent upon professional collectors, excavation teams, local practitioners, and enthusiasts of natural history. Daniel Baldwin, of Canon City Colorado, who worked for O.C. Marsh in the 1870s, is a prime example of such a nature enthusiast, whereas Charles Sternberg was a professional collector that ended up working for both of the feuding scientists at different times.[17] Even at institutions that had more financial backing, such as the AMNH and the Field Museum, large surveys were rare prior to the First World War. Larger surveys did become the norm during the 1920s, due in part to the decreasing role of amateur or local collectors within the natural history establishment, but also due to the maturity of America's main institutions of natural history in Philadelphia, New York, Chicago, and Washington D.C.

Natural history in the late nineteenth century remained dependent upon correspondence and collection networks that linked professional, scientific naturalists with their collectors in the field. These collectors ranged from local amateurs such as college students, hunters, taxonomists, and bird enthusiasts, to professional collectors that collected for multiple institutions such as Frank Stephens and Edmund Heller, to institution/survey staff who were paid to spend

[17] Mark Jaffe, *The Gilded Dinosaur: The Fossil War between E.D. Cope and O.C. Marsh and the Rise of American Science* (New York: Crown, 2000), 145.

all or some of their time in the field, to specimen clearing houses such as Ward's Natural Science Establishment. By the late nineteenth century, all major natural historical entities in the United States had developed specimen collection networks.   Most scientific naturalists had administrative and/or educational responsibilities that prevented them from being in the field, and as such, they were dependent on their collectors to obtain specimens both for the display for an eager public audience, and the naturalist's personal systematic research. Scientific naturalists, therefore, had to direct collection efforts from afar, aided by contemporary advances in transportation and communication. Collection guidelines for collectors were common, and after the advent of evolutionary theory, these guidelines increasingly focused on collectors identifying the geographic distribution of organisms, the variation of organisms collected, and collecting organisms in systematic series rather than in single organisms. Increasingly experienced collectors, such as Frank Stephens, William H. Dall, Elliot Coues, and Joseph Dixon, offered valuable insights into the natural history of collected organisms. Collectors served as systematic naturalists' eyes, ears, and hands in the field, and the result was a collaborative effort. Collectors received instructions and feedback from the naturalists, but also provided specific insight into the relationship between the collected species and the environment, and occasionally would impress upon naturalists their own reflections on systematics. The number of collectors that could be supported by an institution varied based upon its size and fiscal flexibility, but naturalists often had more than one collector or team of collectors in the field at one time, with larger institutions usually employing more collectors, or increasingly, collection survey teams.

Traditional models of collection, therefore, did not disappear, nor did they decrease in scientific significance. They were aided by more systematic surveys, but in lieu of the feasibility of larger surveys, naturalists sought to make their collectors more knowledgeable about what they were collecting and why, to introduce them to systematics, and encourage them to continue collecting and preparing specimens – in short, to make their collectors more scientific. More precise records were required, from field notes, to correspondence, financial receipts, to the labeling of specimens. Field notes, for example, progressed from general notes and personal diaries early in the period, to more detailed notes and specimen lists required by Merriam, to the extensive field diaries implemented by Joseph Grinnell. Collectors also had to keep more or less abreast of trends in classification, no small feat considering contemporary controversies regarding classification – as the lumper/splitter controversy raged, collectors were required to obtain series not just of species, but also collect at the subspecific level. This required an understanding of oftentimes subtle variations within populations, as well as the geographical distributions of different subspecies. Granted, this was often obtained via almost continuous correspondence with the naturalist with whom they were working from the field, but was an essential part of collector's work. This ongoing, on-the-job tutelage regarding systematics made collectors more effective at collecting, and made well grounded educated collectors a necessity in the late nineteenth century.

The sum of these developments within natural history, led to an increasing reliance on a professionalized cadre of collectors like Frank Stephens and Edmund Heller. While amateur experts still had a role within natural history, by the First World War this role was largely limited to collecting for, and being a part of, local natural history societies and organizations. Any articles written by amateur collectors were largely submitted to journals such as *The Condor* – small, localized publications that focused on specific interests. Their role with larger institutions of natural history, such as the Smithsonian and American Museum of Natural History, largely faded from the 1920s onward. They were replaced by more experienced collectors, who themselves were in the process of being subsumed into and/or supplemented by new field biologists.

The importance of collecting to natural history begs the question on why collectors have not been the focus of research into the history of natural history, even as they have been "hidden in plain sight."[18] There are many reasons for this, from logistical and archival to historiographical trends. While many collectors had long standing relationships with particular naturalists and/or particular institutions of natural history, others collected for numerous different institutions and naturalists – meaning that their relevant notes and correspondence can be

[18] Robert Kohler, *All Creatures: Naturalists, Collectors, and Biodiversity, 1850-1950* (Princeton, Princeton, University Press, 2008).

spread out over numerous archival repositories, if they have been kept at all. Institutional archives are dependent upon pertinent records being saved, and in many cases they have not, or have since been lost. Further, collectors rarely have their own set of archival records, so the only way to identify them is to work backwards from institutional files and records of naturalists. Finally, until relatively recently, the majority of histories of natural history focused on the work of naturalists, rather than the collectors on which they depended.[19]

In the post-Darwinian milieu, debates over differentiations between different evolutionary theories and their impact (or lack thereof) on systematics, the nature of species, and the debate over nomenclature, have obscured the role that collectors played within natural history due to historiographical interest in these debates.[20] Another issue is the shifting nature and focus of both natural

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[19] See for example, Dupree, A. Hunter *Asa Gray*, Leonard Warren, *Joseph Leidy,* Robert G. Hays *State Science in Illinois: The Scientific Surveys, 1850-1878*. Carbondale, Ill.: Southern Illinois University Press, 1980; Mary Winsor *Reading the Shape of Nature*, Kier Sterling, *Last of the Naturalists, the Career of C. Hart Merriam.* New York: Arno Press, 1977.

[20] Please see Peter Bowler, *The Non Darwinian Revolution* and *Evolution: The History of an Idea* (Rev Ed.). (Berkeley: University of California Press, 1989); J. David Hoeveler, *The Evolutionists: American Thinkers Confront Charles Darwin, 1860-1920,* (Lanham: Rowman and Littlefield, 2007); Sharon Kingsland, *The Evolution of American Ecology, 1890-2000,* (Baltimore: Johns Hopkins University Press, 2005) Robert Richards, *The Meaning of Evolution: the Morphological Construction and Ideological Reconstruction of Darwin's Theory,* (Chicago: University of Chicago Press, 1992), Michael Ruse, *The Darwinian Revolution: Science Red in Tooth and Claw* (2nd Ed.). (Chicago: University of Chicago Press, 1999); Timothy Shanahan, *The Evolution of Darwinism: Selection, Adaptation, and Progress in Evolutionary Biology.* (Cambridge: Cambridge University Press, 2004); Geoffrey C Browker and Susan Leigh Star, *Sorting*

history and systematics in the years since. Systematics as practiced now does not correlate exactly to the way in which systematics was practiced in the late nineteenth century. Our definitions of basic taxonomic groups are much more complete than they were in post Civil-War America. Naturalists and their collectors essentially had to take an extreme amount of data, and attempt to gauge how all organisms related to one another and their environment in an evolutionary context – something that is the heart of evolutionary ecology today.

Because of the expeditionary nature of natural history, studies of the practice of natural history and the formation of biological knowledge have been implicitly or explicitly related to the core/periphery model of Immanuel Wallerstein. This conceptualization was reinforced by the role of empire in the scientific endeavor, and had much of its roots in the work of William Goetzmann and other historians that focused on the role of empire in the formation of natural knowledge.[21] This is perhaps best encapsulated by Bruno Latour in his influential

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Things Out: Classification and its Consequences, (Cambridge, Mass: MIT Press, 1999).

[21] See for example,William H Goetzmann, *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West*, (New York: Alfred A. Knopf, 1966); A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities to 1940* (Cambridge: Harvard University Press, 1957); Robert Stafford, *Scientist of Empire: Sir Roderick Murchison, Scientific Exploration, and Victorian Imperialism* (Cambridge: Cambridge University Press, 1989); David Phillip Miller and Peter Hanns Reill, *Visions of Empire: Voyages, Botany, and Representations of Nature* (Cambridge: Cambridge University Press, 1996); and Richard Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600-1860* (Cambridge: Cambridge University Press, 1996).

study *Science in Action: How to Follow Scientists and Engineers Through Society*, in which he described metropole as scientific "centres of calculation" where knowledge was created.[22] Applying this model to natural history, the "science" of natural history – identifying, classifying, and describing specimens – was separated from the collection of specimens. While effective in explaining certain relationships in natural history, or the practices of specific naturalists, the model, like most other theoretical models in the history of science, suffers from serious drawbacks, underestimating the role of the periphery in the making of biological knowledge. Many recent studies, have challenged strict Latourian theory in demonstrating that science was alive and well in the periphery, and furthermore peripheral practitioners of science also played an active role in the formation of natural knowledge.[23]

Latour's paradigm works well when applied to the correspondence based collection of the early and middle nineteenth century, but breaks down when

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[22] Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Cambridge: Harvard University Press, 1987), Chapter 6.

[23] Please see James Delbourgo and Nicholas Dew (eds), *Science and Empire in the Atlantic World* (London: Routledge, 2008); Robert Kohler, *Landscapes, Labscapes: Exploring the Lab-Field Border in Biology* (Chicago: University of Chicago Press, 2002), and *All Creatures: Naturalists, Collectors, and Biodiversity, 1850-1950* (Princeton: Princeton University Press, 2006); *Science in the Subarctic: Trappers, Traders, and the Smithsonian Institution* (Washington: Smithsonian Institution Press, 1993); Eugene Cittadino, *Nature as the Laboratory: Darwinian Plant Ecology in the German Empire, 1880-1900* (Cambridge: Cambridge University Press, 1990); Richard A Overfield, *Science with Practice: Charles E. Bessey and the Maturing of American Botany*. (Ames: Iowa State University Press, 1993); and Keith Thomas, *The Legacy of the Mastodon: The Golden Age of Fossils in America* (New Haven: Yale University Press, 2008).

applied to more nuanced collection methods. At first glance, the surveys of the late nineteenth century would seem to fit, but much of the work done on these surveys, even work that would normally take place in a laboratory, took place in the field, signifying the increased importance of the periphery within the formation of knowledge. Naturalists and collectors on surveys set up collection stations at specific localities that reflected aspects of the environment that they wished to study. These stations were in reality field laboratories, in which they collected, prepared, identified and described specimens before shipping the specimens to their metropolitan institutions for further analysis. At these institutions, the sum of the expeditions' collections could be assessed, and inferences finalized with regard to biogeography and systematics, but this process was started in the field. Further, many naturalists in the nineteenth century used their collectors as scientific "missionaries," teaching nature enthusiasts willing to collect specimens how best to collect, prepare, and preserve objects of natural history. At its core, this study also challenges Latourian notions of natural science, demonstrating that collectors in nineteenth century natural history played an increasingly active role in the practice of natural history and the formation of biological knowledge. However, those looking for the complete demolition of Latourian theory may be disappointed in this study. I argue that the relationship between collectors and naturalists in the late nineteenth century became ever more collaborative, which in turn, benefitted the naturalist. Most of this was due to the training of collectors directed by metropolitan naturalists, who remained at the forefront of the discipline.

Further, the Latourian paradigm undervalues the cultural aspect of science as well as cultures that develop within scientific disciplines. In *Epistemic Cultures: How the Sciences Make Knowledge*, Karin Knorr Cetina has argued that each science has its own particular 'knowledge society,' with its own particular culture – different sciences 'make' knowledge in different ways.[24] While Knorr Cetina used two distinct case studies in the present for her research (molecular biology and high energy theoretical physics), this methodology of examining how scientists make knowledge is equally applicable in a historical sense, where letters, memoirs, and correspondences take the place of first person observation. In natural history, the collaboration between naturalists and collectors created a distinct culture that was intrinsically different from that of other contemporary disciplines, even as each particular collecting network had its own inherent culture based upon the relationships between naturalists and collectors. Supportive and collaborative naturalists, such as Joseph Grinnell and Spencer Fullerton Baird, led more efficient collecting networks than naturalists who were less concerned with their collectors on a personal level.

Recently, the field has started to recognize the importance of specimen collectors within the cultural and intellectual framework of late nineteenth century natural history. These studies, such as Robert Kohler's *All Creatures:*

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[24] Karin Knorr Cetina, *Epistemic Cultures: How the Sciences Make Knowledge*, (Cambridge: Harvard University Press, 1999), introduction

Naturalists, Collectors, and Biodiversity, 1850-1950, raise important questions, but do not examine the collaboration between naturalists and collectors or even practice in natural history in much depth. Additionally, the study of natural history has been overly parochial, with researchers focusing on one specialization within of natural history (such as botany, or vertebrate zoology, or individual scientists) rather than the field as a whole, thus ignoring how individuals that studied different aspects of natural history interacted. It was commonplace, even prior to the incorporation of evolutionary theory and systematics, for naturalists to use their own discoveries and apply them to the greater field of natural history, or to use data from a different area of study to supplement and support their own research.

Moreover, the study of natural history suffers from a larger issue with regard to the history of science – it is extremely paradigmatic, and as such, it has led to overgeneralizations with regard to role of religion,[25] region,[26] and even the

[25] For example, Asa Gray was much more conservative religiously than Louis Agassiz, but their debate over evolution has been polarized in light of more modern debates. See Mary Winsor, *Reading the Shape of Nature: Comparative Zoology at the Agassiz Museum* (Chicago: University of Chicago Press, 1991) & A. Hunter Dupree *Asa Gray: 1810-1888* (Baltimore: Johns Hopkins University Press, 1988).

[26] Similarly, the research of eastern naturalists has obscured their western counterparts. See Sharon Kingsland, *The Evolution of American Ecology, 1890-2000.* Baltimore: Johns Hopkins University Press, 2005 & Richard A Overfield, *Science with Practice: Charles E. Bessey and the Maturing of American Botany* (Ames: Iowa State University Press, 1993).

collection of specimens. What is lost in these studies is the larger picture – whether it is the field of natural history or act of collecting in particular.

Natural history was a very broad field of study and the specialization of the late nineteenth century had a profound effect on the field, as individual naturalists began to focus most or all of their efforts on a particular branch of botany or zoology: C.H. Merriam focused on mammals, J.A. Allen and Witmer Stone on birds, etc. The specialization and professionalization of naturalists has been seen as resulting in a decline in natural history in the late nineteenth century, a claim that Lynn Nyhart and others have refuted.[27] Natural history, as we have seen, did not decline but was expanding as it incorporated new data and specimens from the American hinterland and other colonial locales. However, the focus on specialization has obscured this growth in natural history until recently. It has also led to a problem with regard to labeling and describing scientists. The term naturalist has been used to denote someone who studied natural history, but in a generalist or holistic sense. As such it has been used very generally within the historiography either to denote amateurs, or at the very least non specialists, professional naturalists such as Baird, or both. However, I feel that this tautological usage of terms has contributed to the confusion regarding the role of natural history within the biological sciences.

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[27] Nyhart, Lynn K, "Natural History and the New Biology" *in Cultures of Natural History,* ed.by Nicholas Jardine, James Secord, and E.C Spary (Cambridge: Cambridge University Press, 1996).

A naturalist, then should be defined as a scientist who studies the natural world and whose work cuts across specializations. They may focus on one area of research, but use their results to look at the larger picture, often vis-à-vis systematic debate. Scientists that stayed within the boundaries of specialized fields are more accurately referred to as a mammalogist, a physiologist, etc. Most frequently, late nineteenth century naturalists are identified by the main impetus of what they studied: Merriam as a mammalogist, J.A. Allen as an ornithologist, E.D. Cope and Angelo Heilprin as paleontologists, etc. However, given that the sum of their studies was directed at more than just one branch of natural history, and that they were heavily involved in debates over systematics that had profound effects for all of natural history, these scientists are more accurately described as naturalists. For example, E.D. Cope, who worked on extinct and extant fish, reptiles, and mammals, should be referred to as a naturalist, but his rival O.C. Marsh, who only focused on vertebrate paleontology should be thought of as the first modern American paleontologist.

Collectors, as a group, are difficult to classify because they were so diverse: many collectors only collected for a short time, or intermittently, as a hobby; others collected as often as their everyday lives and professions allowed, and still others turned specimen collection into a career. Who, then, are collectors? The simple answer – those that collected objects of natural history for others, is somewhat unsatisfactory, but nonetheless accurate to a large degree. They did serve as an intellectual labor force, providing naturalists with specimens that would be the basis of their studies in biogeography and systematics. Collectors cannot be dismissed as worker bees blindly following the instructions of naturalists. Numerous specimen collectors thought of themselves, and were thought of by others, as amateur naturalists. In less developed parts of the country, these amateur naturalists were often the only persons that studied or participated in science. Many, including Frank Stephens, compiled extensive specimen collections of their own, similar to the cabinets of curiosity common amongst the intellectual elite a century before. They are most distinguishable from systematic naturalists in the role that they played within natural history – more so than just collection, but in the development and application of biological theory. Collectors, as they gained experience, could become naturalists in their own right – both Edward Nelson, and Edward Goldman, who are discussed in Chapter 4, ended up becoming systematic naturalists in their own right. Frank Stephens, whose career is examined in Chapter 3, was a local expert and collector extraordinaire who did not, or was not able to, take this next step, but was still seen as San Diego's most important scientific figure in the early twentieth century. For the purpose of this study, collectors are defined as men and women who provided naturalists with specimens, observations, and inferences based upon their experience and understanding of natural history from the field. As such they played an important role in the production of biological knowledge, one that was more expansive than just collecting specimens for study.

This study examines the trend of professionalization of natural historical collectors, paying particular attention to the role that evolutionary systematics played in this transition by investigating the epistemological underpinnings of naturalist collecting networks in the United States. It focuses on the period from approximately 1850, coinciding with the rise of the Smithsonian as an institution of natural history, to 1910, when C. H. Merriam retired from the United States Biological Survey. The study will assess the acts and scientific accomplishments of collectors, as well as their interactions with systematic naturalists, and is based on the correspondence between the collectors and the scientific naturalists, the field notes of collectors, and relevant publications of both collectors and naturalists. It will concentrate on the work of five collectors: Robert Kennicott, Frank Stephens, Edward W. Nelson, Edward A. Goldman, and Edmund Heller, using their careers as case studies in order to demonstrate how changes in the biological theory affected practice in the field. Prior to doing so, the changes within natural history from 1850-1910 must be discussed.

Chapter 1: A "Golden Age"

The late nineteenth century has frequently been conceptualized as a "golden age" in American natural history. This view was first stated by renowned naturalist (and president of Stanford University) David Starr Jordan in the 1920s, reflecting on the growth of government sponsored science in the late nineteenth century.[1] More recently, the term has been used in studies examining the cultural history of natural history, such as Philip J. Pauly's *Biologists and the Promise of American Life: from Meriwether Lewis to Alfred Kinsey,* Paul Farber's *Finding Order in Nature: the Naturalist Tradition from Linnaeus to E.O. Wilson,* and Keith Thomson's *The Legacy of the Mastodon: The Golden Age of Fossils in America.* This "golden age" therefore, was not merely limited to government science, though the work of naturalists at the Smithsonian and later the United States Biological Survey were instrumental in making it so. Simply speaking, the latter part of the nineteenth century is when natural history caught imagination of the American public. During this roughly fifty year period, from 1860-1910, societies and museums dedicated to natural history flourished, the first modern zoological garden in the United States was opened in Philadelphia, and there was a corresponding increase of emphasis of both science in general and natural history in the popular press.[2]

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[1] Philip J. Pauly, *Biologists and the Promise of American Life: from Meriwether Lewis to Alfred Kinsey* (Princeton: Princeton University Press, 2000), 47

[2] Ibid, chapters 2-5; See also Elizabeth Hanson, *Animal Attractions: Nature on Display in American Zoos* (Princeton: Princeton University Press; 2004) Stephen Asma, *Stuffed Animals & Pickled Heads: the Culture and Evolution of Natural History Museums* (Oxford: Oxford University Press, 2001).

What makes this "golden age" all the more astounding was the state of American science in the first part of the nineteenth century, which was sorely lacking by European standards due to the provincial nature of the early republic and the aftereffects of British colonialism. American science enthusiasts were painfully aware of the state of science in the United States in the early nineteenth century, and this fueled a desire for American science to improve to the point in which it would be recognized by Europe. Science, therefore, became caught up in the nationalistic fervor of the early American republic. One of the key goals of the Lewis and Clark Expedition was to find living examples of mastodons, due to President Jefferson's twin aims of disproving the extinction of animals as well as challenging the degenerist theories of Buffon with regard to animal species in the Americas.[3] The oft-delayed United States Exploring Expedition (U.S. Es. Ex, Wilkes Expedition) of 1838-1842, was developed as a nationalistic response to European ocean surveys, and all of those aboard, 'scientifics' or naval personnel were acutely aware of the surveys significance, both symbolic and scientific.[4] Despite the mercurial nature of the Expedition commander, Charles Wilkes, and the lack of a national scientific museum to deposit the collections from the four year voyage, the expedition was a success, resulting in a better understanding of

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[3] Please see Keith Thomas, *The Legacy of the Mastodon: The Golden Age of Fossils in America* (New Haven: Yale University Press, 2008), chapters 2-4; Stanley Heden, *Big Bone Lick: The Cradle of American Paleontology* (Lexington: University of Kentucky Press, 2008) chapters 5-9.

[4] Please see William Stanton, *The Great United States Exploring Expedition 1838-1842* (Berkeley: University of California Press, 1975).

the Antarctic and the collection of thousands of specimens from across the Pacific.

The rapid expansion of the field of natural history in the United States in the late nineteenth century from a handful of amateur scientific societies in eastern cities to the large research expeditions of systematic natural history museums dated to a nexus of events in the 1840s. New scientific societies – usually small and localized – had been developed throughout the first decades of the nineteenth century in Philadelphia (1812), New York (1817), and Boston (1830), but the first truly national inclusive scientific society, the American Association for the Advancement of Science (AAAS), was developed from the existing American Society of Geologists and Naturalists in 1848.[5] While the model for the new society was the British Association for the Advancement of Science, it created a distinctly American forum for the discussion and debate inherent in science.[6] Two years prior to the founding of the AAAS, Louis Agassiz, a Swiss naturalist who was one of the world's foremost experts on comparative anatomy, traveled to the United States, initially to do a series of lectures at the Lowell Institute in Massachusetts, but ultimately was hired to teach

[5] There had been previous attempts at national scientific societies, including James Poinsett's National Institute for the Promotion of Science, but none had truly gotten off the ground. See Sally Gregory Kohlstedt, *The Formation of the American Scientific Community; The American Association for the Advancement of Science 1848-1860* (Urbana: University of Illinois Press, 1976), Chapter 4.

[6] See Sally Gregory Kohlstedt, Michael M. Sokal, & Bruce V Lewenstein. (eds.) *The Establishment of Science in America: 150 Years of the American Association for the Advancement of Science* (New Brunswick: Rutgers University Press: 1999), 13.

zoology at Harvard. As a renowned scientist and ardent popularizer of science, Agassiz gave America's nascent scientific community an authority which it had lacked before. The AAAS, in conjunction with the growth of northeastern universities as places of natural historical research, and the emerging museum movement – Agassiz's quest for a Museum of Comparative Zoology and the founding of the Smithsonian in 1846 – helped define, organize, and publicize American science.

While the arrival of Agassiz was key to the legitimization of American science for Americans as well as Europeans, the founding of the Smithsonian would have the greatest lasting effect on American natural history of any development or innovation of the nineteenth century. The Institution owed its origins to a massive bequest of James Smithson, an English gentlemanly amateur who died in 1829, and after typical congressional finagling and debate over the constitutionality of accepting such a donation, and then how best to use it, the Smithsonian Institution was incorporated in the summer of 1846.[7] Joseph Henry, perhaps the young republic's finest physicist, was elected as the Institution's first secretary, and four years later he selected the enthusiastic twenty-seven year old naturalist and Dickenson professor Spencer Fullerton Baird to be his assistant secretary.

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[7] E.F. Rivinus and E.M. Youssef, *Spencer Baird of the Smithsonian* (Washington: Smithsonian Institution Press, 1992), Chapter 1.

Spencer Baird and the onset of the "Golden Age"

As assistant secretary and later secretary of the Smithsonian, Spencer Baird would become the most influential naturalist of the nineteenth century. That he was considered, let alone the recipient of the position, says as much about his political, scientific, and social connections as about his scientific achievements. It also reflects the realities of mid-nineteenth century natural science, since he was a member of Pennsylvania's cultural elite. However, the growth and success of the Smithsonian as a center for scientific research as well as an American cultural institution owes more to Baird's work than any of the Institution's other leaders. He was single handedly responsible for the development of the Smithsonian as a museum (now a system of museums) and turned the Smithsonian into the central hub and repository for natural history specimens in the middle nineteenth century.

The growth of the Smithsonian as a national cultural and scientific repository was at odds with the aims of Joseph Henry, the founding Secretary of the Institution, for two distinct reasons. First, he was concerned with containing the costs of the Institution and keeping expenses in line with the funds allocated by Congress. Secondly, as a scientist, he was primarily interested in the creation of new knowledge via observation and experimentation; the storing and preserving of specimens did not conform to this view as once specimens were identified and described, the knowledge would no longer be new – and care for specimens was costly. However, the government was in possession of numerous natural history specimens already, from previous expeditions such as the United States Exploring Expedition, and it was arranged that the new Institution would oversee these collections, as well as any other collections made on government backed expeditions.[8]

Given the precedent from the U.S. Ex. Ex. and other early expeditions that placed specimens from military backed expeditions in the care of the government, it was natural that the role of the Smithsonian with regards to research in natural history would increase dramatically in the 1850s, even though the institution was in its infancy. During the 1850s the Army engaged in numerous expeditions across the American frontier in order to survey potential rail routes as well as the international boundaries with British America and the Empire of Mexico.[9] Generally speaking, each survey included at least one, if not two surgeons who also worked as naturalists.[10] Under these circumstances, Baird would be able to overlook the collection of specimens from afar, though the limited space at the Smithsonian, as well as the small staff would necessitate the outsourcing of examination of the specimens to naturalists across the east coast. However, Baird

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[8] Rivinus &Youssef, *Spencer Baird of the Smithsonian*, 77-78.

[9] See William Goetzmann, *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West* (New York: Alfred A. Knopf, 1966); Richard A Bartlett, *Great Surveys of the American West* (Norman: University of Oklahoma Press, 1962) and A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities to 1940* (Cambridge: Harvard University Press, 1957).

[10] Goetzmann, *Exploration and Empire,* 312-331. I would argue that these men were more collectors than naturalists, but their title was/has been traditionally described as surgeon-naturalists or explorer-scientists.

was able to maximize the potential collecting power of these expeditions due to his personal connections. His father in law, Brigadier General Sylvester Churchill, was Inspector-General of the Army, and often consulted with Baird regarding surgeon-naturalists on U.S. Army supported expeditions.[11] Baird was therefore able to place friends and correspondents on these surveys, such as Drs. C.B.R. Kennerly, J.G. Cooper, George Suckley, and J.S. Newberry.

Baird prepared collection guidelines for these surveys and also corresponded directly with the commanders of these surveys, and many, including George B. McClellan, John Pope, and William Emory, agreed to collect specimens for Baird and atmospheric readings for Professor Henry. The navy was also involved in expeditions during the period, and Baird was able to place William Stimpson, a student of Agassiz on the North Pacific Expedition in 1851-1853; in addition to its other accomplishments with regard to surveying and natural history, the expedition also accompanied Commodore Perry "opening" Japan to trade in 1853. Stimpson, therefore, was one of the first contemporary American or European collectors to collect flora and fauna in Japan; the botanical specimens collected on the voyage would later be used by Asa Gray to formulate his own theories on phytogeography, leading him to support Darwin's theory of natural selection openly in 1860, the first American naturalist to do so.[12]

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[11] William Deiss, "Spencer Baird and his Collectors" *Journal for the Society for the Bibliography of Natural History* 9 (1980): 639.

[12] Phytogeography refers to the geographic distribution of plants. For Gray's role in defending Darwinism, see A. Hunter Dupree, *Asa Gray: American Botanist,*

While natural history was not the first priority on these surveys, they nonetheless formed the backbone of collection efforts sponsored by the Smithsonian in the 1850s. Since the members of the expedition were paid directly from the War Department, and had the majority of their supplies provided by the government through other means, the Institution was able to obtain quality specimens for very little in the way of overhead. The Smithsonian was not the sole benefactor of army surveys, as most specimens were forwarded from the Smithsonian to experts in the specific fields: Baird handled most of the ornithology, but fishes and other vertebrates were sent to Louis Agassiz of Harvard, botany was handled by Asa Gray, also of Harvard, Joseph Leidy of the Academy of Natural Sciences in Philadelphia covered vertebrate paleontology, and geology was referred to J.D. Dana. By splitting collections, the community of American naturalists ensured that they would be able to examine the specimens, classify them, and publish their findings more quickly than if they were piling up at one place or another. Still, this professional courtesy was not enough to prevent real or imagined rivalries from breaking out between members of the scientific community, such as the rivalry that quickly arose between Gray and Agassiz even prior to their debate over Darwinian evolution. While credit for the "working up" of specimens must therefore be spread across the American scientific establishment, the surveys of the 1850s represent a turning point in American natural history, not just in the classification of the specimens but in the

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Friend of Darwin (Baltimore: Johns Hopkins University Press, 1959), chapters 11 & 12.

totality of the collections themselves. These collections represented information that had been heretofore unknown (or poorly known) and the specimens and accompanying reports on the geography of the west, were used by eastern naturalists to tune their understandings of biogeography – the application of geography to biology in order to understand which species lived where.

None of America's leading naturalists – Baird, Agassiz, Leidy, Gray – collected broadly across the United States, their duties and preferences (more so for Gray and Leidy, perhaps) keeping them relatively bound to their respective administrative responsibilities. All were reliant on collection efforts from afar, from their their correspondence and collection networks. While this had definite advantages – Gray was able to solidify himself as the authority in North American botany – it also meant that significant time and effort had to be spent on maintaining and expanding these networks. This put Leidy, Agassiz, and Gray at a disadvantage to Baird, as they were dependent upon the Smithsonian to send specimens their way, and they became increasingly dependent upon younger naturalists in what is now the Midwest and Mountain West of the United States. Baird, however, was able to form lasting relationships with collectors that were familiar with the new regions acquired by the United States in the 1840s and 1850s; these relationships and collaborations fueled further collecting and a close professional relationship when some of his former collectors, such as J.S. Newbery and J.G. Cooper, attained scientific positions on their own merit.

Practice of Natural History

The practice of natural history in the mid-nineteenth century was a two part process. The first part of the process was the collection of specimens, the second the comparative examination of specimens in a laboratory or curatorial setting. Naturalists invariably were active specimen collectors, but as the field broadened in the nineteenth century, it became commonplace for naturalists to employ people to collect specimens for them. The term "employ" here does not necessarily refer to a transfer of money from naturalist to collector – though many naturalists did pay for specimens – but rather a collaborative relationship between the naturalist and the collector. In the early to mid nineteenth century, many collectors were essentially enthusiastic volunteers, collecting in their spare time for recognition, general interest, and/or educational materials. In many cases these enthusiasts opened correspondence with naturalists asking them questions about organisms they had collected, and asked for assistance to become better collectors in order fulfill their own goals with regard to natural history.[13] Enthusiasts that showed promise might be asked by naturalists to start collecting for money, for trading specimens, or most likely, scientific publications. In order to maximize their potential collections, institutional naturalists developed collection networks, based upon the correspondence between the naturalist and numerous collectors from across the country. In this way, naturalists were able to

[13] See, for example, Ferdinand V. Hayden's correspondence with Spencer Baird and Joseph Leidy, and Joseph G. Cooper's initial correspondence with Baird; Spencer Fullerton Baird Correspondence, SIA RU 7002, and Joseph Leidy Correspondence, Academy of Natural Sciences Archives, Collection 1-B.

collect specimens from different localities with a minimum of exertion and institutional capital. All it took to maintain a collection network was time – time to write each collector and provide feedback, time to decipher the work of their collectors, time to organize and examine specimens.

In the middle of the nineteenth century, the goal for the collection of specimens from an institutional level was to have one representative specimen of each species to display.[14] This understanding of the preeminence of the display of a perfect specimen was handed down from an earlier period of natural history, dominated by gentleman naturalists and their cabinets of curiosity. Collectors also sought to collect duplicate copies of each species, so that different naturalists might be able to study the same organism at the same time, or even for their personal collections. Duplicates were also useful from an institutional standpoint as they allowed for potential trades with other individuals and institutions so that both might have a more complete collection, filing holes in the collection of the institution. This swapping of specimens was extremely common, as it led to both institutions having a more comprehensive collection at a lower cost than paying a collector to go find a new specimen. American institutions such as the Smithsonian also used this strategy to obtain specimens from European institutions, which may have had old world specimens that American institutions could not afford to obtain, but themselves had a death of American specimens.

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[14] Stephen Asma, *Stuffed Animals & Pickled Heads: the Culture and Evolution of Natural History Museums.* **(**Oxford: Oxford University Press, 2001), Chapter 4; Robert Kohler, *All Creatures: Naturalists, Collectors, and Biodiversity, 1850-1950* (Princeton: Princeton University Press, 2006), 108.

However, while the trade of duplicates allowed for a more comprehensive selection with regard to the number of species collected, it did not lead to more systematic collections.

In addition to individual collection trips by naturalists, and collection via correspondence with collectors, naturalists in the middle of the nineteenth century also benefitted from the numerous military exploring and survey expeditions that set out across the continent starting in the early 1850s. The aims of these expeditions were varied, from surveying the northern and southern borders of the United States to potential transcontinental rail routes to surveying and mapping the interior, and pertinent to the history of natural history, all of these surveys required surgeons. As was discussed above, many physicians were drawn to natural history as a hobby, and physicians on these surveys were given an additional mandate – to collect objects of natural history and ethnology whenever practicable, that is whenever they could so long as it did not interfere with their other duties or those of the surveying party. These surgeon-naturalists were explicitly directed to "make as full collections as possible of specimens and facts relating to the various departments of natural history...the general principle to be observed in making collections of natural history in a new country, as one previously unexplored is to collect everything which may present itself from time to time…in collecting specimens of any kind it will be important to fix with the upmost precision the localities were found."[15] Of further importance, naturalist Spencer Fullerton Baird, the assistant secretary of the Smithsonian was the son-in-law of the quartermaster of the army, and was frequently able to suggest candidates for expeditionary surgeon-naturalists.[16] Not surprisingly, he chose correspondents such as Drs. F.V. Hayden, Joseph Cooper, and C.B.R. Kennerly that had interest, and some practice, in the collection of specimens of natural history. As noted above, he was also able to place William Stimpson on the navy's North Pacific Exploring and Surveying Expedition that spent significant time in Chinese waters and accompanied Commodore Perry to Japan, allowing Stimpson to collect valuable Asian zoological and botanical specimens.

The sum of these surveys, together with the collections of the earlier United States Exploring Expedition, gave American naturalists a unique opportunity to analyze the zoology and botany of almost all of North America, as well as parts of East Asia and Oceania. Gray, Baird, and Leidy took full advantage of this and pioneered an emphasis in natural history of what may be called comparative biogeography, the comparison of the biota of one region with another and analyzing any differences. North America was uniquely situated for such a comprehensive study, due to its vastly different physical geography across the continent; compared with that of Europe, the American landscape is much

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[15] Collecting instructions for the Stevens Survey (mss), Spencer Fullerton Baird Correspondence, Expedition files, Smithsonian Institution Archives (SIA) Record Unit (RU) 7002, box 66 folder 7

[16] Rivinus and Youssef, *Spencer Baird of the Smithsonian*, 61.

more varied, and few environments compare with the American mountain west save for the Australian outback and the Gobi Desert. The sum of these collections also paved the way for the widespread acceptance of American naturalists of the theory of evolution. The botanical specimens of the North Pacific Exploring and Surveying Expedition are a case in point. The specimens and notes regarding plants had been forwarded to Asa Gray, the botanist at Harvard, and Gray was able to use these specimens to develop his own theory of geographic distribution of plants in 1858. Gray's theory directly challenged the contemporary understanding of plant biogeography, and permitted Gray to accept Darwin's theories on evolution even prior to the publication of *On the Origin of Species*.[17] On a more comprehensive level, the collections at the Smithsonian and Baird's emphasis on biogeography ensured that evolution would become a key component of natural history in the late nineteenth century, because variation and geographic distribution were clearly delineated in specimens accrued from across the continent.

The development of systematic collections of zoological and botanical specimens coincided with an increased emphasis on biogeography from Baird and

[17] Gray was Darwin's American confidant when the latter was writing the *Origin*, and there correspondence in the late 1850s is dominated by their discussion over the Darwin's theory. It may very well be that the theory played a role in Gray's theory on biogeography, that he saw the power of Darwin's theory and used it prior to its publication. However, Gray's published work on the relationships between Asian, American, and European trees does not mention Darwin; neither does the discussion in the Boston Society of Natural History. Still, whether Gray used Darwin's work in the formulation of his own work or not, Gray did then use his work as an example that could only be explained by Darwin's theory.

other naturalists. As the emphasis shifted from examining one representative specimen to the variation within organisms, naturalists required the collection of series of each animal or plant that they wanted to study, leading to a delineation of specimens for display and those that were to be used for systematic research. It is important to note that the emphasis of comparative research on series of organisms predated the transmission of evolutionary theory. Agassiz, for example, used representative series of specimens the basis for his comparative research in anatomy at his newly founded Museum of Comparative Zoology.[18] Through such comparative research, naturalists discovered local variations of species, which would be crucial to later understandings of evolutionary systematics – the "scientific study of the kinds and diversity of organisms and any and all relationships among them."[19]

In the 1850s, there were questions about natural history as a viable career path. Many amateur naturalists were physicians that collected specimens in their spare time. Perhaps physicians were drawn to study the natural world as they could due to their background and training in human anatomy and physiology. Additionally, there were very few universities that had an emphasis on natural history, let alone advanced classwork and degrees. Many interested students went the medical school route to first secure a potential future, not because they were

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[18] Mary P. Winsor, *Reading the Shape of Nature: Comparative Zoology at the Agassiz Museum* (Chicago, University of Chicago Press, 1991), 88.

[19] Ernst Mayr, *Principles of Systematic Zoology* (New York: McGraw Hill, 1969), 2.

interested in medicine. Joseph Leidy practiced medicine only as a field physician during the Civil War, and by the late nineteenth century this route was becoming less common, though C.H. Merriam was pressured into it by his family.[20] Earlier in the century, though, the study natural history for its own sake was still a slightly dangerous career path, due to a lack of career options outside of academia or the scientific establishment of the east. J.P. Kirtland, an amateur naturalist from Ohio, actively attempted to dissuade Robert Kennicott, one of his protégés, from looking at natural history as anything other than "an amusement," given the potential for poverty.[21] This situation gradually begin to change in the period following the Civil War with the increase in available universities, but most universities offered few courses in zoology and botany due to an emphasis in laboratory biology. C.H. Merriam, whose goal it was to create a class of professional systematic naturalists, frequently complained about the lack of instruction in natural history at the university level both in print and in personal correspondence.[22]

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[20] Kier Sterling, *Last of the Naturalists*, 28; Merriam's father, a Congressman, wrote to Baird in 1883 asking him to stop encouraging Merriam to collect in exotic locales. Spencer Fullerton Baird Correspondence, SIA RU 7002 Box 30 folder 2.

[21] Ronald S. Vasile "The Early Career of Robert Kennicott: Illinois' Pioneering Naturalist" *Illinois Historical Journal* 87(3),158; Kirtland warned Kennicott of the fate of Constantine Samuel Rafinesque, a master collector of the early nineteenth century that died in poverty due to his eccentric ideas regarding species.

[22] C. Hart Merriam, "Biology in Our Colleges: A Plea for a Broader and More Liberal Biology," ***Science*,** 21, 543. (Jun. 30, 1893) , 353; C.H. Merriam "On the

Systematic Biogeography:

The expansion of the United States in the nineteenth century, coupled with the overarching goal of naturalists to catalog and describe the totality of life, and contemporary emphasis within the field regarding biogeography, resulted in American collectors working in incredibly diverse, and increasingly exotic locales. Many of these collectors were attached to the military surveys described previously that mapped out the interior and northern and southern borders of the country, and others were interested enthusiasts in previously uncollected regions, at least with regard to American natural history due to their personal interests and need for a hobby. The majority of the Smithsonian's early collections from western Mexico, for example, were through the efforts of John Xántus, a Hungarian émigré and former U.S. Army officer working in the Alexander Dallas Bache's Coast Survey. Through his job in the Coast Survey, which he owed to Baird's influence within the scientific community, he collected throughout Baja California, and became one of Baird's most prominent collectors.[23] In fact, his dedication to the collection of specimens directly affected his job as an observer

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Educational Nature of the Study of Natural History" (unpublished manuscript, C.H. Merriam Papers Volume II, reel 106, Bancroft Library, University of California) January 12, 1896

[23] "John Xántus" retrieved February 7, 2011, http://vertebrates.si.edu/fishes/ichthyology_history/ichs_colls/xantus_john.html

for the Coast Survey, adding to tension between Bache and Baird discussed earlier, and Xántus nearly lost his job.[24]

Baird, Leidy, Gray and others had numerous contacts that collected for them within the American interior, especially physicians at military posts, such as Elliott Coues, who collected for Baird at Fort Verde, Arizona Territory, and Drs. James Van Allen Carter and Joseph Corson, whom collected for Leidy out of Fort Bridger, Wyoming Territory. Baird was also able to facilitate Robert Kennicott's collection trip to British America, and Henry Bryant's ill-fated trip to Puerto Rico, and was in contact with scores of other collectors and correspondents, such as Professor Poey in Cuba, who collected for or traded specimens with the Smithsonian in foreign locales. The regions targeted by naturalists for their collectors, or for naturalists to develop relationships with new collectors from said reagions, were those that were previously unaccounted for in American science, partially due to necessity for a "complete" collection, but also due to the need to "catch up" with European collections. Baird, in particular, valued specimens and information from the entire western hemisphere in order to construct a comprehensive understanding of "American" natural history.

The practice of collection in the nineteenth century, therefore, is rather analogous to the contemporary geographic mapping surveys that crisscrossed not only North America, but also South America, India, and Africa. Specimens needed to be collected from everywhere, filling in holes in collections the way

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[24] William Deiss "Spencer Baird and his Collectors," 640.

that cartographers were busy filling holes in on the map; in essence, collectors were filling in previous blank spots on naturalists' hypothetical biogeographic maps. The main fault of the cartographic analogy, other than of course area of study, is the role that specimen collectors played in the formation of knowledge. On the longitudinal survey in India, for example, British surveyors were the ultimate arbiter of cartographic knowledge, ultimately deciding whether to utilize, ignore, or interpret information from native sources.[25] Surveyors involved in mapping the Great Plains and the American West had similar power to interpret their surroundings. Most collectors, especially early in the early to middle part of the century, were complete novices in natural history that were extremely interested in the subject, and were not well versed enough to make definitive judgments on the species they collected. This power was in the hands of the naturalists of the eastern scientific establishment through the Civil War. However, as collectors became better informed from their own experience, the growth of scientific societies in regions that could have previously been considered the scientific hinterland, and the growth of scientific publishing in the United States, they were able to offer valuable suggestions and observations to naturalists. It should be noted that collectors had always offered comments and observations, but the *usefulness* of these comments increased due to their training

[25] See Matthew Edney, *Mapping an Empire: The Geographical Construction of British India, 1765-1843* (Chicago: University of Chicago Press, 1997). The nexus between geography and biological knowledge is also explored in Graham Burnett, *Masters of All They Surveyed: Exploration, Geography and a British El Dorado* (Chicago: University of Chicago Press, 2000), and in Goetzmann, *Exploration and Empire*.

in the field and via correspondence. As a result, individual collectors became better educated with regard to natural history, and the growth of scientific societies and formation of new institutions of higher learning on the Pacific Coast and what is now the American Midwest led to additional opportunities for enthusiasts to further participate within the field.

In these relatively or completely uncollected regions, amateur collectors and local experts stayed relevant as collaborators when their peers in more "known" regions were fading in importance and relevance. It is notable that C.H. Merriam's early collectors that played an important role in the work of the Biological Survey – Vernon Bailey, Edward W. Nelson, and Frank Stephens – all were from or lived and collected in areas that were not well-collected. Bailey and Nelson would be invited to join the Survey and had stellar careers in the field; Stephens became Merriam's go-to collector for information and specimens from southern California and western Arizona, and would later do the same for Joseph Grinnell in the early twentieth century. Stephens, in fact, may well be one of the last examples of a "professional-amateur" playing an extensive role in systematic natural history.

Debate over Practice: Baird and the Lazzaroni

The rapid growth of science in America quickly resulted in an intellectual battle over the soul of the scientific practice. A group of Boston area scientists, led by Alexander Dallas Bache and Louis Agassiz, sought to become the arbiters of American scientific practice, emphasizing "original" scientific investigation by a small cadre of professionalized scientists. This ideal was supported, at least in theory, by the Secretary of the new Smithsonian Institution, Joseph Henry.[26] Needless to say, the Lazzaroni did not take kindly to the ideals of Spencer Baird, who encouraged his collectors to engage in systematic work and publish their findings, even if it meant ruffling the feathers of the Agassiz with regard to his existing systematic work.[27] During the Civil War, Agassiz, Beche, and their compatriots pressed for the development of a National Academy of Sciences, an important step in the development of America's scientific establishment. However, they also used it as an opportunity to try and belittle the work of Baird as just a "descriptive" scientist, as he did not do comparative anatomy or other work that was seen as original in the eyes of the Lazzaroni. Here, however, Agassiz overplayed his hand, believing that Joseph Henry would support the endeavor; Henry did not and neither did James Dana or Asa Gray, whose work was more descriptive than Baird's, and by this time was doing everything he could in a professional setting to antagonize Agassiz.[28]

While the entire affair was tied up in the rival hopes of Baird and Agassiz to establish the nations definitive natural history museum in Washington or Boston, respectively, it also had much to do with scientific methodology and scientific authority. Baird had a much more democratic view with regard to

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[26] E.F. Rivinus and E.M. Youssef, *Spencer Baird of the Smithsonian,* 103.

[27] Winsor, *Reading the Shape of Nature*, 91.

[28] E.F. Rivinus and E.M. Youssef. *Spencer Baird of the Smithsonian*, 104.

scientific practice than Agassiz did, and encouraged his collectors to publish their findings, whereas Agassiz viewed the discoveries of his students his by fiat. Interestingly, though Agaissiz and his Lazzaroni lost the battle, and Baird would prove to be the most prominent American naturalist of the nineteenth century, the Lazzaroni would ultimately prove to win the war for scientific practice. Laboratory biology would rise in importance in the late nineteenth century, and essentially used the rhetoric of Agassiz to denigrate the field of natural history, while naturalists themselves had ceased to be purely Baconian in nature, seeking to uncover evolutionary mechanisms and leading to a revolution in systematics.

Agassiz's claim of Baird being solely a descriptive naturalist was deeply flawed, despite Baird's Baconian approach to science. Baird had been an enthusiastic field naturalist prior to his appointment as the Assistant Secretary of the Smithsonian, collecting thousands of specimens for study. Most of these were donated to the fledgling Institution when he came to Washington. Despite turning down numerous opportunities to collect on expeditions in the 1840s, giving excuses related to his health and concerns of his family, his collections were substantial enough to fill two railroad cars on the trip.[29] However, his collection activity decreased sharply after 1850, due to the administrative nature his position and the declining health of his wife. He did manage to escape Washington's summer heat from 1863 on, going to Wood's Hole, Massachusetts for vacation and research, especially after being appointed head of the United States Fish

[29] Ibid, 27

Commission in 1871.[30] Though consumed with work at the Smithsonian, Baird managed to avoid the charge of being only a "closet naturalist," on that frequently was aimed (accurately so) at his friend Asa Gray. Gray was originally slated to accompany the United States Exploring Expedition, but backed out due to delays, as well as a personality conflict with the leader of the expedition, Lieutenant Charles Wilkes.[31]

Changes in collection

In order to facilitate collection, naturalists made sure to give their collectors detailed instructions for how best to preserve their specimens. The most widely circulated collection and preservation instructions were those issued by Baird at the Smithsonian, due to every survey of the territories including a surgeon naturalist. The actual instructions of how to preserve specimens were not specific to Baird, having been standard practice for the preservation of specimens, but Baird's influence in the widespread collection of specimens deserves special mention, and the examination of his collection techniques is an excellent way to pinpoint how specimens were collected and preserved in the middle of the century. Small animals, especially reptiles, amphibians, and fish, were to be preserved in alcohol, failing that "rum or whisky (the stronger the better)," and for best results were to be dropped in "alive or as near as possible" after cutting a

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[30] Ibid, 141-142

[31] Stanton, *The Great United States Exploring Expedition of 1838-1842*, 66-67.

small slit in the stomach to aid the distribution of the preserving liquid.[32] Mammals and birds were to be skinned, their skeletons dried and preserved, and the pelts preserved with powdered arsenic.[33] Many collectors may have been familiar with skinning mammals with regard to hunting or trapping, and many others were taxidermists by profession, but preparing a skin for a scientific specimen required more attention to detail than other methods. As important as the preparation of the specimen, was an accompanying note that recorded the locality from where the specimen was obtained.[34]

Baird's collection instructions, in addition to being incredibly widespread, are significant due to their influence on later collection desiderata by naturalists such as C.H. Merriam. Merriam's preparation instructions for mammals are similar to those of Baird, due the comprehensive nature of Baird's instructions, but also Merriam's use of them in the field when a collector attached to the 1872 expedition to Yellowstone. There are notable exceptions, such as Merriam took much more care in describing how best to skin potential specimens, and noting that the preservation of a mammal skin worked best if alum was mixed with

[32] Spencer F. Baird "General Directions for Collections and Preserving Objects of Natural History," Chief Clerk, Forms, Circulars, Announcements, SIA RU 65Box 2.

[33] Ibid

[34] Ibid

arsenic, but other than that the instructions are fairly analogous.[35] A more sizeable change was made with regard to recording locality; Merriam required detailed tags on each specimen that included locality, number of specimen, and the name of the collector. [36] This was due more to the change in emphasis in collecting with regard to systematics and data collection than a significant change in how specimens were collected, however.

The systematic collection of specimens in the late nineteenth century was aided by technological improvements in equipment. Even after World War I, however, naturalists were still collecting zoological specimens the way they had in the middle of the nineteenth century, by trapping, shooting, and poisoning. Collection strategies, however, were much more dynamic, adapting to changes both within the field of natural history, emphasis of a particular naturalist or expedition, and localized conditions. Bait tainted with poisons was still commonly used to collect small carnivores into the twentieth century; Edward Nelson used poison collect foxes in Alaska in the 1880s. Small mammals were most efficiently collected via trapping, and the collection of rodents and other small mammals was greatly aided by more advanced trapping technology. These advances, such as the excellent Cyclone Trap and "museum specials" (varying sizes of the now-familiar snap trap), which trapped mammals more effectively,

[35] C.H. Merriam "Brief Directions for Preparing Skins of Small Mammals," C.H. Merriam Papers Volume II, BANC FILM 1958 reel 1, Bancroft Library, University of California, Berkeley.

[36] C.H. Merriam, "United States Biological Survey Circular no 49."

killing the animal while not damaging it beyond use as a specimen.[37] The collector could thus set lines of traps at varying distances from camp, and then visit them daily or twice daily (once to check for nocturnal specimens, once for diurnal ones) to collect specimens and rebait traps, and spend the remainder of the day hunting for larger animals or spending time putting up specimens. Larger mammals and birds had to be hunted, which required much more time and effort than trapping, especially for larger mammals such as desert bighorn. Hunting birds and mammals also required – or at least was more efficient – with different types of guns. This problem was solved with the introduction of the “aux” an auxiliary, interchangeable barrel which allowed a collector to switch a rifle into a shotgun or vice versa, making collection trips easier to plan and execute.[38]

The collection of botanical specimens was at once more straightforward and more complex than zoological specimens, and was dictated by the way in which botanical specimens were displayed both in museums and in books. Plants were customarily represented by the display of their roots, stems, leaves and reproductive organs – either flowers or cones – and were classified based upon the characteristics of these particular components of their anatomy. For small specimens, it was relatively simple to collect the entire plant, press it, and then

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[37] Sterling, *Last of the Naturalists,* 67-68.

[38] Frank Stephens, who collected for both C.H. Merriam and Joseph Grinnell, frequently used an Aux in the field. See Frank Stephens correspondence, Museum of Vertebrate Zoology Archives, University of California, Berkeley.

send it in to the naturalist in question.[39] For larger plants, the collector was urged to collect the portions of the plant that would be represented and needed for classification. If the naturalist was lucky or the collector well trained in botanical collecting, the collector was also to sketch, as realistic as possible, the plant in its natural state. As a result of this practice, many plants were classified without the botanist ever seeing the entire plant in question.

The collection of paleontological specimens also offered challenges to the collector. In addition to having to excavate for many fossils, collectors faced logistical challenges based upon the sheer weight of potential specimens. Any expedition that hoped to find large fossils needed a large study wagon and team so that the fossils could be transported to the nearest rail depot. The larger size and weight of specimens and the need for a wagon meant that paleontological expeditions covered much less ground than other expeditions that focused on extant plants and animals, which were able to travel lighter. The weight also led to higher freight charges, meaning that collecting teams in the "Bone Wars" needed to be paid in advance for shipping and other logistics.

In the mid nineteenth century, one of the common ways of paying for expeditions was to raise money by selling "subscriptions," in which allied organizations all put in money to support collectors in the field. This allowed for costs to be defrayed across many institutions or interested individuals, but also

[39] For a discussion on the collection and preparation of plant specimens, please see Jim Endersby, Imperial Nature: Joseph Hooker and the Practices of Victorian Science (Chicago: University of Chicago Press, 2008), Chapter 2.

meant that collectors were often collecting specimens for many different naturalists, with each naturalist specializing in one department of natural history. Robert Kennicott's trip to the Hudson Bay Territory under the auspices of the Smithsonian, which is discussed in the next chapter, was funded in this manner, as were many other collection trips prior to the rise of well funded institutions of natural history such as the American Museum of Natural History and the Field Museum in the late nineteenth century.[40] The order of study of specimens, and who was able to examine which specimen, was determined based upon the amount of money and other support donated by a particular institution or society to the cause. This assured that priority in describing specimens would be observed by those that backed the trip, and worked to promote future subscriptions assuming the specimens collected were in good shape.

