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Order Out of Chaos: The Growth of Botanical Science in Nineteenth Century St. Louis

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Abstract

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This thesis places the botanical community in nineteenth century St. Louis back in the centre of the development of botanical science in the United States. Historical models have been focused on east-coast centers, favoring the research of closet botanists in Philadelphia and Harvard University. By reevaluating the scientific research of collectors and residents in St. Louis it reveals the crucial role the community played in the emergence of a particularly American form of botany. In its early development, visiting naturalists explored and sent their collections to Philadelphia to be classified. By mid-century, resident botanists, such as Dr. George Engelmann, collaborated closely with the cities in the east. He exchanged plant material, books and botanical knowledge with Asa Gray in Harvard and John Torrey in New York. The desire of the community to raise the intellectual and cultural status of the city culminated in the founding of the Academy of Science in St. Louis and the Missouri Botanical Gardens. By the turn of the twentieth century, the Garden, under the directorship of Dr. William Trelease, transformed into a world renowned botanical institution. Trelease lead the way for subsequent directors to create an institution for the discovery and education of plants and their environment in order to preserve biodiversity and understand nature. This thesis is an attempt to place this unique botanical community onto the historical stage in the development of science in the United States.

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I have incurred more intellectual debts in the course of this academic adventure than I can ever hope to repay. I am deeply overwhelmed by the sheer support and assistance of others that helped to finish this endeavor. While the contributions of many people helped transform my words into a thesis, I reserve any shortcomings as my own.

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"It would perhaps be well for me to stop here and give place to Prof. Trelease; but the name of Engelmann awakens in my mind a reminiscence, connecting the present movement…with the infant days of science in St. Louis."

Marshall Snow, Chancellor of Washington University in St. Louis,
Introduction for the new George Engelmann Professor of Botany, Dr. William Trelease.
November 6th 1885[1]

On 13 October 1890, at the first annual banquet of the Missouri Botanical Garden, Dr. William Trelease, botanist and Director of the Garden, described how the Garden's founder Henry Shaw was inspired by the Chatsworth estate in England to form a botanical garden in St. Louis. In the audience were sixty gentlemen— horticulturists, gardeners, and members of the board of trustees— who sat in the exclusive Mercantile Club in downtown St. Louis. Trelease explained that Shaw enlarged his scope of the Garden with the "erection of a museum and library building…under the stimulus and advice of the then Director of the famous Kew Gardens, – Sir William Jackson Hooker, – and of Mr. Shaw's friend and our fellow townsman, the late Dr. George Engelmann."[2] Trelease pointed out that "the Missouri Garden took…a step to advance of its prototype, adopting as its new model the public garden at Kew, which…had become… under the wise guidance of the man then at its head, the leading institution for scientific botany in

[1] Marshall Snow, "The Henry Shaw School of Botany Inaugural Exercises," *Annual Report of the Missouri Botanical Garden*, Volume 1, 1890, 61.
[2] William Trelease, "Proceedings at the First Annual Banquet to Gardeners, Florists and Nurserymen." Given at the Mercantile Club, December 13th, 1890, *Annual Report of the Missouri Botanical Garden*, 1891, 38.

the world."[3] He stressed that "Mr. Shaw hoped for a somewhat similar career of usefulness for the Garden founded by him."[4] As the first Director of the Garden, Trelease wished to emphasize to the Trustees in the audience that scientific research and education was foremost in his mind. A month later Trelease reiterated his wish to a local newspaper that "he was carrying out the program of the trustees based on nearly as possible on the twofold wish of Mr. Shaw: to provide a vision of joy for visitors and a research facility for the professional botanist."[5]

By his strong insistence on the necessity of continued development of the herbarium,[6] museum and library, Trelease helped to create a crucial venue for the pursuit of professional botanical research in St. Louis. Trelease knew the potential the Garden held. The Garden had matured considerably in the thirty years since it had opened to the public, with fully-grown trees and greenhouses full of plants. The herbarium Shaw had established from the 1850s onward housed over 160,000 plant specimens, but they were unprocessed and gathering dust in the basement. The name of Engelmann, whom Trelease mentioned in his banquet speech, was written on the labels of over 97,000 plant specimens. Engelmann's collection spanned over fifty years, from the 1830s to 1880s, and contained specimens from all over the Americas and Europe. Trelease, a member of the first generation of American-born and American-educated scientists in the city, set in place the continuation of the taxonomic researches of this German physician. This local taxonomic tradition began nearly a century before Trelease became the first Director. By

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[3] Trelease, Proceedings at the First Annual Banquet to Gardeners, Florists and Nurserymen, 38.
[4] Trelease, Proceedings at the First Annual Banquet to Gardeners, Florists and Nurserymen, 38.
[5] William Barnaby Faherty, *Henry Shaw: his Life and Legacies*, (Columbia: Missouri University Press, 1987), 254.
[6] Herbaria may be defined as botanical museums with collections of dried plants, mounted, labeled and stored for scientific study.