There was a certain amount of personal danger that accompanied collectors into the field throughout the nineteenth century, though the amount of danger of course depended upon the environment in which the collector worked. Members of military expeditions, of course, faced the constant threat of attack from Native Americans, and even as late as the 1880s the threat of Apaches deterred collection in certain parts of Arizona. In the west, ancillary dangers also included the extreme heat, dehydration, and snakes. In the arctic and subarctic, the climate also represented a very real danger, as did the relative lack of logistics in the northern hinterland. For polar ocean expeditions, an added danger was getting

[40] Robert Kennicott to Spencer Fullerton Baird, April 6, 1859. Spencer Fullerton Baird Correspondence, SIA RU 7002, Box 27, folder 2.

caught in the ice. This was still a danger into the twentieth century as the experiences of Harvard University's Thayer Expedition that Joseph Dixon accompanied as a collector in 1913 demonstrate.[41] In the tropics, animal attacks and the extreme heat and humidity were potential problems, but the main danger was tropical diseases. In their explorations of Mexico in the late nineteenth and early twentieth centuries, both Edward A. Goldman and Edward W. Nelson contracted malaria, which was fortunately cured with quinine, and the Roosevelt expedition to Africa also had to deal with disease.[42]

The fate of Spencer F Baird's early cadre of collectors uniquely demonstrates the numerous dangers in the field. Three of his most successful early collectors, Henry Bryant, C.B.R Kennerly, and Robert Kennicott, died in the field within a seven year period. In 1861, Baird lost prominent student and collector, C.B.R. Kennerly while he was working on the border survey of between the United States and Canada. Kennerly's death was not directly caused by the field; his partner on the survey and fellow Baird collector George Suckley wrote to Baird that "Kennerly died at sea between San Francisco and Acapulco. Cause

[41] Joseph Dixon to Joseph Grinnell, September 1, 1913, Joseph Dixon Correspondence, MVZ Archives, University of California, Berkeley.

[42] Kier Sterling, "Two Pioneering American Mammalogists in Mexico: The Field Investigations of Edward W. Nelson and Edward Alphonso Goldman, 1892-1906" in Michael A. Mares & David J Schmidly (eds.) *Latin American Mammalogy: History, Biodiversity, and Conservation* (University of Oklahoma Press: Norman, 1991), 42.

rum."[43] Life in the field was not easy, and it pushed Kennerly to abuse alcohol, though it is possible that the deteriorating state of the nation had something to do with it, since Kennerly was a Virginian. In the winter of 1866, Kennicott, perhaps Baird's most promising protégée, died while on the ill fated and poorly planned Western Union Telegraph Expedition. Bryant, who worked with Baird at the Smithsonian and was one of the charter members of the informal "Megatherium Club," fell ill while collecting for Baird in 1867 in Puerto Rico, and died shortly thereafter. The deaths in the field of Kennicott, Bryant, and Kennerly, combined with the death of another trusted collector, William Stimpson, after the destruction of the Chicago Academy of Sciences in the Chicago Fire in 1871, devastated the collection efforts of Baird and the Smithsonian. However, Baird was able to train a new crop of collectors, including Elliott Coues, and combined with these new collectors and the continued official government surveys of the Western United States, these new collectors were able to continue the work started by Baird's early cadre.

The Priority of Priority

Even as traditional descriptive natural history was being supplanted by a more systematic study of natural history the identification and description of an organism was of still of extreme importance in natural history. Since Linnaeus, the first naturalist or taxonomist to describe an organism had the honor of not only naming the organism but having their name was permanently attached to the

[43] George Suckley to Spencer Fullerton Baird, February 24, 1861. Spencer Fullerton Baird Correspondence, SIA RU 7002, box 34, folder 7.

organism in question, with the describer's surname following the Latin bi- (or later tri-) nomial.[44] Priority with regards to which naturalist would be able to describe which specimen was recognized as an important part of collecting specimens, especially as collectors began collecting for multiple naturalists, or as larger collections came into the Smithsonian, only to have certain parts of the collection sent out for other naturalists to study. As with other aspects of natural history in the early American republic, the concept of priority became infused with nationalistic fervor. Naturalists and collectors both developed a nationalistic conception of ownership of American biota and the American landscape. The desire for legitimacy in the eyes of European scientists may well have created an overarching concern for priority for American naturalists in the nineteenth century – the drive to find more specimens/phenomena/geologic formations faster, coupled with American individualism made priority of find incredibly important to American collectors and naturalists. On overtly nationalistic surveys such as the U.S. Es. Ex, this sentiment fueled the collection of specimens, and even individual collectors used nationalistic rhetoric when espousing the importance of collecting across the continent. Ferdinand V. Hayden lamented to Joseph Leidy about a rival group of foreign collectors examining the Judith River region while collecting specimens and studying the geology of the same region in the late 1850s, and Robert Kennicott was acutely aware of the significance of the specimens he collected from British America being collected for and described by

[44] Note that this is taxonomic priority rather than collection priority, and as such gives more credit to the naturalist or taxonomist than the collector.

American naturalists.[45] This national emphasis on priority had a lasting legacy on American natural history. While European naturalists occasionally squabbled about priority of finds and regional ownership, in the American context it boiled over into outright controversy numerous times, the most famous of which was the “bone wars” of O.C. Marsh and E.D. Cope in the 1870s and 1880s.[46] Priority also was dragged into the lumper-splitter debates of the later nineteenth century, as naturalists debated over the meaning of species within a systematic construct of natural history.

The “Bone Wars” have been an active field of examination in the history of science since their inception, with contemporary authors and current historians joining the fray to support one combatant over the other.[47] Given the way that the affair unfolded, with backstabbing and betrayal, bribery and espionage to the point of stealing specimens off of rail cars and destruction of fossil sites so that

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[45] Thomson, *Legacy of the Mastodon*, 128-129.

[46] See Jaffee, *The Guilded Dinosaur*, amongst other examinations of the Cope/Marsh war of words. Interestingly, James Van Allen Carter, a doctor at Fort Bridger (at the epicenter of the feud) wrote to Joseph Leidy that the priority of collection in the surrounding area should be Leidy, since Leidy had done the first work on the area’s paleontology from a distance, with many of the specimens sent in by Carter. This did not stop Carter from helping Marsh organize his logistics, however. James Carter to Joseph Leidy, December 31, 1870. Joseph Leidy Correspondence, Collection 1B, Academy of Natural Sciences Archives.

[47] Please see Keith Thomson *The Legacy of the Mastodon: The Golden Age of Fossils in America* (New Haven: Yale University Press, 2008), H.F. Osborn, *Cope: Master Naturalist* (Princeton: Princeton University Press, 1931); Jane Pierce Davidson, *The Bone Sharp: The Life of Edward Drinker Cope* (Philadelphia: The Academy of Natural Sciences, 1997). For a more popular account, please see Mark Jaffe, *The Gilded Dinosaur: The Fossil War between E.D. Cope, O.C. Marsh, and the Rise of American Science* (New York: Crown, 2000).

they would be unusable to the other, the hiring away of collectors from one side to another, how government agencies were dragged into the fray, and how it played out in the scientific and popular press, it had all the components of a Victorian melodrama hybridized with a Greek tragedy. At the heart of the matter was the question of priority, and this morphed into a conception of intellectual ownership. As Marsh attacked Cope and vice versa, both felt that their work was being stolen by the other. Priority had become some incredibly important within American natural history due to prestige, the rise of scientific publishing, and the nationalistic sentiment described earlier, that an entire department of natural history exploded in controversy over it. It would be impractical to examine the entire matter here, the long running feud between E.D. Cope and O.C. Marsh had a drastic impact on American paleontology, leading to the discovery of numerous new dinosaurs and extinct mammalian species, and making the American west the center of paleontological research. By extension, it also fueled the American public's interest in natural history, and not just due to the lurid nature of the entire sordid affair. Paleontology, out of all of the components of natural history was the most associated with cultural understandings of progress, given the apparent or interpreted linear progress of fossils, and dinosaurs and other large fossils further captured the American imagination, their very size seeming to encapsulate the American ideal in the age of progress and industry. Cope's finances eventually gave out, necessitating the sale of his fossils to the American Museum of Natural History, where they were a research resource as well as a draw to the public.

Three Collection Strategies from an Institutional Level

One of the most important components of a naturalist's collection network in the late nineteenth century was the contributions of amateur collectors. The work of Asa Gray, for example, would have been impossible without solicitations from amateurs sending in what they felt was interesting and new plant material, or Gray's active role in soliciting material from amateurs. These amateurs, were, as a rule, extremely interested in certain, if not all, aspects of the study of the natural world, and were curious about what they had observed. While some of these collectors solicited payment from naturalists, most others were happy with a different form of compensation: publications. Publications were the main way that amateur collectors were compensated for two reasons. First, most naturalists, especially before the large institutions of natural history were opened in New York and Chicago (The American Museum of Natural History [AMNH] and the Field Museum, respectively), did not have the financial wherewithal to pay collectors cash. Secondly, the goal of sending publications was to stoke the interest of the collector, and would serve to help educate the collector not just on basic collection techniques, but also with regard to their interests in natural history. Coupled with the inclusion of postage to defray shipping costs, it was hoped the amateur could be cultivated to collect more specimens and to begin to apply the knowledge gained from publications into their collecting. For naturalists, this approach to cultivating collectors allowed them to train potential collectors from afar, providing key feedback and instruction via correspondence. Naturalists encouraged collectors to build up their own personal collections, which gave the collector practice at examining (or at least organizing) their specimens systematically. The better trained the collector, the more useful he or she was to the naturalist, and long term collaborations were often fostered out of initial correspondences that professed interest in the natural world.

This form of collaboration between a collector and a naturalist is best described as correspondence based collection; collectors followed collecting guidelines laid out by naturalists, collected specimens as best they can, and in turn were educated by naturalists. In this form of collection, naturalists had to be somewhat patient with their collectors, and often had to repeat similar feedback to numerous collectors. As the century progressed, this form of collection became less common, at least at large, national, institutions of natural history, due to the increase in staff and the change in emphasis in natural history with regard to the number and types of specimens required. Even so, the cultivation of a trustworthy cadre of collectors was a painstaking process for naturalists. The early career of C.H. Merriam offers insight into this complicated procedure. Merriam was consistently frustrated with the efforts of many of his private collectors, and a few shipments of sloppy specimens were usually enough for Merriam to stop his relationship with a given collector. However, the process of asking many to collect for him and gradually weed out those that did not perform up to his (rather lofty) expectations, allowed Merriam to identify two collectors that he would invite to join him at the biological survey, Vernon Bailey and Edward W. Nelson, and another Frank Stephens, that he would form a lengthy collaboration with.

Reliance on correspondence based collection left a naturalist depended upon the flow of specimens inward, and therefore on the willingness of collectors to work with a naturalist. If a naturalist did little of his own field work, then this lead to overreliance on collectors, and left naturalist's work at risk. Asa Gray, for example, passed on the United States Exploring Expedition, and did little collection of his own, due to the tremendous amount of material that was shuttled to him by Baird as well as collected by his own collectors.[48] Gray's ultimate aspiration was to recreate the Royal Gardens at Kew – or at least the imperial nature of Kew's collections – at Harvard University. While he was able to become America's foremost botanist, his claim of priority over American botanical specimens ultimately placed him at odds with a newer generation of botanist, such as Charles E. Bessey, that became prominent in the second half of the nineteenth century. Bessey and his school of botanists rejected Gray's imperial understanding of botany, arguing that plants had to be studied in their environment as living organisms, rather than dried taxonomic specimens. Bessey's argument was based as much on practice, attacking the "closet naturalist" mentality that Gray embodied, as it was on the need to develop a "new

[48] Phillip J, Pauly, *Biologists and the Promise of American Life: From Meriwether Lewis to Alfred Kinsey* (Princeton: Princeton University Press, 2000), 30-31.

botany," a systematic reexamination of botany with regard to Darwinian principles that would become the basis of American ecology by the early twentieth century.[49]

Joseph Leidy, the polymath naturalist of the Academy of Natural Sciences, was, unlike Gray, active in field collection but also found his work interrupted by a reliance on the correspondence method. In 1870, Leidy was America's foremost vertebrate paleontologist, and had a collecting relationship with Drs. James Van Allen Carter and Joseph Corson, the civilian and military (respectively) physicians at Fort Bridger, in Wyoming Territory. Leidy also had a longstanding relationship with Ferdinand V. Hayden, whom forwarded all of his vertebrate specimens to Leidy with Baird's blessing. Had it been twenty or even ten years earlier, Leidy would have been in a unique position to have all of the paleontological specimens of the region sent to him for research and identification – he had willing collectors on the ground, and a unique knowledge of the objects at study. However, Leidy's exclusive access to specimens was effectively cut off in 1870 due to O.C. Marsh's Yale College Scientific Expedition, which combined with the contemporary work in the west by Leidy's colleague E.D. Cope, touched off a contentious feud between Marsh and Cope over paleontological practice and priority that would last for the remainder of their lives. Even though Leidy travelled to the region in 1872 and 1873, and made numerous discoveries regarding microbiology and geology, the flooding of the plains and foothills with

[49] Richard Overfield, *Science with Practice: Charles E. Bessey and the Maturing of American Botany* (Ames: Iowa State University Press, 1993), Chapter 4.

survey expeditions allied to either Cope or Marsh ensured that few paleontological specimens would make it back to Philadelphia for Leidy to examine, indentify, and describe.[50] The Academy of Natural Sciences lacked resources for large scale expeditions until the twentieth century, preventing Leidy from organizing either a rival expedition to Cope and Marsh, which would have been extremely out of character, or expeditions to other regions of interest. The importance of systematic surveys were impressed deeply on Leidy, and one of his first acts when appointed director of the Wagner Free Institute of Science in 1885 was to implement a paleontological survey of southern Florida.

As can be demonstrated by the paleontological example above, the importance of larger collections meant that a more effective and efficient way of attaining specimens was a biological survey expedition overseen by a naturalist. These systematic surveying expeditions gradually supplanted, but did not replace, traditional correspondence based collection in the late nineteenth century and early twentieth century. Systematic collection surveys have many advantages for naturalists over previous forms over correspondence based collection, and were more productive from a naturalist's perspective over earlier exploring expeditions in being completely dedicated to natural history (as opposed to just having one or two surgeon-naturalists collecting part time). At their core, however, collection surveys had a similar mission to earlier survey based exploration. Rather than map out rail routes, mark borders, or determine physical geography, these surveys

[50] Leonard Warren, *Joseph Leidy: The Last Man Who Knew Everything* (New Haven: Yale University Press, 1998), Chapter 12.

sought to synthesize a comprehensive biogeography and relate this to evolutionary systematics, and have accurately been conceptualized as scientific instruments.[51] These collection surveys resulted in the collection of thousands of specimens being collected, flooding systematic institutions of natural history with data. The wealth of specimens collected played an active role in the taxonomic debates over variation within a species (see below), and as a result it took years in many cases to actually produce publications based on the survey in question. In some cases, the amount of data collected actually exceeded an institutions ability to synthesize and analyze the findings, such as the failure of the Biological Survey to produce two of the three expected reports on the Death Valley Expedition in 1891.

Surveys varied in size, though larger surveys such as the Death Valley Expedition were relatively uncommon.[52] It was generally recognized that smaller collection surveys were both more effective in the field and more cost efficient – an important component in the decision making of even the relatively well funded natural history museums in Chicago and New York. Smaller parties could also travel relatively light, with a naturalist, collector, and hired field or camp hands on horseback with another pack animal or two. Even the largest surveys, such as the aforementioned Death Valley Expedition, were broken up into smaller collection parties, for these reasons and also so that they could cover the maximum amount

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[51] Kohler, *All Creatures*, Chapter 4.

[52] Kohler, *All Creatures*, 139.

of territory in the most efficient way, rather than keeping the entire party in a relatively confined area.

Regions that had heretofore not been heavily collected were frequent targets of surveys, since there was little extant systematic material available from these localities to study. These relatively unknown regions were also used to test biogeographical or other theories of naturalists; the surveys of the Biological Survey to the San Francisco Mountain region and to Death Valley and the surrounding regions were key to the development and exploration of Merriam's ideas on life zones (see below), and the New York Botanical Garden's survey in Puerto Rico to examine tropical distribution of plants.[53] Since systematic surveys collected more intensively with improved methods in the field, they were useful tools not just to fill in empty regions on a hypothetical biogeographical map, but also to reevaluate regions that had been previously collected. Rather than just wanting to complete a comprehensive collection of "all creatures" as previous generations of naturalists would have, by the late nineteenth century naturalists used surveys to examine broad swaths of territory, systematically mapping transitions in animal and plant distribution in areas that were previously known and unknown, so as to synthesize a new, more complete systematic understanding of the natural world.

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[53] Sharon Kingsland, *The Evolution of American Ecology: 1890-2000* (Baltimore: Johns Hopkins University Press, 2005), 79-80; Darryl Brock, "Botanical Monroe Doctrine in Puerto Rico: Contours of American Imperial Scientific Expeditions and Research Stations,1898-1933," Paper presented at the annual meeting of the History of Science and Society, Montreal, Quebec, November 2010.

An intermediate collection strategy that contrasts with both the correspondence based model and the systematic survey may be referred to as the "Mandarin-Missionary" collection strategy, and was perfected by Spencer Fullerton Baird and his collectors. This strategy, which would also be used at the Museum of Vertebrate Zoology and other smaller institutions of natural history, was typified by institutional naturalists employing and training small numbers of collectors to act as scientific "missionaries" for the naturalist. The naturalist, as in the correspondence based model, remained the arbiter, or "mandarin" of natural knowledge. The goal of these "missionaries" was to target interested locals while collecting, encouraging them to collect specimens for the naturalist as well, leading to the flow of specimens into scientific institutions not just by their initial collectors, but also by their "converts" to the cause of natural history. Potential "converts" where those that already had an interest in natural history, whether through conceptions of natural theology, transcendentalism, or were just curious about the subject; in short, those that would be interested in further correspondence and collection efforts with naturalists.

This collection model depended upon enthusiastic collectors that could also act as mentors, helping potential "converts" learn how to collect and prepare specimens in a scientific manner, meaning the missionary had to be trained at a high level in addition to being extremely passionate about natural history. Baird's collectors were trained via correspondence and in person not only how to collect and prepare specimens, but also to look for answers with regard to contemporary understandings of biogeography. Better training made for better, more observant collectors whom served as the eyes of naturalists in the field, and made Baird's collector's outstanding missionaries to other enthusiasts. Baird also encouraged and helped his well trained collectors to publish their findings, a marked difference than Louis Agassiz at the Museum of Comparative Zoology, and a key reason in why two of Agassiz's students, William Stimpson and William Healy Dall, left Agassiz to become collectors for Baird. The opportunity to publish, and Baird's encouraging and open management style, further motivated his best collectors, and due to their analysis of the specimens they collected in order to publish, they in turn became better collectors. Robert Kennicott, whose career as a collector will be examined in the next chapter, was perhaps the best example of a scientific missionary for Baird, though many of his other collectors, especially J.G. Cooper, Elliott Coues, and Henry W. Elliot, were also excellent missionaries. The experience gained from this arrangement would also lead many former missionaries, such as Cooper and Coues, to become accomplished naturalists in their own right.

It should be noted that all of these collection models, not just the correspondence model of collection, relied heavily on correspondence between the collector and the naturalist. Collectors were instructed to write in with observations and inferences that would assist the naturalist in their studies. Collectors also naturally asked questions about the organisms which they collected, relied on constant feedback from naturalists in order to become better collectors, both in the preparation of specimens, but in getting instructions to look for organism “X” in environment “Y”. In addition, “Missionaries” used correspondence to suggest the naturalist start corresponding with potential converts. Correspondence on larger systematic surveys later in the century was still extremely important, as systematic naturalists could not always be in the field with their collection parties. Detailed feedback, especially from biological literature, was sent to collectors, so that they were able to incorporate this knowledge into their notes, their field reports (which would make it easier to synthesize definitive reports for press at a later date), and their field practice. Survey chiefs continuously bombarded their collectors with reminders to collect systematic series, and to make sure to include a detailed locality where specimens were collected. Even for experienced survey hands such as Vernon Bailey and E.W. Nelson, this communication and feedback was essential for increased efficiency in the field.[54]

Logistics

The development of the American rail network had as large of an impact on collecting in the late nineteenth century as had the extension and expansion of the postal network some twenty to forty years earlier. The collection of specimens, on some level, is about access. Localities had to be accessible and logistically sustainable in order to be utilized as a center of collection. The expansion of the rail industry in the late nineteenth century made many previously

[54] Robert Kohler, *All Creatures*, 156-157

unattainable or logistically prohibitive regions throughout the United States easier to get to, shortening times in the field, as well as lessening logistical concerns.[55] Survey expeditions relied on rail networks with regard to personal and logistical transportation and communication. For instance, consider the rapid and frantic collection of paleontological specimens during the "Bone Wars." Most of these specimens were collected from fossil beds that were within a few days journey from either a rail line or Fort Bridger, the main outpost in Wyoming territory. While they were certainly rich with fossil material, there are other areas in America's mountain west that held rich fossil beds, the difference is that the Wyoming beds were both known and accessible.[56] Many railroads also allowed survey workers to apply for half priced fares, which lessened financial costs on institutions, and made larger parties financially possible.

Food and sundries were a necessary concern when in the field, and not surprisingly much of the logistical planning for any expedition, whether large scale or individual, revolved around food and water. While the three meal a day paradigm that the rest of society practiced was the goal, collecting time in the field often necessitated an abnormal victual schedule. While there was usually time for a morning meal and an evening meal, anything beyond that was usually at the mercy of time spent collecting. In many cases food was secured in the field via hunting and fishing, though some prey was seen as favorable to others.

[55] Ibid, 162-165.

[56] Thomson, *The Legacy of the Mastodon*, 171-173.

Collector Robert Kennicott noted that American hare was "palatable" when "boiled with pork; when cooked alone, however, the flesh is very dry and flavorless."[57] Edible eggs that were not needed as specimens often ended up as breakfast. Case in point, when Kennicott was in Hudson Bay Territory, his native cooks fried grouse eggs to go along with *galette*, a quick bread similar to johnnycake:

> "This galette is the only form of bread when on a voyage, that is when voyageurs [that is, native porters] are so fortunate to have any flour at all. It is made in very simple style – the flour bag is opened, and a small hollow is made in the flour, into which a little water is added; and the dough is thus mixed in the bag; nothing is added except perhaps some dirt from the cook's *unwashed* hands with which he kneads into flat cakes, which are baked before the fire in a frying pan or cooked in grease. To pampered dyspeptics a breakfast of galette and salt port might not seem very inviting; but let them try it on a northern voyage, after traveling five hours in the morning without eating and they will find it otherwise."[58]

Even eggs that had been incubated (i.e. with embryo) were sometimes consumed, which Kennicott found "more palatable than [a] older goose."[59]

In many cases, collectors in the field were able to find lodging and meals as guests, especially with ranchers or like-minded nature enthusiasts. When in Mexico, Edward W. Nelson and Edward A.

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[57] Robert Kennicott Journal (henceforth RKJ), May 22, 1859 in James Alton James (ed.) *The First Scientific Exploration of Russian America and the Purchase of Alaska* (Evanston: Northwestern University Press, 1942), 53

[58] RKJ, May 26, 1859, in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 57

[59] RKJ, June 5, 1859 in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 67.

Goldman utilized Mexico's social structure to their advantage, spending many nights as guests at local haciendas, and Robert Kennicott spent the majority of his time in British America as a guest of the officers of the Hudson's Bay Company. When near towns, collectors and collecting parties often took advantage of local hotels or boarding houses, though this could rapidly get expensive depending upon the time in town or the size of the party. Frank Stephens eschewed local conveniences for camping, though still occasionally accepted offers from ranchers when they offered shelter for the night. More often than not, however, when collectors were in the field away from their home, camping was the order of the day.

The Impact of Evolutionary Theory and a Revolution in Systematics

The transmission of Darwin's theory of evolution had a profound effect on American natural history, and within ten years most American naturalists outside of Louis Agassiz had begun to utilize evolution within their own systematic work. That evolution had such a quick impact on American natural history may be due to America's rather small community of naturalists and, more importantly, that the sheer amount of new data that had been sent to eastern scientific centers from the rail and border surveys in the preceding years gave American naturalists a unique ability to examine and describe the biota of across an incredibly geographically diverse continent. This experience with the diversity of North American species and the comparison with species from other areas resulted in a handful of naturalists such as Joseph Leidy, Asa Gray, and Spencer Baird, whom immediately embraced Darwin's theory because it provided an explanation for their observations. Leidy, who had espoused an elementary view of transmutation in prior to Darwin's work, wrote to Darwin immediately after reading the Origin thanking him for "putting the night into day."[60] Gray was Darwin's American confidant and actively defended Darwin against the attacks of Agassiz and others, while deftly using Darwin's theory as justification of his own theory on the geographic distribution of plants. Baird never publically supported nor condemned Darwin, but his subsequent work on birds and fish were in line with the Darwinian hypothesis, and his biographer William Healey Dall described Baird's reception of evolution as "friendly."[61] Given his prior emphasis on biogeography and the goal of a systematic synthesis of North American natural history, Baird was able to accept the theory and use it, without publically espousing it. His collection instructions did not change as a result of the transmission of evolutionary theory because his collectors were already instructed to look for variation and geographic distribution. Baird may have been an undercover evolutionist, but an evolutionist he was. Perhaps more importantly, his biogeographic studies laid the groundwork for young naturalists to utilize evolution in their work.

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[60] Leidy to Darwin, in Leonard Warren, *Joseph Leidy: The Last Many Who Knew Everything* (New Haven: Yale University Press, 1998), 177.

[61] William Healy Dall, "Memorial," in *The Annual Report of the Smithsonian Institution for the Year 1888,* (Washington: Government Printing Office, 1889), 736.

While most American naturalists accepted the main concept of evolution, since it gave an explanation for their observations and collections as America expanded westward, many were openly skeptical, if not hostile, toward pure Darwinian natural selection. Many, such as E.D. Cope, opposed Darwinian evolution on theological grounds – even as Asa Gray was defending it on those same grounds, others would have agreed with Herschel's contention that natural selection was a law of "higgledy-piggledy," but most felt it did not completely explain their particular observations of the natural world. Leidy, as we have seen, was ecstatic about the significance of Darwin's work, but his understanding of evolution remained based upon his own musings prior to the *Origin*. Many American naturalists, outside of Gray, Merriam,[62] and a few others, embraced an updated version of Lamarckian evolution, which stressed a progressive, upward interpretation of evolution. The fossil record could be used to validate this understanding of evolution, and the idea that evolution was somehow directed in a progressive manner more palatable to American society.

This emphasis with regard to evolution quickly became an area of emphasis for collectors as well. Leidy's collectors at Fort Bridger, Drs. Corson and Van Allen Carter, debated Darwin's theory and how it applied to their hobby

[62] Merriam's biographer, Kier Sterling, describes Merriam as a neo-Lamarckian based upon the use of subspecies as a category (see below), but Merriam's notes and personal writings clearly make him a Darwinian.

of collecting for the Philadelphia naturalist.[63] Baird's instructions for collectors became rather standardized and would be the basis of later collection instructions of C.H. Merriam, and Joseph Grinnell, amongst others. Likewise, the Bairdian emphasis on biogeography became standard with regard to collection in natural history. To be a valuable collector, one now had to be able to not only prepare specimens effectively, which itself was no mean feat, but also to recognize variation in organisms and to collect comparatively, understand or be able to relate how the effect of geography on species, and extrapolate knowledge to new situations. In short, collecting in the late nineteenth century became a much more labor and knowledge intensive process. Naturalists such as Gray, and to a lesser extent Baird, could afford to have specimens sent in by amateur collectors, classify them as they came in, and then attempt to train them over a period of time. By the late nineteenth century, interested amateurs could attach themselves to survey parties, as many well-to-do enthusiasts volunteered time on Merriam's San Francisco Peaks survey in 1890, or start out as a packer/camp hand, as Charles Camp did for Joseph Grinnell in 1909, but naturalists had less time to train collectors via correspondence.[64] A large part of this was due to increased administrative work – C.H. Merriam constantly complained in correspondence

[63] James Van Allen Carter to Joseph Leidy, August 3, 1871, Academy of Natural Sciences Archives, Collection 1-B.

[64] See C.H. Merriam, *North American Fauna No. 3: Results of a Biological Survey of the San Francisco Mountain Region and Desert of the Little Colorado*, (Washington: Government Printing Office, 1890) 1-5; Kohler, *All Creatures*, 139; Charles Camp to Joseph Grinnell, March 14, 1909; Charles Camp Correspondence, Museum of Vertebrate Zoology archives.

with regard to his bureaucratic workload at the Biological Survey – but it was also due to the changing demands within the field of natural history.

The incorporation of evolutionary theory – Darwinian or Neo-Lamarckian – into natural history had a drastic effect on the practice of systematics. The difference between taxonomy, the classification of organisms, and systematics, is that taxonomy is solely descriptive, whereas systematics encourages comparison across taxa.[65] Prior to an understanding of evolution, systematists sought to reconcile "new" (to Europeans) organisms with previously "known" forms, leading to an understanding that there were *de facto* natural groups of organisms.[66] This in turn led to a greater emphasis on both biogeography, the study of the geographical distribution of organisms as well as the conceptualization that animals that were closely related to one another shared the same "design" or "plan." Evolution gave a new theoretical explanation for the diversity of life, and built upon the comparative nature of existing biogeography; indeed, biogeography helped explain evolution, and vice versa. This led to the synthesis of a new evolutionary systematics, in which the differences between similar groups of organisms were explained with regards to potential evolutionary history, and adaptations were associated with the environment to enhance survival.

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[65] Ernst Mayr, *Principles of Systematic Zoology* , 2-4.

[66] Ibid, 58-60.

With the development of evolutionary systematics, naturalists ideally needed large collections from numerous localities in order to assess intra- and extra-specific variation and how these related to the organisms environment. If collectors were not able to collect in a way that would complement this shift of emphasis, or could not be brought up to speed quickly, they lost their role within the research plans of larger institutions of natural history, though they were still able to contribute on a more local level with regard to regional scientific societies. Collectors did not have to be expert systematists, of course, but they had to be able at least understand the importance of biogeography and systematics so that they could submit useful collections to naturalists for study. Localized collectors were also increasingly asked to collect topotypes, specimens collected from the same locality as the original type specimen. Topotypes, which were first used in the last decade of the nineteenth century,[67] were prized so that naturalists could compare their series of specimens from different localities with a specimen or series of specimens from where the "original" described specimen was previously collected. Collectors were also asked to join systematic collection surveys of regions with which they were familiar. Frank Stephens, one of Merriam's most trusted collectors, was asked to join Merriam's massive Death Valley Expedition in 1891, and was instrumental in Joseph Grinnell's survey of the lower Colorado River in 1910.

[67] "Topotype" *Oxford English Dictionary Online*, retrieved February 10, 2011 from http://www.oed.com.ezproxy1.lib.asu.edu/browsedictionary?scope=SENSE&subjectClass=Taxonomy

The practice of collecting large series of specimens was reinforced by the development and acceptance of evolutionary theory, whether Darwinian or neo-Lamarckian. The size of a series varied, especially with regard to the size of an animal and the practicality of collecting an animal in large numbers. Questions regarding variation with regard to the geographic distribution of animals necessitated series from not just one locality, but multiple localities, so that the sum of the variation in one series could be compared with that of another. This comparative study both *between* and *within* species led to a debate inside systematics that was as influential as the comparative study of anatomical difference between species had been for morphology earlier in the century.

At the heart of the debate over classification was the question of how best to account for the variation within established species. However, the influx of specimens new to science in the late nineteenth century due to European and American imperial expansion led to thousands of new species being described. Larger institutional specimen collections that involved numerous specimens of the same species highlighted the variation within each species. Traditionally speaking, variation in certain species had led to the distinction of a subset of different varieties or forms, though these varieties had little formal taxonomic value. With the influx of specimens from across North America to the Smithsonian, Spencer F. Baird pioneered the use of a new level of classification, the subspecies.[68] At its inception, the subspecies was simply a byproduct of

[68] Robert E. Kohler, *All Creatures*, 253.

Baird's biogeographical work on the collections from the rail surveys of the 1850s. Baird and his staff noticed that there were key geographical bounds to certain species, and implemented the subspecies as a tool to delineate and formalize difference within a species. Ever the Baconian, Baird did not theorize on the nature of the subspecies, but rather preferred simply to record that major differences within a species did exist.

Since the subspecies was a *de facto* measure of variation within an overarching population, it is not surprising that this new classification level was incorporated into an evolutionary context almost immediately following the transmission of Darwin's theory. The connection was so straightforward that it Louis Agassiz, Baird's rival and a passionate anti-evolutionist, refused to recognize subspecies even as he had also noted variation due to geographic distribution, because he knew that they would support Darwin's ideas.[69] Based on the work of J.A. Allen and Elliott Coues on the distribution of birds, the American Ornithologists Union adopted the use of a trinomial system of nomenclature in 1884, cementing the importance of subspecies in a systematic context. Over the next thirty five years, the use of trinomials would spread throughout natural history in order to reevaluate the relationships between organisms that were recognized as members of the same species, but differed enough in appearance or geographical range to be declared subspecies. C. Hart Merriam, perhaps the most influential mammalogist at the turn of the century, viewed subspecies as

[69] Ibid, 257.

“variations tending towards but not reaching specific status until connection with other forms is broken down and isolation established.”[70] Joseph Grinnell applied David Starr Jordan’s work on geographic isolation, arguing for different subspecies of birds for different regions of California. Not all evolutionists agreed with Merriam’s understanding of subspecies or speciation, however. Darwin’s stress on variation led some naturalists to advocate for broader, more inclusive species, while others agreed that the observed variation required breaking organisms into more species and subspecies. To make matters more confusing, both of approaches could be reconciled to either a neo-Lamarckian or a Darwinian conceptualization of evolution.

At its core, the late nineteenth century debate over the utility of subspecies as a taxonomic category and the use of trinomialism, was an extension of an older debate with taxonomy about “lumping” or splitting” that went back to the beginning of Linnaeus.[71] “Lumpers” tended to group organisms in fewer taxonomic categories, while “splitters” tended to break split organisms into more taxonomic categories, especially with regard to variation. While the increase of data available to nineteenth century naturalists led to a corresponding increase in the number of species described, it also led to naturalists such as Merriam splitting established species splitting at the slightest amount of variation; in 1918 for example, he posited that there were eighty-six species and subspecies of

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[70] C.H. Merriam in Kier Sterling, *Last of the Naturalists*, 183.

[71] Ernst Mayr, *The Growth of Biological Thought: Diversity, Evolution, and Inheritance*, (Cambridge: Belknap Press, 1982), 240.

brown and grizzly bears in the western United States![72] Merriam's biographer has argued that Merriam and other splitters were attempting to save the Linnaean concept of fixed species, while somewhat contradictorily using subspecies to attempt to show evolution in action.[73] Whatever the motivation, this extreme form of splitting, and the use of trinomials to examine speciation, fell by the wayside by the late 1920s, and systematists were forced to reassess the work of the period, one of numerous taxonomic reorderings in the twentieth century. Subspecies are still used as a taxonomic category, but since the evolutionary synthesis of the mid twentieth century, systematists have developed more stringent guidelines about how subspecies are recognized and described.[74]

The change in emphasis in natural history in the late nineteenth and early twentieth centuries did not just affect larger, systematic institutions of natural history, but also smaller, more localized institutions and societies. The Wagner Free Institute of Science in Philadelphia was a case in point. Originally opened by William Wagner, a dedicated amateur conchologist, to provide free science education for interested Philadelphians, the Institute included a museum dedicated to natural history and lecture classes on a variety of scientific subjects, from

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[72] Sterling, *Last of the Naturalists*, 184.

[73] Ibid, 189.

[74] Ernst Mayr, *Animal Species and Evolution* (Cambridge: Harvard University Press, 1963), 348. Modern evolutionary systematics, utilizing cladistics, phylogenetics, and DNA sequencing, has further revolutionized classification, but this is outside the scope of this study.

astronomy to geology.[75] Both the museum and the lectures initially were vested in natural theology, stressing God's role and presence in the natural world. Interestingly, one of the initial geology textbooks used at the Wagner was Charles Darwin's seminal works on geology written after his *Beagle* voyage, but this disappeared from the syllabi after the *Origin* was published. No records remain which discuss why this decision was made, since the courses were still steeped in natural theology in 1870, it is quite possible that Darwin's work was proscribed as dangerous.[76] After Wagner died, the trustees of the Institution quickly hired Joseph Leidy away from the Academy of Natural Sciences to run educational and research programs. Leidy brought a vision that even smaller natural history museums should stress systematics in display and expeditions in research. He was aided by Angelo Heilprin, who also came to the Wagner from the Academy, and together they reworked the collections to stress evolutionary history, rather than natural aesthetic. Heilprin, who was in charge of the retrofit, had to pull many of the marine invertebrates off display so as to implement a more comprehensive collection for display that showed all branches of the animal

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[75] Wagner Free Institute of Science, "Education" retrieved from http://www.wagnerfreeinstitute.org/education.shtml, February 11, 2011; conchologist was the contemporary term for someone who studied marine mollusks.

[76] "Announcement for the Wagner Free Institute of Science," 1855, 1856, 1858, 1870, Wagner Free Institute of Science Library, Item number 90-006 folders 1-4. The textbooks written by Darwin on the geology reading lists included *Coral Reefs*, *Volcanic Islands,* and *The Geology of South America*. There are no extant announcements for the 1860s, which would allow a researcher to see exactly when Darwin was dropped.

kingdom.[77] The two naturalists implemented a survey expedition of one of the last unexplored regions on the Atlantic Coast, southern Florida, and started a scholarly *Transactions of the Wagner Free Institute of Science*, to publish their findings.[78] However, this emphasis on field research declined markedly after personality conflicts led Heilprin to leave in 1890 and the death of Leidy the following year.[79]

Field Notes and Professionalization

The gradual change within the field of natural history to a more systematic science is perhaps most clearly demonstrated in the development of modern field notes in the second half of the nineteenth century. At midcentury, it was commonplace for collectors to collect their thoughts and record their travels and collections in journals, especially when they collected in areas that were new to them. These journals were rather informal affairs, akin to personal journals or diaries. An example of this type of reflection is recorded in Robert Kennicott's journal from his time in British America, parts of which were later published in the *Transactions of the Chicago Academy of Science*. In his journal, Kennicott discusses the Canadian environment, the relationship between the personnel of the

[77] Angelo Heilprin to Joseph Leidy, May 5, 1886, The Academy of Natural Sciences Archives, collection 1-B.

[78] Warren, *Joseph Leidy*, 216.

[79] At the heart of the conflict with Heilprin was his desire to get back in the field; he agreed to undertake a survey of Mexico for the Academy of Natural Sciences, by accepting the position he alienated the trustees of the Wagner, even as he was still a faculty member at the Academy. His departure was probably *fait accompli*, as the Wagner had limited abilities to fund research expeditions.

Hudson's Bay Company and indigenous peoples, as well as reflections upon natural history and the collection of specimens. This type of journal was supplanted, but not completely replaced, by more professional field notes by C.H. Merriam and his disciples in the late nineteenth century. Robert E. Kohler has claimed that this shift in emphasis led to the field notebook being conceptualized as an "exact instrument," an essential tool in systematic natural history.[80]

Merriam's staff and collectors at the Biological Survey were urged to take notes in small notepads, so that they could be sent in at regular intervals, and to deemphasize travel narrative and focus on biological and geographical observations. However, there was still a wide variety of notes sent into the Survey headquarters in Washington: Vernon Bailey's were little more than specimen lists from localities, Edward W. Nelson's were in narrative, describing native cultures and physical environment, and Edward A. Goldman's were typified by a short narrative and then description of specimens at a particular location.[81] The collectors and staff of the survey were given collection criteria updated from earlier Smithsonian collection instructions as well as checklists that instructed field workers to collect data on crop and vegetation zones, to relate the animals and plants they observed and collected to altitude and temperature; in short, to collect data that helped Merriam formulate and refine his conception of

[80] Kohler, *All Creatures*, 153.

[81] For Bailey's notes, see Vernon Bailey Papers, SIA RU 7267; for those of Nelson and Goldman's notes, see Edward W. Nelson and Edward A. Goldman Papers, SIA RU 7364.

Life Zones.[82] In addition to recording observations in their field notes, Survey members were required to send in detailed field reports on the biota and physical geography of each locality in which they collected. These reports, which were mailed off whenever convenient, gave Merriam and other staff members in Washington up to date information on their collection teams, which were fanned out from the Canadian arctic to Central America. In their totality, these reports gave detailed information from locality to locality that allowed survey staff to piece together geographic ranges for numerous organisms, relate intraspecies variation to geography, and attempt to understand how evolutionary processes work.

Notebook practices were improved upon by Joseph Grinnell's work at the Museum of Vertebrate Zoology in early twentieth century. Rather than bound notepads and notebooks, Grinnell asked his staff and collectors to use loose leaf paper, which could be mailed in on a more frequent basis, especially when collectors began new localities.[83] He encouraged his collectors and staff to include detailed observations of the environment and of wildlife; while collection of specimens was important, detailed observations of animal and plant species are what set the work of Grinnell's protégés apart from those of Merriam, and would prove to be the model for modern field notes. In format, these field notes were similar to the detailed field reports sent in by Biological Survey staff, streamlining

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[82] Kohler, *All Creatures*, 153.

[83] Kohler, *All Creatures*, 151.

the process of synthesizing data from the field. Even so, the earlier format of field journals as personal narratives was not completely phased out until after the First World War; Edmund Heller, a classmate of Grinnell's at Stanford was still using a narrative form during his forays to Africa with Theodore Roosevelt and Raimsey, though he was able to coauthor a book with Roosevelt on the geographic distribution of big fame animals on the African savanna. With less paperwork to filter through, and a smaller staff, Grinnell's team at the MVZ was able to synthesize publications on virtually all of its surveys – something the larger, more unwieldy Biological Survey could not claim.

Since field notes and reports were extremely important to the work of systematic naturalists, they had a vested interest in training their collectors in compiling notes in a way in which they could readily be used in systematic work and publications. It was impossible, even for Grinnell, to standardize the note taking skills of his collectors, as a casual examination of the notes of Stephens to Rollo Beck to Grinnell protégée Tracy Storer will demonstrate. Since field notes were, however, an integral part of the training of collectors, it is possible to assess their growth as collectors and their application of the instructions given to them by examining how their notes change with more experience and more instruction by naturalists. Even the free-flowing notes of Stephens became more formal after collecting for Grinnell, not an easy task for someone that had collected in the field for over twenty five years before beginning his collaboration with the young naturalist. Perhaps the best example of the gradual change in note taking style over time is that of Edward A Goldman, a young collector that worked with Edward W. Nelson in Mexico for the Biological Survey. The notes of Goldman, a complete amateur with regard to collecting when hired by Nelson at the age of 18, illustrate the transformation of the young man from enthusiast to seasoned field naturalist as he progressed from rough, undetailed, notes to detailed notebooks that combined personal narrative with specific details about the species and specimens he collected.

Cultural Impact of Natural History

Feeding the expansion of natural history was the increasing fashionability of natural history. American expansion in the nineteenth century did not just lead to naturalists asking new questions about the natural world, but also interested amateurs turning to nature for a hobby. This is demonstrated in the sheer number of local scientific societies, many of which were dedicated solely to natural history, as the United States spread westward. The first scientific society on the west coast, the California Academy of Sciences, was founded less than three years after statehood; within twenty-two years, scientific societies had been founded in San Diego and Seattle, neither of which were large population centers at the time. Part of the allure of natural history was due to common understandings of natural theology and transcendentalism, which stressed the beauty of nature and its meaning within a theological or spiritual construct. These religious trends gave landscape and nature had the power to inspire, rather to intimidate. The work of John James Audubon and John Torrey was likewise influential, especially amongst the upper classes.[84] While Robert Kohler has overvalued contemporary conceptions of leisure and its relative societal unacceptability until the late nineteenth century, changing mores amongst the American bourgeoisie also played a role.[85] What has been undervalued with regards to an explosion of interest in the natural world in the American context is the importation of ideals, interests, and mores from Victorian Britain. Just as early Victorian Britain was fascinated by fossils in the 1840s and 1850s, Americans became entranced by fossils in the 1860s and 1870s as the Western interior yielded the most extensive fossil beds yet found. Paleontology, and the rest of the aspects of natural history, had become fashionable not just for physicians or enthusiasts to do in their spare time, but for members of the emergent middle class. The discovery of ancient megafauna, the social applications of evolutionary theory, and wonder of the exotic captured the imagination of *fin de siècle* American society, leading to expansion of natural history societies, the founding of larger, better funded natural history museums in New York and Chicago, and the founding of modern zoological parks.[86]

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[84] Pauly, *Biologists and the Promise of American Life*, 17-25.

[85] See Kohler, *All Creatures*, Chapter 2.

[86] Please see Elizabeth Hanson, Animal *Attractions: Nature on Display in American Zoos* (Princeton: Princeton University Press, 2004); R.J. Hoage and William A. Deiss (eds). *New Worlds, New Animals: From Menagerie to Zoological Park in Nineteenth Century*. (Baltimore: Johns Hopkins University Press, 1996); and Pauly, *Biologists and the Promise of American Life.*

This cultural interest in natural history was closely related to the progressive, "whiggish" ideology that typified late nineteenth century American society, which resulted from a fusion of American exceptionalism, the rapid industrialization of the United States, and the closing of the American frontier. This was aided and abetted by the way in which evolutionary theory took root in the United States; as in other national contexts, this was due to the particular cultural and societal factors. This progressive conception of evolution seemed to have its proof in the fossil record, with more complex organisms succeeding less complex organisms, and fit perfectly within the progressive American narrative at in the late nineteenth century. Lamarckian ideas, albeit with a Darwinian conception of "fitness," became extremely influential within a social setting, and were used to describe the rise of America as a world power, the supposed inferiority of racial and cultural others, and the success of America's industrial elite.

The explosion of cultural interest in natural history was also fueled by the increasing number of natural history museums across the country.[87] Larger museums, such as the Field Museum, the National Museum, and the American Museum of Natural history were profoundly influential in the practice of natural history, but even smaller, regional museums played an active role in educating interested patrons in contemporary natural history. The primary patrons of these museums were from America's emerging middle classes, and would later become

[87] Oliver Cummings Farrington, "The Rise of Natural History Museums," *Science* 42 (1915): 197-208.

an important target of day trips from public schools.[88] Most natural history museums in Europe and America prior to the discovery of evolutionary theory ranked display specimens from less complex to more complex in an extrapolation of the medieval great chain of being. Displays often focused on natural theological concepts, such as "perfect" adaptation to environment and aesthetic appeal.[89] As the focus of natural history changed, so too did the display of specimens. One of the founding principles of the Field Museum in Chicago, for example, was to educate patrons on evolutionary mechanisms.[90] Smaller repositories, such as Wagner Free Institute of Science also embraced this change, though this was largely due to the Institute's hiring of Joseph Leidy and Angelo Heilprin from the Academy of Natural Science in 1885. Leidy and Heilprin remade the Institute's museum from one that focused on natural theology to one that that showcased contemporary evolutionary systematics, using the National Museum as their guide. Tellingly, a human skeleton was on display with those of a gorilla, chimpanzee, and a Gibbon, in a tribute to the frontispiece to T.H. Huxley's *Evidence as to Man's Place in Nature*, the first book by a naturalist that explicitly examined human evolution. However, in displaying evolution most

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[88] Sally Gregory Kohlstedt, "Thoughts in Things: Modernity, History, and North America Museums," *Isis* 96, (2005): 597.

[89] A prime example is the Wagner Free Institute of Science prior to Joseph Leidy and Angelo Heilprin's modernization in the 1880s.

[90] Stephen T. Asma, *Stuffed Animals and Pickled Heads: The Culture and Evolution of Natural History Museums* (Oxford: Oxford University Press, 2001), Chapter 1.

museums did not overtly stress the action of natural selection as the main mechanism by which evolution worked, and many retained their "great chain of being" type of layout. This reinforced the implicit cultural understanding of evolution as an inherently progressive action.

Cultural norms had a reciprocal effect on museums, especially on how specimens were to be displayed. Into the twentieth century, it was common to display "natural" familial groups in dioramas and other exhibits that mirrored the American ideal of the nuclear family, even in the most "unnatural" of examples. The giant panda and African lion displays at the Academy of Sciences in Philadelphia are cases in point. The lion exhibit shows a noble elderly lion reclining on a rock, attended to by a few females and two younger males, while the panda exhibit displays a perfect family of a mother panda, a father panda, and a baby panda. These exhibits may still seem natural to Americans today, even though they were designed in the 1920s, but are merely cultural abstractions as they represent something that would never exist in the wild. The two younger male lions, assuming they were mature, would be fighting the elder lion and each other for dominance of the pride, while pandas are solitary in nature, coming together only to mate. The way in which animals are displayed varies from museum to museum, and forced "naturalness" of the familial unit is not as prevalent in the American or National Museums of Natural History, but rarely was (or is) the natural world portrayed as "red in tooth and claw."[91] The

[91] Asma, *Stuffed Animals and Pickled Heads*, Chapter 5.

importance of popularizing natural history and providing valuable teachable moments on certain aspects of an organism's life history were and are worthy goals, but have often been mitigated by cultural norms regarding a "proper" middle class or family friendly atmosphere. Thus, while not completely scientifically accurate, museums served to feed a cultural appetite for natural history, and served as an inspiration for numerous enthusiasts to get into the field of systematic biology.

The increase in societal awareness and interest in science can also clearly be seen with regard to print culture, both academic and for general readers. In the early nineteenth century, there was one small periodical that focused on science, Benjamin Silliman's *The American Journal of Science and the Arts*, but the *Journal* was known as much for its author as it was its content, and was initially published only quarterly.[92] The mid to late nineteenth century, in contrast, saw an explosion in scientific publishing, with new journals such as *Science* and *The American Naturalist* eventually supplanting the older "Silliman's Journal." Publishing was as an important (though costly) responsibility of scientific societies, and members published many their findings in their respective societies *Transactions*. For newer societies, or for those that wanted to increase their profile, such as the Wagner Free Institute of Science and the San Diego Society of

[92] Virtually everybody in the American scientific community referred to the American Journal of Science and the Arts as "Silliman's Journal". See Robert V Bruce, *The Launching of American Science: 1846-1876* (New York: Alfred A. Knopf Inc, 1987), chapters 1 and 5

Natural History, a scholarly publishing program seen as a critical step. In the public realm, science was aided by the lurid "Bone Wars" playing out in the press, as well as Gray's and Agassiz's very public debate over evolution, publishing their scientific basis for and against it in *The Atlantic* and *Harper's*, respectively. *Scientific American* started publishing as a four page magazine in 1845, becoming the main popular science magazine of the nineteenth century, though its focus was more on physical science and technology. *Forest and Stream* (1873) and *Field and Stream* (1895) focused on outdoor activities such as hunting and fishing, and often examined natural history from an amateur's perspective. Of the two, *Forest and Stream* focused more on topics of interest to an amateur naturalist due to the editor, George Bird Grinnell, who was a former student of O.C. Marsh, and occasional articles from renowned nature enthusiast, Theodore Roosevelt.[93] Amateur enthusiasts also had a niche within certain specialist journals, such as *The Condor*, a journal for ornithological enthusiasts published by the Cooper Ornithological Club. As will be seen in Chapter 3, the reader lists of such journals were often used by naturalists to help hire enthusiasts to collect for them.

Assessing Merriam's Impact

As important as Baird was to the formulation of a new, systematic, natural history based upon biogeography, one of his protégés, C. Hart Merriam formulated one of the most important theoretical models in systematic natural history, the life zone. Merriam's Life Zones were a product of Humboldtean

[93] "The Press: Forest, Field, and Stream." *Time*, June 16, 1930 retrieved February 16, 2011 http://www.time.com/time/magazine/article/0,9171,739586,00.html

ideas that had revolutionized biogeography in the early nineteenth century. Merriam reflected later in life that he was fascinated by Humboldt's accounts of his travels in South America with regard to geographic distribution of plants and Humboldt's "discovery of fundamental facts and laws governing the power of temperature in restricting the spread of animals and plants."[94] He was further influenced by the biogeographical work of Agassiz and ornithologist J. A. Allen, as well as the midcentury conceptions of "faunal zones."[95] His work on the Hayden Yellowstone Survey, where he collected for Baird at the age of 16, was perhaps the most important factor, however. Out west, Merriam was "acutely aware" of the differences between the fauna he was used to in New York, and that which he experienced on the Survey, and the role that differences that altitude and temperature played with regard to the organism he observed.[96]

When he was appointed to head the Division of Economic Ornithology and Mammalogy in the Department of Agriculture (later the Bureau of the Biological Survey) in 1885, he almost immediately devised temperature tables on which workers could record collection stations, altitude, and temperature, which were then used to outline isotherms. Faunal and floral patterns were then compared with the isotherms to determine preliminary life zones. Armed with

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[94] C.H. Merriam "History of the Development of my Life Zone Work in America" (unfinished mss, C.H. Merriam Papers Volume II, Bancroft Library, University of California, reel 103), 1927, 1.

[95] Ibid, 3.

[96] Ibid, 5.

this as a hypothesis, Merriam tested out his life zone idea on successive surveys of the American west, starting with the San Francisco mountain region of northern Arizona. His results confirmed his hypothesis, and in the report of the expedition, he outlined seven life zones in the United States, using temperature as the delineating factor and the biogeography of plants as a practical extension, and most visible result of life zones. While this may have (and did) grate at contemporary botanists, this dependence upon plants was due to two factors: that Merriam was heavily influenced by Humboldt's work on biogeography, and the need to fundamentally describe many, if not most, of his findings in economic natural history terms, that is in terms that could be utilized by farmers, ranchers, and policy makers, given the mandate of the department. Merriam's life zone theory would become a key biogeographical tool for the division, which was later renamed the Biological Survey to reflect Merriam's goals regarding systematic natural history.

Merriam's overarching goal in natural history was to "[train] up a small school of 'systematic naturalists;'"[97] and he used the Survey in an attempt to do so. He surrounded himself at the Survey with his closest confidants, such as A.K. Fisher and T.S. Palmer, and his most skilled former collectors Vernon Bailey and E.W. Nelson. The goal for his cadre was to be able to apply the lessons of systematic natural history not with regard to one branch of life, i.e. mammals, but to all aspects of animal and plant life. While he failed in his attempt to recreate

[97] C.H. Merriam to T.S. Palmer, March 13, 1889, C.H. Merriam Papers Volume II, Banc Film 1958 reel 1, Bancroft Library, University of California, Berkeley.

the generalist naturalist such as Leidy or Baird, as well as his attempt to encourage the instruction of natural history at colleges and universities, it was this emphasis on the totality of life helped pave the way for conservation biology and ecology as disciplines of biology.

The lasting legacy of the Merriam's division is complex. The Biological Survey was enacted in the first of its various forms at a very specific point in time with regard to natural history, as systematic natural history was on the rise, and traditional descriptive natural history was waning. As a government agency, the Survey helped promote the practice of systematic natural history that would come to dominate field biology throughout the twentieth century. However, much of the truly systematic work that *could* have been done was lost due to the various goals of the department – practicing both economic and systematic natural history on a budget that could pass through Congress – as well as the nature of the leader himself. Merriam was a notorious micromanager who assumed much of the publishing responsibility for the Division, serving as editor and taking over projects that he felt mismanaged.[98] In addition to annoying staff members whose writing was impeccable, such as Nelson, this left him little time to complete anything. Further exacerbating the problem was Merriam's conceptualization of species and subspecies; as a classic splitter he was constantly after more data, from more localities, so that he could write the definitive work on a subject.[99]

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[98] Sterling, *Last of the Naturalists,* Chapter 4.

[99] Ibid, chapter 5.

Like Sisyphus, he was never able to reach his goal. The result was a dearth of publications on the most important surveys of the Survey: only two of the three reports on the Death Valley Expedition were published, the sum of Nelson and Goldman's work in Mexico was never definitely published, and countless other projects stagnated in Washington. The vast majority of Survey's work that was published was not systematic, but rather descriptive natural history, an extension of the early work of Gray, Leidy, Agassiz, and Baird.

The true lasting legacy of the Survey was not its many accomplishments – the numerous new species described, Merriam's ground breaking work on the surveys of the San Francisco Mountains and Mt. Shasta, specimens collected from Alaska to Guatemala – but with its influence on scientific practice. Merriam's large survey expeditions, such as the Death Valley Expedition, helped usher in a new "golden age" of natural history, a "golden age" of systematic expeditionary science. In the twentieth century, the number of large surveys exploded, and the region covered by these surveys expanded into Asia, Africa, and South America. However, the influence of the Survey was more than just promoting large surveys; after all, other institutions had also undertaken large surveys in the late nineteenth and early twentieth centuries. It influence was due to its very presence, that there an entire division of the government devoted to systematic natural history, with its quintessential progressive mission of better understanding the natural world for practical use. Further, Merriam pioneered countless techniques in the field, from the collection of specimens to field notes, developed the first theoretical models of applied systematic biogeography, and perhaps most importantly, had a strategic vision about the future of natural history. While the Survey's systematic work *en toto* is rather underwhelming, the overarching goal was for multiple treatises on systematic natural history, and this then became the goal within the field itself. Merriam's techniques, theoretical models, and strategic vision, coupled with the importation of the transect and utilization of ecological quadrants, would heavily influence the practice of field biology in the twentieth century.

A further part of Merriam's legacy was the career of Joseph Grinnell and the formation of the Museum of Vertebrate Zoology at the University of California. While Grinnell was not technically a student of Merriam, Grinnell's ideas on natural history and methodology were heavily influenced by Merriam's work. After numerous trips to Alaska, in which he collected specimens for a natural history museum in Sitka, Grinnell completed a master's degree at Stanford, became a professor of Zoology at his alma matter, Throop Polytechnic Institute (now the California Institute of Technology), and shortly thereafter was offered the head position at Annie Alexander's new Museum of Vertebrate Zoology at the University of California. The museum was unlike most other museums in that it focused solely on research, and not on the display of specimens. Grinnell turned the museum into a center for systematic natural history and applied his research not just to systematics, but also to the new field of conservation biology. Many of his students became his disciples of his methods, producing an extensive academic lineage that spanned Mammalogy, ornithology, and paleontology.[100] Merriam wholeheartedly endorsed the work of the MVZ, was an active correspondent of Grinnell, and praised Grinnell's focus on training naturalists, something that Merriam felt other universities had not done an effective job of.

The end of the Golden Age?

To place a definitive end date on the "golden age" is a complex problem, because even as Jordan lamented the passing of the age, systematic biological surveys had become increasingly common practice for institutional giants in natural history, as witnessed by the large number of surveys taken by the Field Museum, American Museum of Natural History, and to a lesser extent, the Academy of Sciences in the 1920s. Many of these surveys targeted Africa and Latin America, regions that were not scientific *terra incognita* by any stretch of the imagination, but had not been previously systematically surveyed by American scientists, and whose environments offered valuable insights into evolution. It could be argued, at least from the standpoint of systematic surveying expeditions, that the real "golden age" started after World War I. By this point in time, however, the field of study that traditionally had been referred to as natural

[100] Please see "Academic Tree for Joseph Grinnell and MVZ Faculty" Museum of Vertebrate Zoology, accessed February 16, 2011, http://mvz.berkeley.edu/Grinnell_Lineage.html and J. Knox Jones, Jr, " Genealogy of Twentieth Century Systematic Mammalogists in North America: The Descendants of Joseph Grinnell" in *Latin American Mammalogy: History, Biodiversity, and Conservation,* ed. Michael A. Mares and David Schmidly (Norman: University of Oklahoma Press, 1991).

history was gradually transforming into ecology and the typified by further specialization amongst its practitioners. There are also problems with regard to development of institutions; the museum movement did not die out, and intensified in western cities that sought to “catch up” with those in the east, so the slowing of the development of natural history museums is more a factor of new cities wanting what was fashionable than a dying interest or need. When, then, did the “golden age” end?

While impossible to point out a specific date for the reasons examined above, this particular study will assign the end date to approximately 1910. First, it is the year that Merriam retired from the Biological Survey, and while not of course the only systematic naturalist in America, his retirement did lead to a significant decrease in expeditions by the Biological Survey, and its systematic mission ended in the 1920s when it became the Fish and Wildlife Service. Secondly, specialization within the field led to the end of generalist naturalists such as Joseph Leidy and Spencer Baird, as well as those naturalists that looked at two branches of natural history, such as Merriam, and to a lesser extent Joseph Grinnell.

Case Studies

During the “golden age,” the collection of specimens, and by extension, the development of biological knowledge, was predicated on the collaboration between naturalists and collectors. The next three chapters will examine this relationship with successive case studies, examining the importance of Robert

Kennicott, Frank Stephens, Edward W. Nelson and E.A. Goldman. These collectors have been chosen for this study because their work is representative of collectors of the time, even if their results were not. Kennicott, who is examined in the next chapter, was fairly typical of the collectors that worked with naturalists in the middle of the nineteenth century, though his results were anything but typical. At the time of his death, he was Spencer Baird's most valuable collector, and his work with Baird paved the way for more systematic natural history in the later nineteenth century. Frank Stephens, who is examined in the third chapter, was a prototypical local expert, an amateur naturalist and collector extraordinaire that were in high demand from naturalists as collaborators in the late nineteenth century. Stephens was one of the last of the local experts to really make a mark in natural history, and his value was not just in his skill, but in the area, southern California, that he knew so well. The final case study will examine the career of Edward W. Nelson, his rise from collector to systematic naturalist, and his collaboration with Edward A. Goldman in Mexico, which is perhaps the best example of the small team survey strategy of Merriam's United States Biological Survey. Through these case studies, the changes in natural history discussed in this chapter can be examined in more depth, as can the importance of collaboration between naturalist and collector. Each of these case studies also illuminates the centrality of collectors to natural historical knowledge, even as many of them toiled in relative anonymity.

Chapter 2. Collection as Collaboration: Spencer Baird and Robert Kennicott

If the late nineteenth century can be considered the "golden age" of natural history, in the American context, one of the major reasons was the development of many young naturalists in person and via correspondence by Spencer F. Baird. In the mid-nineteenth century, numerous nature enthusiasts, most of whom did not have a background in academic biology, wrote Baird asking for guidance, offering to collect specimens for him, and giving valuable information regarding geographic distribution and variation of species. It was Baird's ability to foster relationships with trained and untrained collectors and naturalists that made him the most influential American naturalist of the nineteenth century, even more so than his more celebrated peers Louis Agassiz, Asa Gray, and Joseph Leidy.

As was discussed in Chapter 1, it was common for institutions of natural history and their corresponding naturalists to have developed extensive correspondence and collecting networks. These literally were the lifeblood of eastern naturalists, most of whom had limited institutional and/or personal resources or time to collect specimens. Baird was no exception, developing a sprawling correspondence and collection network that included members from Europe, Latin America, western Mexico, sub-arctic Canada, California, and Alaska. Many, though not all, of his correspondents collected specimens at some point in time for the Smithsonian, though their efforts varied widely in scope, from interested amateurs sending in curiosities to more dedicated collectors that sent in thousands of specimens. In 1860, a fairly representative year for his correspondence, Baird wrote over three thousand letters, more than eight a day.[1] He was actually admonished at one point by Secretary of the Smithsonian Joseph Henry for mixing personal correspondence with "official" Smithsonian correspondence.[2] However, for Baird, the distinction was moot: many of his early correspondents were considered personal friends, even as he corresponded with them on the basis of his position at the Smithsonian.[3] This speaks to the relationship that he had with his collectors, even those that he had not personally met. During his tenure at the Smithsonian, Baird developed relationships with hundreds of men and women and convinced them to collect specimens whether for the Smithsonian or other institutions of natural history. Indeed, one of his first actions upon arriving at the Smithsonian was to draw up guidelines for how to collect specimens for scientific study and display.[4] Those who were interested in researching natural history, such as J.S. Newberry, J.G. Cooper, F.V. Hayden, and

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[1] William Deiss, "Spencer F. Baird and his Collectors," *Journal for the Society of the Bibliography of Natural* History 9 (1980): 639; Pam Henson, personal correspondence.

[2] Ibid.

[3] This has led to two separate files at the Smithsonian Institution archives that overlap, in many cases with correspondents in both files. There was a gradual transition of keeping correspondence of collectors in the "official" file, though this may be due to the death of many of his early collectors such as Henry Bryant, C.B.R. Kennerly (a former student), Robert Kennicott, and William Stimpson.

[4] Deiss, "Spencer F. Baird and his Collectors," 638; a later version of these collection directions can be found in the Pacific Railroad Survey portion of Spencer Fullerton Baird Correspondence, Smithsonian Institution Archives (hereafter SIA) Record Unit (hereafter RU) 7002, Box 66, folder 7.

C.H. Merriam, amongst many others, actively sought his advice and help on how best to proceed in collection as well as what was needed to become a naturalist. It was through these efforts of encouraging would be collectors that Baird was able to create and maintain the most extensive specimen collection network in the United States.

Part of Baird's success in developing collectors was his rather democratic approach to scientific practice, as well as his facilitative leadership style. It should not be inferred from the use of the term "democratic" that Baird felt that everyone had an equal part to play in the formation of biological knowledge, nor that systematic naturalists were not the most important group in the formation of knowledge of the natural world. Contemporary naturalists looked at themselves as arbiters of scientific knowledge and practice, and Baird was not an exception. In some cases, such as with Louis Agassiz's first cadre of students at the Museum of Vertebrate Zoology, this approach backfired.[5] Asa Gray, a more meritocratic naturalist than Agassiz, nonetheless ran in to trouble in the late nineteenth century when Charles E. Bessey and other naturalists from the west objected to Gray's continued attempt to be the sole botanical voice of record in the United States.

[5] Agassiz, who immigrated to the United States from Switzerland in 1846, was notorious for not giving credit to his younger associates in his publishing, assuming, in the European style, that since it was his research facility, they were his results, and his alone. Unfortunately, this also led him to copy verbatim some of his subordinates work in his own work, which led to a falling out with many of his first students. See Mary Winsor, *Reading the Shape of Nature: Comparative Zoology at the Agassiz Museum* (Chicago: University of Chicago Press,1991), Chapter 2.

Gray's system was modeled on that of the Royal Botanic Gardens at Kew, England, under the direction of William, then Joseph Hooker; an imperial model that required collectors from across the United States to send all new and interesting botanical material to Gray, who would then identify and describe it. Not surprisingly, Bessey and other western botanists objected, and sought to make botany more democratic, and urged a different approach to classification.[6] Later in the nineteenth century, C.H. Merriam's micromanaging rubbed many at the United States Biological Survey the wrong way, and Merriam's insistence on publishing the vast majority of USBS material led to a chronic backlog of potential publications and the relative lack of published material from the USBS based upon the sheer amount of data they had collected.[7]

Baird's democratic ideals were demonstrated in his lifelong desire to open a comprehensive, national natural history museum to help educate the public based at the Smithsonian – something that went against Joseph Henry's plans for the Institution and furthered his rivalry with Louis Agassiz, who desired the museum in the Boston area so that he could oversee it.[8] He also was much more

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[6] For more on the debate within botany, please see Sharon Kingsland, *The Evolution of American Ecology, 1890-2000,(* Baltimore: Johns Hopkins University Press, 2005.) and Richard A. Overfield, *Science with Practice: Charles E. Bessey and the Maturing of American Botany* (Ames, IA: Iowa State University Press, 1993).

[7] See Kier Sterling, T*he Last of the Naturalists*, Chapter 4.

[8] Pamela Henson, "Spencer F. Baird's Vision for a National Museum," Smithsonian Institution, accessed March 23, 2011, http://siarchives.si.edu/history/exhibits/baird/bairdhm.htm.

democratic – or perhaps a better term is meritocratic – with regards to his relationships with his collectors than other eastern naturalists were. He warmly replied to letters from every potential collector, and actively urged his younger colleagues to publish their findings, allowing them to use the prestige of the Smithsonian's *Annual Reports* to attain credit for their findings.[9] Given Baird's numerous other responsibilities and research interests regarding the distribution of American fauna, especially birds, not to mention his massive correspondence, had he not been willing to cede publishing priority to his assistants and collectors, much of the work published by the Smithsonian would have never been completed. Baird nurtured young collectors, encouraging them to not only collect specimens, but also to pursue natural history as a profession in an era that American science in general, and natural history in particular, was in its infancy. He diligently recorded every collector's contributions in the Smithsonian's *Annual Reports*, and honored many collectors by naming new species after them.

An example of Baird's influence and rapport with collectors can be found in his relationship with C. Hart Merriam, a dedicated young collector who would later become the head of the United States Biological Survey and one of the most influential systematic biologists in the United States. Baird was introduced to Merriam, through his father, Congressman C.L. Merriam of New York. Baird

[9] Deiss, "Spencer F. Baird and his Collectors," 639. This occasionally led to minor controversy, such as when a bitter Louis Agassiz attacked Baird's inclusion of Charles Girard's work in *A Catalogue of North American Reptiles in the Museum of the Smithsonian* Institution; Girard had been a student of Agassiz, and had left Harvard because he felt that Agassiz did not adequately support his research. See Rivinus and Youssef, *Spencer Baird of the Smithsonian*, 100.

would be instrumental in getting Merriam started in natural history, helping Merriam attain a position on the Hayden Yellowstone Expedition in 1872 at the age of 17, and three years later arranged for Merriam to get a summer position in the United States Fish Commission, of which Baird was the head. In 1883, Merriam, who had been trained as a physician, gave up medicine to pursue natural history full time, and Baird helped the younger naturalist become the surgeon on the *Proteus*, a steamer that examined the seal fisheries in eastern Canada.[10] Merriam was delighted, collecting specimens throughout the journey, but his father was annoyed, sending Baird a note asking him "[p]lease don't ever again suggest Hart going to the ends of creation. We need him home"[11] The elder Merriam was no doubt annoyed that his son had given up his practice, but it proved to be a good choice – scarcely two years later, in 1885, Merriam had been appointed head of a new governmental institution of science, the Division of Economic Ornithology and Mammalogy in the Department of Agriculture.

While Agassiz may have legitimized American science in the eyes of Europeans and Americans alike, and Joseph Leidy a master at multiple aspects of natural history, Baird was the most influential American naturalist in the nineteenth century. The methodology used by contemporary naturalists was fairly Baconian, calling for the recording of locality, taxonomic identification, and occasionally the surrounding geography. Baird's methodology for collecting and

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[10] Sterling, *Last of the Naturalists*, 40

[11] C. L. Merriam to Baird, November 5, 1883, Spencer Fullerton Baird Correspondence, SIA RU 7002, Box 30, Folder 2.

identifying specimens was more extensively Baconian; the approach of Baird and his collectors was to record as many of what are now referred to as biotic and abiotic factors: physical geography, climate, food, behavior, surrounding species, identifying physical and physiological variations in organisms and relating variation to geographic distribution. When identifying organisms, Baird took the sum of the data into account, which contrasted with the deductive approach of Agassiz, and formed the basis for the "Bairdian School" of ornithology.[12] After attaining the data, Baird diligently compared species across wide geographic regions, in what can best be described as comparative biogeography. His extensive work on North American fauna and their surrounding environment helped pave the way for the study of evolutionary systematics in the United States, the study of biodiversity, extinct and extant, and the relationships between species through time.[13] While Leidy was in practice a Pre-Darwinian evolutionist who praised Darwin for his insight into transmutation,[14] and Gray was the staunch defender of natural selection in the United States,[15] it was Baird's work that led to

[12] Rivinus and Youssef, 186-187.

[13] Ernst Mayr. *Principles of Systematic Zoology*. New York: McGraw-Hill, 1969; 2, 60-62, 78-81.

[14] Leonard Warren, *Joseph Leidy: The Last Man Who Knew Everything*. New Haven: Yale University Press, 1998, 177.

[15] Asa Gray. "Natural Selection not Inconsistent with Natural Theology" in *Darwiniana: Essays and Reviews Pertaining to Darwinism*. Kessinger Reprint (1876/2004).

the explosion of American systematic natural history in the post-Darwinian era, even as Baird did not publicly defend evolution at any point in his career.

Baird's ultimate goal was to obtain the most representative collection of specimens from not just the United States, but of the Americas. There was more than a bit of rivalry here with European institutions, even if Baird rarely, if ever, discussed it with his most frequent correspondents. However, this desire to comprehensively examine "new world" biota fit perfectly within the world view of mid-nineteenth century American science, which chafed at its shortcomings when compared to older, more established establishments in France, Great Britain, and the German states. As such, there was a concerted effort by American naturalists, physical scientists, and scientific institutions to assert themselves as the scientific presence in the Americas, leading to the formation of early scientific societies, specimen collection efforts, and astronomical expeditions in the United States. Baird's goal, however, could only be realized with the help of all of his collectors in his extensive correspondence network, and he relied on naturalists in other areas of the country to refer eager young students in natural history to him. This was especially necessary in sparsely settled areas, where natural history was both accessible practically, but relatively inaccessible professionally and educationally. Baird's net was wider than those of other Eastern naturalists, since he was able to use his previous students and contemporaneous Army survey contacts. He also relied on collectors, whom he described occasionally as "missionaries" to "convert" other nature enthusiasts to the collecting cause. Baird's biographers aptly described him as a "collector of collectors."[16] Unfortunately, many of Baird early collectors met early ends related to their studies, and forced to continue to develop and inspire new collectors and young naturalists.

Even as he was able to inspire and collaborate with collectors throughout his tenure at the Smithsonian, Baird was closest with his earliest collectors. A number of these collectors spent at least part of their time at the Smithsonian, and became members of a community referred to as the "Megatherium Club," which included William Stimpson, Robert Kennicott, Henry Bryant, a young E.D. Cope, F.V. Hayden, as well as institutional staffers F.B. Meek and Theodore Gill.[17] In reality, the "club" was an association of young collectors and naturalists that roomed at the Smithsonian Castle and used the facilities there to complete their studies on specimens collected on collecting expeditions, which had been supported by the Smithsonian through Baird. These were a vibrant bunch, whose antics annoyed Professor Henry to no end: they were loud, rowdy, and had the habit of working and playing well into the night, which left the budget conscious

[16] E.F. Rivinus and E.M. Youssef, Chapter 8.

[17] The "membership" of the society was fairly fluid, and not all sources agree on who was part of the club and who was not. Other members may have included J.G. Cooper, Elliot Coues, C.B.R. Kennerly, John H. Clark, J.S. Newberry, and W.H. Dall. Coues and Dall would have been in a later permutation of the "club," with Newberry, Cooper, and Kennerly in an earlier version. The nebulosity of the club makes it difficult to pin down "membership" with accuracy. Please see E.F. Rivinus and E.M. Youssef, chapter 8, and Herman J. Viola, *Exploring the West*. Washington D.C.: Smithsonian Institution Press, 1987, 146-151.

Henry worried about the overuse of gas lights.[18] It is quite possible that Baird saw himself in the members of the Megatheria; to a man they were fairly carefree, dedicated to natural science to the core, and able to collect anywhere they were asked. Baird, tied up with institutional responsibilities and an occasionally infirm wife, simply did not have the freedom to tackle field collection and its exciting possibilities that his young protégées did. They became extensions of himself, acting as scientific "missionaries:" espousing his methodology in the field and in the lab, making connections with other nature enthusiasts and "converting" them to the cause, and spreading out across North America, expanding the collections of the Smithsonian so greatly that Henry begrudgingly backed Baird's idea of a national museum.

The collector that perhaps best personifies both the type of enthusiast that sought out Baird's help as well as the collaborative relationship between Baird and his collectors was Robert Kennicott. While others in the Baird cadre of collectors may have had closer relationships with Baird, such as his former Dickenson students John H. Clark (whom Baird referred to as "my son" as well as by his nickname Adam in correspondence) and C.B.R. Kennerly, or gone on to become dedicated natural scientists in their own right such as F.V. Hayden, J.G. Cooper, J.S. Newberry, or C.H. Merriam, Kennicott epitomized the dedicated amateur collector that dominated collection of specimens in the early to mid nineteenth century. Kennicott, much like his other Megatheria brethren, had an

[18] Viola, *Exploring the West*, 148.

insatiable appetite for natural history, and was known at the time of his death as the Smithsonian's most productive collector. However, his efforts have largely been lost to history, save for snippets with regard to his activities in the North American subarctic and broader institutional histories of the Smithsonian.[19] Significantly, his work on the rail surveys of Illinois is not examined by the main examinations of state sponsored science in that state,[20] and his role as cofounder of the Chicago Academy of Sciences remains unexamined outside of that institution's history. However, Kennicott not only was one of Baird's best collectors, he also served as one of Baird's primary scientific missionaries.

Unlike Cooper, Kennerly, Hayden, Elliot Coues or even Merriam, Kennicott did not have a medical degree; poor health had prevented him from attending more than two years of school as a youth.[21] However, he was inspired to take up natural history from his father's work as an amateur botanist as well as his childhood explorations of his family's land northwest of Chicago, known as "The Grove." Though he had a sickly childhood, Kennicott was a vivacious collector, more at home in the field than back at "The Grove" or even at the

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[19] See Viola, 146-200; E.F. Rivinus and E.M. Youssef, Chapter 8; Debra Lindsay, *Science in the Subarctic: Trappers, Traders, and the Smithsonian Institution.* (Washington, D.C., Smithsonian Institution Press, 1993); Donald Zochert, "Notes on a Young Naturalist," *Audubon* 82 (1980); Ronald S. Vasile "The Early Career of Robert Kennicott: Illinois' Pioneering Naturalist" *Illinois Historical Journal* 87(3):151-155.

[20] Robert G. Hays. *State Science in Illinois: The Scientific Surveys, 1850-1978*. Carbondale: Southern Illinois University Press, 1980.

[21] Viola, *Exploring the West*, 181.

Smithsonian. His vigor and attitude towards nature were similar to a more famous and privileged nature enthusiast who also had an unwell childhood, Theodore Roosevelt. Kennicott's friend and collaborator B.R. Ross of the Hudson's Bay Company would later marvel at his ability to cross the difficult terrain of the Canadian hinterland, noting that Kennicott had become "quite a pedestrian," hiking and dog sledding across the subarctic.[22]

Kennicott first started collecting for his father's friend and amateur frontier naturalist Jared P. Kirtland in 1852 at the age of 17.[23] Kirtland, a physician, expert on local natural history, and popularizer of science, was also an important correspondent with Baird and had previously recommended Dr. John S. Newberry to Baird as a collector and expeditionary surgeon-naturalist candidate. At 18, after a year of working with Kirtland, Kennicott was urged by the frontier naturalist to open a correspondence with Baird.[24] Kennicott started corresponding with Baird in earnest, asking questions, requesting materials, and offering to collect for Baird as much as he was able. Baird recognized Kennicott's enthusiasm and duly offered to support Kennicott by providing supplies such as alcohol for preserving specimens and Smithsonian publications.[25] The

[22] B.R. Ross to Baird, Fort Simpson, McKenzies River, June 1, 1862. Hudson's Bay Company Correspondence, SIA RU 561, Folder 36.

[23] Ronald S. Vasile "The Early Career of Robert Kennicott," 151-155.

[24] Vasile, "The Early Career of Robert Kennicott," 155.

[25] Robert Kennicott to Spencer F. Baird, November 9, 1853, Spencer Fullerton Baird Correspondence SIA 7002, Box 26, folder 25.

collaboration that resulted from a fairly normal introduction and response would be one of the most productive of Baird's career.

Not long after his initial contact with Baird, he was shipping vast quantities of specimens to Washington, and the two briefly met in Washington in 1854. His earlier collaboration with Kirtland continued into 1854, but at that point, their fruitful collaboration ended amicably, and Kennicott worked briefly with another correspondent of Baird's, Professor P.R. Hoy of Racine, Wisconsin from whom he "learned a heap."[26] Shortly after working with Professor Hoy, Kennicott was able to attain a position as the primary collector on a survey of southern Illinois, a joint venture of the Illinois Central Railroad Company and the Illinois State Agricultural Society through his father John Kennicott, who was the head of State Horticultural Association and the secretary of state Agricultural Society. As a practical matter, the primary objective of the survey was to assess the geology and geography of southern Illinois for the railroad, but a related goal was the collection of as many objects of natural history as possible. The elder Kennicott composed the memoranda sent out to railroad agents, asking for their collaboration with his son with regard to collecting specimens, as well as providing general data on the regions that the agents would be familiar with. Baird assisted from afar by providing the survey numerous copies of his standardized collection instructions for Kennicott to give to the rail agents, no

[26] Kennicott to Baird, March 26, 1855, in Vasile, "The Early Career of Robert Kennicott:" 161.

doubt hoping not just to assist his young collaborator, but also to hopefully gain more correspondents for his collection network.[27]

The survey exposed Kennicott to the slightly different biota of southern Illinois, and as a result, his letters to Baird were filled with questions regarding intraspecific variation, the nature of species, and questions of behavior, questions that would later form the basis of modern systematics.[28] The survey also taxed Kennicott's fragile health, and he wrote to Baird that "instead of just visiting agents and giving them instructions, I have in many instances to do the work myself" which led to him becoming overworked and unable to collect. [29] Kennicott may have had to more than he had anticipated, but he enjoyed field work and bounced back quickly, enthusiastically collecting specimens of all types and sending many to the Smithsonian for Baird to examine. The main impetus for the survey from the perspective of natural history was what would later be called economic natural history; the study of the effect of flora and fauna on agricultural and pastoral endeavors. As C.H. Merriam would later discover, Kennicott noted that much of what farmers thought about native species was based more on superstition and folklore than actual observation. Of particular concern for Kennicott was the way in which snakes were treated by farmers, which was

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[27] Kennicott sent Baird a copy of his father's memoranda. See Kennicott to Baird, May 31, 1855, Spencer Fullerton Baird Correspondence, SIA 7002 Box 26 folder 26.

[28] Vasile, "The Early Career of Robert Kennicott:" 160.

[29] Kennicott to Baird, August 13, 1855. Spencer Fullerton Baird Correspondence, SIA RU 7002, box 26, folder 27.

simply to kill every serpent they could find, even as Kennicott attempted to persuade them that they controlled the rodent population.[30]

The experience on the survey was a defining moment in Kennicott's life. While he scorned the popular understanding of the natural world espoused by farmers;[31] rather than coming to see science as something only to be practiced by elites, he made it his mission to educate the masses. His view of scientific education vis-à-vis practice, therefore, became very similar to that of Baird. While Baird probably had a role in this development, this was mostly due to Kennicott's particular geography. Illinois had been surpassed as the westernmost portion of the republic, but in many ways it still represented the frontier – Chicago was a small town, most of Illinois was still prairie – and scientifically it was even more so. Kennicott, however, saw the region as a den of potential naturalists. He saw the children of farmers as natural naturalists that could use their enthusiasm about the natural world not only to benefit their families economically, but natural history as a whole.

The logical step then, was to popularize natural history in Illinois. Kennicott began writing articles on natural history geared towards laymen in a popular agricultural periodical *The Prairie Farmer*, using commonplace natural

[30] Kennicott to Baird, July, 11, 1856. Spencer Fullerton Baird Correspondence, SIA RU 7002, box 26, folder 28.

[31] It is no accident that the dangers of snakes were misconstrued on the American prairies, given the biblical imagery of serpents.

theological arguments to augment his economic focus.[32] Spurred on by Baird, he also wrote an essay on the quadrupeds of the region that corrected many misconceptions of earlier naturalists.[33] His plans were much bigger than just being a science writer; his ultimate goal was create a Smithsonian of the west in the Chicago reason. He gladly joined forces with Northwestern University to create the region's first natural history museum in 1857, of which he was appointed as curator.[34] Later that year, Kennicott was instrumental in the founding the Chicago Academy of Science, basing the motto of the Academy on that of the Smithsonian, writing Baird excitedly about not only the society but its proposed mission.[35] Not surprisingly, the chief collector of specimens for each of the two museums was none other than Kennicott. He took these positions extremely seriously, and even as Kennicott would predominantly collect for and research at the Smithsonian for the remainder of his brief career, he always attempted to collect a duplicate set of specimens for the Chicago Academy. As a

[32] Natural theology was the attempt to reconcile faith with observation of nature, usually focusing on the "beauty" of the natural world, and arguing that it therefore was the product of an intelligent design. For his work in the *Prairie Farmer*, see Vasile, "The Early Career of Robert Kennicott:" 159, and Kennicott to Baird, January 31, 1856. Spencer Fullerton Baird Correspondence, SIA 7002, Box 26, Folder 28.

[33] Donald Zochert, "Notes on a Young Naturalist": 39.

[34] Kennicott to Baird, December 9, 1856. Spencer Fullerton Baird Correspondence, SIA 7002, Box 26, Folder 29.

[35] Much of Kennicott's correspondence with Baird in late 1856 concerned the proposed Academy of Sciences. Please also see Robert Kennicott to Spencer Fullerton Baird, March 3, 1857 and May 20, 1857, Spencer Fullerton Baird Correspondence, SIA 7002, box 26, folder 30.

result of his efforts, the Smithsonian and the Chicago Academy would have an extremely close working relationship, with his friend and Megatheria brethren William Stimpson moving to Chicago and overseeing the Academy while Kennicott was on the Western Union Telegraph Expedition in Russian America (Alaska).

One of his first acts as leader of the University's museum was to undertake a four month long expedition northward, from Illinois into the Red River region of British North America, which was overseen by the Hudson's Bay Company (HBC).[36] Upon reaching the Red River Settlement, in what is now the Canadian province of Manitoba, he met the highest ranking officer of the Company in the region, Chief Factor William Mactavish, based at the commercial hub of the settlement, Fort Garry, in what is now Winnipeg. Amongst his other duties, Mactavish was in charge of overseeing shipments from Company lands south into the United States via St. Paul, Minnesota and his cooperation proved invaluable to Kennicott, who arranged for transportation of his specimens back to Northwestern through the Company's trading lines. Kennicott also met with Donald Gunn, a retired trapper and nature enthusiast that had been submitting specimens and meteorological data to the Smithsonian since 1855, and it has been argued that this meeting led Kennicott to later seek further collaboration with men

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[36] Debra Lindsay, *Science in the Subarctic,*47; Greg Thomas "The Smithsonian and the Hudson's Bay Company," 290.

of the HBC.[37] During his stay in British America, Kennicott continued his biogeographic work by comparing specimens from the more northern climes with the fauna of his native state.

In late 1857, after returning to Chicago, Kennicott took Baird up on an earlier offer to visit the Smithsonian, to continue his studies on Illinois fauna and compare them with national specimens. While there, he was indoctrinated into informal “Megatherium Club,” becoming, with William Stimpson, one of the more enthusiastic and vociferous members of a club of extroverts. Here Kennicott was able as well as form a truly collaborative relationship with Baird and the Megatheria, as well as to gain the trust of Professor Joseph Henry. His time in Washington was significant, not just because it strengthened the relationship between Kennicott and his mentor-via-correspondence, but also because it allowed him to continue his informal education in natural history and to confirm his earlier work with regard to geographic variation in species. Soon thereafter, he returned to the Chicago to assume his duties as the curator of the museum at Northwestern University, though he soon tired of the internal politicking required of the position, writing to Baird that the trustees were “ignorant.”[38] He did not let affairs at the university get in the way of his summer collecting plans around Lake Superior with fellow Megatherium member Henry

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[37] Ibid.

[38] Kennicott to Baird, June 8, 1958, Spencer Fullerton Baird Correspondence, SIA 7002, Box 27, Folder 1.

“Carabus” Ulke, who had traveled to the region.[39] The two Megatheria collected extensively through Wisconsin, providing valuable specimens for the Smithsonian and the Chicago museums, and furthering Kennicott’s experience with regards to studying biogeography, buy furthering his experience in a region that was roughly in between of Chicago and the Red River Settlement. Kennicott returned to Chicago only to travel once more, this time to the University of Michigan in Ann Arbor, where he was employed by the Smithsonian to arrange the specimens of Lt. W. P. Trowbridge, a former Army officer that had collected extensively along the Pacific Coast.[40]

By this time, Baird had become extremely interested in the natural history of Canada, as it fit in with his goal of constructing a pan-American understanding of natural history. Additionally, little had been published on Canadian zoology since the work of John Richardson on the Franklin relief expedition was published in 1831.[41] Baird had laid the groundwork for a more substantial expedition to the Hudson’s Bay Company shortly after being contacted by Donald Gunn, opening a correspondence with company officers through his colleague John William Dawson of the Natural History Society of Montreal. This effort had led to Baird recruiting Bernard R. (B.R., “Barney”) Ross, the chief trader at Fort Simpson, to

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[39]Kennicott to Baird, July 16, 1858 & August 20, 1858, Ibid.

[40] Kennicott to Lt. W. P. Trowbridge, September 23, 1858. Spencer Fullerton Baird Correspondence, SIA RU 7002, Box 27, Folder 1; *Catalogue of the Trowbridge Collection of Natural History in the Museum of the University of Michigan* (Ann Arbor: Michigan, 1861).

[41] Thomas, “The Smithsonian and the Hudson’s Bay Company,” 291.

collect for the Smithsonian as early as 1858, with Baird trading published works on North American fauna for specimens.[42] Ross already had a relationship with George Gibbs, an ethnologist that had collected geological and anthropological specimens for the Smithsonian on the Pacific Rail Survey in the early 1850s, and was eager to formalize his relationship with the Institution.[43] Ross was an interested amateur collector and hoped that his relationship with the Smithsonian would be a conduit for his work to be publicized within scientific circles. Given his previous experience in Canada and relationship with key members of the Company, Kennicott was the natural choice for Baird to be a scientific envoy to the Canadian subarctic and the trappers of the Hudson's Bay Company the following year to expand this nascent collection network.

As discussed in the previous chapter, it is conceivable, perhaps even necessary, to conceptualize Americas' leading eastern naturalists as mandarins – the arbiters of scientific knowledge. In addition to their correspondence efforts, these mandarins often utilized specific collaborators as scientific "missionaries" and envoys; to meet, consult with, and help train potential collectors not only in collection and preservation of specimens, but in the science behind natural history, including, increasingly, systematics. While common amongst all

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[42] Trevor H. Levere. *Science and the Canadian Arctic: A Century of Exploration, 1818-1918*, (Cambridge: Cambridge University Press, 1993), 345-346; Fort Simpson was located in the Mackenzie River District of Hudson Bay Territory, which is located in the present day Northwest Territories; B.R. Ross to Spencer F. Baird, November 28, 1858 and July 29 1859. Hudson's Bay Company Correspondence, SIA RU 561, Folder 36.

[43] Lindsay, *Science in the Subarctic*, 43.

naturalists in the scientific establishment to a degree, this strategy would be the way in which that smaller and government run institutions were able to compete with better funded and larger institutions in the late nineteenth and early twentieth centuries. Many of Baird's most important collectors worked actively as scientific missionaries: Dr. Elliot Coues would actively solicited assistance in the collection of specimens while serving as an Army Surgeon in Arizona, James G. Cooper helped pave the way for Baird's influence on the West Coast. The most active and enthusiastic of his missionaries, however, was Kennicott, who would not only utilize the hierarchy of the HBC to collect for the Smithsonian, but would also inspire later colleagues to collect for Baird on the ill-fated Western Union Telegraph Expedition.

Before examining Kennicott's time in Hudson Bay Territory, it is first necessary to briefly describe the relationship that the Hudson's Bay Company had with England as well as the lands of Canada. The company itself was a mercantilistic joint-stock company that had a de facto monopoly on trapping beaver and other cash pelts from Hudson Bay to the Yukon. [44] The company ran a

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[44] Scholars of economic history may shudder at the description of a joint-stock company as mercantilistic, given that true mercantilism was typified by heavy, if not overarching government involvement. However, in the British context, MPs, royalty, and the aristocracy often invested heavily in joint-stock companies, and executive officers floated between government service and running these companies (or doing both) until the reform of these corporate entities following numerous bubbles and the demise of the East India Company's rule in India. It was certainly hard to see where the British government ended and company rule began in India, though the Hudson Bay Company was much more independent. Still, it enjoyed government support and had a virtual monopoly on fur trapping in

string of forts that doubled as trading posts across its territory, and its trappers and officers lived in and around nature for the duration of their stay in the territory. By necessity, the trappers were excellent woodsmen, skilled hunters, and survivalists, though most of the officers normally stayed in and around their trading post as befitting a Victorian gentleman. The Hudson's Bay Company also had a rich history of supporting scientific expeditions and scientific learning from its inception through the work of John Richardson on the Franklin expeditions in the 1830s.[45] Furthermore, natural history was a favorite pastime of many of the Company's officers, as it gave them a gentlemanly hobby out in the wilderness. Even though their livelihoods depended upon their ability to oversee the collection of quality skins and furs, and the Company had a strong tradition of supporting and undertaking observations of the natural world, there was not an overt attempt by the leading British scientific institutions to utilize the men of the Hudson's Bay Company as a scientific resource.[46]

At the present time, this oddity cannot be explained – it is well known that Britain's science endeavor was imperialistic in nature, and officers in other

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Canada, so I believe this description fits well; Fort Yukon, the company outpost furthest to the west, was actually situated well into Russian America.

[45] See Levere, *Science and the Canadian Arctic*, R.P. Stearns "The Royal Society and the Company" The Beaver (June 1945); Lindsay, *Science in the Subarctic*, H.G. Deignan, "The HBC and the Smithsonian." *The Beaver* (June, 1947); Carl Berger, *Science, God, and Nature in Victorian Canada*. Toronto: University of Toronto Press, 1983; Greg Thomas, "The Smithsonian and the HBC," *Prairie Forum* 10 (1985): 283-305.

[46] Greg Thomas, "The Smithsonian and the HBC," *Prairie Forum* 10 (1985): 288.

economic ventures provided specimens for Britain's leading naturalists. Why then, was this not the case for the HBC? There are numerous possibilities, the most basic of which was the implicit rivalry between the officers of the British Navy and the Hudson Bay Company. As Trevor Levere has noted, the British Admiralty had not yet abandoned its dream of finding the Northwest Passage, and numerous naval expeditions, with accompanying surgeon-naturalists probed the Canadian Arctic, sending London's naturalists thousands of faunal and floral specimens, though losing many ships and men to the ice in the process.[47] In these forays into the hinterland, the HBC often provided logistical support, but naval commanders had the annoying habit of ignoring much of the advice given to them by the trappers, and onboard naturalists spurned offers of assistance. The collaborative relationship between the scientific and naval establishments was extremely strong, leading metropolitan naturalists to lean on these naval expeditions and not actively seek to supplement collections with HBC personnel. Naturalists during the period generally only desired one specimen of each species, preferably the "type" specimen – the specimen the species or variety that was the basis of the identification. This meant that any specimens sent in by the men of the HBC would have been seen as superfluous, or used to trade for missing specimens from other institutions.

There is another, perhaps more probable reason why trappers of the HBC were not used as collectors by Britain's leading naturalists, one that went to the

[47] Levere, Chapters 1-4.

core of Victorian society: the question of gentlemanly objectivity. While the majority of officers (as opposed to trappers) of the HBC came from the middle classes and should therefore be able to serve as arbiters of reason and the natural world based upon Victorian conceptions of masculine rationality, polite society would most assuredly look upon the lives of these officers as extremely uncouth. In addition to living in the hinterland, they worked with local Indian tribes, many officers took native brides, did not (and could not, at least in the field) dress according to Victorian norms; in short, they may have been seen as semi-savages. Indeed, Charles Wilkes of the United States Exploring Expedition, after meeting with local officers of the HBC in what is now Oregon came away impressed by the enthusiasm and hardiness of the company members, but also shocked at the way in which the trappers lived.[48] Many members of the Company were Scottish, and while this difference in nationality did not carry the same weight it would have a century or two prior, it still may have been a factor for the primarily English naturalists in London. The culture and social make up of the HBC may then have worked against it as a potential scientific collaborator with its native naturalists. Whatever the case, the company was not a major contributor to British biological endeavors.

This did not mean that these men were incapable, unwilling, or unenthusiastic about being a part of the scientific process, as Kennicott's exploits in the Canadian subarctic would show. They were, in reality, an untapped

[48] Please see William Stanton, *The Great United States Exploring Expedition of 1838-1842*, Berkeley: University of California Press, 1975, Chapter 15.

scientific resource; they were familiar with the land, familiar with the organisms to collect, the methods that were used to collect them, and perhaps most importantly, extremely enthusiastic about becoming part of the scientific endeavor, and felt scorned by their native naturalists. Moreover, the Company's organizational structure was predicated on numerous Native American workers doing the majority of the trapping; Kennicott only had to utilize this structure and he would have access to hundreds of skilled collectors. While there were differences with regard to taking pelts for market and the precision needed for scientific specimens, this could be clearly explained via correspondence or in person – Baird was able to do both through Robert Kennicott. It would be fair to say, however, that Kennicott's work in the Hudson's Bay Company would far exceed Baird's wildest expectations.

The preparation for Kennicott's journey, while not as extensive as for later systematic expeditions, still required an immense amount of planning, a task made more difficult by Kennicott being in Canada, Ann Arbor, and Chicago in late 1858 and early 1859. The administration of the Smithsonian was extremely diligent about crafting Kennicott's mission. Joseph Henry wrote to the British minister to the United States, Lord Napier, seeking permission and a recommendation from the British government. Next, Henry wrote to the Governor-in-Chief of Rupert's Land, George Simpson, introducing Kennicott, discussing Kennicott's proposed collections and soliciting aid from Simpson and the Company in order to do so.[49] Simpson enthusiastically agreed, drafting a letter of introduction that Kennicott could carry to officers of the company the same day as his response to Henry that opened every facility that the Company controlled to Kennicott. [50] Meanwhile, Baird and Kennicott designed Kennicott's preferred initial route of collection via correspondence. Baird had previously suggested that Kennicott spend time collecting around Fort William, on Lake Superior, but by April, 1859 the initial target locality seemed to be Ft. Garry, which could be inexpensively reached via mail steamer, and where Kennicott had reasonable collecting experience.[51] They also had to plan for the logistics of transporting specimens from remote locations in Hudson's Bay Territory to the Smithsonian. After debating different options, Kennicott decided the best way to proceed was, as before, to submit shipments to the Smithsonian through Chief Factor Mactavish at Fort Garry. This was especially important since Kennicott would have the freedom to collect wherever was convenient and then utilize the HBC's logistical network. The logistical planning was aided by Simpson, who

[49] Simpson to Henry, Hudson Bay House, Lachine, March 28 1859 (copy), Hudson's Bay Company Correspondence, SIA RU 561 folder 38; this is an acknowledgement to Henry on receipt and acceptance of Henry's correspondence.

[50] Simpson to "All Officers of the Hudson Bay Company", Hudson Bay House, Lachine, March 28 1859 (copy), Hudson's Bay Company Correspondence, SIA RU 561, folder 38; Simpson also agreed to take meteorological data from as many of the facilities as possible for Henry's studies.

[51]Kennicott to Baird, July 16, 1858 & April 19, 1859, Spencer Fullerton Baird Correspondence, SIA 7002, Box 27, Folders 1 and 2, respectively.

actively corresponded with Kennicott about his upcoming trip.[52] Given the humble budget of the Smithsonian, Baird and Kennicott also had to lobby for subscriptions – donations of money from individuals and organizations that would be interested in Kennicott's findings – from national and Chicago based organization, attaining them from, amongst others, Louis Agassiz of Harvard and the Chicago Audubon Society.[53] Kennicott would spend three productive years in Hudson Bay Territory, leaving only when he received word that his father had fallen seriously ill in 1862.

The route that Kennicott took to get to the heart of Rupert's Land might seem circuitous today, but at the time Kennicott took the fastest and most direct route; from Toronto via Fort William, located on the northernmost tip of Lake Superior. Kennicott arrived in Toronto on the morning of May second, where he was greeted by a Dr. Rae, an "influential" man in the Company, who traveled with Kennicott on the first leg of his journey. Writing that he had been treated "very well," Kennicott urged Baird to exploit this relationship by sending Dr. Rae and other officers "the bird and mammal books," even offering to cover the cost of transportation of the material himself, provided that Baird would advance the

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[52] Kennicott to Baird, Chicago, Ill, April 21 1859. Spencer Fullerton Baird Correspondence, SIA Collection 7002, Box 26, Folder 2.

[53] Ibid.

money and Kennicott could pay him back.[54] On the trip from Toronto to Fort William, Kennicott learned of B.R. Ross's scientific tendencies and ambitions, and planned to meet with Ross and utilize him as a resource as much as possible. Kennicott also met Chief Factor George Barnston, "a very accomplished naturalist" who had previously collected for the Montreal Society of Natural History as well as the British Museum.[55] Kennicott also hoped to convert Barnston, the Chief Factor of the Company to collect for the Smithsonian, though Barnston demurred on account of his association with the Montreal Society, which had a longstanding relationship with members of the Company elite.[56] Barnston later wrote to Baird saying that he would also collect for the Smithsonian, but if he did so it was in an extremely limited capacity, and his greatest contribution to the relationship between the HBC and the Smithsonian was to recommend that other officers help Kennicott.[57] During the period of time

[54] Kennicott to Baird, Toronto, Canada, May 2, 1859 and Kennicott to Baird, near Sault St. Mary [sic], Canada, May 7, 1859; Spencer Fullerton Baird Correspondence, SIA Collection 7002, Box 26, Folder 2.

[55] Kennicott to Baird, near Sault St. Mary [sic], Canada, May 7, 1859; Spencer Fullerton Baird Correspondence, SIA Collection 7002, Box 26, Folder 2.

[56] Ibid, for Barnston's career as an amateur naturalist see Lindsay, *Science in the Subarctic* and Thomas, "The Smithsonian and the HBC." For the importance of the Montreal Society, see Thomas, "The Smithsonian and the HBC," 286.

[57] Barntson to Baird, June 23, 1859. Hudson's Bay Company Correspondence, SIA RU 561, Folder 3; for a table that records the specimens collected for the Smithsonian by HBC personnel, see Lindsay, *Science in the Subarctic*, 131 – Barnston is not included on the list. Barnston did have a long running correspondence with Baird and may have exchanged some of his specimens for specimens from the United States to help fill in his own collections. See Barnston

that Kennicott was in Rupert's land, the majority of the Company officers that agreed to work with him collected mainly for the Smithsonian, and much of their published work on natural history would be published by the Smithsonian. Barnston would be the sole holdout, not due to any animosity towards Kennicott or the young Institution for which he collected, but rather due to existing ties to the imperial scientific establishment.

Kennicott's arrival to Fort William was delayed by ice, but he was able to land, set up his kit, and leave for Lake Winnipeg in the company of three HBC canoes by the middle of May. Given the delay, he decided to skip going to Fort Garry altogether and instead headed to Norway House, a HBC trading post on Lake Winnipeg, where Governor Simpson had written Kennicott that he would be in early June.[58] His party carried with them six pounds of tea, twelve and a half pounds of sugar, thirty pounds of flour, fifty-six pounds of biscuits, sixty of pork, and four and seven pounds of rice and split peas, respectively, leading him to joke to Baird "Do you wonder that I find all my clothes getting to small for me?"[59] The convoy of canoes is significant, showing that Governor Simpson not only was supportive of Kennicott's endeavor, but the officers of the company took

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to Baird May 22, 1860, Hudson's Bay Company Correspondence, SIA RU 561, Folder 3.

[58] Kennicott had come up with the contingency plan on the route to Ft. William in case of delays. Kennicott to Baird, near Sault St. Mary [sic], Canada, May 7, 1859; Spencer Fullerton Baird Correspondence, SIA Collection 7002, Box 26, Folder 2.

[59] Kennicott to Baird, Near Ft. William, May 9 1859. Spencer Fullerton Baird Correspondence, SIA Collection 7002, Box 26, Folder 2.

Simpson's order to "provide him (Kennicott) with every facility" to heart.[60] One of the officers that accompanied Kennicott on his initial canoe voyage was Fred Gaudet, who had travelled in the area the year before, and was able to give Kennicott detailed information on the local terrain and feedback with regard to seasonality and commonality of fauna. Gaudet would be one of the first HBC officers that Kennicott would encourage and support to collect for the Smithsonian; Gaudet would do so until at least 1867.[61] Gaudet would be placed in charge of Peel's River Fort to coordinate HBC activity in that sector, as well as to mediate between the Esquimaux and Indian populations.[62] Gaudet's true value was as a middle man between the collection efforts of Smithsonian and the native Esquimaux. He spoke fluent Esquimaux, and was able to get many to collect specimens for him, which he included with his specimens when submitting them to the Smithsonian.[63]

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[60] Simpson to "All Officers of the Hudson Bay Company", Hudson Bay House, Lachine, March 28 1859 (copy), Hudson's Bay Company Correspondence, SIA RU 561 folder 38.

[61] Spencer F. Baird HBC Correspondence, Hudson's Bay Company Correspondence, SIA RU 561 folder 19; *Annual Report of the Smithsonian Institution for the Year 1867 (*Washington: Government Printing Office, 1868.

[62] Kennicott and other contemporaries use the spelling "Esquimaux," rather than the more modernized "eskimo." "Esquimaux" will be used here, in accordance to the spelling of the time. There was little distinction then between different Eskimo tribes, and it may be that those that Kennicott viewed as Eskimos would not be seen as such by scholars of indigenous people today. The men of the HBC and Kennicott did distinguish Esquimaux from other native tribes.

[63] Robert Kennicott Journal (hereafter RKJ), January 2' 1862, concerning September 12, 1861, in James Alton James (ed.) *The First Scientific Exploration*

When Kennicott reached Norway House, in mid-June, he met Governor Simpson, who greeted Kennicott warmly and reiterated his support and interest in the project.[64] Kennicott almost instantly won over company men upon meeting them given his enthusiasm, his willingness to work with them and help them become more informed about the world they lived in, his drive, and his remarkable *joie de vivre.* Simpson was no small enthusiast with regard to the subject himself, having developed a small private museum at his residence near Montreal.[65] Kennicott took the opportunity at Norway House to convince three officers of the Company to collect specimens and to take observations at Fort Pelly and Fort Alexander.[66]

In his biography of Spencer F. Baird, Kennicott protégé William H. Dall wrote of Kennicott's arrival in the north:

> "The advent of Kennicott young joyous full of news of the outside world ready to engage in any of their expeditions or activities and to take hardships without grumbling was an event in their lives When he taught them how to make birdskins and collect Natural History objects and showed them how by means of their collections their names would become known in the civilized and

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of Russian America and the Purchase of Alaska (Evanston: Northwestern University Press, 1942), 92.

[64] James, *The First Scientific Exploration of Russian America and the Purchase of Alaska,* 69

[65] Thomas, "The Smithsonian and the HBC," 292

[66] The three officers were Andrew Murray of Fort Pelly, and Archibald MacDonald and William McMurray at Fort Alexander. However, these officers submitted remarkably few specimens to the Smithsonian, most probably because Kennicott never visited these posts. Please see Thomas, "The Smithsonian and the HBC," note 54.

> even printed in books they seized on the with enthusiasm It gave them a new object in their lives with unlimited possibilities of expansion and time need longer be wasted in futilities"[67]

It must be noted that Dall could not be possibly be objective with regards to Kennicott given his relationship with him starting in Chicago area after Kennicott returned to the United States as well as on the later Western Union Telegraph Expedition, and did not have first-hand knowledge Kennicott's work in the north. While the hyperbole must be taken with a grain of salt, the trappers of the HBC did embrace Kennicott and his mission with open arms, and many officers eagerly became collectors, or at least the nexus of smaller collecting networks based upon the their workers for the Smithsonian. A key reason was the structure of the Company itself; officers oversaw the collection activities at the trading posts, but did little of the actual work. Most trapping was done by the indigenous residents of the hinterland, whom were paid per pelt, much of the work around the post was completed by the workmen of the HBC. This class was extremely diverse, made up of lower class Britons, foreigners, and native French-Canadian traders. Kennicott, in his usual understated way, noted "the officer's duty is almost nothing beyond his actual presence…no wonder they become lazy."[68] Many

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[67] William H. Dall, *The Biography of Spencer Fullerton Baird*, (Philadelphia: J.P. Lippencott, 1915); 334-335.