1900, Trelease had built an extensive research program on the foundation of these stacks of dusty brown packages of plant specimens. Trelease would make the Missouri Botanical Gardens, in association with Washington University in St. Louis, one of the most renowned botanical institutions in the world and sealed the city's fate as a center for botany.

St. Louis as a Botanical Center

Most histories of nineteenth-century American botanical science have focused on East coast scientific centers, such as Philadelphia and Boston. In these histories, botanical science in St. Louis has been foreshortened to two major bookends, the Lewis and Clark expedition of 1804–1806 and the Missouri Botanical Garden's opening in 1859. Many authors have mentioned the city merely as a launching point for expeditions. Articles which discuss botany in St. Louis focus mainly on one aspect of this field, for example, the Missouri Botanical Garden. Rarely have the contributions of the botanical community been integrated into the broader history of the development of the discipline in the United States. St. Louis, therefore, has been relegated to a minor role in the progress of botanical science in the United States.

Spaulding (1908-1909) wrote the first treatment on botanical science in St. Louis. Within five years of this publication, Klem published *The History of Science in St. Louis* (1914), although she discussed all scientific disciplines — medicine, natural history, geology — in St. Louis. Both papers presented a chronological survey of the nineteenth century. Subsequently, many authors (historians and botanists) have written on various aspects of botany in the City, including, George Engelmann (Timberlake 1988; Long

1995, 2003; Shaw 1986), the Academy of Science in St. Louis (Goldstein, 1989) and the Missouri Botanical Garden (Faherty 1987; Kleinman 1997), which formed the core resources available for this study. In the introduction to *Steyermark's Flora of Missouri* (2006) Yatskievych presented the most recent and comprehensive chronology of the development of botanical science in St. Louis. Their work forms the frame for this thesis.

This thesis shall synthesize a century of botany into a single narrative to broaden the historical scope of scientific activity and ideas in nineteenth century St. Louis. This thesis argues that the intellectual contribution of the city has been overlooked for three main reasons; the perception that their was one natural world and one method for understanding it has limited the historical research performed on taxonomic and systematic botany in the United States, the reluctance of the established botanical community in St. Louis during the nineteenth century to embrace new biological ideas from Europe, such as Darwinism, and finally the failure of the founder of the Missouri Botanical Garden, Henry Shaw to develop and establish research in the Garden's early years. By investigating the scientific impact of the botanical community, St. Louis provides a unique window into the transitions of ideas and influences from Europe into a particularly American form of botany.

This research draws upon letters, journals, diaries, scientific publications, herbaria specimens and newspapers. This story unfolds in six chapters, following St. Louis, from a trading outpost in the early 1800's to a bustling metropolis at the close of the century. Chapter 1 will present a brief introduction to botanical science during the nineteenth century. Chapters 2 to 5 are chronological. They describe the growth of botanical science in St. Louis in a narrative fashion. Chapter 2 begins with the founding

of a botanical community by Dr. George Engelmann, a German physician and resident botanist. In his first ten years he was involved in the founding and subsequent demise of the first scientific academy of the west, the Western Academy of Science, and carried out a scientific career of international importance. His important taxonomic monographs increased his reputation in the scientific world, while he laid the foundation for St. Louis to become a botanical center. Chapter 3 discusses Engelmann's role in the Gray and Torrey's ambitious *Flora of North America* project. Chapter 4 explains the rebirth of a scientific institution, the Academy of Science in St. Louis. The Academy became a place of intellectual discourse and associated botanical research. It was here that Darwin's theory of evolution by natural selection was first discussed locally. Chapter 5 investigates the relationship of Engelmann and Henry Shaw, founder of the Missouri Botanical Garden in 1859. Chapter 6 summarizes a century of botany and discusses the role of Dr. William Trelease in establishing St. Louis as a twentieth century botanical center.

One of the themes in this thesis is taxonomy and systematics. This thesis is not, however, a history of systematics or a discussion of the ambiguity of many of the key words and phrases used during the late eighteenth and nineteenth century. Although not strictly interchangeable, for the purpose of this thesis, the terms naturalist, botanist, taxonomist and systematist are synonymous: persons who collect, classify and name plants.