[68] Kennicott to Baird, Fort Simpson, Mackenzies River H.B.T., November 17, 1859; in Debra Lindsay (ed.) *The Modern Beginnings of Subarctic Ornithology: Northern Correspondence with the Smithsonian Institution, 1856-68* (Winnipeg: Manitoba Record Society, 1991), 29.

officers saw the opportunity to collect as an opportunity to shake off the ennui of day to day life in a harsh environment.

Indeed, a major reason for Kennicott's success in the subarctic was due to his ability to utilize the both the hierarchy of the Company and its infrastructure as a resource. The company offered continuous logistical support; while the Institution was still responsible for shipping costs, the ability to utilize the HBC trade route of canoe, dogsled, and Red River cart to St. Paul Minnesota, and from thence to the Institution by train, saved the Smithsonian considerable cost. He travelled freely from post to post based upon the localities desired, and routinely was not charged for anything other than supplies and living expenses; living as a guest of the company and its individual officers, he did not have to worry about room and board. The Smithsonian paid the Company directly for shipping, and kept Kennicott as supplied as possible with collecting supplies. Ross wrote Baird in March of 1860 explaining "I am keeping Mr. Kennicott's expenses as low as possible. He pays for nothing except his personal necessies, [sic] passages in our boats and with our winter parties are granted him free and the population of the Forts are always at his service"[69]

[69] B.R. Ross to Baird, Fort Simpson, HBT, March 25 1860. Hudson's Bay Company Correspondence, SIA RU 561 folder 36.

As it was, Kennicott was constantly worried about the amount of cash he had on hand, as letters to Baird in November and the following March show.[70] Even two years into his trip, in June of 1861, Kennicott was worried about money "I sometimes fear that I am spending too much; but the field is large that we are working and to secure Indian assistance a good deal must be paid."[71] This should not be misconstrued as a worry of personal finances, which would never be an issue due to his family's place in Illinois society. His primary concern financially was how to stay as long afield as possible, while collecting as many specimens as possible, the same questions that modern researchers face when going on expeditions and other collecting trips. Kennicott's relative freedom of movement allowed him to collect specimens from all over Hudson Bay Territory in a three year period, from Lake Winnipeg to the Yukon, though he spent the majority of his time based at three trading posts: Forts Simpson and Resolution in the modern Northwest Territories, and Fort Yukon, in present day Alaska.

While in the wilds of the North, Kennicott kept a journal which was unfortunately lost in the Chicago Fire of 1871 when it destroyed the Chicago Academy of Sciences. It was excerpted for the *Transactions* of that society in

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[70] Kennicott to Baird, Fort Simpson, Mackenzies River H.B.T., November 17, 1859 and March 23, 1860; in Lindsay, *The Beginnings of Modern Subarctic Ornithology* , 17-32 & 40-47.

[71] Robert Kennicott to Baird, Duck's egg Paradise! Ft Youkon North West Am. June 23 1861, in Lindsay, *The Beginnings of Modern Subarctic Ornithology*, 118.

1869, though most copies of this have also been lost.[72] In the journal, Kennicott duly recorded his observations on the surround biota and physical geography, his travels, and his collections. The journal, at least in its published form, is narrative in nature, meaning that it has almost certainly was synthesized from field notes rather than composed purely at the end of each day or when Kennicott had the opportunity to write. As a result, it reads as a combination of a traditional travel narrative, and scientific notebook and some of the reflections included may have been added later, rather than on a given date. While by no means as detailed and systematic as the disciples of Joseph Grinnell a half-century later,[73] Kennicott's journal nonetheless records his collecting activity, collaborations with the members of the HBC, and reflections concerning geographic distribution and variation of animals. Kennicott tended to travel the long distances between distant posts in the autumn, and then winter at a new post, though his journal does not include a discussion of these journeys or the winter period. Still, it is the best source available that includes his reflections on the Hudson Bay Territory as well as his collaborations with HBC officers.

Initially, Kennicott took the time to describe the natural beauty that surrounded him, describing the wilds of Canada with a mix of scientific

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[72] Fortuitously, the excerpts were reprinted in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska,* which primarily looked at Kennicott's role in the W.U.T.E. (see below).

[73] See Chapter 1 for a discussion of field notes and journals, chapters 3 and 5 for an examination of the work of Frank Stephens and Edmund Heller, respectively.

admiration and childish awe. Shortly after arriving in the HBT, while traveling to Lake Winnipeg, he and his canoe train came across a

> "perpendicular fall in the river of about one hundred and fifty feet…the scene is quite too magnificent for me to attempt its full description…though a calm day when I visited it, the fall produced a rush of air that blew the spray in my face while standing at the distance of ten or fifteen rods [~165-248 feet]…Any lover of fine scenery, visiting the north shore of Lake Superior, should not fail to see this splendid waterfall"[74]

In 1861, after being in HBT for two years, Kennicott was still uplifted by the scenery, but no longer described in his journal in detail "I am sorry I do not appreciate fine scenery, else I would be able to describe some of this that I see here…on these grand, ragged old Rocky Mountains, and I enjoy it, yet still I cannot remember the details of any scene that pleases me."[75] The north as a place of wonder had given way to a new conceptualization of place, a place of work, of a natural laboratory.

Collecting in the subarctic was a seasonal affair, due to the changes in climate and resultant migrations and hibernations of animals. His first year in the subarctic, Kennicott wrote to Baird in November, reflecting that collection had slowed, as it "required constant hunting to get anything... Since September I have often hunted all day without seeing a specimen except whiskey Johns and pine

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[74] RKJ, May 20, 1859 in James, *The First Scientific Exploration of Russian American and the Purchase of Alaska*, 59.

[75] RKJ, January 2, 1862, in James, *The First Scientific Exploration of Russian American and the Purchase of Alaska*, 88, concerning late September 1861.

squirrels, and lately red polls."[76] He remained optimistic, however, noting that there would be possibilities to catch small mammals and winter birds in the coming months. Additionally, for animals that underwent seasonal coat or plumage changes, both their winter and summer forms were needed by naturalists for their study. However, the extreme cold was a huge detriment to collecting, and Kennicott's early summer note to Baird regarding his winter collection efforts "I hybernated [sic] (mentally) as usual last winter" reflected both Kennicott's frustration and acceptance of the difficulty of doing work in the subarctic in the deep of winter.[77] The effects of lethargy were not contained to Kennicott; Greg Thomas has argued that this was a common side effect of living through the extreme northern winters and that it was experienced by the officers of the company as well.[78] On the positive side, the winter allowed easy travel between posts via dogsled, and offered respite from the ubiquitous summer mosquitoes. In the muggy heat of summer, Kennicott griped to himself "I got heartily sick of summer voyaging, and longed for snow and cold weather. Summer to me in the north after the birds moult [sic]…for personal comfort summer is by far the most disagreeable part season of the year."[79]

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[76] Kennicott to Baird, Fort Simpson Mackenzie River District, November 15, 1859 in Lindsay, *Modern Beginnings of Subarctic Ornithology*, 21.
[77] Robert Kennicott to Baird, Duck's egg Paradise! Ft Youkon North West Am. June 23 1861, in Lindsay, *Modern Beginnings of Subarctic Ornithology*, 112.

[78] Greg Thomas, "The Smithsonian and the HBC," 296.

[79] RKJ, January 2, 1862, concerning September 7, 1861, in James, *The First Scientific Exploration of Russian American and the Purchase of Alaska*, 87.

In the spring and summer, collecting was an all day affair, noting in his journal that "From the last of May until now (June 24th) Lockhart [a HBC officer that Kennicott worked with throughout 1861, see below] and I have been at work generally about eighteen hours of every twenty-four. As it is light all night…we pay little attention to the time of day, but work as long as we can keep awake."[80] Collecting trips from the various forts were usually two to three days in length, with occasional longer trips, by parties of at least four: Kennicott, an HBC man at times an officer, but others one of the workers, and the remainder of the party made up of native assistants. After the spring thaw, Kennicott and his collaborators were able to utilize the plentiful Canadian rivers to cover between fifty and a hundred miles per trip, while in the winter the most efficient manner of transport was by dog sled. Kennicott reflected thankfully "a good canoe in summer, good dogs in the winter, are among the greatest comforts in the north, and I have them both."[81]

Kennicott would meet B.R. Ross and his colleagues from the Mackenzie River District at Methy Portage, in between the Clearwater River and Lake Winnipeg in late July, which would be the beginning of a

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[80] Ibid, 83.

[81] Ibid, 84.

fruitful relationship.[82] While somewhat eclectic and arrogant, and prone to personality conflicts, Ross was a perfect initial partner for Kennicott in the subarctic. Debra Lindsay has noted that Ross's journals while on post at Fort Simpson depict a "competent and educated" but "not quite satisfied employee" that constantly sought new intellectual and social pursuits to pass the time in the northern hinterland.[83] Further, Ross was based in a region that Baird had recognized as scientific "terra incognita," making it imperative that Kennicott collect or organize collections in the region, and the easiest way for Kennicott to do that was to work with Ross.[84] Ross, in other words, was a key target for Kennicott the missionary. Greg Thomas has described the Mackenzie River District, which was under Ross' immediate jurisdiction as Chief Trader, was "the last great frontier of the Western Canadian fur trade, the last empty space on the map of British North America after 1821…[and] was the most valuable district in the Hudson's Bay Company's Northern Department."[85]

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[82] RKJ, August 1, 1859 in James, *The First Scientific Exploration of Russian American and the Purchase of Alaska*, 71.

[83] Debra Lindsay, "The Hudson's Bay Company-Smithsonian Connection and Fur Trade Intellectual Life: Bernard Rogan Ross, a Case Study" in *Le Castor Fait Tout: Selected Papers of the Fifth North American Fur Trade Conference*, edited by Bruce G. Trigger, Toby Morantz and Louise Dechêne, (Montreal: Lake St. Louis Historical Society, 1985), 593.

[84] Spencer F. Baird to B.R. Ross, March 26, 1859 in Lindsay, "The Hudson's Bay Company-Smithsonian Connection,"601.

[85] Greg Thomas, "The Smithsonian and the HBC," 294.

For his part, Ross, who had previously collected for Baird, sending a shipment of specimens to Washington immediately prior to Kennicott's arrival, was energized to the point of zeal upon meeting Kennicott, and would become the HBC's second leading collector of specimens for the Smithsonian, ultimately sending over 2,200 specimens to Washington.[86] Kennicott would be able to utilize Ross's skill in collection, and Kennicott's expertise and reputation in the United States would allow Ross a better conduit to the scientific world. While it would be inaccurate to say that Kennicott "converted" Ross to the cause of natural history, the collaboration between Kennicott and Ross, and to an extent, the other officers of the HBC, was a microcosm of the collaborative relationship between Kennicott and Baird. Kennicott refused to look at Ross and the other officers as merely collectors. Rather, he saw them much as he saw the children of farmers in rural Illinois – ready-made naturalists that only needed direction and feedback in order to thrive.

Ross and Kennicott traveled the six hundred miles to Fort Simpson on the Great Slave Lake via the Slave and Mackenzie Rivers in a fortnight, arriving mid-August. It would be here that he would base his first in depth collection efforts, remaining at Fort Simpson with shorter trips to neighboring Forts Laird and Rae into spring of the new year, and working with Ross, Roderick Ross Macfarlane, John Mackenzie, the officer in charge of the post, as well as John Reid and James

[86] Thomas, 293; Debra Lindsay compiled a table of specimens sent by Northern collectors to the Smithsonian, please see Lindsay, *Science in the Subarctic*, 131.

Dunlop.[87] Macfarlane would transfer to Fort Good Hope to run the trading post there, and he again would meet up with Kennicott in 1861. It was this second encounter with Kennicott that would inspire Macfarlane to become Kennicott's greatest collaborator in the north surpassing even Ross. James Lockhart, another of Kennicott's collectors, would remark to Baird that Macfarlane had "caught the Oological fever" and after transferring again to Fort Anderson, the northernmost HBC post, Macfarlane diligently set up a collection network consisting of native hunters and trappers with himself at the center.[88] Macfarlane did make four collection trips up to the arctic in order to collect birds and eggs, but for the most part Macfarlane's collections were solely the result of efforts of the native tribes around the Anderson River. Macfarlane's network would produce over 5,000 specimens for the Smithsonian, more than double than that produced by Ross, and roughly five times that submitted by Lockhart, Kennicott's other prodigious collectors, from 1861 to 1869.[89] Unfortunately, Kennicott did not record much of his time at Fort Simpson in his journal. The sum of his experiences are in the few correspondences to Baird, in which he sounds completely exasperated with

[87] Ross to Baird, Fort Simpson, McKenzie River District, June 20, 1860. Hudson's Bay Company Correspondence SIA RU 561, folder 36; Macfarlane's surname was alternatively spelled "Macfarlane" and "McFarlane" by Kennicott, HBC traders, and Smithsonian staff in correspondence and in Kennicott's journal. "MacFarlane" will be used here.

[88] Lockhart to Baird, Fort Resolution, Great Slave Lake, December 7, 1862; Hudson's Bay Company Correspondence, SIA RU 561 Folder 26.

[89] Lindsay, *Science in the Subarctic*, 59-61; 131

himself and his inability to collect as much as he had planned, and refers to the northern winter as "purgatory."[90]

One of the more challenging issues that Kennicott had to deal with was the personality of Ross. Ross very much styled himself a field naturalist, and his correspondences with both Baird and Kennicott reflect this. Ross confidently wrote to Baird in June of 1860 "Write fully to me of all your wants, and if I cannot procure them (*fur animals excepted*) they will indeed be difficult of obtaining."[91] As a result, he had developed a blatant superiority complex regarding natural history and his colleagues, which irked many in the company, especially Lawrence Clarke, Jr., an officer stationed at Fort Rae.[92] Kennicott related the situation to Baird,

> "I don't know if I ever explained fully that as I found Mr. Ross very anxious to send all he could in his own name… As I of course wanted to see all the specimens sent, possible, I thought this better policy than to have them given to me. The more so as Mr. Ross rather insisted on it and agreed to pay any expense. But I find almost all the gentlemen opposed to this, all I've seen since preferring to give me the specimens directly. Clarke says he'll see him d---d first and me too! As he says Mr. R. 'is too fond of getting others to work and he getting the credit'... The gentlemen say that Mr. Ross will "gobble" all the things himself that are sent

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[90] Kennicott to Baird, McKenzie River District, March 23, 1860, in Lindsay, *Modern Beginnings of Subarctic Ornithology*, 43.

[91] Ross to Baird, Fort Simpson, McKenzie River District, June 20, 1860. Hudson's Bay Company Correspondence, SIA RU 561, folder 36; fur animals, of course, would be proprietary for the HBC.

[92] Kennicott would later write Baird that he believed Clarke would be as "valuable a correspondent for you as Mr. Ross. Kennicott to Baird, June 29, 1860. However, Ross's actions had so soured the experience for Clarke, that he submitted very few specimens to the Smithsonian.

> in to the officers generally through him. So pray if anything is sent to be distributed, state what is for Mr. Ross himself. And while I'm here better let me have the distribution of the things myself."[93]

Kennicott felt the best way forward after the flap was to try and appease both parties directly, having Ross send in his own specimens and the other collectors go through him when practicable. Ross was even able to get under Kennicott's skin: "As I've said this much about Mr. Ross I might as well add that I find he has been humbugging me most confoundedly;"[94] with Ross making Kennicott feel in his debt about staying at Fort Simpson, even as he had already written Baird that everything was taken care of. Though Kennicott was glad for Ross's ability to collect specimens, and relied quite a bit on him, he nonetheless was glad to collect in a different locality after wintering with Ross in 1859-60. Reflecting on the flap a week later, after Ross brought in an extraordinary amount of specimens to Kennicott at Fort Resolution, Kennicott wrote Baird "… Mr. Ross may treat me as meanly as he likes and welcome on condition that he makes such a collection every year."[95] The next June, Kennicott and Ross had reconciled their differences: "Mr. Ross was very kind last fall to me personally and gave me every facility in the way of getting my outfit of goods. We shall get on quite well now, and of course I fully appreciate his great exertions in the cause of science." However,

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[93] Kennicott to Baird, Fort Resolution G. Slave L. June 29, 1860 in Lindsay, *Modern Beginnings of Subarctic Ornithology,* 58

[94] Ibid.

[95] Kennicott to Baird, Fort Resolution G. Slave L. July 4, 1860 in Lindsay, *Modern Beginnings of Subarctic Ornithology*, 68.

Ross's personality would rub less forgiving men than Kennicott the wrong way: his zeal for collection would rankle the executives at the Company, especially after Simpson's death, due to his habit of shipping specimens to Washington without billing the Smithsonian, using his privileges as an officer of the Company. This was actually against Company regulations and against the agreement already in place between the Smithsonian and the HBC, and in Clarke's opinion, was due to Ross' desire for personal glory and recognition.[96] In most cases, however, the Institution properly paid the HBC for freight charges, unwilling to alienate the Company over the cost of freight.

By March, right as Kennicott was finalizing his plans to spend the spring collecting around Fort Resolution, some 300 miles to the southeast on the Great Slave Lake, Ross had so many specimens that he and his mini-network had collected that the mess hall was scattered with specimens in the process of being prepped and shipped.[97] After Kennicott left, Ross would take it upon himself to organize a survey of the Mackenzie River valley, coordinating efforts with the officers of the district, with the goal of making climatological readings, and collecting natural history and ethnological specimens.[98] For his part, Kennicott was rejuvenated after traveling to Fort Resolution by dog sled, and was duly

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[96] See Lawrence Clarke Jr to Kennicott, Fort a la Corne, January 16, 1865. Hudson's Bay Company Correspondence, SIA RU 561 folder 9; Debra Lindsay, *Science in the Subarctic*, 52

[97] Thomas, "The Smithsonian and the HBC," 296.

[98] H.G. Deignan "The HBC and the Smithsonian," *The Beaver* (1947): 5.

welcomed there by William Hardisty, whom he had met the previous fall. [99] Hardisty would become one of Kennicott's most trusted friends and companions in Hudson Bay territory, and whose brother, Thomas, likewise a member of the company, would also collect for the Smithsonian. Soon the Hardistys were actively assisting Kennicott in his scientific work making measurements of ice thickness in the Great Slave Lake, as well as carefully noted the return of migratory birds in May.[100]

The productivity of his stay in the Mackenzie District, and his continued interest in collecting in Hudson Bay Territory led Kennicott to ask Spencer F. Baird to request an extension of his stay in Hudson Bay Territory to Governor Simpson. This coincided with Baird's interest in collecting eggs from Moose Factory, a more easterly trading post on the southernmost part of James Bay in what is now Ontario, so he quickly wrote Simpson, whom forwarded his recommendation to the Company, which was duly approved.[101] Baird then made arrangements for Constantin Drexler, a Smithsonian taxonomist, to travel to Moose Factory later that year to collect eggs for the Institution. Kennicott's early work not only contributed to the knowledge of Canadian wildlife, inspired the officers of the HBC to collect for the Smithsonian, but also laid the groundwork

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[99] Much like Macfarlane, Hardisty's name is alternatively spelled as "Hardisty" and "Hardesty" by Kennicott and HBC staff. "Hardisty" will be used here

[100] RKJ, May 5, 1860, in James, *The First Scientific Exploration of Russian American and the Purchase of Alaska*, 76

[101] Simpson to Baird, Hudson Bay House, Lachine, February 11, 1860. Spencer Fullerton Baird Correspondence, SIA RU 7002, Box 26, Folder 2

for a more intensive examination of Hudson Bay Territory by Smithsonian staff. Drexler did not find much success at Moose Factory calling the post "the wors [sic]place for egging i [sic]have seen yet [sic]," grumbling that "if Mr. McKenzie (the ranking officer at the post) dooes [sic]not send me further i [sic]would had better staid [sic]at home and colected [sic]at the Smithsonian ... i [sic]will not stay at this infernal post if other-wise can be helpt [sic], as it is shure [sic]wher [sic]ther [sic]at no birds, ther [sic]can be no Eggs [sic]"[102] Nonetheless, Drexler managed to send in over 600 specimens of eggs, reptiles, and mammals from his one season in the north.

After spending most of 1860 collecting around Fort Resolution, Kennicott descended the Mackenzie and Porcupine Rivers – the later a trip of two hundred miles – to reach Fort Yukon, a HBC fort well within Russian America. Here he spent the winter and spring of 1860-61 in the company of James Lockhart, the chief factor of the company.[103] While Kennicott's early collecting activity in the Yukon was not terribly productive, by late June he wrote to Baird giving his location as "Duck's egg Paradise!" reporting that he and Lockhart had collected "over a bushel of eggs, as well as mobilized native Alaskans to do the same.[104]

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[102] Constatin Drexler to Baird, Moose Factory, May 26 1860, Hudson's Bay Company Correspondence, SIA RU 561 Folder 16.

[103] James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*,80; Members of the HBC often spelled "Yukon" "Youcon" or "Youkon;" "Yukon" will be used unless in a direct quote.

[104] Robert Kennicott to Baird, Duck's egg Paradise! Ft Youkon North West Am. June 23 1861, in Lindsay, *Modern Beginnings of Subarctic Ornithology*, 112.

Lockhart would become, with B.R. Ross and Roderick Ross Macfarlane, Kennicott's primary collectors. Shortly after meeting Kennicott, Lockhart wrote to Baird thanking him for sending Kennicott north, noting he had tried to make collections prior to Kennicott coming to the subarctic, "but had given up in despair and [had] determined that [he] would do nothing until [he] could learn how to do it properly."[105] Baird wrote back encouraging him, and Kennicott noted to Baird "If your letters to the other officers did one half the good the one to Lockhart did, you will have effected more for science by them than I shall in a year's work. Lockhart was pretty well primed for zoological operations, but your letter 'touched him off'."[106] Kennicott showed the frustrated trapper how to best collect and prepare specimens for scientific study, and in thanks, Lockhart pledged to Baird to "make a large collection of anything I lay can lay hands on that would be of interest to the Smithsonian Institution."[107] Lockhart did as he promised, sending over 1100 specimens to the Smithsonian during his relationship with the Institution.[108] With help from encouraging notes from Baird, he and Kennicott also converted his secretary, Strachan Jones to the cause as well.

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[105] James Lockhart to Spencer F. Baird, Fort "Youcon" N.W.A. June 24 1861, Hudson's Bay Company Correspondence, SIA RU 561 folder 28.

[106] Robert Kennicott to Baird, Duck's egg Paradise! Ft Youkon North West Am. June 23 1861, in Lindsay, *Modern Beginnings of Subarctic Ornithology*,112.

[107] Ibid.

[108] Lindsay, *Modern Beginnings of Subarctic Ornithology*, xix

In thanks for his efforts, Baird sent Lockhart scientific publications, whisky to fix specimens, and approved Kennicott's purchase of a Maynard Rifle for him.[109]

Lockhart's relationship with Kennicott grew so close that in letters to Kennicott, he called him "Cheeh-tsoh,"a Native American name that Kennicott had either attained via the HBC men or had appropriated for himself.[110] After working with Kennicott, Lockhart composed life history of the wolverine from the perspective of a trapper, referring to the voracious carnivore as the "greatest enemy of the hunter in the north," noting that "along the Mackenzie and west of the mountains the country is infested with them." [111] For both specimen collectors and the men of the HBC the wolverine, or carcajou (the French name Kennicott always used) was a rival, raiding traps and at times pulling traps for long distances across the forests. While Lockhart focused on the economic aspects of natural history and his work was more of a personal reflection than a detailed life history, he nonetheless looked at important aspects wolverine life, from breeding and the care of young to feeding habits. Lockhart would be a major contributor to the Smithsonian and the Chicago Academy of Sciences until the late 1860s, even visiting Baird in Washington in 1867. He wrote another manuscript, a detailed life history of the moose based on his observations in 1865,

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[109] James Lockhart to Spencer F. Baird, Fort "Youcon" N.W.A. December 7 1862, Hudson's Bay Company Correspondence, SIA RU 561 folder 28.

[110] James Lockhart to Robert Kennicott, Fort Resolution November 21, 1864. Hudson's Bay Company Correspondence, SIA RU 561 folder 28.

[111] James Lockhart. "Wolverine" Hudson's Bay Company Correspondence, SIA RU 561 Folder 28.

which was submitted to the Smithsonian, though it was not published in the Institution's *Transactions* until 1890. Similar and scope and in aim of his earlier work on the wolverine, his article on the moose was accompanied by a footnote praising the efforts of Lockhart and his former colleagues in British North America for their contributions to the development of natural knowledge.[112]

The goal of a scientific missionary was not to just get other nature enthusiasts to collect for a particular naturalist, but also to convert them to a particular methodology of collection that matched the emphasis of the mandarin. For Baird and Kennicott, collection was based on conceptions of biogeography and variation, the same concepts which be at the heart of the systematic surveys of the late nineteenth century. Accordingly, one Kennicott's major areas of emphasis in his research in Hudson Bay Territory can be described as comparative biogeography, in which he and his HBC colleagues compared the flora and fauna of the region not only with that of the United States, but with what had already been recorded at similar latitudes within British America. Kennicott's scientific observations, while not truly "systematic," were nonetheless very thorough.[113] He was able to identify species both with scientific and common names, relate species with geographic range, and make annotations on behavior. When species could not be positively identified, which was not

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[112] H.G. Deignan "The HBC and the Smithsonian" *The Beaver* (1947): 7; James Lockhart, "Notes on the Habits of the Moose in the Far North of British America in 1865," *Proceedings of the National Museum*, 13 (1890): 305.

[113] For a discussion on "systematic natural history" versus "Humboldtean natural history," please see Robert Kohler, *All Creatures*, introduction.

uncommon in the field, he made sure to identify by analogy, comparing them to organisms he was familiar with. When finding large numbers of a type of "meadow mouse" outside of Fort Alexander, he immediately compared it to a meadow mouse of the American Midwest, the *Arvicola austera* based upon the mouse's behavior, burrowing networks, and above ground runs.[114] Many of the examples of northern animals had not been seen in vivo, and Kennicott knew them only from published descriptions or after observing museum specimens. When live fauna differed from their established museum descriptions, Kennicott made sure to note the difference, as well as describing variations within populations based upon maturity or sex of the specimen, and attributed differences in external characteristics between seemingly closely related species due to geography and climate.[115]

Perhaps not surprisingly, given Humboldt's work on biogeography, and his fellow Megatheria William Stimpson's observations on the plants of East Asia while on the North Pacific Expedition, this was consistently done using biogeography of plants, especially trees. Here he used well known and easily discernable species such as maples, spruce, poplars, oaks, and pines as his guide. While not a botanist, he also made relative assessments about soil quality based upon plant appearance. That he should relate these two is not surprising, given

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[114] RKJ, June 4, 1859, in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 66.

[115] RKJ, May 28, 1860, in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 80.

his upbringing in agricultural Illinois and the economic slant of his early science writing. He was often "astonished" by the ability of large trees to grow in thin soil, observing "… on the Winnipeg River, I found, upon examining several localities thickly covered with evergreens, that these were only supported by a few inches of decayed vegetation laying on the otherwise bare rocks. In this region a thick growth of small trees is no certain indication of a soil more than a few inches deep."[116]

Given the importance of biogeography to Kennicott's work, it is not surprising that much of his collection work with regard to animal specimens focused on mammals, and especially, birds. The relative importance given to birds by Kennicott was symptomatic of natural history in the mid-nineteenth century. Many amateurs were drawn to natural history by studying birds, and large portions of a naturalist's collection network dedicated to ornithology. Birds, partly out of necessity, partly out of interest, became the model animal class to study with regards to variation and geographic distribution. Birds also offer striking sexual dimorphism with regard to plumage, with males usually having brighter or more striking colors due to sexual selection. Ross noted that one species of "snow bird" exhibited such sexual dimorphism that he had identified them as two separate species previously, since the males were a "purer"

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[116] RKJ, May 31, 1859, in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska,* 62.

white than females.[117] Unlike most other animals, birds are migratory over large areas, throwing another wrinkle into their study. Due to their migratory nature, Baird saw the study of birds as essential to his greater goal of understanding of pan-American natural history, and was an expert in American ornithology. Therefore, Kennicott was to record the migration, breeding, and nesting seasons of the birds encountered in Hudson's Bay Territory (HBT). The collection of eggs was an extremely important, but delicate proposition. Eggs had to be carefully drained by boring small holes in the shell and letting the white and yolk drain out completely so that the eggs could be preserved. If the holes were too large, they affected the displayability of the specimen; if too small, they would not drain the egg correctly. When coming across the nests of birds, he was careful to ascertain if the eggs were in the process of incubation, useful information with regard to breeding seasons. Further, eggs were to be collected with parents, preferably both, for classification purposes.[118] This explains the emphasis to birds and their eggs given to Kennicott and his collectors in the HBT.

Those that Kennicott had got to collect for the Smithsonian, in turn attempted to get more of their colleagues to do so as well. In November of 1864, as Kennicott was preparing to go on the ill fated Western Union Telegraph Expedition, James Lockhart wrote him from Fort Resolution letting Kennicott

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[117] Ross to Baird, Fort Simpson, McKenzie River, April 15 1861. Hudson's Bay Company Correspondence, SIA RU 561, folder 36.

[118] Spencer F. Baird to C.H. Merriam, June 26 1872. C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, reel 36.

know that he and Macfarlane had "exhorted" fellow HBC officers including Strachan Jones, Charles Gaudet, and James Flett to collect for the Smithsonian, and that they had agreed to do "what they could." [119] Kennicott already had a relationship with these men, so this episode should be seen as more of a pep talk than a tried attempt to convert more officers into Smithsonian collectors, though B.R. Ross, Roderick Macfarlane, and James Lockhart did so; Lockhart arranged for HBC men to collect not only at Fort Resolution, but also Fort Rae. Ross was less successful; Lawrence Clarke Jr., an officer stationed at Fort Rae and Smithsonian collector wrote Baird that Ross had been unable to persuade people to collect specimens, all advances with regard to collection were due to "my admirable friend Mr. Kennycott [sic]."[120]

Even with Ross' personality, the important point to consider is that the officers of the HBC were a fairly tight-knit community, even as they were spread out from Hudson Bay into Russian America. Through a combination of their own volition, the enthusiasm about natural history that Kennicott brought with him to Hudson Bay Territory, the perceived slights from their native naturalists – Ross ridiculed a paper on the fauna of HBT written by an Edinburgh naturalist "Mr.

[119] James Lockhart to Robert Kennicott, Fort Resolution November 21, 1864. Hudson's Bay Company Correspondence, SIA RU 561 folder 28.

[120] Clarke to Baird, Fort Rae, December 1, 1862. Hudson's Bay Company Correspondence, SIA RU 561 folder 9; Clarke's animosity towards Ross undoubtedly played a role in his loathness to grant Ross credit.

Murray" for its gross inaccuracies,[121] and the democratic notions of the practice of science held by both Spencer Baird and Robert Kennicott, this community collectively decided to aid in the collection, preparation, and transport of specimens from the Canadian hinterland to Washington.

Perhaps the largest obstacle for Kennicott and his supporters was the logistical nightmare with regards to transporting correspondence and specimens. Unfortunately for parties in the Hudson's Bay Territory as well as Baird at the Smithsonian, it was common for specimens or supplies to not make it to their intended destination at all, let alone a timely manner. Transportation of supplies, specimens, and correspondence was similar to the transport that Kennicott had taken into the hinterland; steamer as far as possible, then via canoe and overland by dog sled. Kennicott noted that letters sent from the Smithsonian to Fort Yukon, the most remote of the HBC posts, would take between six and seven months to reach their destination.[122] Transportation time was less drastic at other posts that were more accessible, but was still usually measured in months rather than weeks. There was a routinely a four to six month time frame for transporting specimens from Canada to Washington, and in many cases there was a year lag time between collection and contributions being mentioned in the annual reports.

[121] B.R. Ross to Baird, Fort Simpson, HBT, June 20, 1860. Hudson's Bay Company Correspondence, SIA RU 561 folder 36.

[122] Kennicott to Baird, Fort Simpson, Mackenzie River District, November 15, 1859, in Lindsay, *Modern Beginnings of Subarctic Ornithology*, 22.

Specimens often were broken or otherwise ruined while in transit due to having to be hauled across portages, and continuously loaded and offloaded.[123]

One of the common reasons for correspondence between HBC collectors and Washington was that the supplies needed had not yet arrived. The supply of alcohol for fixing specimens was a constant problem; as noted in Chapter 1, whisky or rum was often the cheapest form of alcohol available for specimen preparation.[124] However, whisky was not officially available in Hudson Bay Territory as it was against company policy, meaning it would have to be transported from the United States, and treated so that it would not be consumed by the officers or their staff. However, it was common for both the traders and Kennicott to request unpoisoned whisky, so that it could be consumed, while still used for specimens if necessary.[125] While not the best decision for the bottom line of the Smithsonian, the sending of untreated alcohol kept the officers of the HBC happy, and that in turn kept them collecting for the Smithsonian.

Kennicott's voyage necessitated close contact with the natives of the region, many of whom worked for the Hudson Bay Company, and those that did

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[123] James Lockhart to Spencer F. Baird, Fort Resolution December 12, 1865, Hudson's Bay Company Correspondence, SIA RU 561 folder 28.

[124] James Lockhart to Robert Kennicott, Fort Resolution June 26, 1865; James Lockhart to Spencer F. Baird, July 7 1865, Hudson's Bay Company Correspondence, SIA RU 561 folder 28.

[125] For example, see Kennicott to Baird, Fort Simpson, Mackenzie River District, March 23, 1860 in Lindsay, *Modern Beginnings of Subarctic Ornithology*, 46.

not often traded furs to the Company for guns and sundries.[126] While Kennicott did not delve terribly much into ethnology when in Canada, unlike many of the surgeon naturalists on western expeditions, he nonetheless compiled a rough dictionary of local native words in accordance with Smithsonian guidelines.[127] He also wrote his reflections on the different aboriginal peoples he encountered in his journal. Kennicott no doubt had many of the same prejudices that other mid nineteenth century Americans had with regard to Native Americans, and was amazed what he referred to as their "backwardness" in many instances. However, he admired native peoples for their skills and hospitality, positing that the "Iroquois" that worked for the HBC were "the most respectable Indians I had met with," perhaps due to their long relationship with French Canadians.[128] He marveled at their ability to navigate through rapids in their fragile canoes "the Iroquois are quite in their true element when running rapids, and even aside from a sort of professional pride, they seem to enjoy it greatly," as well as their ability to perform hard labor on little sleep.[129] Kennicott also recorded the unique naming system of the Tinne Indians, whose adult names referenced their eldest

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[126] RKJ, May 22, 1859, in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 53

[127] Spencer Fullerton Baird Correspondence, SIA RU 7002 Box 27 folder 3

[128] RKJ, May 21, 1859, in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 52

[129] RKJ, May 27, 1859, in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 58, 70.

male child rather than continuing with the name they used in their youth.[130] He and the officers of the HBC employed native Canadians as primary collectors; these were trained, if at all possible, by Kennicott. The resulting specimens could then be "put up" either by the natives that collected them or by Kennicott and his colleagues and shipped off to the Smithsonian.[131] Unfortunately, the names of these individuals were rarely, if ever recorded or included in correspondence the way that white collaborators may have been, due to a sort of institutional bias inherent in the HBC. Kennicott did include many of his native collaborators in his journal, but usually those mentioned are chieftains – such as "Ba-keih-na-chah-te" the Black River Chief of the "Kutch-a-kutch-in" tribe, who "made" the men of his tribe work collect for Kennicott – or long time collaborators.[132] These episodes show that Kennicott truly had the entire hierarchy of the HBC collaborating with him, from officers, to clerks and other support staff, to the native trappers and traders that worked with the HBC.

Kennicott's feelings on Indians reflected typical sentiment of the time, tending to view indigenous peoples as childlike, and he was prone to ranking

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[130] RKJ, January 9, 1860, in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 74.

[131] Kennicott to Baird, Fort Resolution, H.B.T., June 29, 1860 in Lindsay, *Modern Beginnings of Subarctic Ornithology*, 59.

[132] RKJ. January 2' 1862, concerning July 3, 1861, in James 84. He refers to Ba-keih-na-chah-te as "an excellent old fellow, the best and most intelligent Indian I have ever seen in the north." Names of native collaborators are spelled phonetically, as Kennicott recorded in his journal.

tribes based upon Eurocentric values.[133] He does not record the name or the tribe of many of his native collaborators, simply referring to them a nameless "savage," though the tribe name may be implied based upon location. Kennicott occasionally was frustrated when native hunters could bag a particular specimen, and he could not, especially if they declined his offer of buying it, grousing to Baird that "For all these rarities, big swan etc., I *offered very large prices but these D__d Indians always refuse to do just what you most want them to"*[134] Other than physical ability, the other attribute he discusses in his journal was the honesty, or lack thereof, of native peoples, praising those groups that "did not steal" and condemning those that did, in keeping with the contemporary American prejudice against Indians as disingenuous peoples. He also had a dim view of the morality of the Esquimaux, contrasting them with his rather 'noble' conceptualization of other northern and American Indian tribes, noting that while they were "far more clever and intelligent than the northern Indians…unlike the Louchioux Indians, who until taught by the whites never *steal*, [Esquimaux] are the greatest thieves I ever saw."[135]

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[133]Ibid.

[134] RKJ, May 27, 1859,in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 57, emphasis Kennicott's

[135] 'noble' in this context refers to the conceptualization of indigenous peoples as the 'noble savage,' an idea handed down from the early modern Europeans. Emphasis is Kennicott's. RKJ September 12, 1861, in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska,* 92.

Kennicott was not only collecting for the Smithsonian Institution in Hudson Bay Territory, of course. In addition to the Institution and other subscribers, Kennicott was collecting a set of specimens for his true "home" institution, the Chicago Academy of Sciences. Despite the abundant number of specimens sent to Washington, his end goal was always to build up the Chicago Academy along the lines of the way that Baird had the Smithsonian. After returning to the United States, Kennicott reminded his collectors that he would like for them to collect specimens for Chicago as well as the Smithsonian.[136] His collaborators amongst the Hudson Bay Company, by and large, agreed to help collect for the new Chicago institution as well as for Baird, sending everything first to Baird, and asking that the duplicates be made available to the Chicago Academy prior to other institutions.[137] Ross, perhaps the most concerned HBC officer with regards to his legacy in natural history, also asked Baird to send a duplicate set of the specimens he collected to the Natural History Society of Montreal.[138] All collectors, including Kennicott, recognized that all of the specimens would first go to Baird, who would then expedite the sending of duplicates to other subscribers and relevant institutions. There were two reasons for this, one logistical, the other scientific. Logistically, it was easier to send

[136] Kennicott to Macfarlane, Smithsonian Institution, Washington, D.C. April 15 1864, Robert Kennicott Papers, SIA RU 7072.

[137] James Lockhart to Spencer F. Baird, November 28 1864, Hudson's Bay Company Correspondence, SIA RU 561 folder 28.

[138] Ross to Baird, Fort Simpson, McKenzie River District, June 20, 1860 Hudson's Bay Company Correspondence, SIA RU 561 folder 36.

everything to one centralized location such as Washington, where specimens could then be forwarded by rail. Scientifically, Baird's expertise was needed to make sure all specimens were correctly identified, so that a duplicate set really was a duplicate set.

The biogeographic emphasis of Kennicott's work was greatly aided by the structure of the Company itself and reinforced by the mandarin-missionary strategy. By the time that Kennicott left Hudson Bay Territory, he had HBC officers collecting for him in at least five different HBC posts, form Moose Factory in Ontario to Fort Yukon in modern day Alaska, all of whom had been trained both in person by Kennicott and via correspondence by Baird. By collaborating and receiving feedback from Kennicott and. Baird, the men of the HBC became more experienced collectors and began to notice the variations in species that so interested Kennicott and Baird, and would become the focus of natural history in the late nineteenth century. In collecting at Fort Resolution, Lockhart wrote to Kennicott that the variation amongst fish would make one "almost swear that they were different species, and doubtless many of them are."[139] Meanwhile, Ross was examining Canadian Geese and attempting to discern how many distinct species of geese there were based upon external characteristics, eventually settling on four.[140] Macfarlane identified his bird

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[139] James Lockhart to Robert Kennicott, Fort Resolution June 26, 1865. Hudson's Bay Company Correspondence, SIA RU 561 folder 28.

[140] Ross to Baird, Fort Simpson, McKenzies River Nov. 10, 1860 Hudson's Bay Company Correspondence, SIA RU 561, folder 36.

specimens as best as he could from Audobon's *Birds of America,* and later with Baird's *Birds and Mammals of North America*; like Kennicott, what he could not identify was done via analogy based upon external characteristics.[141] The collectors of the HBC thus had come to the main question facing taxonomy in the mid to late nineteenth century: what distinguished a species from a variety? What exactly was a species? These questions came to a head in the late nineteenth century, as naturalists sought to reconcile observation with evolutionary theory. This would influence how collectors collected and will be discussed in the remaining chapters.

The two year extension that Kennicott and Baird sought from the HBC was approved and one gets the sense that Kennicott could have stayed in the hinterland almost indefinitely, leaving only due to the sickness of his father in 1862. After Kennicott's return to the United States, HBC officers continued to collect for the Smithsonian for another ten years, "until those who had been inspired by Kennicott retired from active service."[142] The volume of the collections decreased over time but this was not due to a waning enthusiasm for natural history, or even Kennicott's role as an advisor, as by 1863 the officers of the HBC were well trained collectors. Rather, the reason for waning collections was logistical; one less trained collector (Kennicott), and Kennicott's absence

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[141] Macfarlane to Baird, Fort Good Hope, July 28,1862, in Lindsay, *The Beginnings of Modern Subarctic Ornithology*,133-137.

[142] Dall, *The Biography of Spencer Fullerton Baird*, 335.

meant that by necessity the officers had to concentrate on their work for the company. Kennicott continued his correspondence with the HBC collectors, advising collection efforts in the Hudson Bay Territory from afar, reminding Macfarlane on how to best prepare specimens, asking him to collect shrews and getting his Indian collaborators to collect shells, sending advice on procuring specimens from the Institution's resident paleontologist, Ferdinand Meek, and collaborating with Lockhart to obtain more collectors in British America.[143] They returned the favor, keeping him abreast of the situation in the Hudson Bay Territory, and updating him on their collection activities, and teasing him on his return to the industrial lands of the United States.

Kennicott returned to The Grove, writing up reports on the fauna of the HBT and caring for his father. The elder Kennicott died early in June of 1863, and almost immediately Kennicott thought of returning north to finish his work in the Canadian Subarctic.[144] Kennicott visited the Smithsonian periodically over the next two years to work up his specimens and to prepare a report on the fauna of British America, though his insecurities in this regard are contained in a note to Macfarlane in April, where he referred to himself as "incompetent" for the task,

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143 Ibid, Kennicott to Macfarlane, April 15, 1864, Smithsonian Institution, Washington D.C. Robert Kennicott Papers, SIA RU 7072; Lockhart to Kennicott, December 5, 1864 & June 26 1865, Hudson's Bay Company Correspondence, SIA RU 561 folder 28.

144 A morose Kennicott wrote to Baird "Father is dead, he died this morning. Please tell Stimpson, Professor Henry, and [fellow Megatheria] Ulke." Kennicott to Baird, June 4, 1863, Spencer Fullerton Baird Correspondence SIA RU 7002 Box 3.

wishing Macfarlane and Lockhart to write it, and he would see it published.[145] He was asked to assume the role of head of the Chicago Academy of Sciences, which he accepted, though it did not become a salaried position until he was made the head of the Academy Museum late in 1863.[146] This allowed him the financial freedom to turn down an offer from Louis Agassiz to work at the Museum of Comparative Zoology, an offer he considered but found fortunate he did not have to accept.[147] Kennicott spent the better part of 1864 setting up the academy's museum along the lines of the Smithsonian, forwarding proposed museum guidelines to Baird for feedback.[148] He found setting up a museum tedious,

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[145] Kennicott to Macfarlane, Smithsonian Institution, Washington, D.C. April 29, 1863. Robert Kennicott Papers, SIA RU 7072.

[146] Kennicott to Baird, The Grove, November 16, 1862 and November 27, 1863. Spencer Fullerton Baird Correspondence, SIA RU 7002 Box 27, folder 2 and 4 respectively.

[147] For the deliberation over accepting the position from Agassiz, see Kennicott to Baird, October 25, 1863 and November 10, 16, and 18. Spencer Fullerton Baird Correspondence, SIA RU 7002 Box 27 folders 3 and 4 respectively. Professor Henry urged Kennicott to take the position, knowing there would be a salary at Cambridge, Kennicott demurred, preferring to stay at the Chicago Academy and work via correspondence with Baird. Stimpon's experiences with Agassiz while at Cambridge prior to working with Baird probably played a role in Kennicott declining Agassiz's offer – see Kennicott to Baird, November 18, 1863. Agassiz took Kennicott's decline gracefully and even help Kennicott raise funds for the new museum. Kennicott to Baird, February 15, 1864 Spencer Fullerton Baird Correspondence, SIA RU 7002 Box 27 folder 6.

[148] See Spencer Fullerton Baird Correspondence, SIA RU 7002 Box 27, folders 4 through 6.

however, and longed for a return to the field, complaining to Baird that "I get no time at all for natural history and scarce any for legitimate museum work."[149]

By the end of 1864, Kennicott planned to return to the Canadian subarctic, but was contacted by the Western Union Telegraph Company about organizing a scientific expedition to accompany the company expedition to Russian America. The goal of the Western Union Telegraph Expedition (W.U.T.E.) was to link telegraph communication networks in Europe and the America by stringing telegraph cable across the Bering Strait from Siberia to Russian Alaska, down the Pacific Coast into the United States, with the ultimate goal of stretching into China and Japan.[150] The reason for involving a scientific party may seem puzzling now, but the amalgam of scientific and corporate expeditions was fairly common place in the mid-nineteenth century, from the early railroad surveys (technically joint government-scientific parties for corporate gain) forward. Scientific institutions and naturalists benefited from this arrangement as it eased logistics and defrayed costs; corporations hoped to capitalize on publicity from scientific venues. In this instance, Western Union was looking for a naturalist that knew the territory, and Kennicott was the obvious choice given his previous work in the subarctic. Kennicott readily agreed,

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[149] Kennicott to Baird, Chicago, Ill. September 26, 1864 Spencer Fullerton Baird Correspondence, SIA RU 7002 Box 27 Folder 7.

[150] "Statement of the Origin, Organization and Progress of the Russian-American Telegraph, Western Union Extension, Collins' Overland Line, Via Behring Strait and Asiatic Russia to Europe to Stockholders." Rochester New York, May, 1866.

provided that he was able to choose the scientific party to accompany him, selecting his Chicago Academy of Science compatriot Henry Bannister, botanist J.T. Rothrock, and budding naturalists William H. Dall, Henry W. Elliott, Ferndinand Bischoff, and Charles Pease, the grandson of Kennicott's old mentor Jared Kirtland.[151] Logistics of the expedition were handled by the telegraph company, leaving the scientific party responsible only for their scientific supplies. Money for these was raised by the Smithsonian and the Chicago Academy of Sciences, with the understanding that the institutions would split the specimens collected.[152]

Baird and Kennicott arranged for Kennicott's fellow Megatheria, William Stimpson, to take over the stewardship of the Chicago Academy of Sciences in Kennicott's absence while Kennicott hurriedly prepared for a second trip to the subarctic, corresponding and collaborating with the survey's leader, Colonel Charles Bulkley. Bulkey had been in charge of the military telegraph system in the Southwest until tapped by Western Union due to his "ingenuity, untiring perseverance, and complete knowledge of telegraphy."[153] It was decided that the members of the scientific party would be given *faux* military ranks for the

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[151] James, *The First Scientific Exploration of Russian America and the Purchase of Alaska,* 13-14

[152] Ibid, 13.

[153] "Statement of the Origin, Organization and Progress of the Russian-American Telegraph, Western Union Extension, Collins' Overland Line, Via Behring Strait and Asiatic Russia to Europe to Stockholders." Rochester New York, May, 1866, 13.

expedition, the assumption being that this would attract respect and cooperation from the both the Russians who had settled in Alaska, and those staffing small forts there.[154] Kennicott was "given" the rank of Major, signifying he was second in command behind Bulkley, with his scientific assistants given the rank of Lieutenant. The party got left New York on March 21, 1865 with the plan to Alaska via Central America and San Francisco.[155]

Kennicott was ebullient to be back in out in the field, going ashore in Nicaragua as soon as possible in order to collect, often taking Dall, Elliot, and Bannister with him.[156] He wrote Baird from San Juan de Nicaragua (modern Greytown) that they would collect specimens on their way across the isthmus and commenting on the biological richness of the tropics.[157] The scientific party spent two weeks in Nicaragua, one week of that dedicated to crossing the isthmus via

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[154] Kennicott to Baird, Russian America, September 9, 1865. Western Union Telegraph Expedition Papers, SIA RU 7213 Box 1 (Kennicott). Kennicott did not serve in the Civil War, as James reported in *The First Scientific Exploration of Russian American and the Purchase of Alaska*, 46 (plate). He was drafted for the army in 1864, but purchased a substitute. See Kennicott to Baird, Chicago, Ill. September 26, 1864, Spencer Fullerton Baird Correspondence, SIA RU 7002 Box 27 Folder 7.

[155] Even prior to the building of the Panama Canal, it was common to reach the west coast of the United States by sailing to Central America, taking a trans-isthmus train or boat, and then sailing to San Francisco, and then onward to one's ultimate destination. The transcontinental railroad would lessen the need for this circuitous route four years later.

[156] "Journal of Henry Bannister," April 2-6, 1865 in James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 143-144.

[157] Kennicott to Baird, San Juan del Norte (Nicaragua), April 3, 1865. Western Union Telegraph Expedition papers, SIA RU 7213 Box 1 (Kennicott).

river and road, collecting as they went. Kennicott advised Baird that Baird "would be delighted to have some naturalist spend a season on the transit," suggesting Baird find someone to do so sooner rather than later.[158] He also continued his habit of meeting with local nature enthusiasts and recommending them to Baird, discovering a Mr. Holland, an American in Greytown, who was looking at serpents.[159] His recruiting for the Smithsonian continued in San Francisco and especially Victoria, where he urged Baird to enter into correspondence with two gentlemen who promised Kennicott they would collect for the Smithsonian.[160] Kennicott was back in his element after taking the better part of three years away from field biology, and morale amongst the scientific party was high as they steamed slowly towards San Francisco.

From that point forth, the W.U.T.E. beset with difficulties, and despite Kennicott's rosy outlook when the party left New York in the spring of 1865 and the congenial relationship he had with Bulkley, Kennicott was soon discouraged at the state of affairs on the expedition. Upon arriving in San Francisco in late April, the true logistical ambition of the expedition was exposed, and Kennicott battled with Bulkley over the route the telegraph line would take, as well as the role of the scientific party. Kennicott had hoped to form a mobile scientific party

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[158] Kennicott to Baird, Steamer off of Cape St. Lucas (Cabo San Lucas) Cala, April 19, 1865. Western Union Telegraph Expedition papers, SIA RU 7213 Box 1 (Kennicott).

[159] Ibid

[160] G.H. Wilson Brown, and Frederick Dally (?). Kennicott to Baird, Victoria, Vancouver Island, July 28, 1865.

to explore the Yukon consisting of up to fifty individuals, made up of his own colleagues and telegraph employees, but had to be satisfied with two smaller parties. Worse yet for Kennicott, half of his handpicked party, Bannister, Elliot, and Rothrock, were assigned to head straight to Northern British Columbia to accompany the main telegraph line construction force.[161] In retrospect, this was probably the best thing that could have happened with regards to the scientific endeavor of the overall expedition, as it allowed the beginning of field collection while the rest of the party finalized its plans in San Francisco. However, for Kennicott, this was extremely frustrating, and he stewed in San Francisco, growing more agitated with every delay. Kennicott was less upset with Bulkley – whom he respected and found enthusiastic – than with executive decisions handed down from the company, or with the men at Bulkley's command. He distressed over Bulkley's personnel decisions, and believed that the colonel's "subalterns" were jealous of him and prone to starting rumors, send telegrams to the company aimed at clearing his name if the expedition fell apart.[162] Due to the debate over the route to be taken, a lagging of supplies, and a surge of men wanting to work on the expedition, the enterprise was delayed in San Francisco, which Kennicott

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[161] James, *The First Scientific Exploration of Russian America and the Purchase of Alaska,* 14

[162] Kennicott to Baird, San Francisco, Cala., June 4, 1865. Western Union Telegraph Expedition papers, SIA RU 7213 Box 1 (Kennicott).

came to see as "an immense money-grubbing establishment."[163] The delay lengthened when Kennicott suddenly became ill, suffering what has been described as a mild heart attack due to his history of poor health and the anxiety relating to the expedition, furthering the delay. His spirits, and his health, would never truly recover.

Even as Kennicott grew more suspicious, perhaps even paranoid about the motives of the non-scientific members of the expedition, the majority of his anxiety was due to his dissatisfaction with the scientific portion of the expedition. Prior to embarking on the endeavor, he remarked to Baird that the financial support of the Chicago Academy was based solely on the prospect of the collection of specimens, and that they had been assured by the company that would be the case.[164] He was able to mentor the younger collectors on the voyage, especially Dall and Bannister, and helped develop Captain Charles M. Scammon, a whaler interested in natural history in employ of the telegraph company, into a collector for the Smithsonian. He was less successful with other telegraph personnel on the expedition, due to the rivalries mentioned above. Additionally, once in the field, the main body scientific party found its mobility limited, and they were required to stay fairly close to the telegraph line construction party. While this was fairly standard for many expeditionary amalgams with regard to

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[163] Kennicott to Baird, Victoria, Vancouver, July 23, 1865. Western Union Telegraph Expedition papers, SIA RU 7213 Box 1 (Kennicott).

[164] Kennicott to Baird, Chicago, Ill., January 25, 1865. Spencer Fullerton Baird Correspondence, SIA RU 7002 Box 27 Folder 8.

science and corporations, Kennicott chaffed under the limitations he felt imposed upon him. That he felt this way was understandable; he had set his own research agenda in British America with loose oversight from Baird, and prior to that he was collecting more for his own education than anything else. This was his first real experience both at leading an expedition as well as working within a system of command, and his need for independence served him poorly.

His frustration with the expedition only grew as the expedition finally left San Francisco on July 12, 1865. He was forced to split his scientific party again, with Dall leading a party that traveled directly to Sitka, while Kennicott had to stop in Victoria, Vancouver, for more supplies. The productivity he felt in the tropics steadily eroded, and he wrote to Baird on July 23rd complaining that "a summer is gone" and the inordinate delay made him "sick disgusted, & almost disheartened…D___ all corporations!"[165] He well aware of the obstacles faced in the north, knowing it was a short time until the weather would make collection as well as the construction of the line almost impossible, and questioned Bulkley's understanding of the direness of the situation. Bulkley, in the meantime, was attempting to get the rest of the expedition north, and was also frustrated with the delay, a fact that Kennicott missed in his own anxiety. Kennicott concluded his letter to Baird "I have determined not to go back until I have done something for

[165] Kennicott to Baird, Victoria, Vancouver, July 23, 1865. Western Union Telegraph Expedition papers, SIA RU 7213 Box 1 (Kennicott).

Natural History! …I don't like reporting failures…If I get back this will be my last trip under anyone's command."[166]

Once in Russian America, the logistics of the expedition continued to plague the entire endeavor, and the scientific party was forced to wait inside Russian America for supplies leading Kennicott to rage to Baird "I am going to succeed fully, by God, if it is only to punish those who have been in the cause of this absurd outfit which is furnished me."[167] It was not just the scientific party that suffered, however, the logistics were a nightmare for the entire expedition, due in part to the long distance supplies had to be shipped, the size of the expedition – well over five hundred members, counting all of the workers, and the lateness of the season. The largest logistical factor, however, was ignorance: the leaders of the company and the expedition were engineers and veteran electricians and telegraph men, not explorers, and were unfamiliar of to the obstacles of the subarctic. Kennicott was the only person within the leadership of the expedition with any real experience in that region of the world, and he was unable to help others see the practical problems which awaited them. As a result, the expedition faced hardships with regard to climate and provisions, greatly affecting morale.

His solution was to try and do everything, which left him at exhausted, and undermined whatever authority he had amongst the telegraph men: non-

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[166] Ibid.

[167] Kennicott to Baird, St. Michel Norton Sound, Russian America, September 16, 1865. Western Union Telegraph Expedition papers, SIA RU 7213 Box 1 (Kennicott).

scientific personnel attached to his expedition found him indecisive and wondered about his mental health.[168] He found the Russians based in Alaska to be lazy, uninspired, and prone to drinking, and the lack of collaboration between the expedition and the Russians led to further delays. Reaching Nulato, a small trading post on the Yukon River, he planned to test a geographic hypothesis, attempting to confirm the Yukon was the same river the Russians referred to as the Kwikpak, though his plan to navigate up the river in a small steam powered craft went awry due to the boat's total unseaworthiness.[169] In early December, he finally managed to get the party to a locality where he felt it could succeed, noting to Baird that the region was a good one for study if it were logistically supported, and his "opinion of success [was] the same as it was at New York." He and his party set up winter camp in Nulato, prepping for an ascent of the river in the spring.[170] His physical constitution, which had plagued him from childhood, rapidly deteriorated over the winter, and according to Bannister, he felt ill for several weeks at the end of April of 1866 and the beginning of May. He showed a brief improvement at the return of one of his smaller expeditions, and went out a short distance to reconnoiter on the 13th of May; he was found dead later that day

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[168] Rosemary Neering, *Continental Dash: The Russian American Telegraph*. Ganges, B.C.: Horsdal and Schubert, 1989, Chapter 18.

[169] James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 15-16, especially note 1.

[170] Kennicott to Baird, Nulato, Russian America, December 5, 1865. Western Union Telegraph Expedition papers, SIA RU 7213 Box 1 (Kennicott); James, *The First Scientific Exploration of Russian America and the Purchase of Alaska*, 16.

along the bank of the Yukon River, to the distress of his colleagues.[171] Dall arrived back in the area in September, and after being understandably crushed, succeeded Kennicott as leader of the scientific corps. Under his direction, the mapping of the Yukon was completed, confirming Kennicott's hypothesis. Dall would work on the W.U.T.E. for another two years until it was abandoned. The ambitious plan met its end in not in the Alaskan wilderness, but in the successful laying of the transatlantic cable in 1866.

Kennicott's career, while exceptional, followed a track that was symptomatic of many of America's collectors and naturalists in the late nineteenth century; starting as an enthusiast, collecting specimens that interested him, attaining a collaborative relationship with a scientific mentor, becoming a scientific collector, and progressing to become a scientist in his own right.[172] The last step, to which many of Baird's protégés progressed, eluded Kennicott not due to a lack of talent, vigor, or even possibility, but rather due to his early death in the Alaskan hinterland. Kennicott did more to increase collection for the Smithsonian than any of Baird's other early collectors by contacting Baird about potential correspondents and collectors, inspiring those who were already

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[171] Bannister to Baird, On Board the Ship Nightingale, October 12, 1866. Western Union Telegraph Expedition papers, SIA RU 7213 Box 1 (Bannister); The cause of Kennicott's death would remain a mystery until 2001, when his body was exhumed and it was discovered that he died of a heart attack.

[172] The careers of Frank Stephens, Edward Nelson, F.V. Hayden, J.S. Newberry, William Stimpson, and Vernon Bailey all followed similar arcs. For Stephens and Nelson, see chapters 3 and 4 respectively. For Bailey, please see Robert Kohler "From Farm and Family to Career Naturalist: The Apprenticeship of Vernon Bailey." *Isis*, 2008, 99: 28–56.

interested to collect, and encouraging those that had already started collecting to increase their efforts at the behest of the Smithsonian. To return to the conceptualization of naturalists as scientific mandarins, and their collectors as scientific missionaries: was the master missionary, whose democratic ideas about the practice of science allowed him to convert nature enthusiasts into true collectors, bringing them into one of the largest correspondence and collection networks in nineteenth century American science. In the case of HBC collectors, he was able to capitalize on the relative neglect given to them by the British Scientific establishment, and harness their potential for the Smithsonian Institution.

B.R. Ross and W.H. Dall cannot be truly considered converts to the cause of natural history, of course, but their experiences with Kennicott had profound effects on their careers. Ross became the largest collector of specimens for the Smithsonian from British America, with the exception of Kennicott himself. The career of Dall would be Kennicott's final contribution to science, since he served as a mentor to Dall in the way that Baird did for Kennicott. Dall would take his experiences on the W.U.T.E. and make them the basis for his long career, joining the United States Coast Survey, becoming an expert in Arctic biology and America's foremost invertebrate paleontologist, concluding his brilliant career by joining the Harriman Expedition to Alaska in 1899.

Baird was the most influential American naturalist of the nineteenth century, whose work on the reports of the railroad surveys and position as the assistant secretary of the Smithsonian advanced him into the realm of the eastern scientific mandarin class, but of course could not be everywhere at once. Instead, he relied on training scientific missionaries, such as Kennicott, that branched out across North America, ensuring a constant flow of specimens into the Smithsonian for study, turning the Institution, despite its relative lack of funding, into one of the main centers of systematic natural history in the United States. Kennicott was a case of a scientific missionary par excellence, and his collaboration with Baird is perhaps the best example of the "mandarin-missionary" collection strategy in nineteenth century natural history. Of all of Baird's collectors, he had the largest influence on the development of the Smithsonian as a center for systematic natural history in the mid nineteenth century due to his ability to help inspire others to collect specimens, to join in an idealistic quest for scientific knowledge. In the case of the Hudson Bay Company, Kennicott was able to utilize the hierarchy of the company to turn the company into a massive specimen collection venture, and his relationship with the officers of the HBC assured that those specimens would travel south to Washington, not east to London. The specimens that resulted from this venture would be crucial in Baird's systematic construction of a holistic pan- American natural history.

Kennicott's collections from British America, coupled with those from official government expeditions in the 1840s and 1850s, and the dynamic leadership of Spencer F. Baird, turned the relatively young Smithsonian into the center of American natural history by the end of the Civil War. The emphasis on biogeography and geographic variation in the work that he and other American collectors did prior to the transmission of Darwinian evolution laid the groundwork for the widespread acceptance and use of evolutionary systematics by the vast majority of American naturalists by the late 1860s. Natural selection as a mechanism may have been questioned, but outside of Louis Agassiz and a few others, evolution was not; thanks to their correspondence and collection networks, American naturalists had compiled fifty years of pan-continental data that showed substantial variation amongst organisms and allowed them to induce relationships between closely related species. Kennicott's work in the north was invaluable to this process, as it allowed Baird and other naturalists to compare variations not only in the United States, but across all of North America. The transition within natural history leading to the embrace of evolutionary systematics would reach its completion with the efforts of another Baird protégé, C. Hart Merriam.

Chapter 3. Frank Stephens: From Amateur Collector to Local Expert

Frank Stephens has been often been described as a frontier or pioneer naturalist. As was mentioned in the previous chapter, pioneer naturalists played an extremely important role in late nineteenth century natural history, both in describing new specimens and what would now be referred to as ecosystems, as well as acting as correspondents to more academic systematic naturalists of the eastern scientific establishment. Like most pioneer naturalists, he had received little training or schooling in natural history, and the pursuit of natural history remained a part-time pastime into the twentieth century. He was able to ride the wave of growing cultural interest in natural history, collecting for private collectors, specimen dealers, and academic naturalists. In the early years of his scientific career, before turning to natural history as a full time endeavor, he can be accurately be described as a systematic collector who was employed by the leading ornithologists and mammalogists of the day: William Brewster, C. H. Merriam, and Joseph Grinnell.

In addition to his importance as a specimen collector, Stephens represents an important cog in the production of natural historical knowledge in the late nineteenth and early twentieth century – the local expert. Stephens' role as a collector was enhanced given the area in which he worked in; the biota of the southwestern United States, while not scientific *terra incognita*, was not well understood in the late nineteenth and early twentieth centuries. Stephens lived and collected specimens in southern California for over sixty years, and for much of that time was the most experienced collector and naturalist in the region, writing an acclaimed study of California mammals in 1906. As such, he was an indispensible resource for private collectors and systematic naturalists alike, and their feedback in turn made him a more scientific collector and a more systematic amateur naturalist in his own right.

Stephens, along with Edward W. Nelson and Vernon Bailey, was one of C.H. Merriam's most important collectors, even prior Merriam's employment in the U.S. Department of Agriculture. Unlike Nelson and Bailey, however, Stephens never joined the U.S. Biological Survey (USBS), or its direct predecessor, the Division of Economic Mammalogy and Ornithology.[1] He would however, continue to be one of the Division's most valuable collectors from afar, and was seamlessly integrated into official expeditions of the Division in the Southwest, directly taking part of the Death Valley Expedition of 1891, and serving as an advisor for Nelson's trips into Mexico with E.A. Goldman.[2] Later he would join numerous collection trips organized by the newer Museum of Vertebrate Zoology in Berkeley, and serve as Joseph Grinnell's main collector and advisor on the fauna of San Diego and Imperial Counties. An active member of the San Diego Natural History Society, he would become the first true Curator of the San Diego Museum of History and would later become director of the San

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[1] The Division of Economic Ornithology and Mammalogy was established in the U.S. Department of Agriculture in 1885. While it was not renamed the Bureau of the Biological Survey until 1895, it had long since referred to itself that way, and had been referred to as the Biological Survey.

[2] See Chapter 4.

Diego Zoo. As a collector he specialized mostly in birds and mammals, though in his brief autobiography for the western ornithological journal *The Condor* in 1918, he noted that he was initially more interested in botanical work, even though he spent little effort on botany during his career.[3]

In comparison with Robert Kennicott, or Vernon Bailey, both of whom were collecting specimens in their late teens and early twenties, Stephens got a relatively late start in natural history. Stephens was born in New York in 1849, and moved with his family to Michigan when he was thirteen. With the shortage of agricultural labor due to the Civil War, he worked full time in his family's fields from the time he was fifteen. As with many other young Americans the need for him on the farm forced him to leave school permanently, though he continued to be an avid reader, devouring books that focused on natural history.[4] His next step in his informal training in natural history was to take lessons in taxidermy after moving to Illinois in his early twenties, though Stephens was often frustrated by what he saw as subpar results.[5] Despite his early troubles, the desire to improve was there, and his skills gradually improved due to collaboration with a succession of naturalists.

After marrying his first wife in 1874, Stephens started a slow, haphazard migration to the west coast. In Colorado Springs, he met Charles E. Aiken, a

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[3] Frank Stephens, "Frank Stephens – An Autobiography" *The Condor,* vol. 20 (1), 165.

[4] Ibid.

[5] Ibid.

fellow taxidermist, amateur ornithologist, and local expert on the fauna of Colorado.[6] Aiken instructed Stephens on how to improve his skill with regard to collecting and preparing bird skins, and was the first to employ Stephens as a collector, offering to purchase skins that Stephens proposed to collect in New Mexico and Arizona. Stephens and his wife spent over a year in Arizona, "more or less" focused solely on collecting bird skins, before troubles with the Apaches led them to quit the state.[7] The young couple moved to California in the late fall of 1876, and settled in the Campo region of San Diego County. Although Stephens would travel extensively on collection trips, he would live in Southern California for the rest of his life, splitting his time between agriculture and the collection of specimens.

Stephens continued his collecting relationship with Aiken into the early 1880s, which provided Stephens with more practice on collection as well as provided Aiken with specimens from Southern California, allowing Aiken to branch out from just examining birds of the mountain and desert west. A new opportunity arose for Stephens in 1881 when he was employed to collect bird specimens in southeastern Arizona by William Brewster, of Harvard's Museum of Comparative Zoology. Presumably Brewster contacted Stephens to do so via the

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[6] Frank Stephens, "Frank Stephens – An Autobiography," 165; "Charles E. Aiken Papers Finding Aid" Colorado College Library Special Elections, accessed March 10, 2011, http://www.coloradocollege.edu/library/specialcollections/Manuscript/Aiken.html.

[7] Frank Stephens, "Frank Stephens – An Autobiography," 165.

Nuttall Ornithological Club of which both were members; though it is possible Stephens may have been recommended by Aiken or another naturalist. [8] Whichever the case, this was the Stephen's first opportunity to collect for a truly systematic naturalist.

Stephens spent his time collecting for Brewster in southern Arizona, following a list of localities that Brewster had previously suggested, and was paid by Brewster by the specimen rather than receiving a monthly stipend or salary. As was explained in Chapter 1, this was fairly ubiquitous for collection efforts in the late nineteenth century, especially relatively new collaborative efforts such as the one between Brewster and Stephens. Stephens was a determined and enthusiastic collector; by early April he had not only sent a box of specimens to Brewster, but he had already prepared enough to send a few more off in short order. Unfortunately, his insecurities with collecting bird skins resurfaced after being informed by Brewster that his first submission had arrived in poor condition, though he resolved to take better skins and take more care in packing them.[9] While only self educated in natural history, he was experienced enough to

[8] The Nuttall Ornithological Club predated the American Ornithologist's Union by 12 years; many naturalists and collectors were members, and naturalists often used this and other clubs as a way to form new collecting contacts.

[9] Frank Stephens to William Brewster, April 10, 1881, Museum of Comparative Zoology Archives, Ernst Mayr Library, Harvard University.

ask Brewster questions – and by extension – inform the naturalist on the distribution of bird species.[10]

In addition to his role as a collector in Arizona, Stephens was able to provide Brewster information on the distribution of birds in his adopted home state of California. At the time, the most respected and experienced naturalist that focused on the biota of California was Dr. James Cooper, former collector and protégé of Spencer F. Baird, veteran of numerous western surveys, and one of the founding members of the California Academy of Sciences. Stephens communicated his dissatisfaction with the work of Cooper with Brewster, arguing that Cooper "jumped to conclusions often" and doubting his inferences with regard to the distribution of bird species in California's Mojave Desert. Stephens had lived and worked both in Riverside and eastern San Diego County in agriculture, with his spare time devoted to collecting specimens for Aiken, and disagreed strongly with Cooper's assertions on the distribution of the genus *Harporhynchus* in the region.[11] By providing first hand observational data about birds throughout the Southwest, Stephens gave was able to supplement Brewster's knowledge of the region (he had collected their previously himself) and to provide access to localities that Brewster had not previously examined.

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[10] Ibid.

[11] Stephens to Brewster, April 22, 1881. Museum of Comparative Zoology Archives, Ernst Mayr Library, Harvard University; this genus name is no longer in use, and the birds have been reorganized throughout the current family Mimidae. Stephens was specifically doubting the distribution of the LeConte Thrasher then known as *Harporhynchus lecontei* and now identified as *Toxostoma lecontei.*

While roving the deserts of Eastern Arizona and collecting specimens, Stephens was careful to keep a journal, for field notes, observations, and localities. Even though this was his first systematic collecting outing, Stephens' notes are surprisingly detailed, not only describing his specimens and observations of birds, but also describe the physical geography of the region in detail. Stephens clearly noted what species he had observed, their frequency, their locality and surrounding physical geography and if it was the first time he observed a particular species in the region. Brewster used the data provided by Stephens to publish his findings regarding Arizona birds in the *Bulletin of the Nuttall Ornithological Club* in 1882 and 1883.[12] While a rather standard note about the findings of his collector, wither regard to breeding period, diet, and variation, Brewster made sure to also include Stephen's notes regarding geographic distribution of species, including Stephen's note on the apparent coextensive range of Malherbe's Flicker (*Colaptes chrysoides)* with the Giant Saguaro Cactus.[13] Now known as the Gilded Flicker, this bird nests exclusively in the cactus; given that Brewster made a note of it in the preeminent ornithological journal of the day, the relationship between the species was still being determined, demonstrating how much of a scientific hinterland the

[12] William Brewster, *Bulletin Nuttall Ornithological Club*, volume VII and VIII.

[13] Brewster, *Bulletin Nuttall Ornithological Club* 1883, 24.

southwest was in the late nineteenth century, despite the earlier efforts of Elliot Coues and E.A. Mearns.[14]

While Brewster hoped to have Stephens in the field until autumn of that year, Stephens demurred, noting that while he would love to do so, he would have to decline based upon the "unhealthfulness" of the climate.[15] His trip back to California was not without strife crossing the desert in the heat of summer, and Brewster noted in the *Bulletin* that Stephens was largely unable to collect birds on his return transit.[16] This was to be the end of the collaboration between Brewster and Stephens, though the exact reason why it ended is not currently known. However, the collection trip into southeastern Arizona established Stephens as a regional collector of importance, and while the collaboration with Brewster was at an end, Stephens would soon enter into a lifelong collaborative effort with C.H. Merriam.

C.H. Merriam was a doctor by profession and education, though he had chosen this field so as to focus as much of his efforts as possible on natural history. He had been on the Hayden expedition to the Yellowstone in 1872, and had shown considerable promise as a young naturalist, working as an assistant to Spencer F. Baird with the U.S. Fish Commission in 1875, and again on the

[14] Both Coues and Mearns were disciples of Baird and physicians in the military. Coues became an expert on Birds, and Mearns would serve as the chief naturalist of many surveys, including a border survey with Mexico and Theodore Roosevelt's African Expedition.

[15] Stephens to Brewster, April 22, 1881. Museum of Comparative Zoology Archives, Ernst Mayr Library, Harvard University.

[16] Brewster, *Bulletin Nuttall Ornithological Club 1883*, 66-67.

commission to work out sealing concerns between the United States and British America from 1881-1883. A protégé of Baird's, Merriam was a member of the Nuttall Club, and was one of the founders of the new American Ornithologists Union in 1883. By the early 1880s, Merriam had developed an extensive correspondence network with collectors across the United States, including Stephens, Vernon Bailey, and Edward W. Nelson. How Stephens and Merriam got in contact with one another is not known, though it may have been through the Nuttall Ornithological club. Stephens was certainly collecting for Merriam prior to 1885, when he offered Merriam a discount on specimens as an "old customer."[17]

By this point in time, Stephens, who had joined the AOU as a correspondent in 1883, was already augmenting his agricultural income by collecting specimens for Southwick and Jencks' Natural History Store.

[17] Frank Stephens to C.H. Merriam, May 24, 1885. C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 82, Bancroft Library, University of California, Berkeley. Establishing initial contact between Merriam and his collectors is a tricky proposition, since Merriam entered into relationships with his collectors prior to working at the U.S Department of Agriculture in 1885, and little in the way of correspondence has been saved regarding these contacts. For example, the first contact between Vernon Bailey and Merriam that is available in the C.H. Merriam papers at the Bancroft Library at U.C. Berkeley is from 1885; this is used to determine the beginning of their collaboration by Robert Kohler in "From Farm and Family to Career Naturalist: The Apprenticeship of Vernon Bailey" (*Isis*, 2008, 99:28-56). However, in his short biography of C.H. Merriam, Wilfred Osgood, who worked with Merriam as a member of the United States Biological Survey, notes that Bailey and Merriam were corresponding with each other as early as "about 1883." "Biographical Memoir of Clinton Hart Merriam: 1855-1942" *National Academy of Sciences of The United States of America Biographical Memoirs*, Volume XXIV.

Southwick and Jencks' was one of many specimen dealers similar to Ward's Natural Science Establishment that opened for business in the post-Civil War period.[18] While Southwick and Jencks' primarily focused on stocking and selling the fauna of their native Rhode Island, purchasing specimens from the southwest was no doubt seen as part of an ambitious growth plan, given the relative scarcity of southwestern specimens in many private and academic specimen collections. Stephens, who had now spent almost ten years collecting in Southern California, would have been an obvious choice to help them collect specimens from the region, especially with regard to birds and small mammals. The purveyors of the Natural History Store were also in constant contact with Brewster and Robert Ridgway, the curator of birds at the United States National Museum, so it is possible that Stephens was able to network with eastern naturalists such as Brewster and Merriam through his contacts with Southwick and Jencks'.

This may very well be the case with Merriam, given Stephens' correspondence of May 24, 1885: "According to our agreement with Southwick and Jencks I shall furnish them with such mammals as I can procure here and I have agreed to retail such mammals at their prices, I can allow you but a 10%

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[18] Natural history became increasingly fashionable in the post-Civil War period due to changing conceptions of leisure time, as well as imported conceptions of fashionable hobbies for the middle classes from Great Britain. See Chapter 1. For more on specimen dealers in the late nineteenth century, please see Mark V. Barrow, Jr " The Specimen Dealer: Entrepreneurial Natural History in America's Gilded Age" *Journal of the History of Biology*, Vol. 33, No. 3 (Winter, 2000): 493-534.

reduction from their list prices."[19] A letter three weeks letter seems to confirm not only the role of "S & J" in the early stages, but also Merriam's determination to utilize Stephens as a collector in his new position at the USDA. Stephens noted:

> "I know my prices are high, but as my agreement with Southwick and Jencks covers all things mutually handled, I have no option…I don't know where to get the Avricolas as they are not common here at present, in any locality I know of. Will try for them the first opportunity and if I get them will make a price for them. As S & J do not handle skulls or alcoholics (as far as I know) I am at liberty to make such prices as I please one them." [20]

Whether the two were able to begin their collaboration with the help of Southwick and Jencks for certain is impossible to say; the collaboration itself, and the impact it would have on Merriam's work at the USDA and on Stephens' development as a systematic collector, is of the most importance to the current study.

At the latest, Stephens started collecting for Merriam in conjunction with his collection for Southwick and Jencks' in late 1884 as he sent a box of mammal skins to Merriam early in January, 1885. Stephens asked Merriam to not only positively identify all of the skins –presumably to the subspecific level – but also to provide feedback on the preparation of the skins themselves.[21] Having Merriam specifically or subspecifically identify the specimens was of paramount importance to Stephens. Later correspondence shows that he was adept at

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[19] Frank Stephens to C.H. Merriam, May 24 1885. C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 82 Bancroft Library, University of California, Berkeley.
[20] Frank Stephens to C.H. Merriam, June 17 1885, Ibid.

[21] Stephens to Merriam, San Bernardino Ca, Jan 4, 1885, Ibid.

identifying specimens to the generic or even specific level, but affirmation or correction would help him become a more accurate, and therefore, valuable collector – if not for Merriam, than for specimen dealers such as Southwick and Jencks', or other naturalists. There were also ancillary details such as transportation costs to be worked out, in addition to price per specimen.   As was demonstrated in the correspondence above, Stephens' rates were not inexpensive, but as witnessed by his concurrent collaborations with E.W. Nelson and Vernon Bailey, Merriam cared much more for well prepared specimens than the cost involved in attaining them. While not himself overly wealthy, Merriam's practice, and later his government salary and operating expenses, were adequate to the task of paying collectors for their efforts, especially since collectors such as Stephens may have received between ten to twenty dollars a month for their efforts, and were paid by specimen rather than a monthly salary.

To say that Merriam had a profound impact on Stephens' development as a systematic collector would be an understatement. The appointment of Merriam to head the Division of Economic Ornithology and Mammalogy (DEOM) in the Department of Agriculture in 1885 led to a twenty year collaborative relationship between the naturalist and Stephens, during which Stephens collected almost exclusively for Merriam. Stephens only accompanied one large DEOM expedition, the 1891 Death Valley Expedition, but was nevertheless one of Merriam's most reliable and trusted collectors. Working with Merriam provided Stephens with a state of the art, if informal, training in natural history.   At the beginning of their association, Stephens was primarily a collector of birds. Partially due to his own increasing interest in mammals, Merriam immediately suggested that Stephens collect mammal specimens in addition those of birds.[22] Stephens would later regard his work researching the mammals of California a direct result of this initial prodding to become a more complete collector by Merriam, and it is notable Stephens' definitive study on California animals focused mammals, not birds.[23]

Merriam and Stephens managed to work out most of the variables with regard to collection of specimens early in 1885, and later that year Stephens underwent his first small specimen collecting expedition for Merriam, a weeklong trip to the Mojave Desert at the beginning of October to trap small rodents. Merriam had agreed to pay Stephens $1.50 a day, plus a quarter per rodent skull, plus expenses.[24] While the trip was not a terribly productive one – Stephens only captured five specimens in that week – it would be the first in many such excursions that Stephens would undertake for Merriam and the Department of Economic Mammalogy and Ornithology. The relative lack of specimens collected by Stephens was probably more due to time on the ground than relative

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[22] Frank Stephens, "Frank Stephens – An Autobiography" *The Condor*, vol. 20 (1), 166; Merriam focused increasingly on mammals throughout the rest of his career, and engaging Stephens to collect mammals from the southwest meant that he could kill two birds with one stone.

[23] Ibid.

[24] Stephens to Merriam, San Bernardino Ca, September 30 and October 12, 1885, C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 82 Bancroft Library, University of California, Berkeley.

skill, since the number of rodents trapped varies with the time spent in a region, as well as the number of traps, as well as variables beyond the control of the collector such as weather and animal behavior. It certainly was not a large concern to Merriam, who paid Stephens a bit over and above what Stephens requested for the trip and expenses.[25] Merriam probably thought the money well spent, perhaps not so much on specimens, but on the further development of Stephens as a collector. While the expedition was, at least in part, a test of Stephens' skills as a collector, it was also an investment in future specimens. While Merriam's collection network included pure amateur collectors such as the Brinkley brothers and Ira Henry (a Methodist preacher from Macon Co., Texas), he truncated correspondence and orders from collectors when he they no longer served his needs with regard to quantity, locality, and quality of specimens.[26]

Merriam's confidence in Stephens was high enough to start consulting with Stephens with regard to distribution and locality of species in the spring of 1885, when Merriam inquired with regard to the types of foxes found in San Diego County.[27] Stephens also offered feedback on variation and distribution without having to be encouraged to do so; the ability to do this, even if his

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[25] Stephens to Merriam, October 12, 1885, Ibid; this is not noted in the letter itself, but rather in Merriam's note on the letter; he remitted $18 to Stephens after Stephens submitted receipts for $16.55

[26] See Ira Henry Correspondence, C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 60 Bancroft Library, University of California, Berkeley.

[27] Stephens to Merriam, April 30, 1885. C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 82 Bancroft Library, University of California, Berkeley.

identifications and observations were not always borne out by further analysis by the more experienced Merriam, made Stephens a more valuable collector. As important to Merriam as the feedback on specific species in Southern California was Stephen's practical experience as a specimen collector and the feedback he could provide not just on selecting possible localities for his own collection trips, but for Merriam's official expeditions under the aegis of the Department of Agriculture.

A case in point: in August of 1885, Merriam wrote to Stephens about the feasibility of Stephens undertaking a long collection trip back to Arizona and New Mexico, to collect Prairie Dogs and other small mammals and birds. Stephens replied on the 24th of the month, discussing in detail the financial and logistical factors involved in such a trip, also reminding Merriam that he might not be able to be in the field for the entire agricultural season:

> "You ask what I think of the chances of one's getting enough mammals to repay the outlay, if you could purchase of dealers or collectors all of the species that one would be likely to get on say a two months trip, you could get them at less expense than to send a collector for them. The question is whether the chances of getting rarities that you are not likely to get other ways will balance the extra expense. Of this you must be your own judge. I presume I can arrange to make a trip for you, but would prefer to make it in the fore part of the winter as I would like to work certain fields in Southern Cal. from the first of March to July, still I can put that off."[28]

Stephens offered to undertake the trip for a dollar a day, plus expenses, but preferred Merriam "to allow [Stephens] to make such bird skins" as "without

[28] Stephens to Merriam, August 24, 1885, Ibid.

hindrance to the main object of the trip."[29] However, Stephens recommended that Merriam discuss the potential trip with William Brewster, who was familiar with Stephens' work in the region "if you think seriously of trying the thing"[30] A week later, Stephens wrote to Merriam pricing out the potential rail charges for the trip, Merriam would spend a healthy portion of the late summer attempting to raise funds for the trip, even entertaining the possibility of joining Stephens in the desert.[31]

An illness in late fall caused Stephens to cancel the trip, which he had conceptualized as a six month long, 2000 mile collection trip starting at the beginning of March the following year.[32] The illness would adversely affect the sheer amount of preparation for the trip, though he offered to collect for Merriam in a reduced capacity for parts of the summer. While the trip was probably overly ambitious from the start, the planning for the trip undoubtedly helped Merriam conceptualize his long awaited expedition to Death Valley in 1891, an expedition in which Stephens played an integral role. It also foreshadowed difficulties with health that affected Stephens' ability to collect in the coming years, causing him to cancel or reschedule collection for Merriam and Joseph Grinnell on numerous occasions, and forcing him to sit out portions of expeditions until his health improved. It was not a case of continued illness, but one surmises that the amount

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[29] Ibid.
[30] Ibid.

[31] Stephens to Merriam, August 31 & September 18, 1885. Ibid.

[32] Stephens to Merriam, November 17, 1885, Ibid.

of time in the field led to increasing propensity to sickness as he aged. Then again, it is possible that Stephens was looking for an excuse to cancel the trip altogether; as early as September 18, he wrote Merriam saying that he "had much rather put [the trip] off until another year," and a month after canceling the trip, Stephens traveled back to the San Diego region from San Bernardino to collect specimens for Merriam.[33]

While his relationship with Merriam continued to increase in productivity for both parties, Merriam was not the only person for whom Stephens collected. In January of 1886, Stephens was contacted by George F. Morcom, an Englishman living in Chicago and who was an influential member in the local Ridgway Ornithological Club. Morcom was visiting Southern California with the family of a young Harry S. Swarth, who would later be a leading California naturalist in his own right, and who would count Stephens as an important mentor. Morcom met with Stephens, and proposed that Stephens collect for him from April to June at a salary of $200, while allowing Stephens to collect three skins a week for his own collection. This was not an opportunity that Stephens could well afford to pass up, since he was averaging about $15 a month collecting part time for Merriam. Stephens wrote to Merriam about the new scenario "[This will] affect your interests somewhat, but I made the reservation of having the privilege to make three mammal skins per week for myself, and all the alcoholics I wished to save, though I can't spend any extra time in hunting for them, such as

[33] Stephens to Merriam, September 18 & December 26, 1885. Ibid.

I can get incidentally."[34] Stephens offered to send the alcoholics along to Merriam, and proposed that leave early and collect specimens for Merriam at his first locality for about a week.[35] According to Swarth:

> "[Stephens] made a magnificent collection of birds which formed the basis for a report that was published in the Bulletin of the Ridgway Ornithological Club…a generous selection there from was sent to the British Museum. At about the same time he purchased from Stephens the type specimen of the recently described *Colinus ridgwayi* and sent that to the British Museum also."[36]

Stephens also managed to collect specimens for Merriam on the side, most probably using his weekly allotment of skins in so doing, sending Merriam at least one box of mammals from San Bernardino in late May.[37] As always, Stephens was on the lookout for varieties that he had not previously seen before, noting to Merriam with regard to the specimens of the genus *Thomomys* he had collected, "The *Thomomys* will probably prove to be a new variety…they are very much paler than any other gopher I ever saw…they are good size to large. Their habits are similar to *Bulbivorous numbrinus*, but they are much more unsuspicious and easily caught"[38]

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[34] Stephens to Merriam, January 28, 1886, Ibid.

[35] Ibid.

[36] Harry Swarth " In Memoriam: George Frean Morcom, March 16, 1845-March 25, 1932" *The Condor,* Vol. 36, No. 1 (Jan. - Feb., 1934): 16-24.

[37] Stephens to Merriam, May 24, 1886; C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 82 Bancroft Library, University of California, Berkeley.

[38] Stephens to Merriam, April 26, 1886, Ibid.

He would also turn down Merriam's offer to collect specimens in the spring of 1889, as he was then collecting for F.D. Godman, a British naturalist, and Charles Foster Batchelder, then the head of the AOU, but for the most part Stephens was a steady "go-to" collector for Merriam, who usually only turned down collection offers if he had a better paying proposition from another naturalist.[39] Given that Stephens was supplementing his agricultural income with his earnings from collecting, it was only natural to attempt to maximize his potential earnings, especially if granted a monthly salary as he was by Morcom. However, given his agricultural interests, in most cases he was not able to take three months to collect, let alone spend three consecutive months to do work in the field. This was by no means a quandary faced only by Stephens, but was one that was faced by numerous nature enthusiasts and collectors from the mid-nineteenth century, including Vernon Bailey and later, Joseph Dixon. Stephens, as did other part time collectors, would often check with the naturalists with whom they normally worked both to receive informal permission to work with others, as well as to assure naturalists that they would continue their relationship with them as soon as they were able.

It was common practice for naturalists to allow collectors to keep some specimens which they had collected for their own personal collections. Stephens, an experienced collector, had a very large collection that grew with every season and foray into the field. While he would later donate the collection en masse to

[39] Stephens to Merriam, May 7, 1889, Ibid.

the San Diego Museum of Natural History to form the backbone of their collection, he also was forced to use the collection as a way to obtain income in tight times. In fall of 1886, Stephens send a catalogue of the duplicates in his collection to Merriam, asking if Merriam would like to purchase all or some of the extraneous specimens. Merriam bought the lot, sending Stephens $54 dollars in cash on November 24.[40] This would not be the only time that Stephens would need an infusion of cash from those he collected for: a similar rocky period (Stephens wrote his friend Joseph Grinnell that he had earned all of three dollars in as many months) was survived by an overmarket purchase of specimens by patron of the sciences Annie M. Alexander in 1908.[41] While these instances demonstrate that collectors could use their own particular collections as an insurance policy, it is also important to note that the return for the effort was fairly low: Stephens netted more on numerous collection trips than on the sale of his own specimens, though this is partially due to his asking price – Merriam may very well have paid more had more been requested.

By 1890, Merriam had started to attract naturalists to Washington to become full time government scientists for the Division of Economic Ornithology and Mammalogy.

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[40] Stephens to Merriam November 15, 1886 with accompanying note by Merriam dated November 24, 1886. C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 82 Bancroft Library, University of California, Berkeley.

[41] Frank Stephens to Joseph Grinnell, February 2, 1908. Joseph Grinnell Papers, Collection, C-B 995 Box 17, Bancroft Library, University of California, Berkeley.

His goal, as he wrote his friend and colleague, Dr. T.S. Palmer, in 1889 was to:

> "I hope to be able to make [the DEOM] the means of training up a small school of 'systematic naturalists…' At the present time there are too many highly specialized specialists and altogether too few 'all around' naturalists… I want to get a hold of a few sturdy, honest, intelligent young men who are not afraid of anything and who are willing to begin at the bottom of the ladder with the intention of climbing higher year by year, and of devoting their lives to biological work. I believe you…are of this stamp. You are the first to whom I have spoken"[42]

The influence of his mentor, Spencer F. Baird, can clearly be seen in Merriam's goals for the DEOM, and the new division had a very cordial relationship with the National Museum, by now run by fellow Baird disciple G. Browne Goode. In the coming years, Merriam would draw heavily on his former collectors to form the backbone of his cadre of "systematic naturalists," luring A.K. Fisher (1885), Vernon Bailey (1887), and E.W. Nelson (1890) with the opportunity to study and practice natural history on a national, even continental scale. It is not known if Stephens was likewise asked to become part of Merriam's division, though it is clear that Stephens never formally became a full time employee of the DEOM or its successor, the Bureau of the Biological Survey. He would continue his rather informal seasonal arrangements with Merriam until 1907, when he began collecting primarily for Annie Alexander and Joseph Grinnell of the Museum of Vertebrate Zoology in Berkeley.

[42] C.H. Merriam to T.S. Palmer March 13, 1889. C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 1 Bancroft Library, University of California, Berkeley.

With a staff of practical, experienced collectors whom he could mould into systematic naturalists, Merriam started to use the DEOM not just to focus on economic natural history, but on larger questions of biogeography and evolutionary systematics. Merriam organized a sequence of expeditionary surveys starting in 1890, primarily focused on the biota of the American west. The target of these expeditions was practical for two reasons: first, the biota of the west less known than that of the east, still posing questions to naturalists with regard to variation and geographic distribution and secondly, the west, with its rugged physical geography and diverse living conditions were the perfect natural laboratory for Merriam to refine his ideas on biological "life zones." While many of these expeditions were relatively small, led by one or two members of the Survey,[43] others were much more involved, requiring the mobilization of more of the Survey's staff. The first such expedition was Merriam's survey of central and northern Arizona in 1890, focusing primarily on the San Francisco mountain range outside of Flagstaff; this expedition would be crucial to Merriam's development of his theory on life zones.[44] Stephens was not a participant in this particular expedition, but given his previous work in Arizona for Merriam and Brewster, it is unlikely that Merriam did not at least request Stephen's help in planning the expedition, or even joining at some point, though Stephens is not

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[43] See Chapter 4.

[44] W. C. Henderson and Edward A. Preble, Sr "1885--Fiftieth Anniversary Notes—1935: Work and Workers of the First Twenty Years," *The Survey*, April-June 1935.

mentioned in the report, and any correspondence between the two for the time period has been lost.[45]

Perhaps Stephens' most important contribution to Merriam's systematic work was his accompanying Survey staff on the famed Death Valley expedition (DVE) in 1891. Merriam chose Death Valley the target for an extensive survey due to the "extreme hear and aridity of its valleys, the great height of the adjacent mountains, and the fact that nothing, or next to nothing, was known of its animals and plants" as well as his "curios[ity]" regarding "forms of life that could exist in such a hostile environment."[46] The DVE was actually a series of interrelated smaller surveys across a broad geographic area stretching from the Sierras in the north to Utah in the East, as well as being focused on the interior of California – it was by far the most extensive expedition in terms of area covered and naturalists employed in Merriam's term at the Biological Survey, and captured the interest not only of the American scientific establishment, but popular interest as well. [47] His conceptual model of life zones played heavily in this decision to have small

[45] Stephens' correspondence with Merriam in the C.H. Merriam Papers at the Bancroft library does not include any correspondence between May of 1889 and 1902. The two men did correspond during the time, as Stephens collected for the survey in the interim and played a key role on the Death Valley Survey of 1891.

[46] C. H. Merriam "History of the Development of My Life Zone work in America." C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 103. Bancroft Library, University of California, Berkeley.

[47] Unfortunately, much of the archival material regarding the survey, such as field notes and correspondence, has been lost. This is probably a result of the bureaucratic consolidation of the 1920s, in which the Biological Survey was merged with other agencies to form the United States Fish and Wildlife Service, based in the Interior Department.

teams examine a broad swath of California, hoping that his teams would find data that would allow him to nail down borders of particular life zones, as well as potential areas of transition, in which zones intergraded, and organisms common to both zones might both be present.

Part of the rationale for a six month long expedition was the opportunity to view animals emerging from hibernation, and observe them through the summer months, thus allowing members of the survey to report full life histories on many of the organisms observed and collected. The six month timetable was also an indicator of the scope of the survey, which stretched from California into Utah and stressed the comprehensive study of the regions biotic and abiotic factors.[48] The survey started early enough to catch late winter weather, where even in the desert it occasionally still snowed – Stephens recorded two inches of snow fell on March 22, not terribly surprising in the high desert (two days later he reported on the Inyo Mountains and Mt Whitney in the distance, and their respective snow packs).[49] The expedition, coupled with the expedition to San Francisco Mountain the year prior, were more systematic versions of the solo expedition Stephens and Merriam had discussed and tentatively planned for early 1886. Merriam later

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[48] The term "biota" and its derivations was first used by Joseph Grinnell in the early twentieth century, and became a key term in modern ecology. The use here is not implying that the DVE was a modern ecological field study, but rather that the expedition sought to understand how organisms were connected to their environment. Merriam himself never used the term, and chided Grinnell for using it.

[49] Frank Stephens Diary of the Death Valley Expedition, March 22, 1891. Frank Stephens Field Diaries, Box 177, San Diego Natural History Museum Archives.

estimated in his unpublished reflection on his formation of the life zone concept that the survey led to the collection of approximately 9,000 specimens, two thirds of them mammals.[50]

Stephens joined the ubiquitous Vernon Bailey, E.W. Nelson, T.S. Palmer, Frederick Coville, and Merriam himself on the expedition, and would spend over seven months working with survey members, ultimately being placed in charge of one of the four "subdivisions" of the survey.[51] That he was invited when not a member of Merriam's division or the National Museum, and even given a position of leadership on the survey was a measure of Merriam's trust in Stephens' practical experience as a collector and of his knowledge of the area to be covered. He left San Bernardino on the 6th of February, meeting Fisher and Bailey at Resting Spring, California a week later.[52] His duties on the expedition itself were not terribly different than they would have been had he been collecting

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[50] C. H. Merriam "History of the Development of My Life Zone work in America." C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 103, Bancroft Library, University of California, Berkeley. Interestingly, he doesn't estimate the number of fish specimens collected, even though there were many. See Charles H Gilbert "Report on Fishes" in *North American Fauna, No. 7; The Death Valley Expedition,* Washington: United States Department of Agriculture, 1893. Given the unpublished manuscript focused on life zones, fish were probably not deemed important to the subject at hand, as Merriam focused only on terrestrial life zones in his work. Then again, Merriam did not include an estimate of insect or amphibian specimens either, so it could also be that these types of specimens had either negligible numbers or were overlooked by Merriam given his interests in terrestrial vertebrates.

[51] Ibid; presumably Merriam is referring to the subdivisions of life zones in the area.

[52] Frank Stephens Diary of the Death Valley Expedition, Frank Stephens Field Diaries, Box 177, San Diego Natural History Museum Archives.

alone as usual, setting out from camp to lay traps at different localities, taking birds when possible, and then "putting up" the skins from collected animals. His journal of the expedition is fairly workmanlike, much as his journal with Brewster had been – a running field diary, with specimen lists (incomplete) at the end of the notebook. Some days are skipped, indicating a stay on locality, and the entries for many days, especially travel days, are extremely brief. Taken collectively, his notes are not as specific as one of his frequent collaborators of the expedition, E.W. Nelson, a collector of Merriam's who had just recently become a field naturalist with the survey. Further, Stephens did not record much in the way of intrapersonal relationships, or interactions with Survey staff in his journal, focusing on the natural history of the survey as well as particular events during the trip, such as when the wind and rain blew their tents over and kept them up the entire night, or when one of their teamsters notified them that one of their supply wagons was stuck and required assistance.[53] He also made sure to record observations on the physical environment, among these noting that Oasis Valley did not look much like an oasis due to the sheer number of alkali deposits.[54]

Although his notes in his diary were fairly brief, they were of use to him as he composed more detailed reports for the Biological Survey. These handwritten reports comprised a description of each locality listed that included information on the local physical geography and climate, as well as a list and

[53] Ibid; February 24 and March 13 respectively.

[54] Ibid, March 17, 1891.

general notes on the specimens collected. Included in the reports were discussions of the prevalence of specimens with regard to locality, including inferences with regard to scarcity or abundance of species. For example, in his report regarding Little Owens Lake, visited from May 6-11. 1891, Stephens noted "I had a rather light catch of animals at Little Lake, probably caused by the region being overstocked with cattle, and alas by it being in the route of migration of sheep…At least 10,000 a day passed while we were there, and every eatable plant was devoured for miles each site of [their] route."[55] The reports also included Stephens' inferences with regard to distribution of fauna being related to that of flora, "*Pinus ponderosa* and *P. albicollis* are abundant and good sized all around [Monache Meadows]. The timber is entirely open, no underbrush, and no oaks as that it is monotonous, and therefore not as good collecting as in more varied timber. This seemed to be a characteristic of the entire western slope, as far as I saw it."[56]

Stephens' notes on the physiography of the localities visited are fairly informal – almost folksy – with a personal touch reminiscent of a travel narrative, as opposed to a truly scientific observer. The prose and tone used in his reports therefore differs little from that which is used in his correspondence or his personal notebooks. His locality species lists, in contrast, are straightforward,

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[55] Frank Stephens Field Reports,1891 "Little Owen Lake, Cal". SIA RU 7176 Box 41, Folder 4. Sheep ranching was very common in California at the turn of the century and the reaction to it by John Muir and others played a key role in the development of the modern conservation movement.

[56] Ibid, "Monache Meadows."

with notes on specific variations, and distribution, and whether the species were collected or solely observed. The difference in the tone in these two portions of the report was due to their differing scope: the object of physiographical notes was to describe the locality, whereas species lists note which species were found in which locality. The act of taking physiographical notes lends itself to a narrative, describing the area in detail and including anecdotes. Further, Stephens was well aware that his reports would later be used in the formation of formalized published government reports, and that these formalized reports would be synthesized from informal field reports submitted by the entire survey team. Personal anecdotes could be kept or (more likely) edited out based upon their importance to the overall report, meaning that including them in field reports could provide Merriam and other Biological Survey staff with insights that they could use, especially in localities that they themselves did not visit. Back in Washington, after the survey, the amalgamated notes of the survey staff would be used to synthesize the definitive reports of the expedition: *The Death Valley Expedition: A Biological Survey of Parts of California, Nevada, Arizona, and Utah Volume II* and *The Botany of the Death Valley Expedition*, both of which were published in 1893. Three reports were originally planned, but as often was the case with regard to government sponsored science, the associated costs prevented the last of the reports – Merriam's study of the region's mammals – from being published.[57]

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[57] For costs associated with printing, see William Stanton, *The Great United*

As with all other surveys the Death Valley Expedition was greatly assisted by the inclusion of local knowledge, and like most western surveys, a key component to local knowledge was given to members of the expedition by Native American sources. Stephens noted in his journal "Had a visit from an Indian that lives out in the valley. He did not speak very good English, but gave me a good deal of information of various springs, etc."[58] The local mountain and high desert springs, of course, were essential to the lives of the surrounding organisms, and would therefore be one of the most important survey localities of the entire expedition. The expedition also included numerous ranches on their list of localities, and ranchers were no doubt extremely helpful to the survey members. Choosing ranches as localities, of course, was not an accident, and was fairly commonplace in western surveys; Joseph Grinnell's surveys of California through the Museum of Vertebrate Zoology frequently drew on the local knowledge and potential logistical support of ranchers. Practically speaking, ranches may have been closer to postal routes or even on them, allowing survey staff an easier method of dispatching specimens, and ranchers were very familiar with the local landscape, even if they were not knowledgeable with regards to practical natural history. Additionally, naturalists and collectors could rent the use of a team and wagon for a short period of time, ask the rancher or staff for assistance in the

States Exploring Expedition of 1838-1842, (Berkeley: University of California Press, 1975).

[58] Frank Stephens, Diary of the Death Valley Expedition, April 6, 1891. Frank Stephens Field Diaries, Box 177, San Diego Natural History Museum Archives.

field, or purchase provisions and sundries, though this was of course dependent upon their own personal supplies. However, it is clear from the Stephens' report on Little Owen Lake, as well as later campaigns to restrict ranching in California led by John Muir and supported by C.H. Merriam, that the act of ranching could and did inhibit the study of natural history, as many habitats had become "overrun" with livestock. Ranches can be seen as integral localities for many western surveys, including the DVE, but both local and systematic naturalists were wary of the effect that ranching had on the natural environment.

Stephens spent most of his time on the survey in one of the smaller parties that focused mainly on the mountainous regions along the western edge of Death Valley, and many of the localities that he visited were mountain and high desert springs. As in all desert environments, organisms tended to congregate around the natural springs of the region, making them natural areas of interest with regard to natural history. The mountainous regions were a specific area of focus for the survey, with Merriam hoping to understand how the natural history of the mountains differed from that of the arid desert valleys to the east, as well as the better understood natural history of the areas west of the mountains, and to map out any transitions between the areas. In his journeys through the Inyo Mountains and portions of the Owens Valley, Stephens was occasionally teamed with Edward W. Nelson. He recorded on June 17 that he and Nelson were "ordered to work out the Owen Valley and White Mountains," with later journal entries describing Onion Valley, a small valley adjacent to the White Mountains, which held such unique landscape that Stephens regretted not having his camera.[59] It is unclear how much time that Stephens and Nelson worked together – Nelson's journal by this time containing mainly just specimen data in contrast to its earlier detailed narrative – but it may have been through June and July. Stephens recorded on July 27 he "accompanied Mr. Nelson to the Upper San Joaquin River," but this is the first time in five weeks Stephens had mentioned Nelson. Given the lack of regularity of journal entries by Stephens, and that Nelson's abbreviated entries that do not always include the locality after the early spring, it is impossible to know how much the two expert collectors worked with one another, or what they discussed during the survey. However, their work together on the DVE would be integral to their on-again-off again collaboration in the next decade as E.W. Nelson and his partner E.A. Goldman surveyed Mexico for the Biological Survey.

Stephens' relationship with the Biological Survey continued through the first decade of the twentieth century, with his area of focus continuing to be Southern California, especially San Diego County. Stephens described this work with the Biological Survey as "intermittent," though this was a continuation of the relationship that he and Merriam had prior to the DVE.[60] Stephens' 1894 weeklong visit to California's Sherwood Valley was one of their more productive collaborations, and he submitted a list of 51 distinct birds to Merriam that he

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[59] Ibid.

[60] Frank Stephens, "Frank Stephens – An Autobiography" *The Condor,* vol. 20 (1), 166.

observed in the valley, carefully noting the commonality of the birds as well as their preferred habitat in the region, along with specimens of the birds he was able to collect there.[61] However, tragedy would also befall Stephens in the late 1890s, and in 1897, Stephens' wife died, though shortly thereafter he married an Englishwoman and kindred spirit Kate Brown. While Stephens did not discuss the death of his first wife in any real detail in his 1918 autobiography for *The Condor* – nor did any authors writing in memoriam articles after his death – Kate Stephens would become a full fledged scientific partner for Frank, accompanying him on expeditions as well as likewise being a leading member of the San Diego Society for Natural History.

In 1902, Stephens was asked by Merriam to survey the Colorado Desert, the desert region surrounding the Colorado River stretching from Arizona in the east through California's Imperial Valley into eastern San Diego County. Stephens had collected in the Colorado Desert since resettling in San Diego County in the early 1880s, as his homestead in Witch Creek was there. His extensive experience in the area made him an expert on the Southern California desert, and later he would serve as Joseph Grinnell's local expert on the region when Grinnell became the head of the Museum of Vertebrate Zoology in 1908. The locality was a critical one for Merriam's research on life zones, and included in Stephens' reports for the Death Valley Expedition is a report on the locality,

[61] "Birds of Sherwood Valley, California, Noted by F. Stephens, May 5-12, 1894" C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 183. Bancroft Library, University of California, Berkeley.

even though he did not spend time collecting there on this particular expedition, having started from San Bernardino and traveling north to meet Biological Survey staff. The report was a compilation of his experiences collecting in the area, including a sketched map and interesting inferences on the distribution of cactuses around Palm Springs: "Many cactuses are abundant in San Gorgonio Pass and most of the desert plants go up as high as Cabezon, but the desert flora and accompanying birds and mammals stop abruptly two or three miles east of Banning. It has always been a puzzle to me why this change is so abrupt just there; Banning is six miles down on the desert side of the summit of the Pass."[62] His experience in the desert, coupled with his experience working for Merriam, made Stephens a natural choice to survey the locality. The timing of Stephens' survey also strongly suggests that Merriam wanted specific data to compare with the collection efforts of E.W. Nelson and E.A. Goldman, who were presently working on the other side of the Mexican border.[63] In early May, Stephens, his wife Kate, a hired hand that doubled as a teamster and cook set off for a three month expedition in the desert.[64]

The expedition would be the first of many for the husband and wife team, and Kate especially saw the expedition as a wonderful chance for adventure.

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[62] Frank Stephens Field Reports,1891. "Colorado Desert". SIA RU 7176 Box 41, Folder 4.

[63] See Chapter 4.

[64] Kate Stephens field notebook, May 1902. Kate Stephens Papers, Box 313, San Diego Natural History Museum Archives.