Chapter 1

Order Out of Chaos

Among the numerous useful and interesting objects of natural history discovered on the vast extent of the New Continent none claim our attention in a higher degree than the vegetable productions of North America

Frederick Pursh
Preface to *Flora Americæ Septentrionalis* (1814)

Botanical Science in Nineteenth Century America

In 1897 William Gilson Farlow, Professor of Botany at Harvard University, noted that "the first botanical problem to be solved in a new country is of necessity the exploration of its different parts and the description of the native species. As the systematic knowledge of the native flora increases, the important question as to the causes of the distribution of the different species…assume[s] a greater significance….the main object of botanists was to find out what plants grew in North America."[7] As Farlow pointed out, the field of taxonomy (the naming of individual plants) and systematics (trying to ascertain the relationships between plant groups) dominated botanical science during the nineteenth century. Botanists and naturalists attempted to observe, collect, analyze, name and describe every plant in the United States. Therefore, the beginning of American botany is the story of the progress of the written flora.[8]

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[7] William Gilson Farlow, "Botany," in *The Smithsonian Institute 1846–1896: The History of its First Half Century*, ed. George Brown Goode, (Washington D.C., De Vinne Press, 1897), 708.

[8] Ronald L. Stuckey (Ed.), *Development of Botany in Selected Regions of North America Before 1800*, (New York: Arno Press, 1978), 3. A flora refers to the plants occurring within a given region as well as to a publication describing these plants. It may contain anything from a simple list of the plants occurring in an area to a very detailed account of these plants.

A small community of botanists, mostly physicians and amateurs, carried out this botanical endeavor.[9] Their botanical activity mirrored the task that European botanists were undertaking across the globe. Most of these botanists were engaged in building cabinets of plants specimens, the raw material for scientific research. Americans pursued science for a variety of reasons: to understanding God's laws of nature, as a moral inspiration or as a means of intellectual improvement. A very small group of botanists were driven by its intrinsic interest and value, using their collections as "a tool that would permit them to solve problems."[10] These men of science were driven by the need to organize the chaos of nature and create order. This order was a window into understanding how the natural world worked.

In the early republic, many of these men of science were disgruntled by European scientists becoming immortalized in academia while they were being left behind. [11] Greene stated that no complaint was commoner among American botanists than that the botanical wealth of North America was being explored by foreigners far more that by native-born Americans. As plants, roots and seeds were sent back to the Old World to enrich the private gardens and cabinets there, American botanists began to claim proprietary rights to nature's productions in the western hemisphere. They sought hegemony of their flora and the community began to collaborate to become independent of Europe. They began to build their own herbaria and develop an interconnected

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[9] Keeney published an excellent account of the relationship between amateurs and professional botanists in America during the nineteenth century. Elizabeth B. Keeney, *The Botanizers: Amateur Scientists in Nineteenth Century America*. (Chapel Hill: University of North Carolina Press, 1992).

[10] Daniel Goldstein, *Midwestern Naturalists: Academies of Science in the Mississippi Valley, 1850–1900*, (Yale University: Ph.D. Dissertation, 1989), 8.

[11] John C. Greene, "American Science Comes of Age, 1780-1820," *The Journal of American History,* Vol.55 No.1 (1984), 34.

network of like-minded botanists across the United States. Botanical science developed regionally across the United States during the early part of the century leading to the emergence of botanical science practiced by American-born and American-university trained professional scientists at its close.

Many historians have stated that the spread of science from Europe occurred in three overlapping stages. Scientific activities began by European travelers and explorers who made some of the first observations of the foreign lands they travelled through. They surveyed and collected specimens new to western science. Usually they were not men of financial means and depended on being commissioned by someone with private means or a scientific institution, such as Royal Botanic Gardens in Kew, England. This early activity was succeeded by "colonial science." Native-born Americans and naturalized immigrants engaged in science. They were educated in European and utilized their connections to enable the growth of science in their local cities and states. This growth took shape in the form of the founding of universities and academies of science. As the century wore one, these institutions began to produce the American-born and American-educated scientists. This formed the final stage of "American science," an independent scientific tradition free of European domination and the movement into professionalization of science. [12] Botanical science in St. Louis developed in these three overlapping stages.

[12] George Basalla, "The Spread of Western Science: A three-stage model describes the introduction of modern science into any non-European nation" *Science*, 156 (May 1967), 618.

Botanical Science in St. Louis

The earliest taxonomic botanists to collect in St. Louis arrived three years after the return of the Lewis and Clark expedition. Greene stated that it was Jefferson's sense of patriotism combined with his passionate interest in natural history that swayed him to send out the first government-funded expedition of the new republic.[13] In 1804, the expedition was sent to explore and collect the products of the newly purchased lands of 'Louisiana,' and to ascend the Missouri River to the Pacific. American exploration of the West is said to have begun with this expedition.[14] Although the expedition had no trained systematic botanist, they made the first observations of the vegetation and botany of the Missouri River valley and adjacent areas.[15] Lewis returned with 230 neatly pressed and dried plants constituting the first plant collections from the American West.[16]

With no scientific institutions west of the Alleghenies to process these plants, these specimens were destined to go to Benjamin Smith Barton, Professor of Natural History and Botany at the University of Philadelphia. Philadelphia was the center of botanical activity during this period.[17] Barton received the specimens, but gave them to

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13 Greene, *American Science in the Age of Jefferson*, 510.