Following Frank's lead, she kept detailed field diaries of the expedition, and while not as focused on the natural history of the expedition, she recorded much more of the mundane day to day activities and personal anecdotes about their travels. As a result, they are the most complete summary of the expedition, recording when new collaborators joined the party as well as referencing local residents who supported them both logistically and by imparting knowledge of local conditions are located. Her journals also record the assistance of a "Carl" and a "Mr. Brandegee" on the expedition, the later almost certainly being Townshend Stith Brandagee, a plant collector, San Diego resident, and the husband of one of the leading Pacific botanists, Kate Brandagee.[65] While in Frank's report, Brandagee is mentioned in passing in doing botanical work, it is unclear who "Carl" was, except he aided Frank in the collection of specimens – Frank Stephens usually referred to people by their surname, whereas Kate was more informal with her notes, though only with people she had a personal relationship with. Carl may be the teamster, or the "Johnson" that Frank mentions in his report on the Chuckwalla Mountain locality. Whoever Carl was, it is clear that he played an integral role throughout the survey, since he is mentioned in each of the monthly field notebooks compiled by Kate Stephens. Brandagee accompanied the party through May, though it is unclear if his specimens or notes made it back to Washington, or if they were for Brandagee's own personal records or a different

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[65] Ibid; for an overview of the career of Kate Brandagee, leading Pacific botanist and former botanical curator of the California Academy of Sciences, please see Marcia Myers Bonita, *Women in the Field: America's Pioneering Women Naturalists.* College Station: Texas A & M University Press, 1991.

institution. Kate's notebooks also mention "the Bishop boys," though, again, it is unclear who these "boys" were. While this is unfortunate on one level, since the participation of many nature enthusiasts and amateur collectors has been lost to history, the attraction of such enthusiasts and collectors to such a small survey demonstrates both the role of these groups in the scientific endeavor as well as the cultural importance of natural history in the late nineteenth and early twentieth centuries.

Stephens primarily focused on mammals and birds in the expedition, partially due to his own personal interest and experience, but presumably also due to the preferences of Merriam. In his reports to the USBS, Stephens included reports on ten different localities in Arizona and California. The formatting of the reports was similar to that of his notes from the DVE, consisting first of a general description of the locality, and then lists of mammals and birds recorded at each locality that included general notes on abundance of a species and occasionally on its behavior. This strongly suggests that this format was Merriam's preferred method for his naturalists and collectors to write their reports. It is also clear from Stephens' notes that there was additional emphasis, by either Merriam or by Stephens himself, placed on the study of *Ovis nelsoni* (now *Ovis canadensis nelsoni*) a local variant of bighorn sheep. In his notes of the Chuckwalla mountains locality, Stephens described his hunt for bighorn with one of the assistants of the survey named Johnson, including general notes on the observed behavior of the local herd, including that the sheep "did not seem shy and probably had been hunted out little."[66] That the mammal notes of the other localities visited invariably start with discussion of bighorn is further evidence to the importance of the large mammals to Stephens and Merriam. This would not be his last journey into the desert after bighorns; he would spend time stalking the elusive sheep in the summer of 1905 and occasionally again for Joseph Grinnell's Museum of Vertebrate Zoology. When Grinnell inquired about bighorns in the San Gabriel mountains of Los Angeles country, Stephens replied that there were, but they were well protected and if one was collected "you [Grinnell] will have to be careful to keep it out of sight" from the local rangers.[67]

Merriam visited Stephens in October, 1902, after he and Kate had returned home. While there is not a record of their discussions, Merriam was clearly pleased by the collaboration of the husband and wife team, and they were asked to spend the better part of 1903 in the field, their compiled field notes showing that they did not return home for any length of time until late October, after starting in early January.[68] Their object was to survey the California boundary with Mexico,

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[66] Frank Stephens 1902 notes. Frank Stephens Field Diaries, Box 177, San Diego Natural History Museum Archives

[67] Frank Stephens to Joseph Grinnell, May 5, 1905. Joseph Grinnell papers, C-B 995 box 17, Bancroft Library, University of California, Berkeley.

[68] The Stephens's notes for their 1903 expeditions are found at the San Diego Natural History Museum Archives, in the Kate Stephens papers (box 313) and the Frank Stephens Field Diaries (box 177). Unfortunately, and perhaps not surprisingly given their long standing collaboration with each other and the San Diego Society for Natural History, some of the notes are misfiled, with two of Kate's notebooks in Frank's box, and vice versa. It is possible that by the time

as well as the examining natural history of the San Jacinto and San Bernardino Mountains. Given the region that they set out to survey, it is logical to conclude that their work of 1903 must be seen as a continuation of their work of the previous year, and likewise an extension of the work of E.W. Nelson and E.A. Nelson who were concurrently in Mexico for the Biological Survey. Stephens' diligently reported his findings to the USBS, in the same format as he always did. Only one part of this report deserves special mention, and that was again his quest for bighorn, this time in the notes for his Lytle Creek locality,[69] as well as notes on the biota of the border. Also of note was the scientific name used for the bighorn: along the border, the sheep was referred to as *Ovis nelsoni*, at Lytle Creek *Ovis cervina*; all varieties of the bighorn are now known as *Ovis canadensis*.[70] One of the dilemmas in late nineteenth century natural history was the reconciling the sheer amount of new forms and varieties of organisms with previously classified species. This lead to a prolonged debate over how to classify organisms in which Baird, Merriam, and later Joseph Grinnell were all passionate actors, the debate centering on whether to "lump" new forms into old species, or come up with new classifications (to "split") on the specific or subspecific level, for the new varieties. Classification became increasingly

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this project is finished, these notebooks will be re-filed, but they will be referenced as is here, correcting only the name.

[69] Lytle Creek "drains that part of the San Gabriel Mountains that lies in San Bernardino Valley". Frank Stephens 1903 Field Report, Frank Stephens Field Diaries, San Diego Natural History Museum Archives, Box 177.

[70] Ibid.

confusing, and it has taken a fair amount of re-evaluation of nineteenth century classification to standardize modern taxonomy. This debate directly affected the way that collectors such as Stephens recorded their information, which was by using the most up to date classifications possible, and increasingly incorporating a similar mindset on classification that the naturalists they worked with had.[71]

It is interesting that Stephens, who had had a close collecting relationship with Merriam, had participated in USBS expeditions, and had written many of the related reports for the Survey, did not become an formal employee of the Survey itself. It would have well fit Merriam's habits of employing former collectors in the hopes of training a new cadre of "systematic naturalists" – two of his closest associates in the Bureau were Vernon Bailey and E.W. Nelson, both of whom had collected specimens for Merriam prior to becoming federal employees. There are numerous potential answers, but little in the way of concrete evidence that would support any of these suppositions. It could be that Stephens did not see himself as a full time naturalist, or that Merriam felt this way. A stronger possibility is that Stephens was so entrenched in southern California that he may have turned down any potential move to Washington, or even to become a naturalist who spent most of his time in his home state, as Nelson did.[72] It must also be noted that Stephens never really gave up on the prospect of ranching in southern California, and when

[71] The later is probably more apparent from Stephens' work with the MVZ and Joseph Grinnell, please see below.

[72] Nelson spent much of his time in the arid southwest due to respiratory issues, see Chapter 4.

he did decide to work in natural history full time, it was with the local San Diego Natural History Museum. Perhaps, despite examples such as Baird, Merriam, Nelson, Bailey, and a host of others, Stephens believed in the mantra that had been given to Robert Kennicott by Jared P. Kirtland, that there were few careers in natural history. Most likely, Stephens is representative of a host of nature enthusiasts, collectors, and amateur naturalists that worked in natural history as a hobby or a part-time occupation due to practical realities with regard to time, family, and income.

Collaborating with Merriam, even via correspondence, as well as his practical experience in the field, had made Stephens a truly systematic collector, and Southern California's foremost expert on natural history. Stephens became a leading member of San Diego's Society of Natural History, and would later be one of the founders of the San Diego Natural History Museum in 1910. Stephens was a primary actor in collection trips in the region even when he did not participate. As early as 1889, Stephens wrote to Merriam suggesting that if Merriam were to send "a man into this region, he had better write to me or still better come and see me. I can post him as to localities, &c."[73] Prior to setting out to collect for a number of consecutive seasons in Mexico in 1891, E.W. Nelson and E.A. Goldman consulted with Stephens prior to working the field in Baja California, even as Stephens had probably not spent any time collecting in the

[73] Frank Stephens to C.H. Merriam, May 29, 1889. C.H. Merriam Papers, Volume 2; BANC FILM 1958, Reel 82 Bancroft Library, University of California, Berkeley.

region. Nelson had met Stephens on the Death Valley expedition, and he and Merriam felt it best to consult with Stephens prior to leaving the country since many of the same species populated both sides of the border, and Stephens was more experienced in the American southwest than even Nelson, who had gone to live in Arizona due to health reasons. This was a long lasting, but sporadic collaboration; in 1906 Stephens wrote Joseph Grinnell: “Nelson and Goldman are just in from Lower Cal. Goldman has just left here…They appear to have had a successful trip and covered the whole peninsula [Baja California] pretty thoroughly. They took about six thousand skins, more mammals than birds.”[74] Nelson and Goldman probably stopped by the Stephens household when traveling through San Diego, but little remains from any correspondence between Merriam’s collectors.

Frank and Kate also played leading roles in San Diego’s Society of Natural History, which they had belonged to for many years. Founded in 1874, the SDSNH was the second local scientific society in California after the California Academy of Sciences, but by the late 1890s the society had fallen on hard times, meeting extremely infrequently and was financially hamstrung. Perhaps the state of the society can be summed up best in that one of the more important reforms that the new president Anthony Vogdes implemented was

[74] Frank Stephens to Joseph Grinnell March 2, 1906. Joseph Grinnell Papers, Collection C_B 995 Box 18, Bancroft Library, University of California, Berkeley.

making sure that members paid their dues.[75] The Stephenses were integral to the turning around of the society, with Kate becoming the initial curator of the collections in 1910, and in 1905, Frank urged the society to become more active in natural history, especially with regard to publications and expeditions. Five years later, he donated his personal collection of mammals and birds to the society instantly giving the small group one of the most comprehensive collections of specimens from San Diego County in the nation. Starting in 1905, the Society started organizing small collecting expeditions in and about San Diego, usually at the direction of the Stephenses. This, coupled with Stephens' donation, resulted in a collection that would serve as the backbone of the specimen collection of the San Diego Natural History Museum when it was opened in 1914. This collection was stored at their house for a period in 1912 when the Society was awaiting a home for their proposed museum. In the mind of Frank and many other members of the society, publishing peer reviewed articles would increase the scientific standing of the society, establishing it as a legitimate voice for natural history, akin to the Academy in San Francisco, as well as eastern scientific societies.[76] Frank took an active role in the publication process, taking advantage of a local medium to publish the result of his own studies in natural history, a result of reflecting on thirty years experience in the field.

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[75] Iris Engstrand & Anne Bullard, *Inspired by Nature: The San Diego Natural History Museum after 125 years.* San Diego Natural History Museum: San Diego, 1999, 52.

[76] Ibid.

The inaugural article in the new *Transactions of the San Diego Society of Natural History* was a brief article by Stephens entitled “Life Areas of California.” In a mere eight pages, Stephens was able to describe seventeen distinct “faunal” areas in California in an open conversational way that spoke to amateur naturalists and nature enthusiasts. In the article, Stephens argued that the most important determining factor in variation of life was heat, and that climate played an important role in the evolutionary process: “A great yearly or daily range of temperature unfavorably affects the life of an area by weeding out the forms most sensitive to such changes, on the principle of the “survival of the fittest.”[77] In this, he was clearly influenced by Merriam’s evaluation of climate in determining the differing “life zones” of in the United States. Reviewing the article for the national ornithological journal *The Auk*, J. A. Allen, the preeminent ornithologist in the United States, praised Stephens’ extensive personal experience and noted that even as this was based on the earlier work of Merriam “this appears to be the first attempt to delimit and name the Faunas of the State.”[78] Allen did lament that the faunal areas were not better delineated and explained, but given the focus of the article on the general reader, Stephens no doubt decided against an in depth explanation.

[77] Frank Stephens, “Life Areas of California.” *Transactions of the San Diego Society of Natural History*, Vol. I, No. i, 1-8.

[78] J.A. Allen. “Review: Stephens's 'Life Areas of California'” *The Auk.* Vol. 22, No. 4 (Oct., 1905), 424-426.

The *Transactions* would be published infrequently (volume III was published twelve years after volume I), but the journal represented an important step in Stephens' career in natural history. The following year, he published *California Mammals*, an exhaustive examination of the mammals of California, the first such since Baird's series on the railway surveys.[79] Like his "Life Areas of California," *California Mammals* was not a work for specialists, rather for the general public. Given his lack of a formal education and his extensive experience, Stephens' goal in writing the treatise seems to be tied closely his democratic understanding of scientific practice. While not, in the strictest terms, a systematic naturalist, Stephen's can and should be seen as one of the last of the amateur naturalists that dominated American natural history in the first part of the nineteenth century. For Stephens, the practice of natural history should be democratic in nature; he owed his career to this particular mindset. *California Mammals* looked at mammals on a family by family basis, striving to give the layman an understanding of mammals' classification, geographic distribution, variation, and life histories. It was well received publically as well as in the scientific community, but the personal cost in time, and more importantly, money, was very high. In his autobiographical sketch for *The Condor*, Stephens noted the heavy expense of publishing "I may as well say here for the benefit of others that publishing books of this class does not pay. My receipts on account of 'California Mammals' are now [in 1917] over twelve hundred dollars behind expenses

[79] Frank Stephens, *California Mammals*. West Coast Publishing Co.: San Diego, 1906.

incurred."[80] His work on mammals did, however, did attract the attention of the nature enthusiast and patron of the sciences Annie M. Alexander, and would lead to the Stephens' being asked to accompany Miss Alexander on her Alaska trip in 1907.[81]

Perhaps as important as Stephen's work as an informal sounding board for USBS expeditions and his work in the SDSNH was his role as an advisor to budding naturalists in southern California. Both Harry Swarth, of Los Angeles, and Joseph Grinnell of Pasadena, were active correspondents of Stephens, asking and receiving assistance in identifying local birds and mammals. Swarth had met Stephens as a young boy when his family had introduced Stephens to the Englishman George F. Morcom in 1886, and his family had permanently moved to the region in 1891, when he was fifteen. In short order, Swarth was spending much of his free time combing the back country of Los Angeles, starting with the area close to his family home, collecting small animals, especially birds. Grinnell, whose father had been a doctor at an Indian Agency in Oklahoma, also moved permanently to southern California in 1891, and like Swarth, almost immediately began collecting specimens locally. Grinnell also pursued a degree in zoology at Pasadena's Throop Institute of Technology (later the California

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[80] Frank Stephens, "Frank Stephens – An Autobiography" *The Condor*, vol. 20 (1), 166; Annie Alexander was frequently referred to as Miss. Alexander by Joseph Grinnell and his collectors, see below.

[81] Barbara R. Stein, *On Her Own Terms: Annie Montague Alexander and the Rise of Science in the American West*. University of California Press: Berkeley, 2001, 63

Institute of Techechnology), graduating in 1897, and spent consecutive three seasons from 1896-1898 collecting specimens in Alaska. Both Swarth and Grinnell were corresponding with Stephens by 1897, and Stephens took an active role in mentoring both young naturalists via correspondence. By this point in time, Stephens had also formed a relationship with Joseph Dixon, a student of Grinnell's from the Throop Institute who was from Escondido, a small agricultural town in northern San Diego County. The new Cooper Ornithological Club, California's ornithological association which had been founded just four years earlier, played a large role in putting the younger enthusiasts in contact with Stephens, as they were all members and contributors to the society.[82]

By 1897, Grinnell began requesting examples of bird skins from Stephens so that he could compare them with his own collected specimens, and also so that he could become more familiar with species that he had not yet collected. Stephens was happy to oblige, and the two exchanged information relating to the distribution and the possible variation in a species of goldfinch, *Spinus tristis pallidus*. This episode demonstrates that Stephens played an integral role in the development of Grinnell as a systematic naturalist. This would ultimately lead to a long term collaborative effort between Stephens and Grinnell, including Stephens' idea for a mammalogical society of California, based off the Cooper Ornithological Club. This subject dominated the correspondence of Stephens and

[82] The Cooper Ornithological Club, and its journal, *The Condor*, were in turn based upon the American Ornithological Club and its journal *The Auk*, and had capitalized on the interest of naturalists and nature enthusiasts alike on the ornithology of Western birds.

Grinnell for a two year period, from 1904 to 1906, and Stephens clearly hoped that his work on the mammals of California would help drive interest in this club. Unfortunately, despite the reception that *California Mammals* had received and its attempt to make the study of mammals possible for the common man, because the book was self-published and not with the financial support of an organization, the limited scope of publishing meant that Stephens' work ended up in the hands of specialists, not enthusiasts. Further, the study of mammals did not have the same popular appeal that ornithology had had for over a century, and although it was founded by Stephens and Grinnell, the Pacific Coast Mammalogical Club never really got off the ground. Edmund Heller, a friend of Grinnell's from Stanford and a later collaborator with both Grinnell and Stephens, eulogized the effort pre-mortem, writing Grinnell that he did not see the effort succeeding.[83] From the beginning, the society was hamstrung by basic operating costs, and there was not a practical way the club to fund the papers that Stephens had hoped it could publish. Perhaps most importantly, most of the leading members, including Grinnell, Stephens, Swarth and Walter K Fisher, had duties for other societies and clubs – all were members of the Cooper Club and Grinnell was already the editor of Club's periodical, *The Condor*, Swarth relocated to Chicago in 1904 to work at the field Museum, and Stephens was busy attempting to necessitate the San Diego Society.

[83] Edmund Heller to Joseph Grinnell, April 26, 1904. Joseph Grinnell Papers, Collection C-B 995 Box 10, Bancroft Library, University of California, Berkeley.

In early 1907, Frank and Kate Stephens were visited by Annie M. Alexander of Oakland, heir to a profitable Hawaiian estate and nature enthusiast. Alexander was extremely interested in the natural history of Alaska, especially with regard to bears, a passion she shared with Stephens' long time collaborator, C.H. Merriam. After a disastrous trip to Alaska in 1906,[84] Alexander desperately wanted to find an experienced field collector to help her on a proposed expedition to Alaska the following summer. Merriam recommended Stephens, and after meeting in January, she offered two couple an opportunity to accompany her and collect specimens that summer. In addition to their experience in the field, hiring the Stephenses fulfilled an important need for Alexander; Kate could play the part of a female companion. As Barbara Stein has ably noted, gender norms required Alexander to travel, even on scientific expeditions, with a woman if at all possible.[85] Stephens' reflected to Grinnell, "If she offers fair wages we will probably go... Did you do any work around Sitka? Has anyone worked that particular region thoroughly for mammals?" By this time, the relationship between Grinnell, by now an accomplished ornithologist and professor at the Throop Institute of Technology in Pasadena, and Stephens had inverted: Stephens had started to collect mammals and birds for Grinnell by this time, and now Stephens' was relying on prior experience of Grinnell, who had collected in Alaska at the beginning of the decade. Stephens also offered to collect birds for

[84] See Stein, *On Her Own Terms,* Chapter 6.

[85] Stein, *On Her Own Terms*, 63-64.

Grinnell while in Alaska since “a general collection of mammals and a few birds will be taken. She does not care much for birds.”[86] This appears to be an attempt to maximize his collecting (and by extension) financial opportunities on the trip; Stephens had told Miss Alexander that he preferred to work on mammals, and recommended she hire Joseph Dixon to collect birds on the trip. Dixon was a student of Grinnell’s from Throop and a budding naturalist in his own right, having collected off and on for Grinnell in the previous two years.

By February, Alexander had formalized her offer to the couple, and had followed Stephens’ recommendation, offering a position to Dixon. The Alexander expedition set off for Alaska in mid-March and was a fairly productive one, collecting over six hundred mammals and birds by the beginning of July.[87] The most experienced collector on the trip, Stephens played an integral role in trapping and shooting specimens, even as he was unfamiliar with the terrain. He also helped Alexander in her quest to become better at preparing bird skins, [88] and appointed himself the unofficial photographer of the trip. However, it is clear from the letters of Dixon that Stephens grew increasingly frustrated on the expedition, at times staying with Kate rather than going out for specimens, and

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[86] Frank Stephens to Joseph Grinnell, January 31, 1907. Joseph Grinnell Papers, Collection C-B 995 Box 17 Bancroft Library, University of California, Berkeley.

[86] See Stein, *On Her Own Terms,* Chapter 6.

[87] Joseph Dixon to Joseph Grinnell, July 4, 1907. Joseph Grinnell Papers, Bancroft Library C-B 995 box 6.

[88] Stein, *On Her Own Terms*, 68.

snapping at an expedition member whose trapping habits interrupted with Frank's plan for taking photos of small mammals close to camp.[89] Alexander noted in a letter to her friend Martha Beckwith that the all the years in the field appeared to have taken their toll on Stephens, and planned the much of the expedition with his health in mind.[90] The next year, Alexander planned a return trip to Alaska, and offered Stephens a position on the expedition. Despite his monetary troubles, he declined, and Alexander would take Edmund Heller, friend and colleague of Grinnell who was the new mammal specialist at the Museum of Vertebrate Zoology instead.[91]

After so many years in the field, and with so many productive years left as a field collector, Stephens' troubles in Alaska are somewhat puzzling. At 58 years of age, it is quite possible that the climate did not agree with him, especially as the majority of his work had taken place in arid regions. Likewise, his unfamiliarity with the terrain, after years of working in familiar localities in southern California, was probably disconcerting. Another explanation might be that Stephens had more or less worked on his own or with Kate and a few others since the Death Valley Expedition, and so party of seven may have felt crowded and claustrophobic to Stephens. It almost certainly was not a personality conflict, as he respected Miss Alexander and would collect from afar for Museum of

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[89] Dixon to Grinnell, July 4, 1907. Joseph Grinnell Papers , Collection C-B 995 box 6, Bancroft Library, University of California, Berkeley.

[90] Stein, *On Her Own Terms,* 69-70.

[91] See note 41; Stein, *On Her Own Terms*, 98.

Vertebrate Zoology, which Alexander essentially bankrolled, and he had advised Dixon prior to the trip and would work with him extensively through the MVZ in the coming years. Whatever the reason, the trip to Alaska would be the last major collecting expedition for Stephens outside of the southwest and California.

Shortly after returning from Alaska, Miss Alexander was able to finalize her dream of opening a natural history research institution, and the Museum of Vertebrate Zoology opened on the University of California campus in 1908. For a director of the museum, she had chosen Joseph Grinnell, who by this time had become the state's leading ornithologist and editor of *The Condor*. She began weighing the virtues of hiring Grinnell after he was endorsed by both Stephens and Dixon in the planning stages of the Alaska trip, and asked Grinnell to go through the specimens collected and help her catalogue them when she returned from the Arctic. Grinnell and Alexander would plan the museum through their correspondence throughout 1907, debating over the best place to start the institution. Grinnell, being a Stanford man, favored the campus in Palo Alto, but Alexander already had a relationship with the University of California in Berkeley (which had the added bonus of being much closer to her residence in Oakland), and did not feel a similar kinship with Stanford.[92] Further, Alexander offered funds to the University of California that would cover the cost of the museum, and the university readily agreed. Part of the deal was that Grinnell would be the director of the museum, despite his relatively junior status in the field of natural

[92] Stein, *On Her Own Terms*, 77

history, instead of hiring someone more experienced from the East. In November, Stephens stopped in Berkeley on his way home from Alaska, and met with Miss Alexander regarding not only his collections in the north after her return to California, but also about the museum. He wrote Grinnell, "Miss Alexander wishes me to stop on the way home and have a talk with you about her proposed plan of what is practically a biological survey of California, and also about publishing a report on our summer work in Alaska"[93] while Grinnell had already been in conversations with Alexander via correspondence about both of these, Alexander apparently felt that Stephens would be able to help Grinnell come to a positive decision. It is unlikely given the tone of their correspondence and their mutual goals regarding systematic natural history that Grinnell would have turned down an offer to head the MVZ, but using Stephens as a proxy was inspired, given the respect that Grinnell had for Stephens. Alexander formally asked Grinnell to become the head of the museum that winter, and he accepted enthusiastically.[94] The two would become an effective management team, with the museum becoming an extension of Grinnell's work on systematic natural history, and quickly became the center for systematic zoology in California.

Stephens benefitted immensely from the Grinnell's appointment to the lead the MVZ, and would soon become Grinnell's lead collector in southern California. Their previous relationship and Stephens' experience made the

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[93] Frank Stephens to Joseph Grinnell, November 2, 1907. Joseph Grinnell Papers, Collection C-B 995 Box 17, Bancroft Library, University of California, Berkeley.

[94] Stein, *On Her Own Terms*, Chapters 7 and 8.

collaboration much less top-down than it would be for many other of Grinnell's collectors; Stephens was able to operate fairly independently in the field when collecting for the MVZ. Additionally, Stephens' inferences with regard to the specimens collected, and general collecting ability greatly aided Grinnell's systematic work. Still, despite his lengthy experience in the field, Grinnell made sure to offer Stephens with constructive criticism and feedback to not only make the life of the museum staff easier, but also to make Stephens as more complete collector and de facto field naturalist. In one instance this involved Grinnell asking Stephens to include more general localities on his specimens, because the localities that Stephens included were too specific.[95] While this may seem somewhat counter-intuitive, Stephens had a habit of naming the locality based upon whose land it was on, especially if it was more exact than the small towns in the rural regions of San Diego County. This practice of course, made it extremely hard for those unfamiliar with the region to place specimens, hence why Grinnell asked Stephens to just use regional names. He also occasionally had to remind Stephens to completely clean his skulls before shipping.[96] This was a common request of naturalists to their collectors, because skulls that were not properly cleaned could be ruined by the time they reached the naturalist. In addition to collection trips, Grinnell also utilized Stephens in attempts to attain topotypes of

[95] Joseph Grinnell to Frank Stephens, February 16, 1909, Frank Stephens Correspondence, Museum of Vertebrate Zoology Archives, University of California, Berkeley.

[96] Joseph Grinnell to Frank Stephens, February 15, 1909, Ibid.

species first described in San Diego County.[97] Topotypes, or specimens of a given species from the same locality as where the 'type' species – the first specimen of a species that was comprehensively described, all other examples would reference the type species – was taken, were extremely important in late nineteenth and early twentieth century natural history. While not every museum could have a 'type' specimen, they could have a 'topotype' specimen, which would allow naturalists in these smaller institutions to comparative systematic work.

In the summer of 1908, just as Grinnell was departing of the east coast for a review of the leading natural history museums for ideas on how best to organize the MVZ, Stephens reached an agreement to collect in San Diego County for Miss Alexander with the understanding that specimens collected would be given to the MVZ, at the respectable salary of ninety dollars a month.[98] Despite personal financial troubles as well as a brief logistical delay in setting up a d*e facto* localized expedition, Stephens would spend 1908 almost entirely in the field, collecting at contrasting localities (most were either in the desert or the coastal regions) with a team of three to four other men, including at least one other

[97] Joseph Grinnell to Frank Stephens, September 11, 1908, Ibid.

[98] Frank Stephens to Joseph Grinnell, March 24, 28; April 9, 19, 1908. Joseph Grinnell Papers, Collection C-B 95 Box 17, Bancroft Library, University of California, Berkeley; Salary receipt for September 1908, Grinnell's trip to the east coast was financed by Annie Alexander for ideas in organization and emphasis in their new museum venture.

member of the San Diego Society for Natural History, a Mr. Rickseeker.[99] The team spent various times in the field, ranging from one to two months at a time, and was joined on one occasion by Mr. Rickseeker's wife, a member of the SDSNH board of directors.[100] Kate joined Frank in the field for at least a portion of the year, helping mainly in camp with regard to cooking and skinning, but no doubt also collected a bit herself – it would have been out of character for her not to have done so.[101] Collecting for the MVZ from afar meant that Stephens had to keep detailed expense records and submit vouchers for repayment for collection supplies, food, and other sundries, which had to be submitted in a timely manner in order to stay in the field. While less challenging in San Diego County than it was in the high desert of eastern California, it required Stephens to be in a position where he could access mail service at least once every few weeks.

The various mini-expeditions in one of the most ecologically diverse counties in the United States were fruitful ones, and Stephens collected a total of 857 specimens for the year. Most of these specimens were birds, but he did

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[99] Frank Stephens Field Notebook, 1908-1910. Frank Stephens Field Diaries, Box 177, San Diego Natural History Museum Archives

[100] Ibid; Iris Engstrand & Anne Bullard, *Inspired by Nature*, 50.

[101] Joseph Grinnell to Frank Stephens, September 10, 1908 & September 26, 1908. Frank Stephens Correspondence, Museum of Vertebrate Zoology Archives, University of California, Berkeley.

collect massive series of small mammals, such as *Neotoma macrotis macrotis*.[102] As usual, Stephens compiled detailed notes of his experiences in the field, with much the same format as before: reflection of the locality, and then a detailed specimen list. However, due to Grinnell's insistence on more systematic and complete notes than even Merriam had asked for, from 1908 forward, Stephens' notes for the MVZ are incredibly detailed and specific. Rather than a running diary with field notes at the end, the field notebooks of Grinnell's collectors at the MVZ are organized more like the reports of the Biological Survey than informal field notes. Notes were to be prepared in the field, but also edited so as to be more helpful to museum staff. Even though Stephens was far from a reptile expert (neither was Grinnell), Stephens and his collaborators made sure to collect all the reptiles they could while in the field, especially snakes, demonstrating the new museum's dedication to a systematic understanding of all of California zoology.[103] However, given the area of expertise of Grinnell and his collectors and museum staff – Stephens had focused mainly on mammals and birds up until this point, Grinnell and Swarth on birds, Heller on mammals, and Dixon on small mammals and birds – the MVZ collections remained light on reptiles for much of the early years. By this time, Stephens had become so well attuned to California

[102] Arctos Multi-institution Multi-Collection Database, "Frank Stephens 1908" accessed February 13, 2011 from http://arctos.database.museum/SpecimenResults.cfm?coll=Frank+Stephens&begdate=1908-06-18&enddate=1908-12-20.

[103] Frank Stephens to Joseph Grinnell, May 3, 1908 & June 9, 1908. Frank Stephens Correspondence, Museum of Vertebrate Zoology Archives, University of California, Berkeley.

species that he was able to make correlations about variation and geographic distribution in the field, writing Grinnell in June of 1908 that he "struck a problem with the distribution of local *Neotoma* [a genus of small rodents], and am working it out."[104] Further, he was disappointed in one of his trips to the coast because he was unable to collect enough specimens of a local bird to "to determine if the local race differs from the eastern birds," and that he was unable to collect any *Peromyscus*, a genus of mice that Grinnell was specifically examining for gradations in geographic distribution.[105]

Miss Alexander, though fairly wealthy, and dedicated to the cause of natural history, could only allocate her funds so far, and in late September, Grinnell wrote to Stephens saying that they would be unable to employ Stephens through the coming winter.[106] Stephens took this in stride, and the two parties were able to come to an agreement with regard to smaller scale collecting, and Stephens continued his work hunting topotypes. By December and January, Stephens had grown incredibly anxious, constantly writing Grinnell with suggestions about how he could be utilized collecting for the coming year. Grinnell was forced to demure until Alexander returned to the mainland from Hawaii, but upon her return, they again contracted him to collect in southern California, especially in the Colorado Desert, though this year at the salary of

[104] Frank Stephens to Joseph Grinnell, June 9, 1908, Ibid.

[105] Frank Stephens to Joseph Grinnell, June 29, 1908, Ibid.

[106] Joseph Grinnell to Frank Stephens, September 26, 1908, Ibid.

seventy-five dollars a month plus expenses, though they also offered to pay for a camp assistant at a salary of thirty dollars a month.[107] While Grinnell suggested a route of collection, Stephens wrote back a week later asking that he be able to modify the route, still covering the proposed localities, but "making it work out more economically," and Grinnell and Alexander readily agreed.[108] Grinnell had originally hoped to escape Berkeley and spend some time with Stephens in the Desert for at least part of the season, but was unable to do so, due to the influx of specimens into the Museum, and Heller's departure to accompany Theodore Roosevelt on his expedition through Africa, leaving Grinnell shorthanded.

While in the desert, Stephens took time to stalk bighorn sheep, given the importance of the sheep to Grinnell, Merriam, and himself, and having had only a small amount of time the previous year to do so. This was more a luxury than an aim of the expedition, and he, his wife, and a hired hand spent a few weeks collecting around the Salton Sea, a place where Grinnell's collection was wanting. Meanwhile, Grinnell had him set his assistant out on capturing reptiles, telling Stephens that they needed series of at least twenty five to thirty animals per species.[109] They then traveled south, collecting throughout Imperial County before crossing back in to San Diego County. However, 1909 was a frustrating year for Stephens in the field. At the beginning of the trip, he was beset by horse

[107] Joseph Grinnell to Frank Stephens, February 2, 1908, Ibid.

[108] Frank Stevens to Joseph Grinnell, February 8, 1908; Joseph Grinnell to Frank Stephens, February 15, 1909. Ibid.

[109] Joseph Grinnell to Frank Stephens, April 28, 1909, Ibid

troubles, with one of the horses refusing to carry the load that it needed to, and even with a new horse, the horses needed to be led more so than normal.[110] In late spring, he became very ill, and while he tried to work through it, he had to call off the rest of the summer's work due to illness and return home in early July. He was also anxious to get back into San Diego due to the turnaround of the real estate market, but the primary reason why he returned from the desert was his illness.[111] A short while after returning home, Stephens was already planning to return to the field after a two to three month recovery period, with the aim of going back into the desert for Bighorn, though this was later vetoed by Miss Alexander, who felt it best to preserve the funds needed for another trip into the desert for another year.[112] Nonplussed, Stephens thought about joining a small expedition to the desert, presumably to the San Diego Society, as well as chasing sheep for the California Academy of Sciences, but there is nothing in his notes or correspondence that would demonstrate that he followed up on these initial plans. He did collect a few specimens for Grinnell and the MVZ on an a la carte basis, but focused most of his efforts on designing a collecting trip to the San Joaquin Valley that he proposed for the next summer. This trip fell through, due more to

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[110] Frank Stephens 1908-1910 Field Journal. Frank Stephens Field Diaries, Box 177, San Diego Natural History Museum Archives.

[111] Frank Stephens to Joseph Grinnell, May 4, 1909, May 18, 1909, July 8, 1909; Joseph Grinnell to Frank Stephens, July 12, 1909; Frank Stephens Correspondence, Museum of Vertebrate Zoology Archives, University of California, Berkeley.

[112] Joseph Grinnell to Frank Stephens October 1, 1909, Ibid.

differing plans by Grinnell than due a weakness in the overall proposal. In fact, Grinnell would base his trip in 1911 with Harry Swarth to the San Joaquin Valley on Stephens' earlier proposal.

Shortly after the New Year, Grinnell wrote to Stephens letting him know that the MVZ would be undertaking a three month expedition to the Colorado River in the upcoming year and invited Stephens to accompany him and Dixon on the trip at a salary of seventy-five dollars a month.[113] Since Stephens had proposed an almost similar trip over two years prior, and Grinnell had been trying to implement since he began his time at the MVZ, Stephens jumped at the opportunity. When inviting Stephens, Grinnell was getting more than experienced collector that could concentrate on mammals while he focused on birds, he was employing an expert in Southern California species who knew the region to be surveyed intimately. Indeed, in his note to Grinnell accepting the terms of the expedition, Stephens enthusiastically offered advice on how to proceed, from offering to build skiffs and boats onsite, to relating information about the probable weather conditions that the expedition would find in the desert in late winter and early spring, to offering to get to Needles a day early to get camp established prior to Grinnell's arrival.[114] Remarkably, the period of time which Grinnell, and to an extent Stephens, had to plan and execute the logistics of

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[113] Joseph Grinnell to Frank Stephens, January 7, 1910, Ibid.

[114] Frank Stephens to Joseph Grinnell, January 10, 1910 & January, 26, 1910, Frank Stephens Correspondence, Museum of Vertebrate Zoology Archives, University of California, Berkeley.

the expedition was a little over a month, but the expedition had a successful start in the middle of February 1910.

It was the first systematic zoological survey of the region, with little written on the area in scientific literature since the work of J.C. Cooper and Elliott Coues almost fifty years earlier. The goal of the expedition was to survey the biota within and on both sides of the Colorado River from Needles to south of Yuma, as well as to contrast southern biota with that from the Upper Colorado. [115] While both aspects of this goal were grounded in traditional biogeography, the former would essentially transform the Colorado River into a laboratory to test David Starr Jordan's hypothesis on geographic isolation as a factor in the evolution of new species. Jordan, the president of Stanford University, was a famed ichthyologist and former mentor to Baird while at Stanford had published an article in *Science* entitled ""The Origin of Species through Isolation" five years earlier which became part of the lively debate within systematics about how speciation occurred. In the article, Jordan argued

> "It is evident that the nature of any fauna bears an immediate relation to the barriers, geographical or climatic, that surround it...Whenever free movement and interbreeding is checked, the character of the species itself is altered… On the other, hand, a barrier of any sort brings a certain group of individuals together. These are subjected to a selection different from that which obtains

[115] Joseph Grinnell, "An Account of the Mammals and Birds of the Lower Colorado Valley with Especial Reference to the Distributional Problems" *University of California Publications in Zoology*, Number 12. University of California, 1916, 52.

> with the species at large, and under these conditions new forms are developed."[116]

Grinnell's plan for the expedition, then, was designed to test the Colorado as a barrier to species and agent of speciation by systematically assessing the relationships between species on either side of the river.

Stephens arrived in Needles on the morning of February 14, 1910, immediately set up camp, and was joined by Grinnell and Dixon that evening.[117] While the next few days were taken up constructing a flatboat and purchasing a skiff for the party, the expedition was underway by 19 February, floating a few miles down the river, making camp, and starting collections.[118] The expedition would continue the pragmatic pattern of floating down river or crossing it and setting up camp at a new "station" every few days. A total of twenty nine stations were utilized in the expedition, from which trap lines were spread out from the water line up into the surrounding hills, so as record the life along different habitats along the river.[119] The team also fanned out in order to hunt for additional specimens; while not a transecting survey per se, the results of the two

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[116] David Starr Jordan, "The Origin of Species Through Isolation", *Science* Vol. 22, No. 566 (Nov. 3, 1905): 546-547.

[117] February 14, 1910, Frank Stephens 1908-1910 Field Journal, Frank Stephens Field Diaries, Box 177, San Diego Natural History Museum Archives.

[118] February 19, 1910, Ibid.

[119] Joseph Grinnell, "Account of the Mammals and Birds of the Lower Colorado Valley with Especial Reference to the Distributional Problems" 55-57.

strategies allowed for a near continuous survey of life on the river and for between five and ten miles or so on either side.

Traveling down the Lower Colorado by small craft, while not as hazardous as attempting the same in the Upper Colorado, still was not an easy proposition. Swells and whirlpools from rapids and narrowing canyons were a constant danger, and on at least one occurrence, Dixon and Grinnell almost wrecked the flatboat on the rocks.[120] Another time, when landing the flatboat to avoid a whirlpool, the flatboat tipped up on its side, resulting in many items, including the skins in Stephens' collecting chest becoming wet, resulting in lost time as the collected skins had to dry, and the party was forced to backtrack up river to avoid the hazard.[121] Despite the difficulties, the party managed to adhere to its schedule, reaching Yuma in early May without serious incident.

The trip was a resounding success, having collected over 3000 specimens for the Museum of Vertebrate Zoology, including 1374 bird skins, 443 reptile and amphibian specimens, and 1272 mammal specimens.[122] Even more important than the sheer number of specimens were the observations that the party made with regard to animal distribution and behavior. Grinnell noted that the flooding nature of the Colorado could "account for the total lack of terrestrial reptiles and

[120] March 2, 1910, Frank Stephens 1908-1910 Field Journal, Frank Stephens Field Diaries, Box 177, San Diego Natural History Museum Archives.

[121] March 11, 1910, Ibid.

[122] Joseph Grinnell, "Account of the Mammals and Birds of the Lower Colorado Valley with Especial Reference to the Distributional Problems"; 52.

small mammals on the alluvial floodplain of the river," and identified vegetation belts that ran parallel to the river.[123] Even for the experienced Stephens, collecting in the area was extremely "interesting" and the survey found that the river "pro[ved] to be a sharp dividing line for several sp[ecies] of mammals" with different species of the same genus on either side of the river, and "other species that we find on both sides seem to differ a little and on close comparison may turn out subspecifically different in the opposite sides of the river."[124]

After taking the specimens back to Berkeley and examining them, Grinnell wrote the definitive report regarding systematic zoology along the Colorado: "An Account of the Mammals and Birds of the Lower Colorado Valley with Especial Reference to the Distributional Problems." It was the first work of systematic zoology of the region, helping to fill a hole in the systematic map of North American biota. Grinnell reflected that while "none of the carnivores, not even the cats, are averse to swimming the river … among rodents, however, our work showed a number of cases in which the Colorado River had effectively checked the distribution of species."[125] Grinnell narrowed down the reason for isolation even further, showing that the species of rodent that were the least likely to occupy both sides of the river were those that only lived in desert environs, did

[123] February 15, 1910; February 19, 1910, Joseph Grinnell 1910 Field Notebook, Museum of Vertebrate Zoology Archives, University of California, Berkeley.

[124] March 2, 1910, Frank Stephens 1908-1910 Field Journal, Frank Stephens Field Diaries, Box 177, San Diego Natural History Museum Archives.

[125] Joseph Grinnell, "Account of the Mammals and Birds of the Lower Colorado Valley with Especial Reference to the Distributional Problems"; 100.

not need to drink water on a regular basis and where therefore unlikely to travel to the river on a daily or weekly basis, and furthermore had very limited foraging ranges.[126] The difference in the Arizona and California species was described, then as now, as a case of geographic isolation, leading to divergent evolution. However, Grinnell argued that mechanical barriers, such as the Colorado, were only one type of barrier that could lead to speciation; others included temperature, humidity, the availability of food and breeding opportunities. Barriers, in all of their various forms, he argued, were the necessary factor in the "*multiplication of species.*"[127] For Grinnell, even the slight variations were seen as harbingers of evolution; Grinnell was as much a "splitter" with regards to identifying distinct species as Merriam was, and like Merriam, used subspecies to delineate evolution in motion.

After working for three months in the desert, Stephens returned home, only to be offered another collecting opportunity by Grinnell in Humboldt County in late summer, where he would be joined by Joseph Dixon.[128] Stephens readily agreed and after a short visit to the Museum, was in the field by the middle of August, and he would collect specimens in the region, including important topotypes, into early October, at which time he returned home. As with other

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[126] Ibid.

[127] Ibid, 110.

[128] Joseph Grinnell to Frank Stephens, July 22, 1910. Frank Stephens Correspondence, Museum of Vertebrate Zoology Archives, University of California, Berkeley.

collection trips that Grinnell oversaw, the small team avoided towns if at all possible, so as to more accurately record native fauna. Stephens found the conditions in the region "surprising," writing Grinnell that the area was much more diverse with regard to life zones than either of them had previously supposed.[129] Stephens and Dixon worked well together, the two of them gathering over 800 specimens combined, and Grinnell wrote to Stephens that "you have sized up the region as I could not possibly do from here," and urging Stephens to set out after *Aplodontia*, the curious mountain beaver.[130] While Stephens was only able to capture one of the secretive rodents, the *Aplodontia* was important for Grinnell's studies on systematics and would be the basis for one of his most influential papers. This was the last major collecting collaboration between Grinnell and Stephens, who would turn his attention to ranching as well as the San Diego Society in the coming years, and would collect only sporadically for Grinnell from that point forward.

1910, with his experience on the Colorado River expedition, and his donation of his personal collection to the San Diego Society of Natural History, would be a pivotal year in Stephens' life. While he still occasionally went into

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[129] Frank Stephens to Joseph Grinnell, September 11, 1910, Ibid.

[130] Joseph Grinnell to Frank Stephens, September 19, 1910, Ibid; Arctos Multi-institution Multi-Collection Database, "Joseph Dixon 1910" accessed February 13, 2011 from http://arctos.database.museum/SpecimenResults.cfm?coll=Joseph+S.+Dixon&begdate=1910-08-02&enddate=1910-09-23; Arctos Multi-institution Multi-Collection Database, "Frank Stephens 1910" accessed February 13, 2011 from http://arctos.database.museum/SpecimenResults.cfm?coll=Frank+Stephens&begdate=1910-08-12&enddate=1910-10-05

the field, accompanied by Kate, who feared for his safety due to his atrocious skill at driving a car, the expedition to the Colorado River would be his last large scale expedition. He began to settle into more sedentary duties with the San Diego Society, eventually serving the society in almost every executive position.[131] He was sixty-one years old, and could not nearly amble about the region as frequently as he had in the past. Still, he was leading shorter collecting trips for the society into his eighties, some twenty years later. 1910, though, was a definite year of transition for Stephens. His years of work in the field, constant feedback by Merriam and Grinnell, and own comparative work in examining California zoology, had left him the most experienced naturalist in the region. While not nearly the systematic naturalist of his mentors, he had become the face of natural history in San Diego. He began to oversee the collections of the Society with Kate, serving as the curator of Birds and Mammals, rather appropriate considering he was intimately familiar with the collection. Stephens continued to edit the Society's infrequent *Transactions*, and would become the director of the San Diego Natural History Museum when it moved to its permanent location in Balboa Park in 1917. He would later step down, but would continue his employment at the Museum as curator emeritus. The Society/Museum would not be the only institutional venture for Stephens in his twilight years. In 1916, Dr. Harry M. Wegeworth approached Stephens about joining a proposed San Diego

[131] Marjorie Betts Shaw "The San Diego Zoological Garden: A Foundation to Build On "*The Journal of San Diego History: San Diego Historical Society Quarterly* Summer 1978, Volume 24, Number 3.

Zoological Society to the purpose of developing a Zoological Gardens, and Stephens jumped at the opportunity. He would serve as the first director of the San Diego Zoo, serving without pay, in its early, financially insecure period.[132]

Stephens died in the fall of 1937 at the age of eighty-eight, ten days after being struck by a street car. In the *Journal of Mammalogy*, C.G. Abbott eulogized Stephens thusly: "he left a record of natural history achievement in the west that well reflects his tireless energy, his breadth of interest and his high scientific ideals."[133] While not a true systematic naturalist, he nonetheless was the most important figure in southern California natural history, breathing life into the San Diego Society of Natural History, forming a formidable husband-wife collection team with Kate Stephens, and serving as the primary southern California collector for two of the most influential naturalists of the period, in Joseph Grinnell and C.H. Merriam. In short, he was the quintessential local expert whose assistance was necessary if collection attempts in Southern California were to succeed.

For all of his scientific accomplishments, as well as his views with regards to publishing new discoveries, it is interesting that Stephens did not himself publish more. His only substantive effort was his 1906 *Mammals of California*, and while the cost of printing may have dissuaded him from tackling a study on the birds of California, which actually his initial goal in writing on California zoology, it doesn't explain the reluctance to publish articles on his natural history

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[132] Ibid.

[133] Clinton G. Abbott, "Frank Stephens," *Journal of Mammalogy* 19 (Feb. 1938): 135.

work. While he did write short articles discussing his findings, usually for *The Condor*, on many occasions he had to be harangued by Grinnell to do so. His eulogists attributed this to his modesty, that he was content to help Grinnell and Merriam with their research and then allow them to do the more analytical work with regard to scientific publishing. It certainly is true that the majority of his publications, including *Mammals of California*, were descriptive natural history, the type of publications in natural history that were commonplace in the mid to late nineteenth century. Perhaps Stephens was insecure about his conclusions regarding life histories and evolutionary natural history because his training was informal and *ad hoc*, because he didn't practice natural history full time, or simply felt it more appropriate that those paying him to collect take the credit for the analytical research. What we cannot conclude is that Stephens' understandings of natural history were so deeply rooted in the nineteenth century that he viewed descriptive work as the "way" to practice natural history. It is clear from his correspondence with Grinnell and Merriam, and has been demonstrated here that Stephens had a much more contemporary understanding of natural history, even if it was not as nuanced theoretically as that of Grinnell, Merriam or other leading naturalists of the late nineteenth and early twentieth centuries.

To return to the models of collection that were outlined in the introduction and in Chapter 1, Stephen's career in natural history is intriguing as it encompassed all three of these models at one point or another, and occasionally two models were utilized contemporaneously. In his early work with both William Brewster and C.H. Merriam, Stephens collected almost exclusively via correspondence. As was outlined in the first chapter, and is illustrated with the case of Kennicott, Stephens, and E.W. Nelson, this form of collection emerged from the completely Latourian conceptualization as practiced by Asa Gray, and into a much more collaborative relationship. Merriam mentored Stephens on how to collect via correspondence, and how to utilize systematics. Stephens, for his part, was open to looking for answers to natural historical questions, and was not just satisfied with collecting specimens. Thus mentored, he was able to play an integral role in systematic surveys with both Merriam and Grinnell and attempted to replicate these systematic collection trips with the San Diego Society and later Museum. This training also allowed Stephens to act as a scientific missionary, though in a different way than Kennicott was. The primary difference is that while Stephens was instrumental in broadening Grinnell's correspondence network, based upon his work for Grinnell in both San Diego and Humboldt counties, Stephens, and by extension, the San Diego Society, were the main beneficiaries of new collectors. Stephens was a missionary, but due to his role as a local expert, also functioned to a certain extent as a mandarin. As natural history changed in the late nineteenth and early twentieth centuries, it was increasingly common for collectors to engage in more than one form of collection, since the needs of naturalists changed with the field itself.

In many ways, Stephens can be seen as a throwback to an earlier era in natural history, in which amateur pioneer naturalists did much of the work regarding the natural history of the "west" and assisted more systematic naturalists via correspondence. He was largely self-taught and used feedback from established naturalists to become not only a better collector, but a local expert in the natural history of southern California. In this role, he advised local nature enthusiasts, much like Jared Kirtland and Charles Aiken did, ultimately benefiting not only himself, but also the budding naturalists he advised. His work helped reinvigorate the San Diego Society for Natural History, and he played an integral role in the formation of biological knowledge in one of the United States' last scientific frontiers. Stephens was one of the last, if not the last, influential "professional" amateurs in natural history. By the time of his death, it was commonplace for directors of natural history institutions to have terminal degrees in biology, and to work within the field full time. These institutions, even those that were relatively small, became places where professional systematic natural history was practiced. Collection, too, had been professionalized. Naturalists depended less and less on amateur enthusiasts and more on trained field naturalists and professional specimen collectors. Even when large surveys were not possible, small teams of naturalists and collectors worked in the field, systematically collecting material and contributing to theoretical discussions on systematics and life zones. These smaller surveys had the same goal as the collaboration of Kennicott and Baird, as well as that of Stephens with Grinnell and Merriam: how to best collect information on the natural world in a systematic way, without a grandiose, logistically intensive, large survey. It is to one of these collaborations that we now turn, the collaborative partnership of E.A. Goldman and E.W. Nelson, and their place within C.H. Merriam's United States Biological Survey.

Chapter 4. The Career of Edward W. Nelson and the Training of Edward A. Goldman

The final chapter of this study concerns itself with the work of Edward W. Nelson and Edward A. Goldman, especially their collaborative effort in Mexico for the United States Biological Survey over a fifteen year period from 1892 to 1906. Goldman was only eighteen when he started working with Nelson, an experienced field naturalist who had just started his life-long association with the Biological Survey, and had a lengthy collection relationship with C.H. Merriam prior to joining Merriam's organization officially. Their work in Mexico was the first systematic attempt to collect and identify the natural history of the region, and coupled with the Harriman expedition and the exploits of Charles Sheldon – another of Merriman's collectors who hunted big game in Canada – allowed the Biological Survey to expand its area of focus from solely the United States to the whole of North America. It would have a drastic effect on both of their careers, ultimately contributing to Nelson becoming the head of the Survey in the 1920s and allowing the Goldman, who lacked academic credentials, to become one of the most influential naturalists in the country due to his collaboration with and training by Nelson. While the area of emphasis in the chapter is the collaboration between Goldman and Nelson, Nelson's early career in natural history will also be examined to assess the influence of Spencer F Baird and C.H. Merriam, the two most important systematic naturalists of the late nineteenth century, as well as the gradual shift from the comparative biogeography of Baird to the systematic natural history of Merriam.

The collaboration of Goldman and Nelson in Mexico was emblematic of the shift in collection in natural history to a more systematic form of collection by a field naturalist or a field naturalist-led small group. This model was an extension of the collection model used by Nelson when he was a private collector for C.H. Merriam, which was similar to that used by Stephens in the same capacity, as well as the collection trips of Edmund Heller and Harry Swarth for the Field Museum. This small group collection model was standard in the Biological Survey because it allowed for Merriam to spread his collectors out and collect from numerous places at the same time. The partnership of Nelson and Goldman is therefore emblematic of the majority of collection undertaken by the U.S.B.S., and the study of their collaboration not only sheds light on the collaboration of senior and junior members of the collection framework, but also on the work of the Survey itself. As was discussed in Chapter 1, the Survey was a hugely influential, if not the most influential entity with regard to systematic natural history in late nineteenth and early twentieth century American science. Nelson and Goldman's expedition differed from the large surveys undertaken by the U.S.B.S. (Death Valley, San Francisco Mountains, Mount Shasta, the Harriman expedition) and the MVZ (Colorado River, Yosemite) due to size and ability to examine multiple locations at similar times. However, the partnership was a way in which a scaled down systematic survey could be undertaken, and the data collected served as the basis for further biological examinations of Mexico by Edmund Heller (for the Field Museum) and Angelo Heilprin (for the Academy of Natural Sciences). It also signified an important stepping stone in the increasingly imperialistic nature of American natural history, as by the 1920s numerous expeditions from the Academy of Natural Sciences, Smithsonian, New York Botanical Gardens, American Museum of Natural History, and Field Museum targeted Latin America during a new "golden age" of natural history – the golden age of systematic expeditions.

Edward W. Nelson spent his formative years in post-Civil War Chicago, the conflict costing Nelson, like so many others, his father at a relatively young age. He was initially drawn to natural history through his friends in Chicago and became a skilled "weekend collector."[1] At seventeen, a year after his family lost their house in the Chicago Fire of 1871, and at the same time that Merriam was out collecting with F.V. Hayden on the Yellowstone Expedition of 1872, Nelson accompanied naturalist Samuel Garman on a collection expedition west to Nevada, Utah, and California.[2] Garman's expedition proceeded to Fort Bridger, in Wyoming territory, where the initial plan was to join E.D. Cope, the mercurial

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[1] Kier Sterling, "Edward William Nelson," Biographical *Dictionary of Canadian and American Naturalists and Environmentalists*. Westport, CT: Greenwood, 1997 ; United States Geological Survey, "Edward William Nelson" http://www.pwrc.usgs.gov/resshow/perry/bios/nelsonedward.htm, accessed February 13, 2011.

[2] Garman was a student of Agassiz and in 1873 became the assistant director of ichthyology and herpetology at the Museum of Comparative Zoology in Cambridge. See Edward Alphonso Goldman, "Edward William Nelson, Naturalist" in *The Auk*, vol 52, April 1935.

naturalist and paleontologist. Nelson impressed Cope with his nascent collecting skills, and the professor requested that Nelson work with him as a collector.[3] However, by this time, Garman and Cope had fallen out, and Nelson was forced to decline as one of his friends had committed to Garman, and instead of becoming a participant in the "Bone Wars," he was able to collect birds across the mountain west.[4] The ability to collect specimens over such a large geographic range was extremely influential in Nelson's early training as a naturalist, and discussing birds and fossils with E.D. Cope certainly helped as well – despite his numerous personal demons and combative personality, Cope was a superb naturalist who was the country's leading herpetologist and ichthyologist in addition to his paleontological work. After returning home Nelson continued to collect at a voracious rate, even as he took up teaching after graduating from Cook County Normal School in 1875. He became something of a local amateur expert on his native fauna, publishing his first work on natural history in 1876, "A Partial Catalogue of the Fishes of Illinois" in the *Bulletin of the Illinois Museum of Natural History*.[5] The same year he became a regional collector for C.H.

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[3] Edward A. Goldman, "Edward William Nelson, Naturalist."

[4] That Garman and Cope had a falling out is not surprising, given Cope's personality. What is interesting is that none of the numerous accounts of the Bone Wars or the biographies of Cope mention Nelson on expedition with Cope and Garman, and few even mention Garman.

[5] Edward W Nelson "A Partial Catalogue of the Fishes of Illinois" *Bulletin of the Illinois Museum of Natural History*, 1876.

Merriam, agreeing to collaborate and exchange specimens with the future head of the U.S.B.S., who was still attending medical school.[6]

As was discussed in Chapter 3, Merriam would later surround himself at the Biological Survey with collectors that he formed relationships with early in his own career and had spent years corresponding and collaborating with, such as T.S. Palmer and Vernon Bailey. Nelson, likewise, falls into this category, and the future chief of the Biological Survey made contact with the young enthusiast from Chicago in late winter of 1876.[7] Nelson readily agreed to the collaboration, which centered on the exchange of bird specimens, itself not surprising given the importance of ornithology to late nineteenth century natural history as well as ornithology's popularity with professionals and amateurs alike. Despite the close of the school year, Nelson wrote to Merriam that he planned to spend the next three or four months collecting heavily, and requested that Merriam send a list of specimens that he would especially like to obtain.[8] Over the next six months, Nelson sent numerous Midwestern specimens east to Merriam in exchange for more eastern species, and the two developed a congenial relationship via correspondence. It did not take long, however, for Merriam's notorious habit of failing to return correspondence in a timely manner to worry Nelson, and Nelson

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[6] Edward W. Nelson to C.H. Merriam, March 2, 1876, C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74.

[7] Ibid.

[8] Ibid.

wrote in jest replying to a long overdue note from Merriam that he had begun "to think perhaps [Merriam's] silence was caused by an encounter with some ferocious <u>annelid</u>."[9] The initial exchange of specimens, though productive for both young naturalists, came to a close at the end of 1876, when Nelson accepted a position as a weather observer in the in the United States Signal Corps in Alaska with the help of Spencer F. Baird.

In addition to his correspondence to the budding naturalist at Columbia, by 1876 Nelson had also opened a correspondence with Henry Wetherbee Henshaw, a member of Lt. George Wheeler's 100th Meridian Survey and close friend of Merriam.[10] Nelson did not record if Merriam suggested that he contact Henshaw, though this may have been the case. In short order, Henshaw suggested that Nelson get in contact with Spencer Baird, the assistant secretary of the Smithsonian, and dean of American natural history. Nelson visited Washington later in the year, and while Baird could not offer the eager Nelson a position with the Smithsonian in Washington, he shrewdly was able to obtain a position for Nelson in the Army's Signal Corps as a weather observer at St. Michael, on the

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[9] Edward W. Nelson to C.H. Merriam, August 14, 1876, C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74, emphasis Nelson's.

[10] Formally known as the "Geographical Explorations and Surveys West of the 100th Meridian," Wheeler's survey was one of multiple government surveys in the western United States in the late nineteenth century. Keir Sterling "Edward William Nelson." *Biographical Dictionary of Canadian and American Naturalists and Environmentalists*, 572; Edward W. Nelson "Henry Wetherbee Henshaw – Naturalist: 1850-1930," *The Auk* 49, (October, 1932), 399-432. Henshaw would later replace Merriam as the head of the USBS.

Bering Sea in Alaskan Territory.[11] While Nelson's official function in the hinterland would of course be to record meteorological data, Baird knew that he would have ample time to collect natural history specimens and ethnological materials for the Smithsonian in and around St. Michael. Further, placing the eager Nelson in Alaska would allow Baird to continue the collection of Alaskan specimens started by his protégée Robert Kennicott and his young compatriot William H. Dall on the Western Union Telegraph Expedition. Coincidently, St. Michael was where Dall had been informed of Kennicott's death, and the small sample of local specimens from the region were collected by Dall some ten years prior. Dall was still studying Alaskan natural history from his position in the United States Coast Survey, but by placing Nelson at St. Michael, Baird assured himself a collector in a region that was effectively *terra incognita* whose specimens could both supplement and contrast with those collected by Dall from his ten years in the Arctic, strengthening Baird's biogeographic studies.

Nelson left for Alaska in late April, 1877, making numerous observations and inferences with regard to seabirds in his notebook on his way to St. Michael. As was common at the time, the steamer on which he traveled made multiple cargo stops on the way to his destination, which allowed Nelson also to start

[11] United States Geological Survey, "Edward William Nelson" http://www.pwrc.usgs.gov/resshow/perry/bios/nelsonedward.htm, accessed February 13, 2011; for Baird's connections to the army and his ability to place collectors in advantageous positions, see Chapter 1.

taking notes on local marine mammals such as seals and sea otters.[12] Nelson reached St Michaels on June 20, 1877, which would be his base of operations for the next four years.[13] In his first year in the Arctic, Nelson stayed fairly close St. Michael, duly recording meteorological observations and investigating the natural history and the native tribes of the region in his spare time. Any collecting trips were relatively short, and usually involved less than a week in the field. This did not stop him from collecting quality specimens, and Baird wrote to Nelson complementing him on his early collections, especially that Nelson had taken the efforts to secure specimens of local fish, in addition to birds and mammals. These specimens, coupled with earlier collections by Dall, and Baird's other collections via the United States Fish Commission had made Baird "increasingly interested in the subject of the northern species, both of the Atlantic and the Pacific," reinforcing the biogeographic slant to Nelson's mission.[14]

In addition to, or perhaps due to, his study of the natural world, Nelson would also become a dedicated amateur ethnologist. This life-long interest as kindled by his time in Alaska, where he could observe numerous distinct native Alaskan cultures, but also the remnants of Russian culture and the subculture of Alaskan trappers. His ethnological notes start in his voyage notebook, where he

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[12] Edward W. Nelson 1877 Field Journal. Edward W. Nelson and Edward A. Goldman Collection, Smithsonian Institution Archives, Record Unit 7364, Box 11, Folder 1.

[13] Nelson 1877-78 Field Journal, June 20, 1877, SIA RU 7364 Box 11, Folder 2.

[14] Spencer F. Baird to Edward W. Nelson, December 26, 1878. Edward William Nelson and Edward Alphonso Goldman Collection, SIA RU 7364 Box 2 Folder 4.

discussed Aleutian hunting tactics as well as more mundane sociological notes, recording the organization and practice of a "Greek" (Russian Orthodox) church.[15] This initial year also allowed Nelson to study the indigenous tribes near St Michael, the post itself being relatively close to numerous different tribes and along a "dividing line between two essentially different patterns of Alaskan Eskimo language, culture, and physical type."[16] Since the fort also was the predominant trading post in the region, it ensured that Nelson not only was able to learn about and interact with different native groups, but also that he could form relationships with fur traders and steamer captains that had experience throughout the Alaskan region.

Much like Kennicott, Nelson was fascinated by the life that thrived in Alaska's extreme conditions, but also noted the tedium that accompanied an assignment to such a remote post. \In early August of 1877, he noted that those stationed at the post had "begun to lift weight for amusement and exercise."[17] The bitter winter cold was a strong psychological adversary for Nelson, much as it was for Kennicott. This can clearly be seen in the journal documenting his first winter in Alaska. Relatively early in the winter, Nelson's entries are as buoyant as ever, and he continued to describe normal events at the post as well as any

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[15] Nelson 1877 Journal, May 8,1877. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364, Box 11, Folder 1.

[16] Henry B. Collins "The Man Who Buys Good –For-Nothing Things." *In Inua: Spirit World of the Bering Sea* Eskimo, William W. Fitzhugh, Susan A. Kaplan & Henry B. Collins eds. (Washington: Smithsonian Institution Press, 1982), 30.

[17] Nelson 1877-78 Field Journal, August 9, 1877, Edward W. Nelson and Edward A. Goldman Collection SIA RU 7364 Box 11, Folder 2.

pertinent ethnological or biological observations or specimens. Once the dead of winter set in, however, his entries became shorter and shorter, even to the point where February of 1878 was summarized in a few paragraphs, rather than detailed daily entries.[18] It was not until the middle of March that his entries became similar to those the previous summer and fall. While the decreased amount of traffic into and out of the post definitely played a role in this, this would not account for a total drop off of recording daily life. It is impossible to say if he was ill or not, but he did not record any illness in his journal. Notebooks from later years do not have a similar gap in coverage, so presumably Nelson was less affected by winter lethargy as his time in the Arctic passed.

However interesting the study of St. Michael was, after his first year at the post, Nelson was quite ready to sally forth from his post to collect as many Alaskan specimens as he could for the Smithsonian. This was problematic given his official duty at the post, but Nelson made do by hiring traders and friends, such as Rudolph Neumann and M. Lorenz of the Alaska Commercial Company, from around the post to make his measurements for him while he was away.[19] Nelson was then able to investigate Alaskan zoology and ethnology for a few months on end, managing long collection trips in late 1878, early 1879, and early

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[18] Nelson Field Journal, February, 1878, Ibid.

[19] Edward W. Nelson, *The Eskimo About the Bering Strait: Extract from the Eighteenth Annual Report of the Bureau of American Ethnology* (1899) (Washington: Government Printing Office, 1900), 21. The Alaska Commercial Company was the main retail company in Alaska Territory, and were also involved in the seal fur trade.

and late 1880.[20] The aim of the trips was to collect data from as wide and as uncovered a region as possible, visiting native villages and studying customs and collecting ethnological specimens primarily, and collecting biological specimens along the way and when otherwise convenient. Much like Kennicott, Nelson took full advantage of the numerous streams in the region after the thaw, and during the winter traveled mainly by dogsled and walking with snowshoes overland. Travel in the hinterland was treacherous in the best of times, and he almost lost his life on his sledding expedition in late 1880 as he traversed the Seward Peninsula.[21] The trip, which took lasted months in the harsh winter was a success, but was in his words "an "extremely rough journey."[22]

Much of the area covered by Nelson and his compatriots on these trips had not previously been the object of scientific or anthropological study, though his early 1880 trip did coincide with a region worked by the Western Union Telegraph Expedition a decade and a half earlier. However, this was still an important region to examine since Kennicott and his company of "Carcajous" had not been able to accomplish much in the way of biological or ethnological

[20] Collins, "The Man Who Buys Good –For-Nothing Things," 30.

[21] Ibid, 34.

[22] Edward W. Nelson, *The Eskimo About the Bering Strait*, 20. Nelson places this trip as in 1880 in *The Eskimo About the Bering Strait*, and Collins repeats this. However, Nelson returned on April 3, 1880, so it may be that Collins conflated two trips, or that Nelson mistakenly wrote that the trip started on November 9, 1880, and ended of April 3 of the next year. See Collins, 34, Nelson 20, and Nelson 1880 Field Journal, SIA 7364 Box 12 Folder 1.

collection.[23] In his overland voyages, he maximized his study of native peoples by compiling extensive lists of native vocabulary. In this, he went beyond the usual lists provided by the Smithsonian, recording native names for both the physical biological specimens and those animals which he observed, but was not able to collect. Nelson would ultimately be responsible for the submission of close to ten thousand anthropological artifacts to the Smithsonian, giving the institution the definitive collection of Eskimo cultural artifacts in the world.[24] His success on these grounds may have inspired the Harriman Expedition, which was led by Merriam in 1899, to collect as many native artifacts as possible, to the extent that villages were essentially stripped bare by members of the expedition for museums such as the California Academy of Sciences and the Field Museum in Chicago.[25] Nelson would later write the definitive nineteenth century anthropological study on northern peoples *The Eskimo About the Bering Strait,* which detailed the different tribes of the north, their particular traditions, and also legends and creation myths. This study may have been the basis of Merriam's later study of the Native Americans of California, which was similarly formatted,

[23] Edward W. Nelson Journal, February 1880. SIA RU 7364, Box 11, Folder 9. Dall was able to attain some semblance of specimens for the cause of natural history, but Kennicott's branch of the expedition was not able to. See Chapter 2

[24] Collins, "The Man Who Buys Good –For-Nothing Things," 36

[25] William H. Goetzmann and Kay Sloan, *Looking Far North: The Harriman Expedition to Alaska, 1899* (Princeton: Princeton University Press, 1982), Chapter 10.

though no mention of Nelson's work is made in the introduction to that of Merriam. Rather, it may have been a standard format for ethnological work.

In addition to living around and studying native Alaskans, Nelson relied on native assistants and guides during his time in the Arctic. By the summer of 1877, Nelson had already acquired the help of a native assistant, Alexai who collected both zoological and ethnological specimens for the budding naturalist.[26] In the first year around the station, Alexai was Nelson's main zoological contributor, leaving the fort for days, even weeks at a time to collect, while Nelson remained to take the required readings. Nelson did not record in his notes how much Alexai was paid for his assistance, but since Nelson referred to Alexai as his "workman" in his official report, it is extremely likely that Alexai was compensated in some way.[27] In addition to collecting specimens himself, Alexai also traded for specimens from the local tribes, using trade goods supplied by Nelson.[28] Other local natives also brought specimens to Nelson, but they are usually unnamed in his notes, unless it was a common occurrence. When planning even short collection trips around St Michael, Nelson was accompanied

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[26] Nelson Field Journal, July 20, 1877. Edward W. Nelson and Edward A. Goldman Collection SIA RU 7364 Box 11, Folder 2; Nelson refers to his assistance as "Alexis" in his notes, though he referred to the assistant in his Report on the Natural History of Alaska as Alexai, as does Collins, which seems to be more probable given that Alaska was previously Russian Territory.

[27] Edward Nelson, *Report Upon the Natural History Collections Made in Alaska between the Years 1877-1881* Washington: Government Printing Office, 1887, 15.

[28] Nelson Field Journal, September 25, 1877, Edward W. Nelson and Edward A. Goldman Collection SIA RU 7364 Box 11, Folder 2.

by native Alaskans, to serve as guides, collectors, and other helpers; one such trip undertaken in fall 1877 required five such helpers.[29] Nelson was thus able, much as many other naturalists such as Dall and Kennicott had previously, to capitalize on native knowledge as well as to utilize interested natives in his collection effort. This, of course, was not as extensive as the invention of a native collection network by Roderick MacFarlane of the Hudson's Bay Company, but nonetheless assured that Nelson could obtain more ethnological and natural historical specimens than he could collect alone, especially when officially tied to a particular location. It also demonstrates that he was known, by white traders and natives alike, as someone that took a keen interest in native artifacts and biological specimens. Whether he paid natives for the specimens they brought him is not recorded in his journals, but it is probable that some form of compensation was presented to these informal collectors, whether via trade or currency. Once Nelson started to hire others to take care of his meteorological readings, Alexai accompanied him on his collection trips into the hinterland until he joined the crew of the doomed *Jeannette* in late 1879.[30] After Alexai's

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[29] Nelson Field Journal, September 30, 1877, Ibid.

[30] Collins "The Man Who Buys Good –For-Nothing Things." 33. The *Jeannette's* mission was to attempt to reach the North Pole via sea; it became trapped in ice and eventually crushed. About half of the crew managed to reach friendly territory over the ice and survived, Alexai did not. For the navy's overview of the expedition, please see http://www.history.navy.mil/photos/events/ev-1880s/jeannett.htm . Nelson was involved in the search for the steamer, see below.

departure, Nelson continued to traverse western Alaska as much as possible, always with the help of native guides.

This is not to say that Nelson did not view himself or other whites as culturally and racially superior to the native Alaskan tribes; he described natives on occasion as superstitious, primitive, and recorded what he termed "amusing" trading habits between natives and the authorities at St. Michael.[31] At the same time, many natives were themselves amused by Nelson's habit of not just collecting zoological and occasional botanical specimens, but also of purchasing used goods from local tribesmen and women. While Nelson, Baird, and other scientists viewed these objects as ethnological specimens, to many natives, they were old, worn items that were bound to be replaced. Nelson later wrote of the difference in views, from when he had attended a native ceremony honoring the dead in the small village of Razbinsky, in the lower Yukon in 1880. One aspect of the ceremony involved giving presents to those attending, and Nelson's "presence in the village to obtain ethnological specimens had excited great curiosity, and one woman caused shouts of laughter by crying out, 'Where is the buyer of good-for-nothing things'" as she went to present him with gifts.[32] Nelson was able to garner respect from the northern peoples in his quest for knowledge, and while definitely holding common American stereotypes of the

[31] Nelson Field Journal 1877-1878. Edward W. Nelson and Edward A. Goldman Collection SIA RU 7364 Box 11, Folders 1 and 2; Collins "The Man Who Buys Good-For-Nothing Things."

[32] Nelson, *The Eskimo About the Bering Strait*, 377

time, was nonetheless able to be fairly objective with his observations, rather than overtly moralistic. His work in this regard contrasts strongly with that of Robert Kennicott, for example, who consistently attached moralistic tones and qualifiers in his journal about natives, even as he depended upon them to collect the majority of his specimens.[33] Nelson was therefore able to be a more accurate observer of native customs and cultures than Kennicott as well as his successor in the Arctic, William Healey Dall. Nelson also recorded with horror the violence that was often present at trading posts in Alaska, in one instance detailing the rape of a native woman who was married to a native cook at a nearby post after the "whites, or rather, brutes" in charge of the post drove her husband away. The young woman suffered severe wounds during the ordeal and fled to St. Michael where Nelson and others were able to staunch the flow of blood.[34] Later that year, he wrote somewhat nonchalantly of a reprisal raid on a native village that killed thirteen natives due to the potential damaging of a ship.[35]

In addition to his ethnological work, Nelson was of course active in collecting biological specimens for the Smithsonian. Rather than focus only on one or two types of animals, birds, and mammals, for instance, Nelson collected specimens of birds, fish, marine and terrestrial mammals, and even insects, which

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[33] See Chapter 2

[34] Nelson Field Journal, August 9, 1877, Edward W. Nelson and Edward A. Goldman Collection SIA RU 7364 Box 11, Folder 2

[35] Nelson Field Journal, August 26, 1878, Ibid.

many naturalists would have overlooked or distained.[36] Able to distinguish variation and importance in all of these branches of the animal kingdom was not an easy task for such a young naturalist, but it was incredibly important given the rarity of specimens for local species and forms. In short, he was the perfect choice for Baird's holistic and biogeographic approach to natural history. Nelson corresponded with Baird as much as possible; with the long transit time between St. Michael and Washington, a simple correspondence and reply could take several months, making daily or weekly correspondences impractical. Nelson's work augmented that of earlier naturalists such as Dall and Kennicott, and allowed Baird and his staff to make comparisons of Arctic work on a continental basis. Still, it must be kept in mind that Nelson was still a fairly raw collector, less experienced than Kennicott had been when he started his collection efforts in British America some thirty years prior. This occasionally led to what could be termed "rookie" mistakes, such as when Baird wrote to his young protégée admonishing him for forgetting to include vital information with a batch of specimens, including locality, date collected, and the circumstances by which he obtained the specimens.[37] Even with occasional errors, Nelson's collections in natural history greatly contributed to the Smithsonian's existing Arctic collections, supplementing and improving the largest collection on northern American fauna in the world.

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[36] Collins, "The Man Who Buys Good-For-Nothing Things," 35

[37] Baird to Nelson, April 12, 1880. Edward W. Nelson and Edward A. Goldman Collection, Smithsonian Institution Archives, Record Unit 7364, Box 2, Folder 4

In late spring of 1881, Nelson left his observation post at St Michael for his final expedition in Alaska. This time he was not venturing overland by sled in the dead of winter, or exploring the hinterland by canoe, but rather was offered a position as ship's naturalist on the revenue cutter *Corwin*. The *Corwin*'s mission was to search for the stricken *Jeannette*, which had been captured and then crushed by the ice.[38] Nelson promptly accepted, given the potential to collect specimens from all over the region, and perhaps due to a sense of duty with regard to his former assistant Alexai, who was on board the *Jeannette* during the ordeal. The *Corwin* crossed and recrossed the Bering Sea and Bering Strait in its search for the doomed ship, but was unsuccessful in its search. The voyage did take Nelson along the entire western coast of Alaska, all the way to Point Barrow in the North, across the straits to Siberia, and along with fellow crewmates of the *Corwin,* occasionally including the ship's doctor, were the first non-indigenous people to set foot on Wrangel Island, off Siberia's northern coast.[39] Nelson was therefore not only able to collect and compare ethnographic and biological specimens from Alaska, but also comparable specimens from northeastern Asia. He discovered that although all together desolate and almost completely ice-locked throughout the year, Wrangel Island was home to lemmings, Arctic foxes, and other northern mammals and birds, though he concluded that geese probably

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[38] Nelson, *The Eskimo About the Bering Strait*, 20.

[39] Collins, "The Man Who Buys Good For Nothing Things," Figure 4, 32; Nelson Journal, August 12, 1881, SIA RU 7364 Box 12 Folder 7.

just used the island as a seasonal stopping point in their migrations.[40] He also measured the speed and direction of the pack ice surrounding the island, concluding that the northerly direction most probably sealed the *Jeannette's* fate.[41]

Nelson returned with the *Corwin* to San Francisco of the United States in fall of 1881, and he wrote that the hills along California's northern coast were a "welcoming sight" as he returned from his "exile."[42] From San Francisco, Nelson traveled to Washington to start writing the associated reports of his four year stay in the Arctic. Interestingly, Nelson's return to Washington in late 1881 spurred Baird to write Merriam asking the young naturalist, now a physician in Locust Grove, New York, to suggest a potential signal officer/collector for assignment to Alaska, in essence seeking to replace Nelson with another productive collector.[43] Nelson settled into his work at the National Museum, comparing his natural history specimens with the Museum's collections, as well as writing Merriam regarding bird classification and requesting a loan of specimens to more fully

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[40] Nelson Field Journal, August 12, 1881. Edward W. Nelson and Edward A. Goldman Collection SIA RU 7364 Box 12 Folder 7.

[41] Ibid.

[42] Edward Nelson, *Report Upon the Natural History Collections Made in Alaska,* 16.

[43] Spencer F. Baird to C.H. Merriam, C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 36.

compare varieties of certain birds.[44] Within a year, however, Nelson suffered a near fatal attack of tuberculosis. Where and when he contracted the disease is not precisely known, and it has been was alternatively attributed to either his last year on the *Corwin*,[45] or his return to Washington.[46] The disease was to have a profound and long lasting effect on his health. After an initial recovery period in Washington, during which Henshaw frequently drove him around the city to observe birds, Nelson was forced, like so many others in the late nineteenth century, to relocate to the and dry climes of the west to recuperate, traveling first to Colorado Springs, then to Santa Fe, before ultimately settling in Arizona.[47] His family, most notably, his mother, was able to nurse him back to health, but other than writing the majority of his *Report upon the Natural History of Alaska*, Nelson was out of commission with regard to natural history until early 1884.

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[44] Nelson to Merriam, March 28, 1882. C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74.

[45] Collins, "The Man Who Buys Good-For-Nothing Things,"36; Henry W. Henshaw to Chief Signal Office, March 11, 1887 in Nelson, *Report Upon the Natural History Collections Made in Alaska.*

[46] Sterling, "Edward William Nelson,"572; United States Geological Survey, "Edward William Nelson" http://www.pwrc.usgs.gov/resshow/perry/bios/nelsonedward.htm, accessed February 13, 2011; E.W. Nelson to Spencer Baird, October 17, 1883, Assistant Secretary in Charge of the United States National Museum Correspondence, SIA RU 189, Box 89, Folder 3.

[47] Sterling, "Edward William Nelson,"572; United States Geological Survey, "Edward William Nelson" http://www.pwrc.usgs.gov/resshow/perry/bios/nelsonedward.htm, accessed February 13, 2011; E.W. Nelson to Spencer Fullerton Baird, June 18, 1883 and October 17, 1883. Assistant Secretary of the United States Museum Correspondence, SIA RU 189, Box 89, Folder 3.

In the spring of 1884, Nelson had recuperated to a point that he again began collecting specimens "as [he] was able," even as he was to suffer from heart problems the remainder of his life.[48] After initially approaching Merriam to collect, he decided to send most of his specimens to the Smithsonian Institution, which had offered to continue his salary in return for collections from the desert.[49] These collections would supplement the collections of Elliot Coues, a naturalist at Fort Verde, made ten years prior, as well as those made by Edgar Mearns, likewise stationed in Arizona. Apparently this arrangement expired by the end of the year, and in December he wrote Merriam optimistically, "My health is very much better than it was last winter and I will be able in consequence to do some more satisfactory field work." Nelson offered to collect series of local species that effectively demonstrated their variation, and asked the naturalist for assistance in pinpointing an institution that would be interested in his potential duplicate specimens.[50] Rather than being overtly discouraged about being forced to live in the arid southwest, Nelson went afield as much as he could and became

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48 Edward W. Nelson to C.H. Merriam, March 3, 1884, C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74; Kier Sterling, *The Last of the Naturalists.*

49 Edward W. Nelson to C.H. Merriam, April 11, 1884. C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74; Edward W. Nelson to Spencer F. Baird, July 31, 1884, Assistant Secretary of the United States Museum Correspondence, SIA RU 189, Box 89, Folder 3

50 Edward W. Nelson to C.H. Merriam, December 12, 1884, C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74.

an expert on the natural history of the region, collecting throughout Arizona and New Mexico for the rest of the decade. While little of his correspondence from the period survives, he continued to provide Merriam with specimens and data, and kept in touch with the rest of the naturalist community via correspondence and publications. While he did not accompany Merriam and Vernon Bailey on the survey of the San Francisco Mountains (the peaks near Flagstaff, Arizona) in 1889, his contributions to the biota of central and southern Arizona almost certainly played a supporting role to Merriam's findings in northern Arizona, which he would formalize into his famous "Life Zone" theory. The next year, as Merriam was investigating life zones in Idaho, Nelson had recovered to the point that he accepted an offer from Merriam to join the Division of Economic Ornithology and Mammology as a field naturalist specifically to help plan and execute Merriam's next planned survey, the Death Valley Expedition in 1891.

The Death Valley Expedition was the second of three major surveys by Merriam's division prior to the refocusing of the program into the United States Biological Survey in 1895, following the survey of the San Francisco Mountains and anticipating the Mount Shasta survey of 1898.[51] Merriam chose the desolate region in southeastern California because he viewed it as the perfect laboratory to further test his ideas regarding life zones, and the geographic distribution and variation of organisms. The area surrounding Death Valley is incredibly diverse, including the valley itself, the foothills of the Sierras, larger peaks such as Mt.

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[51] For a history of the origins of the Survey, as well as its etymology, please see Jenks Cameron, *The Bureau of the Biological Survey*, Chapter 1.

Whitney, high desert regions, and desert plains stretching eastward. According to Merriam the region "included all of the life zones of the American continent from the Plateau of Mexico to the Polar Sea may be crossed by traversing a distance of only ten miles."[52] Given the relative importance of the survey to the work of Merriam's division, it is not surprising that most of the division took an active part in the survey, and experts from the USDA and the National Museum also went along. As noted in Chapter 3, the survey utilized small groups that crisscrossed assigned regions, mapping out physical geography and collecting as many specimens as possible, ultimately resulting in the collection of over 12,000 zoological specimens and 25,000 botanical specimens,[53] which were jointly used by Merriam and Division staff to systematically outline the ranges of hundreds of species as well as the broadening of the Life Zone concept into a tool that would be used in natural history and ecology into the middle of the twentieth century. While the survey stopped short of utilizing modern ecological transects (which Joseph Grinnell would be using at the Museum of Vertebrate Zoology by 1910), the mapping of the area and the comparative nature of the research laid groundwork for the later utilization of this field research strategy. However the crush of material that resulted from the survey, coupled with Merriam's notorious inability to delegate responsibility to the point of taking all responsibility, meant

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[52] C. H. Merriam (uncited) in Kier Sterling, *The Last of the Naturalists,* 220.

[53] Sterling puts the specimen count as follows: 6,000 mammals, 1,000 birds, 1,000 reptiles and amphibians, 4,500 insects, and 25,000 plants. See Sterling, *The Last of the Naturalists: The Career of C. Hart Merriam*, 222.

that the definitive account of the expedition was never published, nor was his account of the mammals of the expedition. The only large report published was on everything except mammals, was fittingly the second part of the larger, more comprehensive report, the remainder of which was not published.[54]

Nelson's played a key role on the expedition, and was put in charge with one of the zones of the survey.[55] His portion of the expedition actually began in mid December of 1890, when he travelled via rail to the region with Vernon Bailey, while the substantive part of the expedition did not begin until January of 1891.[56] The two experienced collectors immediately got to work once setting up camp near Lone Pine in the Owens Valley, west of Death Valley and east of the foothills of the important regions for the expedition, because of the expected transitions in animal and plant life as the high Mojave Desert gave way to the Sierra foothills, and Nelson would spend much of his time on the expedition examining and collecting specimens in the region; Frank Stephens, a collector of Merriam's from San Diego also examined the region occasionally joining up with the younger Nelson. Nelson's notes and collections in the Owens Valley focus mainly on small mammals, such as *Arvicolas, Dipodomys, Neotomas,*

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[54] A.K. Fisher et al *The Death Valley Expedition: A Biological Survey of parts of California, Nevada, Arizona, and Utah, Part II*. USDA Department of Ornithology and Mammology: North American Fauna, Number 7. (Washington: Government Printing Office, 1893).

[55] See Chapter 3.

[56] Nelson Death Valley Expedition Journal, December 11, 1890. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364, Box 13, folder 1.

Ochetodons, and *Thomymy*s, which were collected from trap lines set around his camp, and then varying distances into the foothills.[57] These rodents were a key component in contemporary biogeographic work, due to the high level of variation in species especially across geographic range, which was thought by Merriam and some other naturalists to be significant in an evolutionary context. Catching and comparing numerous individuals over a region was an attempt of visualizing evolution adaptation, and it was hoped, evolution in action.[58] He and Bailey continued their collaboration into the early months of 1891, though by February, Bailey had departed to work T.S. Palmer, another naturalist with the Survey on a different region. Nelson seems to have stayed in the Owens Valley region into the summer, when he collaborated with Frank Stephens. Nelson's notes in his notebook from this period are much less detailed than usual from May onward; perhaps he kept a second, now lost notebook, or was editing for space, or the time in the field had taken a toll on his fragile constitution. It is clear that he spent a significant portion of May and early June collecting in the Sierran foothills with his typical thoroughness, and by August he had returned to the Lone Pine Region.[59]

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[57] Ibid, December 12-24, 1890.

[58] In attempting to better delineate evolutionary decent, many naturalists, including Merriam, became "splitters" dividing species into numerous species or subspecies based upon variation and distribution. See Chapter 1.

[59] Nelson Death Valley Expedition Journal. Edward W. Nelson and Edward A. Goldman Collection, SIA SIA RU 7364 Box 13, folder 1; Fisher "Birds of the Death Valley Expedition", in Fisher, *The Death Valley Expedition: A Biological*

By the official end of the expedition in late September, Nelson had spent ten continuous months in the field, enduring numerous hardships, especially with regard to the extreme summer heat and relative lack of water. Death Valley is always hot in the summer, but the summer of 1891 it was especially so. One day, one of Bailey's thermometers was blown out when the temperature exceeded the thermometer's maximum temperature of 135º F, another account recorded a similar day with the heat of 136º in the shade.[60] Bailey later wrote that the heat was less of a problem for the expedition members (provided they got enough water) than it was for their specimens and their pack animals, many of which had to be abandoned in the desert. If specimens were not collected and prepared in a timely manner, the extreme heat would "cook" them, meaning that expedition members had to check their traps before the daybreak.[61] While Nelson spend the majority of his time further west, in Owens Valley, summer temperatures can still break triple digits – not the most hospitable of environs for someone with the health concerns that Nelson had. However, if there were any health setbacks for Nelson on the expedition, they are not recorded in his journal or his correspondence.

Survey of parts of California, Nevada, Arizona, and Utah, Part II. Nelson's journal for the expedition has a long gap between early January and the middle of May, even as he was active collecting in the region. Having a gap in his notes is not typical for Nelson, so it may be that he simply started another notebook that has since been lost.

[60] Sterling, *The Last of the Naturalists,* 221

[61] Ibid, 221-222.

The collaboration between the Edward Nelson and Edward Goldman owed much to a rather serendipitous meeting. After the completion of the Death Valley Expedition, Merriam asked Nelson to continue his collection efforts in California, more than likely to augment the collections of Frank Stephens, whose relationship with Merriam was explored in Chapter 3. Shortly thereafter, needing repairs to his wagon, Nelson reached the ranch of Jacob Goldman, and as was common at the time, stopped to ask for assistance.[62] Nelson's wagon was repaired by the next day, but the true prize was the fact that he had chosen this particular ranch to stop at. Jacob Goldman was a nature enthusiast himself, and he and Nelson spent the evening discussing natural history, when Nelson mentioned in passing that he needed an assistant in the field. Goldman suggested that his son, Edward, would be a good fit, even though Edward had just been hired on as a ranch foreman at a vineyard in the San Joaquin Valley, and becoming a field assistant would result in a drastic reduction in pay.[63] Nelson agreed to hire the young man on at $30 a month, plus board, and Jacob managed to convince his son that this was a wise decision. In part this can be seen as a father attempting to live vicariously through his son, but Edward Goldman could have easily returned to ranching had the partnership with Nelson not worked out;

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[62] Kier B. Sterling, "Two Pioneering American Mammalogists in Mexico: The Field Investigations of Edward W. Nelson and Edward Alphonso Goldman, 1892-1906" in Michael A. Mares & David J Schmidly (eds.) *Latin American Mammology: History, Biodiversity, and Conservation* (University of Oklahoma Press: Norman, 1991), 35.

[63] Ibid, 35-36.

as was already discussed, many collectors returned back to their "normal lives" in agriculture or related fields once the season was over. However, Goldman, like Merriam's earlier convert to natural history, Vernon Bailey, was one of the "enthusiastic farm boys" that Merriam was looking for in order to assist the U.S.B.S, and Goldman would have a long and prosperous career in natural history until his death in 1946.[64]

The collaborators had almost opposite personalities, which may have contributed to their success. Goldman, who soon became enamored with natural history to the extent that he never went back to farming,[65] had a warm personality, a great sense of humor which comes across even in his field notes, and was always willing to help colleagues at a moment's notice.[66] Nelson, on the other hand was more reserved, often seen as brusque by his colleagues, one who was blunt and to the point in his interactions with others. Goldman even noted this shortness, but also commented on Nelson's "balanced temperament."[67] W.L. McAtee, a member of the Survey staff in Washington, felt Nelson was abrasive and abusive, especially towards his younger assistant Goldman. That said, almost anything that McAtee said about the Biological Survey or its members should be taken with a grain of salt since he was rather bitter and disillusioned at the way in

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[64] See C. Hart Merriam, "Biology in Our Colleges: A Plea for a Broader and More Liberal Biology," *Science*, 21, 543. (Jun. 30, 1893)

[65] Contrast Goldman with Frank Stephens and Joseph Dixon, for example

[66] Sterling, "Two Pioneering American Mammalogists," 36

[67] Goldman in Sterling, "Two Pioneering American Mammalogists," 36

which Merriam ran the survey, and as such, had numerous personality conflicts.[68] The way that many of his colleagues describe Nelson is almost exactly the way in which they could and did describe C.H. Merriam. This characterization may not have been altogether fair to Nelson, and may be another case of perception becoming reality. Nelson's anxiety at times with regard to his work in Merriam's eyes does not seem to match these descriptions, nor does the tone in his correspondence, which was nowhere near as brusque as that of Merriam. Similarly, it is unlikely that this form of personality would have been anywhere near as successful as Nelson was with his interactions with people from other cultures, whether in the Arctic or the Yucatan. Perhaps his friend and colleague A.K. Fisher was correct when he postulated that Nelson's solitude in Alaska and then while recuperation in Arizona, led to a lack of tact on Nelson's part, or at least contributed to others perceiving Nelson as more haughty than he really was.[69] There is likely more than a grain of truth in this, and it may be that Nelson never really felt quite at home in bureaucratic Washington, or with McAtee and other colleagues, and was able to interact with people more effectively in the informal setting of the village, the field, and the small town than in more "polite" society.

Nelson left the Goldman Ranch with his newly minted assistant, and they would spend the first few months of their collaboration collecting in the

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[68] Sterling, "Two Pioneering American Mammalogists," 36; Sterling, *The Last of the Naturalists*, Chapter 4.

[69] Sterling, "Two Pioneering American Mammalogists," 36.

mountains surrounding Los Angeles.[70] In early December, Nelson was directed by Merriam to travel to Manzanillo, on the Mexican Pacific coast in the state of Colima. Merriam wrote Nelson, "To my mind, this is one of the most important localities in the whole continent in America and you are unquestionably the right man to go there in order to secure the best possible results."[71] A little over a week later, the Secretary of Agriculture, Jeremiah Rusk, formalized the request, ordering Nelson to sail to Manzanillo from San Francisco, and to "visit several points in the states of Colima, Jalisco, and Sinaloa, making Natural History collections and obtaining as much information as possible concerning the agricultural products of the region visited, and *studying the climatic conditions governing the distribution of species*."[72] While the first clause in these directions, to investigate the region's agricultural products was important with regard to the rationale for the trip given the economic slant of the Agriculture Department as well as its responsibility to American taxpayers, the real, tangible reason for sending Nelson was in the second clause – to determine geographic distribution of species, and any climatic conditions that governed these. In short, Nelson was

[70] Ibid.

[71] Merriam to Nelson, December 2, 1891. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 7, Folder 43.

[72] Jeremiah Rusk to Nelson, December 11, 1891. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364, Box 1, Folder 3, emphasis added.

sent to Mexico to determine the region's life zones.[73] Manzanillo had been picked as their initial collection locality for two reasons – it was easily accessed via steamer from American ports, and secondly, there was existing data from the region that their collections would supplement from Spencer Baird's protégée John Xántus, who had collected in Mexico as a part of the Coast Survey and later the United States Consul in Manzanillo.[74] Nelson invited Goldman to come along, even though Merriam had not officially hired Goldman yet and Nelson would therefore have to pay the young man's salary and expenses out of his own pocket. While paying assistants from their own pay was common at the time, Nelson clearly saw potential in Goldman from their brief time collecting in California to make such an offer. Any potential troubles on this front were alleviated when Merriam officially hired Goldman in March of 1892 at a salary of $75 a month, half of Nelson's salary.[75]

Nelson and Goldman's expedition to Mexico was the first attempt to systematically determine the biogeography of the country, and was the first large

[73] Merriam made this distinction explicit in a letter to Nelson on December 15, 1893, though Nelson had already begun to compile the requisite notes to do so. See Merriam to Nelson, December 15, 1893, SIA RU 7364, Box 1, Folder 3.

[74] For Xántus' extensive career as a collector, please see Henry Miller Madden, *Xántus: Hungarian Naturalist in the Pioneer West* (Palo Alton: Books of the West, 1949).

[75] Sterling "Two Pioneering American Mammalogists," 37-38. The increase in pay helped keep Goldman employed by the Survey, as it was roughly $20 a month more than he could make agriculturally. The pay ration between field agent and assistant was fairly consistent with contemporary practices, see Chapter 1.

American collection effort in Mexico since the work of Xántus and Frank Chapman of the American Museum of Natural History. Unlike Xántus and Chapman, they explored and collected across the entire country, not just in specific localities; they worked almost continuously in Mexico until 1906, visiting every Mexican state and territory during the period. This relative freedom required permission granted to the USDA from the Mexican government, and the two carried letters of introduction that requested the support of local government officials. While not exactly the *terra incognita* of Alaska, the goal of the expedition in its entirety was to fill in holes in understanding in Mexican biogeography. Goldman and Nelson would be examining the region in a new, systematic way, supplementing the earlier collection strategies of Xántus, and the localities they collected from were mandated by the lack of collections from these regions in the United States. Accordingly, they compiled extensive notes and specimen lists, published short papers on their findings, and outlined the life zones in Mexico.   It would be more accurate to refer to Nelson and Goldman's trips to Mexico as a series of expeditions rather than one running expedition; while they investigated the region for a decade and a half, they would often return home to Arizona and California, respectively, in the winter months, and Nelson was frequently summoned to Washington to work with the collections. Goldman did spend a period of nearly five straight years in Mexico at the beginning of their time in Mexico, but thenceforth returned occasionally returned home over the last nine years or so.

Merriam's division had numerous small parties in the field at any given time in order to maximize data and specimen collection. Larger survey efforts, such as the Death Valley Expedition, were extremely costly and required years of planning. The small party model of a field naturalist and assistant was therefore standard operating procedure for the Survey, but the length that Goldman and Nelson spent in the field made their particular survey of Mexico rather unusual. This duration of their expedition to Mexico was due to the relative importance of the project to Merriam, Nelson's health, and most importantly, it allowed a small party to replicate the success of a larger, more systematic expedition. A systematic survey done small had another advantage in that while the overall cost of Goldman and Nelson's fifteen years in Mexico probably exceeded the cost of a large systematic survey expedition for six months or so, it was a small yearly cost that was easier to justify to the USDA and Congress. Occasionally, the partners teamed up with American nature enthusiasts living in Mexico, as well as Mexican collectors to form slightly larger expedition parties,[76] but more often than not their field collection party consisted of each other and local hired support staff.

For Merriam, the study of Mexico's biogeography was an extension of that of his study of natural history in the United States. The expansion of Merriam's work in Mexico can therefore be seen as an extension of Baird's attempts to understand natural history in a Pan-American context, not terribly surprising considering Baird's role as a mentor for the younger Merriam. It was

[76] See Edward A. Goldman Field Journal and Edward W. Nelson Field Journal, October 1892; SIA RU 7364 Box 27 Folder 28 and Box 13 Folder 4 respectively.

also a serious expansion of the purview of Merriam's department, even though it was imperative for his understanding of systematic natural history. At least one of his most important collectors, Frank Stephens, was vehemently opposed to the idea, and it technically exceeded the mandate of the division as originally written, which referred to the study of economic natural history in the United States.[77] However, Merriam was not deterred by this and seized the opportunity to expand his Division's responsibilities. It also gave Merriam an opportunity to fully utilize Nelson's skills as a collector and field naturalist, given the perceived need of hot dry air with respect to Nelson's past illness, and worries about the potential health effects of moving back to Washington.

Nelson and Goldman reached Manzanillo at the end of January, 1892, and remained in the region into the middle of February. Collecting was good - Goldman recorded that they "got a lot of stuff" in his notes[78] – giving Nelson ample opportunities to train his young assistant. Goldman quickly learned collection techniques developed by Merriam, how to properly 'put up' (prepare) specimens, how best to package specimens for transportation, the importance of taking detailed notes, and how to compile necessary paperwork. From the Pacific Coast, Nelson and Goldman began a transit of the country, heading eastward and tracking changes in physical geography, climate, and biodiversity in their notes

[77] Frank Stephens to Joseph Grinnell, February 15, 1907. Joseph Grinnell Papers, Bancroft Library, University of California, Berkeley, Collection C-B 995, box 17; Jenks Cameron, *The Bureau of the Biological Survey*, 21-31

[78] Edward A Goldman field notes (T.S.) February 17, 1892. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 27, folder 8.

and reports. Rather than just striking out dead east and compiling data on what would later be referred to as a transect, their collections were driven by locality, resulting in zigzagging across the countryside, collecting as they went. This longitudinal transit would become the standard pattern for Nelson and Goldman's work in Mexico, traveling back and forth from the coast to coast, looping alternatively further north or south in their travels.

On these transits of the countryside, larger towns and cities, such as Guadalajara and Mexico City were important stepping stones. This was not just for Nelson's anthropological interests, but also because the surrounding areas were seen as localities on which that data was needed, and for logistical reasons – they not only utilized rail travel whenever possible, but also had to regularly transmit reports and specimens. Visiting state capitals and calling on local leaders was essential so that Nelson could formally present the leaders with letters of introduction that requested the help of local governments with regard to the logistics of forwarding specimens and reports.[79] On this and other transcontinental portions of their expedition, the collecting team lingered in the central mountains of Mexico, due to both the time to cross the mountains as well as the importance of mapping out the transitions in species as they ascended and then descended in elevation.[80] This allowed them, as well as Merriam and Survey

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[79] Edward W Nelson Field Journal, September 15, 1895. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 14, Folder 6

[80] See Edward W Nelson Field Journal, April, July, October 1892, and February of 1893. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364.

staff in Washington, to comparatively study specimens, hoping to delineate variations distinct enough to determine new species and subspecies.

A working day for the pair depended on the season. Like Kennicott in Canada, they routinely worked for as many hours as they had daylight, though in the summer they often had to check their traps at or before sunrise to collect specimens before they were ruined by broiling sun. In one letter, Nelson noted that they were spending eighteen hours a day working, and that they travelled at night so as to maximize time in the field.[81] Other times, they covered 30 miles a day in travel, collecting along the way.[82] Often either Goldman or Nelson would venture between 20 and 50 miles away from their main camp to collect topotypes of specimens from slightly varying localities so as to compare them with series collected near their main camp site.[83] Working expenses for field work varied from year to year, depending on how much time they planned to spend in the field and anticipated needs. For the year of 1903 this amount was $200, and by their final year in the field this amounted to $800 for each of the collaborators, equal to one-third of Nelson's salary. However, this amount was still not enough, and by

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Box 13, Folders 2-5. They did not stay in the mountains continuously but visited and later transited them in this period.

[81] Nelson to Merriam, October 21, 1905. C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74

[82] Nelson to Merriam, December 20, 1905, Ibid.

[83] Nelson to Merriam, May 30, 1905, Ibid.

February of the next year the pair was fast running out of spending cash, accelerating their return to Washington later in the spring.[84]

Even though Nelson and Goldman were mostly interested in collecting specimens of mammals and birds, plant life was nonetheless important in their research, and they duly collected numerous specimens from localities across Mexico. Still, Nelson was frequently reminded by Survey botanist Joseph Rose Nelson to collect whole plant, flower, leaves, roots and fruit, and to include specific information on locality.[85] Given his experience doing the same for animal specimens, that he would have to be reminded of this demonstrates a sloppiness to Nelson's botanical collecting. The true value of plants to Goldman and Nelson, however, was in the comparative study of vegetation from one locality to the next. This emphasis on plant locality and biodiversity was handed down from Merriam, who had made vegetative patterns – or more formally zones – at the center of his entire life zone hypothesis, due in part to the adaptation of animal species to specific types of plants.[86] Since the type of vegetation varies with elevation, they spent a considerable amount of time collecting in and around areas where the vegetation transitioned from one type to the next, essentially adapting Merriam's paradigm for life zone research at in mountainous northern

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[84] Field expense money was normally dispensed in July, due to the start of the Government's fiscal year on July 1. Please see Nelson to Merriam, August 4, 1905 & February 2, 1906. C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74.

[85] Joseph Nelson Rose correspondence to Edward William Nelson, Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 8, Folder 12.

[86] See Chapter 1.

Arizona to inform their own work on life zones in Mexico. Plant life also varies with temperature and humidity, both of which were used by Nelson and Goldman in systematic comparisons of plants from different localities, again, for the main purpose of delineating life zones and expected animal life. They often relied on local common names when comparing plants, referring to agaves as "tequila plants," and classified many trees as simply "oaks" or "pines," since they often did not know more specific common names let alone scientific names.[87] They could make important systematic observations of plant life, such as Nelson's notes regarding "the abundance of…several species of small plants not found elsewhere" at the Volcano de Tuxtla in 1894, but it should be noted that neither Nelson nor Goldman was a trained botanist.[88] In their written work, plants are described as living components of the landscape – as objects making up part of the environment – rather than dynamic organisms, a practice rather encouraged by Merriam's theories on biogeography.

Merriam's life zone concept was at the heart of the expedition, with Nelson and Goldman duly recording temperatures and floral conditions at each locality they visited. Their work on life zones was vital to an understanding of systematics with regards to Mexican flora and fauna. However, Merriam did not

[87] This is commonplace throughout their journals. For pictures of "tequila plants," see Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364, box 38.

[88] Edward W. Nelson Field Journal, May 12, 1894. Edward William Nelson, Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 14, Folder 1.

solely determine life zones based upon his collectors observations, feedback from his staff in the field was a key component to Merriam's research. Nelson continuously described the regions visited in terms of their prescribed life zones, and actively debated life zone boundaries with Merriam from the field. In 1902 Nelson wrote Merriam from Soto la Marina, a town in the Mexican gulf state of Tamaulipas:

> "With the exception of a few, grassy prairies the country we crossed is covered with a jungle of thorny and scrubby shrubs and low trees mainly lower Sonoran in character all the way down to our present locality.
>
> You will remember my objecting to the tropical red on your map running up to the Rio Grande but I did not for a moment imagine it should end so far south as our present trip demonstrates. This locality has some tropical or subtropical birds, mammals, and plants, but it is essentially lower Sonoran in character as I think you will admit when you are [looking] over results. Frosts occur here regularly in Dec and Jan and a fall of one or two inches of snow occurs at long intervals"[89]

By the end of the expedition, Goldman was likewise able to describe his surroundings according with regard to life zone, describing the Baja peninsula thusly:

> "Most of the Peninsula is probably lower Sonoran. Much of the California flora extends south along the Hanson Laguna and San Pedro Martir Mountains and ends rather abruptly a short distance further. There is wide over-lapping between the Lower Sonoran

[89] Nelson to Merriam, March 31(?), 1902. C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74.

> and Tropical, in fact we have not yet seen any purely tropical country"[90]

It is possible to see the influence of Nelson and Goldman on Merriam's systematic work by comparing the life zone maps published by the Survey prior to their expedition with those that were published as they were in the field. Zone boundaries changed, and as Merriam's theory matured, Nelson and Goldman's data was instrumental in outlining the Transition zone in Mexico. The Transition, as its name implies, encapsulates the area at which the desert life zones give way to more mountainous ones. The changes in life zones were not just based upon Merriam's interpretation of their work; they played an active role of describing these zones from the field and compiled their own maps. Nelson described the area around Chiapas thusly: "The abundant moisture causes a [sic] luxuriant vegetation and places this within *my* humid upper tropic zone."[91] Nelson would also created the definitive life zone map for Baja California, though this was not published until 1921 as part of *Lower California and its Natural Resources*, his sole monograph detailing his findings of Mexico.[92] Taking an active role with regard to identifying life zones made it much easier for Merriam to utilize the data

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[90] Edward A. Goldman to Merriam, December 20, 1905. C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 57.

[91] Edward W. Nelson Field Journal, November 18, 1895, Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 14, Folder 7, emphasis added.

[92] Edward W. Nelson, *Lower California and its Resources* (Washington D.C.: Government Printing Office, 1921), 120.

sent in by Nelson and Goldman reinforced the comparative systematic goal of their expedition.

This comparative emphasis was at the heart of their 1893 surveys of the volcanic peaks Popocatépetl and Iztaccíhuatl and the surrounding region.[93] The volcanoes, which lie some 40 miles away from Mexico City and 25 miles from Puebla, are part of a volcanic ridge and rises 10,000 feet above these two cites; Popocatépetl doubles as the continent's second highest volcano and Mexico's second highest peak. [94] It was a natural parallel to the San Francisco peaks in Arizona and Mount Shasta in California, making the volcano and its surrounding area an excellent region to study the transitions in biota due to elevation. Nelson thought the expedition so important that he dedicated a complete notebook to the survey, rather than combining his notes on Popocatépetl with notes on other regions. On their way up the mountains from the "gently" sloping plains, Nelson and Goldman spent a few days observing birds and trapping at around one of the first transition zone at 10,000 feet in elevation, and from there spent another day investigating the area around the timber line and laying traps for rodents. Nelson recorded that "various species of plants were in flower from 9500 to 10,000 feet" and pines and willows were "conspicuous" up through 10,000 feet in elevation,

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[93] The two peaks overlook the Valley of Mexico and played an active role in Aztec and Mexican mythos.

[94] Smithsonian Museum of Natural History, Global Volcano Project "Popocatépetl," retrieved January 18, 2011 from http://www.volcano.si.edu/world/volcano.cfm?vnum=1401-09.

but thereafter ceased “abruptly.”[95] Goldman described three distinct vegetation zones on around the mountains, “lower pine,” “fir,” and “upper pine,” with the pines differing in not only in location but reproductive physiology.[96] Led by Indian guides, they summitted the peaks by traveling on horseback as long as was feasible, then by foot as the terrain became alternatively rocky and ashy. When they ascended the summits, there was little time to collect specimens due to the need to ascend the peak and return to camp prior to darkness, so Nelson and Goldman instead photographed as much as possible and recorded observations in their notes, including observation on insect life at 16,000 feet.[97] The ordeal was not an easy test for Nelson, who lamented in his notes that his “lack of lung power” forced him to stop frequently on the climb, and he marveled at the ability of the local Indians to keep their breath at altitude.[98] The two also experienced snow blindness, and were forced to recuperate for a few days prior to returning to Mexico City.

They were later directed by Merriam to do a similar survey around Mt. Orizaba, a volcano further southeast and the highest mountain in Mexico. The

[95] Edward W. Nelson Field Journal, February 22, 1893, Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 13 folder 5.

[96] Edward A. Goldman Field Journal (T.S.) February 21, 1893. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 27, folder 8.

[97] Edward W. Nelson Field Journal, March 2, 1893, Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 13 folder 5.