14 Sandra Knapp, "Asa Gray. The Plants of the American West (1810–1888)," *Harvard Papers in Botany*, 15(2) (2010), 286.

15 Yatskievych, George. *Steyermark's Flora of Missouri*, Volume 1, (Jefferson City: Missouri Dept. of Conservation & Missouri Botanical Garden Press, 1999), 7.

16 Lewis and Clark did not keep completely accurate numbers of the plant specimens they collected. The first thirty collections recorded by Lewis during the winter of 1804–1805, and sent to President Jefferson, are now lost. They disappeared after they were received by the American Philosophical Society in November 16th, 1805 and apparently were not seen by the botanist Frederick Pursh. It is difficult to know precisely how many plant specimens were collected, because of the movement of the plants nationally and internationally, with much of the original plant material seems to be missing. The current location for most of their collection is the Academy of Natural Sciences in Philadelphia.

17 James A. Mears, "The Relevance of Plant Collections at the Academy of Natural Sciences of Philadelphia to Torrey and Gray's *Flora of North America,* 1838-1842." *Proceedings of the Academy of Natural Science of Philadelphia*, (132, 1980), 238.

his curatorial assistant, the Prussian botanist Frederick Pursh to analyze. In 1814, Pursh published his two-volume *Flora Americae Septentrionalis* (Flora of North America) in London. Pursh's *Flora* was important for two main reasons; it nearly doubled the number of known North American plant species, and was the first to include plants west of the Mississippi. These specimens were important in revealing the nature of what grew there and how it related to the better known plants elsewhere. As the plants from the East became known, botanists began to look towards the West to see what plants grew there. Suddenly "the attention of the scientific world [was] every day becoming more strongly fixed upon that immense tract of country, that lies between the western borders of civilization and the Pacific Ocean. The few adventurers who have yet dared to explore it have returned laden with treasures of nature and knowledge heretofore unknown." [18]

The Louisiana Purchase had brought St. Louis, a small multicultural commercial city of affluent French families, into the territory of the United States. Located on the confluence of the Missouri and Mississippi but sixty miles from the frontier St. Louis was now in a central geographic location for scientific discovery. [19] It offered Lewis and Clark all the comforts an explorer wished for before and after an expedition; a fine meal, a hot bath, and invaluable information—including prepared maps of the Missouri River.[20] In 1810, when John Bradbury (1768–1823) met his fellow British naturalist Thomas Nuttall (1786–1759) St. Louis a village that had never sheltered any systematic botanists

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[18] Address. *Act of Incorporation, Constitution and By-Laws of the Western Academy of Natural Sciences in St. Louis* (St. Louis: William Weber, 1837), 13.

[19] Frederick J. Fausz, *Founding St. Louis. First City of the New West*, (Charleston: The History Press, 2011), 183-184.

[20] Fausz, *Founding St. Louis. First City of the New West*,184.

now entertained two. Their fieldwork and subsequent collections signaled the beginning of the European tradition of botanical science in St. Louis.

An Incongruous Pair of Botanists

Bradbury had been commissioned by the Liverpool Botanical Garden to travel to New Orleans to find suitable land for growing cotton. Upon meeting Jefferson at his Monticello residence soon after he arrived in the United States, Bradbury decided to follow the ex-President's advice and travel to St. Louis in pursuit of the unnamed flora of the west. Bradbury, a man in his forties with a wife and ten children in England, had risked everything to make his botanical fortune in the United States. On 31 December 1809, Bradbury arrived in St. Louis. He found a bustling village of two hundred white-washed houses with a population of 1,600, extending for over a mile along the river bluff.[21] He observed that "the fur trade of the Mississippi and the Missouri, almost wholly centers in this village…trading with the nations of the head waters of the Missouri…that no part of the western country that holds out greater advantages…than the Missouri Territory"[22] Indeed the village had been founded forty-fives years earlier as a trading outpost by two Frenchmen, Pierre de Laclède (1729–1778) and Auguste Choteau (1749–1825). [23] As the town was founded for trade it did not have any established scientific community. Hendrickson noted that the establishment of scientific societies

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[21] Jeannette E. Graustein, *Thomas Nuttall Naturalist, Explorations in America* 1808–1841. (Cambridge: Harvard University Press, 1967), 54.

[22] Bradbury, *Travels in the Interior of America,* 261-262.

[23] Frederick J. Fausz, *Founding St. Louis. First City of the New West*, (Charleston: The History Press, 2011), 183-184.

was population dependent.[24] Scientific institutions were generally established in prosperous cities with more than 30,000 inhabitants.

In the spring of 1810, Bradbury made the first exhaustive collection of the flora of St. Louis and its environs. He dispatched seven packages of plant specimens for the Garden by way of New Orleans. Within days, he heard that the boat containing his collection was driven ashore and damaged on an island near St. Genevieve, sixty miles below St. Louis. He left immediately to salvage his specimens, but soon learned that the boat had been repaired and had continued on its voyage. He returned to St. Louis with the intention to "remove from St. Louis to Ozark…on the Arkansas." He soon met the newly arrived Wilson Price Hunt of the Pacific Fur Company. Hunt was planning to follow the Lewis and Clark route to the mouth of the Columbia River to establish a trading post. "In a very friendly and pressing manner" Hunt invited Bradbury along "as far as might be agreeable to [his] views." Bradbury considered this "opportunity of exploring" the Missouri "too valuable to be lost" and accepted. [25]

Hunt had invited Thomas Nuttall, another British botanist along and introduced Bradbury to this young botanist. Nuttall had met Hunt in Michilimackinac many days earlier while he was exploring the region on behalf of Barton.[26] Nuttall had undertaken an extensive two-year botanical journey, from Philadelphia to the Great Lakes and into Saskatchewan, returning via the Missouri River. At Lake Superior, Nuttall was prevented from travelling any further by the British North West Company who controlled

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[24] Walter B. Henrickson, "Science and Culture in the American Middle West," *Isis*, 64 (September, 1973), 329.

[25] Bradbury, *Travels in the Interior of America*, 90.

[26] Fort Michilimackinac was an 18th century fort built by the French, and later used by the British, as a trading post for the Great Lakes of North America.

the entrance to Lake Superior and Grand Portage and permitted no encroachments on their territory. Nuttall, facing a difficult decision about what to do, met with a serendipitous substitution. He met Hunt, who invited him to join the expedition.

Nuttall and Bradbury were quite the incongruous pair of botanists. Bradbury was an "amiable yet stubborn" man who was "determined in his methods and opinions."[27] Nuttall was a "zealous" twenty-two year old at the beginning of what would turn out to be a successful scientific career. Nuttall's "enthusiasm was awakened at beholding…the boundless prairies, clad in…unknown flowers…groping and stumbling along…forgetful of everything but his immediate pursuit."[28] Indeed, members of the Company called Nuttall *"le fou"* (the crazy) as he so often had little concentration on anything but the flora on the ground.[29] It seems that neither man was particularly fond of the other, but they found a mutual and tolerable companionship. As two naturalists in a small village, it would have been difficult to avoid each other.

The First Taxonomic Collections

"[A]s it was not practicable to ascent [sic] the Missouri until the breaking of the ice in spring" Nuttall and Bradbury began field collecting trips together.[30] This was companionship rather than collaboration. Collaboration yet was not a common practice in the early nineteenth century science. Although they field collected together, none of their

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[27] Hill, *Bygone Stalybridge*, 207.

[28] Irving, *Astoria: or Anecdotes of an enterprise beyond the Rocky Mountains*, 202.

[29] Nuttall often had complete disregard for his own well-being. The voyagers who accompanied him "labored in vain trying to tell him that he was risking… his life… when he wandered off through prairies, thickets and bottom lands…no Indians existed for Nuttall… no interruptions or delays, no possibilities of disaster or death, there were only the flora that no one had seen. So the voyagers cursed him, decided he was touched and kept an eye on him." In Bernard DeVoto, *Across the Missouri Wide*, (Boston: Houghton Mifflin, 1998), 183.

[30] Bradbury, *Travels into the Interior*, 66.

field specimen labels referenced the presence of the other as a collector.[31] It seems that of an incidental acquaintanceship that even their common interest and nationality failed to convert into a real comradeship. They were clearly focused on their own careers and reputations. Bradbury desperately needed to produce a monumental botanical work; Nuttall needed to build his career as a naturalist.

On 13 March 1811, after many months collecting together, they left St. Louis with the fur-traders. Bradbury eventually took leave of the expedition at Fort Mandan on 17 July, arriving back in St. Louis on 29 July 1811. He sent his portfolio of plant specimens, including his first collections from the vicinity of St. Louis, to his son John Leigh. He wished his son to sell the collections but instead his son sent them to William Roscoe, the founder of the Garden and his patron. His plant collections were sorted, with duplicates of specimens sent to various botanists' personal herbaria in exchange for their collections. Aylmer Bourke Lambert, a fellow of the Linnaean Society, received a full set of Bradbury's plant specimens and annotated the herbarium sheets with the phrase "Louisiana. Bradbury." Pursh, Barton's former assistant, was living in England and working on his *Flora*. He gained access to Lambert's herbarium and found Bradbury's "valuable collection…many rare and new species, having been collected in a tract of country never explored before."[32] Without Bradbury's permission, Pursh studied, described and named forty species from Bradbury's collection using the Linnaean classification system. It was the utility of the Linnean system that enabled Pursh to name plants so readily.

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[31] The relationship between these two botanists is evident in Bradbury's *Travels.* Bradbury mentioned Nuttall only four times when he published his travel memoirs a few years later.