[98] Edward W. Nelson Field Journal, December, 1895, Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 14 folder 7.

collaborators had previously surveyed Orizaba the previous year, prior to Popocatépetl, but a return trip was desired by Merriam in order to collect more data on the area. On their way, Merriam made it very clear that they were to collect as many specimens of the rodent genus Geomys as possible on transit, including a large series of *Geomys mexicanus* from the high plains and a series of *Geomys hispidus* from Vera Cruz.[99] The differing *Geomys* would then be studied by Nelson and Goldman and further analyzed by Merriam and other Survey staff in Washington in order to determine how they differed from one another and how the respective species "fit" into their respective environments. Once they reached the mountain, their goal was to collect a series of *Lepus orizaba*, a rabbit species that lived on the mountain at an altitude of nearly two miles, for a comparative study of regional lagomorphs, as well as many additional specimens as they could collect.[100]

At Mt. Orizaba, they were again assisted by guides in their ascent, and despite Goldman and his guide suffering from "mountain sickness," they summitted the mountain while Nelson made observations from just below the

[99] C.H. Merriam to E.W. Nelson, December 15, 1893. C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74.

[100] Edward W. Nelson Field Journal, March 21, 1894 , Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 14 folder; Merriam had named the *Lepus orizaba* as a distinct species based upon Nelson and Goldman's 1893 survey of the mountain. It has been discovered not to be a distinct species but rather a subspecies of the Eastern Cottontail, itself reclassified as *Sylvilagus floridanus.*

snow line.[101] After ascending the summit, they spent a few days collecting below the snow line, even as Goldman was still had the lingering effects of mountain sickness, and Nelson experienced difficulty breathing for a period. As with their previous survey of Popocatépetl, Nelson diligently recorded the changes in vegetation with regards to elevation, though this time he included detailed notes, including scientific names, on the types of trees that comprised the mountain's different arboreal zones.[102] Unlike their survey of the central Mexican volcanoes, in which they ascended and descended the mountain while collecting at Orizaba, Nelson and Goldman were able to partially transit the circumference of the mountain at an elevation of between 10,000 and 12,500 feet, and descended the mountain's eastern slope after ascending the western side. They found that on the eastern slope "animal life was found to be scarcer than on the west slope," lacked the volcanic ash layer of the western side, and inferred that it received a greater amount of rainfall than the western slope due to the larger trees.[103] After descending the mountain, they proceeded to Veracruz before transiting the country west, to Oaxaca.

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[101] Edward W. Nelson Field Journal, March 19, 1894 , Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 14 folder 1.

[102] Edward W. Nelson Field Journal, March 18, 1894 , Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 14 folder 1. The use of a scientific name in the discussion of plant life is significant for its uniqueness in Nelson's notes.

[103] Edward W. Nelson Field Journal, March 21, 1894 , Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 14 folder 1.

The study of variation with regard to geographic locality can also be demonstrated by Nelson and Goldman's expeditions to southern Mexico. Southern Mexico has a vastly different environment that northern Mexico, with the central plateau giving way to lush rainforests that extend from Chiapas, Campeche and the Yucatan through Central America. This difference, which had fascinated Academy of Natural Sciences naturalist Angelo Heilprin in his geological examination of Mexico in 1890, became an important part of Nelson and Goldman's field research, and they visited the southern states on two separate occasions, exploring southern Oaxaca in 1894 and again in 1904, Chiapas and neighboring Guatemala in late 1895-1896, Campeche in 1900 and neighboring Yucatan in early 1901. The comparison of fauna from one region to another was especially important to the their work in the south, as they compared the fauna they observed there not just to similar humid regions, and contrasting coastal regions, but also to the more arid north and central portions of Mexico. While in Guatemala, Nelson noted "as a rule" that the birds and mammals of the region were very similar to those on the Pacific coast of Oaxaca, although on opposite coasts and separated by the mesas of the southern Sierra Madre.[104] Further comparisons were described in their field reports, including contrasting the species of the verdant south with the more arid north.

Working in the humid south offered distinctly different challenges from the arid north. In addition to the increased chances of contracting malaria or other

[104] Edward W. Nelson Field Journal, February 25, 1893, Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 13 folder 5.

tropical diseases, southern Mexico did not offer the same logistical advantages that northern and central Mexico had. While rail connected the south with the north, southern Mexico's rail network was not nearly as developed as it was to the north. Basic overland travel on horseback was also slower due to the density of the rainforest, and torrential rain could slow exploration to a crawl to protect the horses and valuable pack animals. The damp also meant that all specimens collected had to be put up quickly before they would start to decompose, and that even then the specimens had to be kept as dry as possible. As a result, the two had to almost overcollect specimens in order to make sure that enough quality specimens were collected and that specimen quality was maintained until they could be shipped to Washington.[105]

Given their interests with regard to transitional biogeographic zones, it is somewhat surprising that they did not make the southern rainforests part of a more extensive survey, such as transiting from Chiapas to the Yucatan to Campeche, but this was most probably due to bureaucratic and logistical concerns. Their relatively short period in the Yucatan was a case in point. Nelson, who had returned to the United States in late 1900, sailed directly from New York to Progresso, and quickly rendezvoused with Goldman, who had continued his work in neighboring Campeche.[106] They collected at only three localities in the Yucatan, following up on the research of Frank Chapman, and

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[105] Sterling, "Two Pioneer Mammalogists," 43

[106] Edward W. Nelson, "A Naturalist in the Yucatan" (Mss.) Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 22 folder 14.

completed a quick survey of Cozumel Island, off the peninsula's eastern coast, and then returned to New York, all in about a month.[107]

While the survey of the south was thorough by all accounts, by breaking it into two parts and only just examining the Yucatan prevented them from transiting the transitional areas as completely or as diligently as they may have liked. This approach, which had played such a central role in much of their other research in Mexico, would have allowed them to further analyze the transitions in physical geography and biodiversity of the region. However, the sum of their experiences in the south roughly approximated a clear transit, even as their observations were not just separated by miles, but also by years – the difference of six years between collecting in neighboring Guatemala and the Yucatan could have led to disparities in specimen collection and observation as could have the differing time of year each region was examined. Even so, the comprehensive transits that were completed in the Mexican heartland were only part of the overall expedition strategy, which was to collect and observe as much as possible in as many places as possible. The result of the sum of the expeditions was a systematic survey, but the individual components were analogous to filling in blank spots on a map – much more so, for example than many of their other explorations in the central portion of the country. In this, these individual components were similar to earlier collection trips by collectors such as Kennicott

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[107] Ibid; Chapman was a naturalist from the American Museum of Natural History that had previously collected specimens in the region for that institution, and would become, with Goldman, one of America's experts on Central American zoology.

and Stephens. The difference lay in the evolution of collection techniques and the theoretical background of later surveys in systematics.

While Goldman and Nelson spent the majority of their time in Mexico working collaboratively, Goldman's enthusiasm for studying natural history and ability to picking up collection strategies and techniques quickly soon allowed for the pair to split up, either to cover more ground, or to allow Goldman to collect when Nelson had to worry about compiling reports. By late August,1892, after seven months in the field, Goldman was able to identify at least some of the local bird species solely through observation, which Goldman rather self consciously recorded in his notes, and had begun to indentify small mammals by the name of their genera.[108] At this time, Nelson felt comfortable enough to send the young collector out into the field on his own for short periods of time, and sent Goldman on a weeklong collection trip to collect in and around Ahualulco, a small town in Central Mexico. Goldman's primary goals in collecting around Ahualulco were local bats and small rodents, and he was quite successful in so doing, due not only to his own efforts but by his ability in enlisting the help of town locals.[109] This was a rather short collection trip, but it demonstrated Goldman's growing ability as a collector and the success of Nelson's instruction in field work. It would be the first of many solo short collection trips for Goldman in his first full year in the field as he became more and more experienced, allowing Nelson to broaden their

[108] Edward A Goldman Field Journal (T.S.) August ? - 30, 1892. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 27, folder 8.

[109] Ibid, August 25-30, 1892.

field coverage by splitting up. By that December, Goldman was making systematic comparisons between specimens collected in the field, comparing specimens of *Oryzomys* from two different localities, and was comparing vegetation from two localities as early as the following January.[110] Goldman's side trips would lengthen in time and responsibility, and after the first few years, the collaborators frequently separated for days or even weeks on end to collect at differing localities. Goldman's maturation also allowed Nelson to travel to Washington for a few months on end from 1893 on. While in Washington, Nelson worked to organize the collections that he and Goldman had sent in, identifying and classifying any new species, filling any "gaps" in the collections. By 1902, Goldman was also visiting Washington for brief periods to likewise work up the collections, and with this the young man's transformation from amateur enthusiast to professional naturalist was more or less complete.

During his time in Mexico, Nelson continued his practice of examining society and culture that he had developed when in Alaska. Among the first observations in his field journals in Mexico are his comments regarding "instances of almost Chinese methods by which Mexico is held back," with regard to the unloading of cargo from ships.[111] In doing so he demonstrated the popular stereotypes of both Chinese and Mexican people: that the Chinese depended upon a Byzantine social structure that stagnated society, and the idea

[110] Ibid, December -January, 1892-1893.

[111] Edward W Nelson Field Journal, January 21, 1892. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364, Box 13, folder 2.

that Mexican society, while inferior to that of the United States, could be improved – a combination of the Enlightenment ideas on society, the American Progressive movement, and the virulently racist ideals of the "White Man's Burden." While he and Goldman depended upon Indian guides for much of their time in Mexico, he was quick to criticize them if they did not live up to his hopes for them. On his 1894 survey of Mt. Orizaba, he condemned his native guides in his notes for cowardice, and their uneasiness at transiting a portion of the mountain they were not familiar with. Aside from general comments that demonstrated contemporary ideals of American superiority, Nelson's commentary on Mexican society was fairly objective, complementing workers,[112] noting differences in commercial signage,[113] and the caste-like nature of Mexican social structure.[114] While not the glowing terminology that Hungarian émigré and Academy of Sciences naturalist Angelo Heilprin used regarding Mexican society in his own geological survey of Mexico in 1890, it was far from the virulently racist commentary of Samuel Francis Aaron, an entomologist collecting in Mexico in 1884.[115] Goldman's notes on Mexican society are less objective in the

[112] Edward W Nelson Field Journal, January 21, 1892. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364, Box 13, folder 2.

[113] Ibid, January 26-31, 1892 .

[114] Ibid, February 1, 1892.

[115] Samuel Francis Aaron "A Pencil Journey of a Naturalist." Samuel Francis Aaron Papers, Academy of Natural Science Archives, Collection. 44 (A), Box 1, File 5.

sense that he was not attempting to scientifically observe society, and rather just made passing comments in his field journal rather than detailed observations.

Nelson was very impressed with the developing scientific community in Mexico, including nascent scientific societies ‘in nearly every capital in the country.”[116] The pair took pains to network with these societies whenever possible, and the result was that native collectors, enthusiasts, and naturalists would at times accompany Nelson and Goldman into the field. While Mexican naturalists were generally sympathetic to the aims of their expedition, an American expedition in Mexico could raise concerns in Mexico’s scientific community. Baird’s goal for the National Museum was to create the definitive nationalistic American natural history collection in Washington, and Merriam’s had similar research based goals for the Biological Survey. It is only natural that not all naturalists in other countries would be completely sympathetic to these aims; rather, many of these naturalists wanted to have the authoritative collection on their nation’s flora and fauna as a matter of national pride. This pride was occasionally expressed in print and to Nelson personally. Nelson recorded that “Alf. Herrera” of the Mexican National Museum was “antagonistic” towards the collecting that he and Goldman were doing in Mexico on the grounds that they were taking too many specimens of native species, and had also complained about

[116] Ibid, July (no date given)?, 1892.

this in the proceedings of a local scientific journal.[117] Part of this conflict may be due to the practice of Nelson and Goldman in collecting series of specimens from numerous localities as opposed to just a few specimens, but the nationalistic aspect should not be ignored. It would be completely understandable for Mexican naturalists to feel frustrated about naturalists from the United States working in Mexico, "discovering" knowledge that Mexican naturalists naturally felt that they should have authority over; after all, naturalists from the United States were similarly frustrated when European collecting parties worked in the western territories in the 1850s.[118]

In their travels, they had to deal with the extreme Mexican climate, potential bouts with disease, numerous encounters with ticks and bedbugs, and occasional highwayman thuggery. Nelson recorded a particularly annoying bout with ticks in his journal "The drawback to enjoyment here…is in the myriad of small ticks which swarm on the bushes and cover one from head to toe in a few minutes. The young fellow with me [Goldman] after a day or two became a mass of small pimples from their bites and neither of us could sleep at night from the nervous irritation brought on by these."[119] Goldman noted that "bedbugs overran [him]" when staying in Ahualulco, observing more than forty of the nuisances on

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[117] Edward W. Nelson Field Journal, May 26, 1896, Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364, Box 14, Folder 7.

[118] Keith Thomson, *The Legacy of the Mastodon*, 128-129.

[119] Edward W. Nelson Field Journal, February 3rd to 14th, 1892. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 13, folder 2.

one particular evening.[120] The summer heat in the Mexican desert was as intense or more so, in Nelson's opinion, than the conditions of the Death Valley Expedition, comparing the later with a "pleasure trip" compared to his time in Mexico.[121] In January of 1893, Nelson was hit with back to back bouts of diarrhea and almost came down with pneumonia, and while in Baja California in 1905 was so bothered by a rotten tooth that he had to hire a team to transport him from the field to Ensenada to have the tooth extracted.[122] Both men had the bad fortune to catch malaria for a short period on their trip, though at different periods, and both recuperated quickly after copious amounts of quinine.[123] In most cases, collecting was relatively unaffected as they were lucky enough to not be sick at the same time, and Goldman, being a hale young man, did not sicken easily. He was however, robbed by a gang of highwaymen in the fall of 1892 that stole his gun, watch, seventy-five cents, and bashed the young collector over the

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[120] Edward A Goldman field notes (T.S.) August 25, 1892. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 27, folder 8.

[121] Edward W. Nelson in Sterling, "Two Pioneering American Mammalogists," 40.

[122] Nelson to Merriam, August 4, 1905. C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74; Edward Goldman Field Journal, January 18, 1983 Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 27, folder 8.

[123] Edward Goldman Field Journal, January 18, 1983 Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364 Box 27, folder 8; Sterling, "Two Pioneering American Mammalogists," 42.

head with a rock for good measure when he attempted to defend himself.[124] When ailments bothered one or the other and forced them from the field, they made the best of it by taking the opportunity while in town to send off specimens and correspondence.[125]

Of all the potential problems they encountered, perhaps none were as vexing as dealing with Merriam from afar. Merriam, unlike Spencer Baird, could be, and usually was, brusque in written communication. The director of the Biological Survey did not usually offer positive feedback, usually dwelling on what needed to be improved, and was notoriously poor about returning correspondence in a timely manner. The paucity of communication left even his most experienced collaborators, Nelson amongst them, feeling unappreciated and doubting their handiwork.[126] However, this was nothing but par for the course with Merriam, who routinely overworked himself due to a micromanaging style that grated on many of his colleagues at the USBS and had so many correspondents that corresponding with them all was seen as a nagging chore. Merriam also seemed to expect excellence, not just from his staff, but also from contractors that he hired to work on personal residences, and woe to those that fell

[124] Edward A. Goldman Field Journal, November 5, 1892. Edward William Nelson and Edward Alphonso Goldman Collection, SIA RU 7364, Box 27 folder 8.

[125] Nelson to Merriam, August 4, 1905. C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74.

[126] Sterling, "Two Pioneering American Mammalogists," 42.

short of the goal.[127] From Merriam's perspective, as long as the specimens coming in were in good shape, were accompanied by notes and reports that would allow him to complete his work, there was no need to send feedback or praise – it was simply a job well done. Nelson read into Merriam's lack of correspondence and positive feedback as a sign that Merriam was displeased with his and Goldman's work.[128] That this actually affected Nelson, who had been a correspondent of Merriam's for years and had occasionally cajoled his colleague to be more active in replying to correspondence, shows just how difficult it was to be in the field for months, even years, on end. The lack of correspondence reinforced the perception of isolation that Nelson often felt while in the field; Mexico was not seen being exiled as Alaska did at times, but neither was it home. On the other hand, this can be seen as a bit ironic considering Nelson's often brusque personality, which many in the Survey attributed to his relative isolation in Alaska, Arizona, and Mexico.[129]

As was discussed in the first chapter, it is possible to examine the research emphasis of a collector as well as his scientific growth by examining their field notebooks. The notebooks compiled by Nelson during his time in the North focused mainly on ethnography and natural history; general meteorological notes were taken, but only as they affected his collection work. He did record official

[127] See C.H. Merriam Correspondence, C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958.

[128] Sterling, "Two Pioneering American Mammalogists," 40.

[129] Ibid, 36.

readings for the Signal Corps, ultimately bringing over twelve thousand observations from his time in the Arctic back to Washington in 1881.[130] It is interesting, however, that even a summary of the official readings is rare in Nelson's field notes; these were occasionally recorded by Baird protégées on similar missions. Nelson therefore firmly intended his notebooks to be solely a record of his work in natural history and ethnology, though they are written less as formalized field notes as they are a field journal. Less colloquial than those of Frank Stephens, whose formal articles were still very informal, they were not the precise notes of Merriam, or the detailed field notes/journals of a later Merriam disciple, Joseph Grinnell. Even after becoming a part of the Biological Survey, the form and tone of his notebooks remained more or less the same – an informal field journal with day to day activities that included brief notes regarding specimens and field observations, intermittently discussing how the surrounding environment affects the type of animal species living there. During his days at the Biological Survey, more detailed reports were drawn up in the field and submitted directly to the Bureau; similar, if less formal reports were no doubt submitted to the Smithsonian during his time in Alaska. While on the Death Valley expedition, it is notable that his notes focus completely on natural history, without a real discussion of ethnography. This is probably for two reasons – the focus of the expedition as well as the relative lack of ethnographic research material. Whence in Mexico, he again included ethnological notes, even at times just listing

[130] Edward Nelson, *Report on the Natural History Collections Made in Alaska*, 13.

specimens collected on the back of a page, and focusing his journal on his travels and his observations of society. Still, the ethnological slant of his notes was not to the same extent which he had in Alaska; most probably, again, due to the biological focus of his research. One large difference between his notes in Alaska and in Mexico is the inclusion of detailed notes of the physical geography and soil composition that he encountered in Mexico, due to the importance of the environment to Merriam's life zone theory. In all, Nelson's field notes closely resemble those of Edmund Heller, in that they are almost written in narrative form, discussing the sum of the day's collection activities and notable events.

Perhaps more interesting than Nelson's detailed field journals, are the notes of his young assistant, Goldman. As an eighteen year old amateur when he joined Nelson, he was very much a *tabula rasa* with regard to the day to day practice of natural history, so Goldman's notes give us the opportunity to examine the "on the job" training of a collector in natural history. Goldman's notes begin rather simply, using extremely simple common names (mice, coons, etc) to describe animal specimens, and noting movement from place to place, rather than including specific notes on the surrounding environment or towns they visited. For a short period early in their Mexican expeditions, Goldman began recording his notes in Spanish.[131] No doubt Goldman was attempting to immerse himself in the language so as to learn it as quickly as possible, which probably contributed to

[131] Edward A Goldman Field Journal, May 1892; this may have continued longer but the notes are torn out from the end of May until August 1892, Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364, Box 27, Folder 8.

his quick mastery of Spanish. While this practice ceased relatively quickly, it demonstrates how eager the young man was to collect knowledge, not just about the natural world, but also about different cultures. By August of 1892, Goldman's notes had become exponentially more descriptive, recording physical geography, notes on towns, native culture, and most importantly, the use of scientific names in describing genera of small mammals, all of which allowed Nelson to start sending the young man on short collecting trips out on his own. By the following year, Goldman's notes had become as comprehensive as Nelson's, though perhaps not as detailed. Goldman's increasing notekeeping skills with regard to specimens allowed Nelson to make more anthropological observations in his own notebook, reinforcing Nelson's strength of societal observation. By the end of the expeditions, Goldman's journals were the equal of anyone associated with the Biological Survey, as detailed as Nelson's, much more so than Bailey's, which more often than not were simply specimen lists, and much more succinct and formalized than those of Frank Stephens. Rather than being more of a personal diary that included pertinent information on natural history, such the notes of Nelson or Edmund Heller, Goldman's notes anticipated the change in field note format that would be popularized by Joseph Grinnell, in that they included relevant personal data, but kept collection information segregated, either at the beginning or ending of a journal entry.[132]

[132] See Chapter 1; Edward A Goldman Field Journal, 1902-1903. Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364, Box 27, Folder 1.

In the spring of 1905, the pair set out from Washington for their last year in the field, first traveling to San Diego, where they rendezvoused briefly with Frank Stephens before traveling south to work in Baja California, collecting through almost the entire peninsula. By this time, Nelson, who was fifty years old, was growing weary of spending more time in the field. He wrote to Merriam that he had lost twenty pounds or so in the preceding year, and "I find I cannot get about among the rocks quite as well as once and do not like it."[133] Clearly Nelson, who was still not in the best of health two decades after his tuberculosis attack, was wearing down. By this time, counting the Death Valley Expedition, he had spent well over fifteen years in the field, not counting vacations or trips to Washington. The end of the expedition came almost as a relief to Nelson, who returned to Washington to work for the Survey in an administrative function. By the time the expedition ended in early 1906, the pair had spent the better part of fourteen years in Mexico, collecting specimens and recording biogeographic data from Cabo San Lucas to the Rio Grande to the Yucatan and Guatemala. To put this in comparison, that is almost twice as long as the total amount of time than Edmund Heller spent in Africa on various expeditions,[134] or roughly three times as long as Kennicott spent working in the subarctic.

The partnership of Nelson and Goldman was one of the most fruitful in late nineteenth and early twentieth century science. In addition to their detailed

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[133] Nelson to Merriam, August 19, 1905. C.H. Merriam Papers, Volume II, Bancroft Library, University of California, Berkeley, Bancfilm 1958, Reel 74 .

[134] See conclusion.

field reports from every locality they collected in Mexico over fourteen years, they submitted over 30,000 specimens to Washington, and described more than 350 new species and subspecies.[135] Their work on the distribution of plants and animals, coupled with their observations of Mexico's physical geography, allowed Merriam to constantly update his comprehensive North American life zone map as well as lead to the definitive life zone chart of Baja California, published in Nelson's comprehensive narrative of the region, *Lower California and its Natural Resources*, published after long delay in 1921.[136] They composed numerous small papers on their findings, in which they described some of the new species they discovered, and their collections played an integral role in the completion of Robert Ridgway's seminal treatise on the birds of North and Central America.[137] However, like so many other extensive projects of Merriam's Division, the comprehensive report of their work was never completed. This had less to do with Merriam's micromanagement than inevitable promotion of Nelson and Goldman into more bureaucratic positions. Shortly after his return to Washington, Nelson became the head of the Bureau's Division of Biological

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[135] Sterling, "Two Pioneering American Mammalogists," 43; Sterling puts the specimen count at "17,400 mammals, 12,400 birds, together with many reptiles amphibians and plants," It should be noted that these "new species" may have in fact also included new subspecies of birds and mammals, and given the "splitting" tendency of Merriam and naturalists at the USBS, this number should be taken somewhat with a grain of salt.

[136] Edward W. Nelson, *Lower California and its Natural Resources* (Washington, Government Printing Office, 1921).

[137] Ridgway was a Baird disciple and curator of birds at the Smithsonian's National Museum.

Investigations, and by 1913 he was appointed assistant chief of the Survey.[138] Goldman continued his work in the field, leading a surveys of Panama from 1911-12, and Arizona from 1913-1917, becoming chief of Biological Investigations in the Survey after serving in the Sanitation Corps in France during the war. As Merriam had continuously found to his chagrin, administrative duties often hindered one's ability to publish their findings, and by the time Goldman's work on Mexico was published posthumously, the findings were severely dated.[139]

By the time he was promoted from the field to administration, Nelson had done perhaps more to advance the study of biogeographic natural history than any other field naturalist, paving the way for the systematic naturalists and ecologists such as Edmund Heller that came to dominate the field in the late 1910s and 1920s. His vast experience in the field came in the harshest environments in the western hemisphere, from Pt. Barrow in the north to Guatemala in the south, giving him a unique perspective on the application of Merriam's theories of biogeography. As important as his thirty years in the field in North America's scientific frontiers was the training of Goldman, who became an excellent naturalist in his own right, and an expert in Mexican and Central American zoology. Goldman was to be one of the last of a generation of naturalists who

[138] Sterling, "Two Pioneering American Mammalogists," 43. Sterling puts the date of his promotion at 1914, but Nelson was promoted as of May 21, 1913. See USDA Secretary's office to Nelson, May 21, 1913, Edward W. Nelson and Edward A. Goldman Collection, SIA RU 7364, Box 1, Folder 3.

[139] Sterling, "Two Pioneering American Mammalogists, 43-44.

could find success without academic training, as the field of natural history further professionalized and specialized in the early twentieth century.

In many ways, the collaboration of Nelson and Goldman can be seen as a microcosm of the entire Biological Survey. The techniques they used were of course standard for Merriam's outfit, as was the nature of their small expeditionary party. Over the course of nearly decade and a half, they were able to carry out one of the more systematic surveys in any region prior to the explosion of large survey expeditions in the early twentieth century. Like other small collection parties in the Biological Survey, their time in the field was balanced between completely uncollected areas and localities that served as a biological field laboratory which they could test contemporary theories in systematics. More so than this, the relationship between the two mirrored the earlier collaboration of Merriam and Nelson, with Nelson being the definitive, perhaps even authoritative, mentor, and Goldman, the willing student; extending that analogy, the relationship between Nelson and Goldman in the field reflected the relationship between Merriam and the rest of his Survey staff. Their emphasis on geographic variation paved the way for the modern synthesis of evolutionary systematics, but like other Survey leaders, especially Merriam, their life's work became bogged down in the details. Their lasting legacy, similar to that of the Survey, was the beginning of the truly systematic natural history that dominated field biology throughout the twentieth century, but the vast majority of their published work was not systematic, but rather descriptive natural history, an extension of the early work of Gray, Leidy, Agassiz, and Baird. They, and the Survey itself, were at an inflection point in the study of the natural world, when descriptive natural history was subsumed by systematic natural history, and although Merriam's Survey attempted to usher in this new era, it was largely confined to the duties of nineteenth century natural history, if only due to the sheer amount of data that was collected. Nelson and Goldman, like Merriam, made it to the top of the mountain, but did not make it to the promised land.

Afterword.

One way to assess the changes during the “golden age” of natural history is to examine the early career of Edmund Heller, and compare it to that of Robert Kennicott some fifty years earlier. Heller, like Kennicott, would become a consummate and dedicated collector, vastly preferring life in the field to administrative or laboratory work. He can also be described as one of the first true systematic field naturalists in the vein of C.H. Merriam and E.W. Nelson. Unlike Vernon Bailey, Merriam’s most trusted collector, and similar to his friend Joseph Grinnell, Heller had both academic and practical training in natural history and systematics, both of which greatly contributed to his success in the field. He participated in numerous zoological expeditions on four continents, and by the end of his time in the field had become one of America’s foremost authorities on African mammals. Heller was typical of the systematic field naturalists in the early twentieth century in his approach to, and skill in, collecting. Even though he did not break out of the mold of natural history into that of modern field biology, which emphasizes observation over collection, expeditionary naturalists of Heller’s type were instrumental in the transition from natural history to ecology and conservation biology.

Heller’s career as a field naturalist was predicated on his education at Stanford University, where he was a classmate of Joseph Grinnell. Stanford opened during the explosion of American universities, both private and public, during the late nineteenth century. The result of this exponential increase was a great increase in access with regard to the study of the sciences. Many of these new universities focused more on laboratory biology to the detriment of the traditional study of zoology, botany, and other aspects of natural history, but the increase in educational access naturally allowed many interested students to study natural history in an academic setting. Stanford had one of the premier systematic zoological departments in the country, which counted as one of its members the President of the University, David Starr Jordan. It was more conducive to studying natural history than many other universities and a natural spot for Heller and Grinnell to pursue their academic work.

Heller's dedication to field collection was evident from his first days at Stanford. Early in his university career, Heller did some elementary collecting work in the California deserts and then formed a collaborative relationship with Robert E. Snodgrass, a fellow student studying entomology. In 1898-1899, Snodgrass and Heller took extensive time off of school to lead the Hopkins-Stanford Expedition, which sought to systematically examine the biota of the Clipperton, Cocos, and Galapagos Islands in the eastern Pacific islands. All of these island groups are very isolated from the mainland, and so offered interesting areas to study and collect. The collection trips to Cocos and Clipperton were fairly short, lasting a few days, but their expedition to the Galapagos lasted seven months.[1] While in the Galapagos, Heller was fascinated by the large tortoises

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[1] Hilda Grinnell "Edmund Heller: 1875-1939" *Journal of Mammology* 28 (2, August 19, 1947): 209; Robert E. Snodgrass and Edmund Heller, "Papers from the Hopkins-Stanford Galapagos Expedition, 1898-1899: XI, The Birds of

indigenous to the islands, taking extensive notes on the large reptiles and numerous pictures of them, including pictures with children riding them.[2] However, his main focus on the trip, much as it would be for the rest of his career, was the mammals of the islands. He was the lead author of the article that described the mammals of the islands, "Mammals of the Galapagos Archipelago: Exclusive of the Cetacea," one in a series of seven scholarly papers in the *Proceedings* of the Washington and California Academies of Science described their findings on the trip. In these articles, Heller and Snodgrass related the biota of the islands to the American mainland as well as the other islands that they visited. For example, they noted that the biota of the Clipperton Island had populated the island due to ocean currents surrounding the islands came directly from the mainland, but "land fauna [was] very scant."[3] In his report on mammals, Heller noted that the Galapagos version of the rat, *Mus alexandrinus,* had a shorter tail than "typical" *M. alexandrinus,* that there were differences in coloration of the rat from island to island, and that the skulls of alexandrines "agree essentially" with its cousin, the Black Rat, *Mus rattus*.[4] With their

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Clipperton and Cocos Islands" in *Proceedings of the Washington Academy of Sciences* IV (1902): 501-520.

[2] See Edmund Heller Papers, SIA RU 7179, Box 1, folders 31 & 33.
[3] Robert E. Snodgrass and Edmund Heller, "The Birds of Clipperton and Cocos Islands," 502.

[4] Edmund Heller, "Mammals of the Galapagos Archipelago: Exclusive of the Cetacea," *Proceedings of the California Academy of Sciences*, 3 (1904): 237; the two rats are now recognized subspecies of the Black Rat; *Rattus rattus alexandrinus*, and *Rattus rattus rattus*, respectively.

publications, the students had made a significant contribution to the study of the natural history of these island groups.

After returning from the Galapagos, Heller was part of another expedition the following year, accompanying Wilfred Osgood of the United States Biological Survey on an inspection of Alaskan canneries. The trip allowed Heller to learn from Osgood, another of Merriam's premier collectors, supplementing his academic education with practical know-how. Heller was encouraged by Osgood to collect birds and mammals as their steamer went up and down the Alaskan coastline, making stops at canneries and ports along the way. His notes of the expedition consisted mainly of a personal narrative, but also included specific inferences on Alaskan biota. Heller did not take a great many specimens on the trip, but made systematic observations about those that he did manage to collect, comparing mammals from southern Alaska to those at more northerly latitudes, and making generic biogeographic notes on fishes.[5]

Heller graduated from Stanford in 1901, and immediately went back into the field. He was hired as the western regional collector for the Field Museum of Chicago, and collected along the Pacific coast for both the museum and his friend Joseph Grinnell. While collecting, Heller continued his focus on mammals, reflecting a change of sorts within natural history. Beginning in the late nineteenth century, based upon the work of C.H. Merriam and others, mammal specimens became increasingly important to the study of evolutionary

[5] Edmund Heller Journal, 1900, Bancroft Library collection P-K 233 Folder 7, Bancroft Library, University of California, Berkeley.

systematics, building on earlier work with birds that stretched back prior to Spencer Baird's tenure at the Smithsonian. Heller made sure to collect birds as well, cognizant of Grinnell's ornithological preference, though tended to ignore or overlook reptiles, amphibians and most invertebrates. This specialization is significant with regard to the direction in which the field of natural history was progressing: Nelson and Goldman were not expert herpetologists by any stretch of the imagination, but they collected many of them while in Mexico due to the mandate from the Biological Survey. As a collector, to be sure, Heller had more freedom to choose what to focus on, but this emphasis on mammals continued at the Field Museum and throughout his career as a field naturalist.

Heller would work at the Field Museum until 1908, when he accepted a position at Grinnell's new Museum of Vertebrate Zoology. The position at the Field Museum gave Heller ample time to work in the field, usually as the lead naturalist of small collection parties. During his more than six years working at the Field Museum, Heller collected in Africa, throughout Mexico, into Guatemala, Louisiana, and in northern Wisconsin, focusing on the biogeography and variation of mammals, usually spending in numerous consecutive months in the field. For example, in 1902, he spent nine months collecting in Baja California, collecting birds and reptiles, and making extensive if non-specialized notes on native plants, in addition to his mammal collections.[6] When trapping mammals, he utilized the same strategies that had been pioneered by Merriam and

[6] Edmund Heller Baja California Field Notes (1902 Field Journal), MSS 0332, Mandeville Special Collections Library, University of California, San Diego.

other naturalists after the development of the cyclone trap; lines of traps interspersed at increasing distances around camp. His specialization in mammals led to struggles in field identification of birds, especially when collecting in the vibrant rainforests of southern Mexico, writing to Grinnell that he was "completely lost as regards identification, and cannot even trust myself to put them in their families."[7] His time at the Field Museum was rocky, due mainly to strains between museum administrators and staff, which intensified as the time delineated for Heller's field work. Harry Swarth, a young collaborator of Grinnell's in southern California, was also working at the Field in the early aughts, and correspondence between Grinnell and his two friends reveals that from their perspectives at least, the institutional culture at the Field Museum was dysfunctional at best. In the year prior to leaving Chicago for Berkeley, Heller continuously described the atmosphere at the Field as "depressing" and that he was "ready to migrate" if and when Grinnell got the MVZ off the ground and if he needed someone to work on mammals.[8]

Thankfully for Heller, Grinnell did indeed need someone to focus on mammal work, especially when he rescued Swarth from the Field Museum in late 1908 to focus on birds. That a new museum with a dedicated but relatively junior systematic naturalist could hire away two important members of the Field

[7] Edmund Heller to Joseph Grinnell, January 16, 1904. Joseph Grinnell Papers, Collection C-B 995, Box 10, Bancroft Library, University of California, Berkeley.

[8] Edmund Heller to Joseph Grinnell, April 8, 1908 & January 27, 1908. Joseph Grinnell Papers, Collection C-B 995, Box 10, Bancroft Library, University of California, Berkeley.

Museum's zoological staff, speaks volumes about not only the Field Museum's problems but also Grinnell's goals with regard to the systematic collection and research of vertebrate specimens.[9] Upon being hired in early 1908, Heller was immediately assigned to compare the mammal data from Annie Alexander's 1907 expedition to Alaska with that of C.H. Merriam in Washington D.C. His work on these specimens caught Miss Alexander's attention, and he was asked to accompany her on her second expedition to Alaska that summer. Heller was a productive collector on the expedition, contributing over six hundred specimens, mostly mammals, to the nascent museum.[10]

Almost immediately after returning to Berkeley, Heller was offered a position on Theodore Roosevelt's proposed African expedition sponsored by the Smithsonian due to his experience in Africa. A large reason is while Grinnell had promised extensive time in the field, Heller's position at the MVZ necessitated the majority of the year spent in a curatorial position, helping identify, describe, and organize the specimens collected in the field. Heller knew this whence moving to Berkeley, but the opportunity to accompany the president, collect and study large mammals out on the savanna was too tempting to turn down. Grinnell

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[9] The issues at the Field Museum were eventually alleviated to a large degree by the hiring of Wilfred Osgood of the United States Biological Survey to head the Museum in 1909, but by that time Heller and Swarth were gone. Heller eventually returned to the Field Museum in 1919 after being hired by Osgood to help curate the mammal collection

[10] Museum of Vertebrate Zoology Collections Database http://arctos.database.museum/SpecimenSearch.cfm Query "Heller" completed February 23, 2011.

granted his friend a leave of absence from the MVZ, and Heller would spend the better part of the next four years in Africa, first on the Roosevelt expedition, and then later helping the Anglo-American hunter Paul Ramsey on his African expedition. All of the specimens from the Roosevelt expedition were given to the Smithsonian, and Roosevelt and Heller later wrote the definitive study of the geographic distribution of large African mammals, published in 1914 as *The Life Histories of African Game Mammals*.

Heller would never return to the MVZ, instead taking positions that allowed him to collect specimens and explore interesting exotic places. He was a member of the 1915 National Geographic Society expedition to Machu Picchu, Roy Chapman Andrew's 1916 expedition to Asia through the American Museum of Natural History, and collected throughout Siberia in the waning days of the First World War before returning to the Field Museum to work for Osgood in 1921. His stay at institutions was usually short and invariably ended when he felt he did not receive enough time in the field to keep himself satisfied. He was finally forced from the field all together in 1927 from a scandal due to a power struggle on an African Expedition between him and his wife, which cost the Field Museum $3,000 and led to Heller's dismissal from the Chicago museum.[11] He spent the rest of his career as the director of zoos in Milwaukee and then San

[11] Edmund Heller to Joseph Grinnell, May 15, 1927. Joseph Grinnell Papers, C-B 995, Box 10 Bancroft Library, University of California Berkeley.

Francisco, where he dedicated his efforts to improving the enclosures and care for the animals which he had studied in the wild.[12]

Whereas other systematic naturalists, such as Grinnell and Merriam, were active in field collections whenever possible, Heller took field collection to a new level. His goal was to be in the field at all times, leaving institutional positions as soon as new positions that had more opportunities to collect and to study were made available. His dedication to field collection was very similar to that of Kennicott, who felt depressed and beaten down when unable to collect due to the weather in British America or the disastrous organizational structure of the Western Union Telegraph Expedition. Similar to Nelson, but unlike Kennicott and Stephens, he had a sufficient background in systematic work to be able to apply systematics in the field and make inferences and conclusions about the organisms which he was collecting and studying. In contrast to Nelson, who also found mammal work interesting, Heller almost exclusively focused on mammals in his work; it may be more appropriate to refer to Heller as a systematic mammalogist than a naturalist. Heller, then, represented one of the new generation of specialists within natural history that came to dominate the field in the early twentieth century. At the same time, Heller was also a throwback to the nineteenth century explorer-collectors in that he did not have a particular region of focus with regard to collection and went wherever he was needed or offered the greatest opportunities for learning and excitement.

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[12] Hilda Grinnell "Edmund Heller: 1875-1939" *Journal of Mammology* 28 (2, August 19, 1947): 214.

His love of field work did not prevent him from publishing detailed reports on the expeditions participated in. His collaboration with Theodore Roosevelt on the life histories of large African mammals, for example, the scientific aspect of the study was compiled by Heller alone, even as Roosevelt was an accomplished amateur naturalist.[13] In so doing, Heller incorporated a systematic examination, including outlining geographic variations, of the different subspecies of mammals within a traditional collection of life histories. His work, both on African mammals, as well as South American wildlife, was critically praised for its attention to detail, and his field notes from his Peruvian expedition were critical in the success of Frank M. Chapman, an ornithologist from the American Museum of Natural History who visited the Machu Picchu region six years after Heller.[14] He was dedicated to publishing the reports of previous expeditions, even if he was working for a different institution. For example, Heller's report on the mammals of Alaska for the MVZ was published two years after he left that institution, though undoubtedly much of the work was completed prior to leaving for Africa with Roosevelt.

In the introduction, it was argued that the changes within natural history with regard to an increased stress first on biogeography, and later on systematics, necessitated an increasingly professionalized cadre of collectors. Heller's career represents the completion of this trend; as more professionalized collectors and

[13] Hilda Grinnell "Edmund Heller: 1875-1939," 211.

[14] Ibid, 212.

field naturalists rose to prominence, amateur collectors and naturalists saw their role within natural history decrease exponentially. Dedicated amateurs such as Frank Stephens could play an active role in the formation of biological knowledge in the early twentieth century, but by the middle of the century there was little place within the scientific community for interested amateurs. Systematic survey expeditions after the First World War still needed volunteers and interested individuals for support and logistical purposes, but even if they were active with regard to the collection of specimens, they were not responsible for systematic research on these collections. It could be argued that this de-emphasis on amateur collectors within the creation of knowledge was just a return to the status quo of the early nineteenth century, when systematic naturalists asked collectors to send in specimens for comparative research completed by the naturalists. However, in the early nineteenth century, amateurs still had opportunities to publish findings, and more importantly, to be trained via correspondence and in person to become naturalists in their own right. These opportunities all but disappeared as natural history became more professionalized and more tied to higher education in the twentieth century.

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This dissertation has examined how theoretical changes in natural history led to changes in field practice. Changes in the conceptualization of natural history, from an emphasis on biogeography, to the growth of a truly systematic natural history based upon evolutionary theory, were mediated by naturalists, but had profound effects on the practice of natural history in the field, changing the dynamic between naturalists and the specimen collectors that worked for them. New collecting methodologies were developed and evolved in order to better match the epistemological background of natural history. Given these developments and the importance of increased collection to natural history, collectors became more active in the creation of biological knowledge, ultimately leading to the evolution of fully trained systematic field naturalists.

In the mid-nineteenth century, American naturalists were eager to examine the vast natural diversity throughout what is now the continental United States. As was discussed in Chapter 1, this was due in part to a nationalistic scientific rivalry constructed by Americans with Europeans and the understanding by naturalists of all nationalities that American science lagged far behind that of that in Europe. On a practical level, there was much unknown about the natural history of North America, and this necessitated the collection of as many specimens as possible from across the republic. Naturalists relied, partially by choice, partially by necessity, on collection networks made up of amateur collectors. These networks were based upon correspondence and constant feedback from naturalists to their collectors, asking them to attain (or just look out for) certain types of specimens, sending detailed collection instructions and then providing feedback with regard to the preparation of specimens, helping their collectors identify their specimens; in short, to facilitate their own work and to train their collectors. Naturalists were also aided by the numerous military surveying expeditions, both overland and nautical, in the mid-nineteenth century. These expeditions included "surgeon-naturalists" to collect objects of natural history when convenient, and though most of the collection on these government backed surveys was overseen by Spencer Baird at the Smithsonian, the specimens were distributed amongst the most prominent naturalists of the day, including Asa Gray and Louis Agassiz at Harvard, and Joseph Leidy at the Academy of Natural Sciences. Given the number of specimens sent east, and the diverse geography of North America, the collections made by these "surgeon-naturalists" were instrumental in the progression of American biogeography.

The biogeographical emphasis of American natural history in the mid-nineteenth century was Baconian in nature. One reason is that so much of the data was so new, that it took an enormous amount of time just to identify, describe, and organize the specimens flowing in from collectors. Another reason was the worldview of American naturalists themselves. Spencer Baird and Joseph Leidy believed fundamentally that their role as naturalists was to organize and describe the natural world and that there was little importance in devising theory. Louis Agassiz brought a more transcendentalist framework with him from Europe, but even he sought to argue from "facts" – though he was prone to using his own theoretical background as if it were established fact. Baird's dedication to the Baconian approach to science, his Bairdian method, was responsible for compiling much of the data that could and would be used in the acceptance of evolutionary theory, but Baird himself never substantially weighed in on the evolution issue. In one respect, the theory did not add much to Baird's own research, because his advances with systematic biogeography preceded evolutionary theory and demonstrated much of what evolution argued.

This approach with regards to biogeography by American naturalists may have been a "dedication to the demonstrable," as Baird's biographers have described, but was nonetheless instrumental in the widespread acceptance of evolutionary theory by American naturalists outside of Agassiz.[15] Asa Gray famously defended evolution in his series of reviews and essays, but more importantly accepted and utilized evolution because it helped explain his observations of the natural world, including his comparative work on the biogeography of America, Asian, and European plants. Leidy, who was a staid Baconian in his approach to natural history, likewise accepted evolution because it meshed with his own research, and it is not surprising that he transformed the emphasis of the Wagner Free Institute of Science from natural theology to systematic, evolutionary, natural history.

By the 1880s, the emphasis on evolution had dramatically reshaped American natural history, as naturalists increasingly looked not just at geographical distribution and variation of species, but how these fit within an evolutionary context. While there was not a consensus on what type of evolutionary mechanisms were at work in the natural world, naturalists hurried to apply their understanding of evolution to the data that had already been collected,

[15] See E.F. Rivinus and E.M. Youssef, *Spencer Baird of the Smithsonian*, Chapter 10, and Leonard Warren, *Joseph Leidy: The Last Man who Knew Everything.*

or that they were in the process of collecting. This revolutionized systematics, and led to an intensification of the "lumper-splitter" debate with regard to taxonomic classification, as naturalists argued if Darwinian and neo-Lamarckian evolution fit better with the creation of thousands of new subspecies or the broader species that showed a range of variation. The next generation of naturalists, including Elliot Coues, J.A. Allen, and C.H. Merriam, were exposed to evolutionary theory early in their careers, and made it a cornerstone of their own research in natural history. Additionally, many of these younger naturalists (including the three above) spent substantial time in the field on expeditions in the 1860s and 1870s, which had a profound impact on the importance of field collections to their own work, and highlighted the connection between biogeography and evolutionary systematics. It was no longer possible to be a closet naturalist in the second half of natural history's "golden age" and be an effective systematist; one had to also utilize nature as a laboratory in order to make connections between organisms and their environment.

The shift in emphasis in natural history led to a corresponding shift with regard to the collection of specimens. In the 1870s, Leidy's collectors at Fort Bridger, Drs. Carter and Corson, had discussed evolution and where it fit in their hobby of collecting; by the 1890s Frank Stephens was using evolutionary systematics in his work for Merriam on the Death Valley Expedition. Larger series of specimens were needed to examine intraspecific variation, which was helped by new methods and technological advances that allowed for more efficient collecting. More importantly, the emphasis on evolution and systematics required increasingly professionalized, experienced, and skilled collectors. Collectors could not just send naturalists subpar specimens or interesting oddities any longer, their collections had to be useful for the naturalist, or as many of Merriam's collector's found out, they would not be active in collecting for naturalists much longer.

This required intensive training of the collector, often over the period of many years, both via correspondence and in person. In person training was especially valuable – one of the main reasons why Baird's Megatheria were so valuable in the early part of the golden age – but the majority of training for collectors was done by correspondence. Training via correspondence included detailed feedback regarding past collections and suggestions for the future, but as importantly, it often took the form of natural history publications that were accepted as payment by collectors. This practice made for a more educated cadre of collectors, and also utilized their thirst for knowledge as an asset; in order to receive more publications, more collections were needed, forming a feedback loop that could ultimately result in highly trained "scientific" collectors. This resulted in an increased scientific literacy that allowed many collectors, especially those that worked for Baird, to become active in comparative research and strive to publish their findings, and many including, J.G. Cooper, Elliott Coues, and E.W. Nelson, became dedicated naturalists in their own right. Merriam, a disciple of and successor to Baird, relied on the same methods to train many of his collectors, including Frank Stephens and Vernon Bailey.

By the late nineteenth century, collectors had to recognize the difference between different species and subspecies of organism, take increasingly detailed notes on their specimens and the localities at which they were collected, and to make sure to prepare the specimens in a way which allowed them to be utilized in systematic research. Rather than pass through a region of interest, and merely collect as they went, collectors were increasingly encouraged to spend a few days collecting in each locality, which allowed them to trap more efficiently. They did not have to be expert systematists, but had to be able to apply a basic understanding of systematics to their work in order to facilitate the work of the naturalist, most of whom had become increasingly burdened with administrative work. In many cases, these collectors, such as Frank Stephens and E.A. Goldman, made inferences based upon evolutionary systematics in their notes and their correspondence with the naturalists with whom they worked. By the end of the nineteenth century, many collectors had become de facto field naturalists, foreshadowing the career of Edmund Heller and other systematic field naturalists of the twentieth century.

As the century progressed, the traditional method by which naturalists received specimens, through correspondence, was rapidly overtaken by the use of systematic surveys. Systematic surveys, like the 1891 Death Valley Expedition organized by the Biological Survey, contrasted from the railroad surveys of the

1850s, and even the expeditions led by Hayden, Powell, and Wheeler in their focus. These earlier surveys were mainly focused on traditional topographic surveying with natural history as an afterthought. Surgeon naturalists and other collectors were expected to collect when they had an opportunity rather than spend time setting up dedicated trapping lines and specific collection localities. These earlier surveys, then, were an extension of the correspondence collection method, analogous to a collector travelling through an area of interest, collecting as they went, and most of the work down by surgeon naturalists and other enthusiasts did with regard to natural history was in fact done via correspondence.

The systematic surveys of the late nineteenth century, however, were dedicated to the systematic collection and study of organisms in their environment, often staying days at a time at a particular locality and often revisiting past localities to build on previous findings. Used as instruments of systematic naturalists, surveys were able to focus field research on biogeography, biodiversity, climate, and compare variation in species with regard to locality. Having even small surveys in the field vastly increased the amount of specimens and data that could be collected and systematic surveys usually consisted of at least a naturalist, a collector, and support personnel, but others were fairly large, including numerous specialists dedicated to one branch of natural history. These systematic surveys did not subsume other collecting methods – Frank Stephens continued his individual collection for Merriam and later Joseph Grinnell, and R.W. Schufeldt, a collector for the Smithsonian, spent much of his time collecting solo – but they became the model method for collection in natural history, leading to an explosion of survey expeditions in the 1920s. The survey model, minus much of the collection, would also serve as a model for later research in ecology and conservation biology.

Another collection strategy that was utilized in the "golden age" of natural history has been described in this study as the "mandarin-missionary" strategy. This strategy allowed naturalists, such as Spencer Baird and Joseph Grinnell, to receive collections over a wide region for little institutional capital. The main investment for the naturalist was training and supporting scientific missionaries, which, while more expensive and time consuming than supporting a traditional collector, was more cost efficient than relying on one. These missionaries, such as Robert Kennicott, were expert and enthusiastic collectors that used their enthusiasm to inspire others to collect with and for them. If the missionary was effective and could convince many interested enthusiasts to collect for or with him or her, the results for the naturalist working with the missionary could be far beyond that of their normal collection network. A truly effective missionary, such as Kennicott in Hudson's Bay Territory, could get the approximate results of a later systematic survey, without the cost, making this model of collection popular with smaller institutions. For all of its benefits, the mandarin-missionary strategy was, at its core, an extension of the correspondence collection strategy, and was less effective and efficient than the later systematic survey. The later collection strategy had the advantage not only of technology but also the level of biological expertise in the field.

This boom in natural historical research would not have been possible without increased cultural interest in natural history. The incorporation of enthusiastic young collectors, such as Vernon Bailey, E.W. Nelson, and Edmund Heller, into the field as *paid* collectors demonstrated the changing cultural relevance of natural history. New museums, made possible by earlier collection efforts mid-century, served as an outlet for inspiration for an interested public. This public interest fed into a positive feedback loop with regard to increased opportunities for research. The United States Biological Survey was both a prime example of progressive political ideology and an example of the cultural importance of natural history; in twenty years it expanded from a small division focusing on economic natural history to a bureau that examined the systematic natural history of North America by constantly keeping collection parties and surveys in the field.

The focus on evolutionary systematics accelerated the process of specialization that had already taken hold in American natural history. C.H. Merriam rightly remembered Baird's generation of naturalists as specialists that could make inferences about all of the departments of natural history. However, one of the main reasons why they could do so was the nature of the field at that time; there were few institutions dedicated to natural history and consequently few experts. These experts, confined to a relatively small geographic area, acted as the arbiters of natural science, integrating new discoveries into the existing canon. On the other hand, Merriam's reminisces were rather romanticized; virtually all of that generation of naturalist – Asa Gray, Joseph Leidy, Spencer Baird, Louis Agassiz – still specialized in one aspect of natural history, and they referred issues in classification and description to the naturalist that specialized on the organism in question. On a more fundamental level, the field had been split between zoology and botany much earlier than the 1840s, with zoologists and botanists largely leaving the opposing field alone. A notable exception was the use of findings in one aspect to make overarching theoretical inferences, much as Gray did with plant biogeography.

Still, Merriam attempted to use his opportunity as head of the Biological Survey to train a new cadre of "systematic naturalists." Merriam's influence and personality may not have been that of his own mentor, Spencer Fullerton Baird, but Merriam's organization rose to the forefront of systematic natural history nonetheless, based upon his attempts to synthesize a truly systematic understanding of North American natural history. However, for all of his influence, Merriam was not able to stem the tide of specialization, and his systematic naturalists were not the overarching generalists of old. On the other hand, one of the main reasons for continued specialization was the increasing importance of systematic work which Merriam championed. It simply became too time consuming for one person to examine every branch of the animal or plant kingdom. Joseph Leidy, Asa Gray, Louis Agassiz, and Spencer Baird had been instrumental in the formation of systematic natural history in the United States, but had passed from the scene by the time the implications of this development were realized in the late nineteenth and early twentieth centuries. Merriam, who all but ignored work on herpetology or on invertebrates, narrowed his focus from birds and mammals to solely mammals while at the Survey, and never finished his definitive systematic examination mammals, let alone his work on bears, due to his conceptualization of systematics. Even Joseph Grinnell mainly focused on birds, even though he was also interested in mammals. The specialization demonstrated by Edmund Heller, described above, became standard in early twentieth century natural history, and ultimately led to the decline of natural history as an overarching scientific discipline in the mid twentieth century.

This study has focused on the work of five collectors: Robert Kennicott, Frank Stevens, Edward W. Nelson, and to a lesser extent, Edward A. Goldman and Edmund Heller, in order to focus on the changes that occurred during the "golden age" (1860-1910) of natural history. These collectors were chosen as "case studies" in order to demonstrate their collaborative relationships with naturalists, and how that relationship was typical of an institutional culture of collection. Thus, examining Kennicott's work led to insight on the systematic work of the Smithsonian; the career of Frank Stephens has shed light on dedicated collectors and local experts; the work of Nelson and Goldman in Mexico is used to examine the collection strategies of the Biological Survey. Taken together, these case studies effectively examine how institutions developed collaborations with and trained collectors, employed collectors in the collection of specimens, and revised collection methodologies with regard to changing emphases in natural history.

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