[32] Pursh, *Flora Americae Septentrionalis,* xvii.

The Linnaean system of classification was the most popular system in use since Carolus Linnaeus published this method in his 1756 compendium, *Species Plantarum*. It was a simple technique of classifying different plants under genera—names that had been used since antiquity to denominate groups of plants like roses, oaks or willows. The features of the flower and fruit were utilized as a means of separating plants, placing particular emphasis on the number of parts of the flower. Where there were no earlier names available for the genera names were invented for the new genera. Two words were used to name the plant: the genera name and a descriptor or "specific epithet." Linnaeus' binomial system of classification was arbitrary and convenient. Botanists, amateur and professional alike, quickly adopted it as the standard way of referring to individual organisms.

Pursh and Bradbury had trained using this method and understood that in systematic botany reputations were built on the naming of plants. To be considered the author of a species, you had to be the first to name it. Nothing else mattered. Pursh recognized Bradbury's contribution to botanical science as a collector in his *Flora* forty-two times.[33] Bradbury, reduced to a collector, was powerless to do anything. Bradbury desperately tried to reclaim these plants by including an appendix in his travel journal, *Travels in the Interior of America, in the Years 1809, 1810, and 1811* (1817).[34] In *A Catalogue of some of the more rare or valuable plants, Discovered in the Neighborhood*

[33] Perhaps to make himself feel better, he shows his gratitude to Bradbury in a short note. When he tried to classify one particular plant species to which he "had an imperfect specimen in the Lewisian Herbarium" it led him "to error of placing it under that genus; but having seen fine specimens in the collection of Mr. Bradbury, I was enabled to correct this error." Pursh, *Flora Americae Septentrionalis*, 740.

[34] In the preface of his *Travels* comments bitterly over the poor treatment by Pursh; "I had intended that this should have been accompanied by a description of the objects collected, that had not been before discovered; but…I found that my design was frustrated, by my collection having been submitted to the inspection of a person of the name of Pursh, who has published the most interesting of my plants in an appendix to the *Flora Americae Septentrionalis*."[34]

of St. Louis and on the Missouri. Bradbury listed ninety-nine of his plants, including ten collected in the vicinity of St. Louis. This short list of plants was Bradbury's only contribution to the American flora.[35] Things ended poorly for Bradbury. He traveled to England after the War of 1812 and duly returned to the United States in 1816. He spent many years in St. Louis trying to create a nursery or botanical garden but his financial situation hindered him from making that possible. He eventually moved to Middlevillage, Kentucky where he died on 16 March 1823.

Nuttall was more fortunate; after he returned to St. Louis he immediately left for England. He was astute enough to realize that for the hardships he had endured and the valuable collections he made, Barton would merely demote him to a collector. Before sailing home, he sent Barton some herbarium specimens, seeds, and notes of his journey as his contract demanded, but kept a substantial collection on his own. In London, Nuttall sorted his collection and, published some of his collection in John Fraser's nursery catalogue, *A Catalogue of New and Interesting Plants, Collected in the Upper Louisiana, and principally on the River Missouri, North America* (1813).[36] Of the eighty-nine plants listed, Nuttall included eight plant species collected in St. Louis and its environs. Nuttall returned to the United States in 1815 and explored thousands of miles of the country. In 1818 he published his *Genera of North American Plants*, which won him international acclaim. This was a monumental work about the American flora published in the United States and the first botanical treatise of the systematic arrangement of plants

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[35] The disappointment and anger at being usurped is palpable in his *Travels*, "This man has been suffered to examine the collection of specimens which I sent to Liverpool, and to describe almost the whole, thereby depriving me both of the credit and profit of what was justly due to me." Bradbury, *Travels in the Interior of America,* 79.

[36] While the catalogue is authorless, the publication has been attributed to Nuttall.

to be published in English and not Latin—the language of natural history. Nuttall used the Linnaean system of arrangement, but he noted in the introduction that he much prefers the "natural" system of de Jussieu, but only for convenience uses the Linnaean system, as this was most familiar in the United States.[37]

De Jussieu's 'natural' method revolutionized science. Antoine-Laurent de Jussieu, a French botanist, published his *Genera plantarum secundum ordines naturales disposita* in 1789.[38] As opposed to the Linnaean method of using reproductive parts to define genera, Jussieu suggested using many characters, such as the leaf shape or petiole length. Jussieu's natural system "served as a basis for subsequent botanical studies in systematics for the next two centuries."[39] Dr. George Engelmann (1809–1884), a German physician in St. Louis was an advocate for this taxonomic method and produced impressive taxonomic monographs on plants that many botanists found difficult to identify. He moved to St. Louis to open his medical practice nearly twenty-five years after Bradbury and Nuttall left this frontier village. The demographic landscape changed drastically in the years since the two British botanists visited. Engelmann, a brilliant and tireless scholar, began almost immediately to shape the city's intellectual relationship with botanical science and his influence continued for nearly fifty years.[40]

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[37] Many American botanists were Linnaean by training and inclination. Nuttall did use de Jussieu's ordinal nomenclature. By the 1820's botany in Europe was becoming firmly based upon the natural system of de Jussieu's *Genera Plantarum*.

[38] He made it clear that his natural method was both a natural series (an arrangement of plants that reflected natural relationships) as well as a method in constructing the series. The *Genera* was influential both because it was the first accepted treatment in which all plant taxa at and above the rank of genus were placed in a natural sequence.

[39] Peter F. Stevens, *The Development of Biological Systematics: Antoine-Laurent de Jussieu, Nature and the Natural System*. xx.

[40] As early as 1830, researchers, such as Engelmann, and teachers began to diverge in the method used in classifying. The Jussieuian system was preferred by professional researchers, whilst the Linnean method was used by teachers to educate schools. This in part was due to the ease of use for teachers in demonstrating how to

A German on the Botanical Frontier

During the 1830's, thousands of impoverished Irish immigrants, fleeing the potato famine, and German immigrants flooded into the village. Although the Irish were largely unskilled, the German immigrants were generally better educated and better skilled.[41] This influx of educated German immigrants gave St. Louis a distinctive German colorization. They brought with them a strong tradition of university-training and elite organizations. Engelmann arrived during an exciting time for science. Alexander von Humboldt had returned from his travels and was promoting exploration and scientific discoveries. Georges Cuvier and Étienne Geoffroy Saint-Hilaire were debating the nature of species and the span of creation in the animal kingdom. Engelmann, as a man of science, knew the potential of St. Louis's location so close to the unexplored frontier. He immediately set about establishing a botanical community and the first Academy west of the Mississippi, the Western Academy of Science. It was Engelmann's precise attention to detail and authority in plant taxonomy that drew the attention of the young Asa Gray (1810–1889). Gray along with his collaborator and former professor John Torrey decided to embark on writing a Flora of North America. This project was ambitious and its long-term goal was to produce the first comprehensive and authoritative account of the flora of the United States by American-born botanists. Gray recognized a botanical ally in Engelmann and was involved with this German living on the frontier for over forty years.

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arrange plants. Using a single character, such as a reproductive part, made it more convenient and straightforward for teachers and students alike.

41 William Barnaby Faherty S.J., *Henry Shaw His Life and Legacies*, (Columbia: University of Missouri Press, 1987), 75-76.

As a full time professor, Gray was unable to travel to the West to collect in the "field," and was considered a "closet botanist." This expression, a term of derision, was applied to those botanists who spent their time indoors armed with large libraries, significant herbarium collections and knowledgeable colleagues.[42] Botanical science depended on access to plant specimens and an exchange system, thus, closet botanists needed a supply of people willing to go out to find and collect plants. Many of those who field collected had at least some form of rudimentary systematic training, though many were untrained and had become collectors for monetary gain. Keeney noted that these collectors were "the legs, hands, and eyes of the individuals and institutions," but in the majority of cases the naming of new plants was the job of the naturalist in the closet.[43] This vital relationship between the field naturalist and the closet botanist enabled botanical studies to progress.

Knapp stated that it was Gray "who catalogued the plants of the West and set them into a global context."[44] Science, however, during the nineteenth century was a complex interlocking web of correspondents working in the field and the closet. With Gray in Cambridge, he began to form his network of knowledgeable colleagues across the globe. Engelmann was one of Gray's main knowledgeable connections. For over forty years, they collaborated, conspired and transformed botanical science. Gray called Engelmann "one of the most eminent and venerable cultivators" of science. "Personally one of the most affable and kindly men…The name of Engelmann has, by his own

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[42] James L. Reveal, "Asa Gray and the Botanical Exploration of the American West," *Harvard Papers in* Botany, 15(2), 2010, 309.

[43] Elizabeth B. Keeney, *The Botanizers: Amateur Scientists in Nineteenth Century America*. (Chapel Hill: University of North Carolina Press, 1992), 22.

[44] Sandra Knapp, "Asa Gray. The Plants of the American West (1810-1888), *Harvard Papers in Botany*, 15(2) (2010), 286.

researches and authorship, become unalterably associated with the buffalo grass of the plains, the noblest conifers of the Rocky Mountains, the most stately cacti in the world."[45] Dupree's definite biography of Gray recognizes Engelmann as a correspondent more than a collaborator. This reduces not only Engelmann's role in the *Flora of North America* project with Gray and Torrey, but ignores the intellectual relationship and friendship he had with them. In assisting in cataloguing the plants from the American West, Engelmann involved his fellow immigrants in a uniquely American patronage. He found, trained and sent them out to collect in uncharted lands. Engelmann was a gifted man of science and worked endlessly to bring academic science to the city he adopted and loved.[46] As a young man Engelmann never intended to stay in the United States but his influence on the development of botany in the United States reveals the exciting world of discovery in nineteenth century America. His influence would last for over a century.

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[45] Asa Gray, "Biographical Sketch" in *The Botanical Works of the Late George Engelmann, collected for Henry Shaw, Esq.*, ed. William Trelease and Asa Gray, (Cambridge: John Wilson and Son, 1887), iii.

[46] As early as 1830, researchers, such as Engelmann, and teachers began to diverge in the method used in classifying. The Jussieuian system was preferred by professional researchers, whilst the Linnean method was used by teachers to educate schools. This in part was due to the ease of use for teachers in demonstrating how to arrange plants. Using a single character made it more convenient and straightforward for teachers and students alike.

Chapter 2

The Center of North America[47]

On November 20 1835, twenty-six year old George Engelmann and his close friend Frederick Adolph Wislizenus (1810–1889) opened a medical practice at Second and Chestnut Street in St. Louis. His main intention was to make enough money to return home to Frankfurt in Germany. [48] As the medical practice flourished Engelmann became financial solvent. With the security of an income, he had more spare time to return to his deep interest in the sciences, particularly botany. He discovered that the plants in the vicinity of the city—like the Twistpine Prickly Pear (*Opuntia macrorhiza* Engelm.)—were far more interesting than those in Europe. Engelmann found no good reason to return to Germany and decided to stay in the city. As a man with a scientific mind, he knew that living in St. Louis gave him a unique advantage, geographically and scientifically, but recognized how isolated he was from the rapid advances occurring in science on the east coast and in Europe. Immediately Engelmann set about meeting likeminded men of science to create the first established scientific community in the city.

As a physician of two distinct communities (the German community and the local Anglo-American one) he quickly became known as a highly regarded member of society and a dedicated scientist.[49] With his broad interests in many different aspects of science, he was able to promote "the intellectual improvement…and… diffusion of scientific

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[47] Letter from Engelmann to Asa Gray, as quoted in Primm, *Lion in the Valley: St. Louis, Missouri, 1764–1980, 3rd Ed.,* 196.

[48] George Engelmann, "Instructions for the Collection and Preservation of Botanical Specimens," *Annals of the Missouri Botanical Garden*, Vol. 73. No. 3 (1986), 505.

[49] Engelmann, "Instructions for the Collection and Preservation of Botanical Specimens,"505.

information…within the city and for the good of the nation."[50] He spearheaded the founding member of the Western Academy of Science; the first of its kind west of the Mississippi.

The Making of a Botanist

George Engelmann was born on 2 February 1809, in Frankfurt am Main. He studied medicine at the University of Heidelberg. His training as a physician exposed him to many lectures on the natural world, and he was quickly "befriended" by his classmates, Alexander Braun, Karl Schimper, and Louis Agassiz.[51] His fellow-students were deeply interested in botanical science, especially plant morphology. As the youngest of this group, this intellectual kinship about the natural world was highly influential in his personal and intellectual development. He left the university in the autumn 1828, after being involved in "political excitement," and completed his medical degree in Berlin and Würzberg in July 19, 1831.[52]

Engelmann joined Braun, Agassiz and other university friends in Paris in 1831, arriving at an exciting time. Decades before Darwinism, Cuvier and Saint-Hilaire were debating the nature of species at the National Museum of Natural History in Paris, the great center of natural science in Europe. This great biological debate attempted to answer how form and function were related. Is function the mechanical result of form (morphology), or is form merely the manifestation of function or use? What is the

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[50] *Act of Incorporation, Constitution and By-Laws of the Western Academy of Natural Sciences in St. Louis* (St. Louis: William Weber, 1837), 3.

[51] George Julius Engelmann, *Sketch of the Life and Work of the Late George Engelmann*, 3, George Engelmann Papers, Missouri Botanical Garden Archive and Manuscript Collection (hereafter cited as GEP-MBGAMC).

[52] Engelmann, *Sketch of the Life and Work of the Late George Engelmann*, 3 (GEP-MBGAMC).

essence of life? Unfortunately Engelmann arrived too late to hear his fellow German, Alexander von Humboldt's lectures, but his close friend Agassiz, arriving earlier, fell under Humboldt's tutelage. Agassiz shared Humboldt's lectures and Engelmann spent a "glorious" year "in scientific union" in Paris in spite of the cholera epidemic scourging the city.[53]

During this time he completed his inaugural dissertation *De Antholysi Prodromus*. His dissertation departed from direct medical study and focused on teratology, the study of malformations or abnormal growth, in its relation to plant morphology. His research was heavily influenced by Braun and Schimper's recent theory on the arrangement of leaves (phyllotaxis), and Johann Wolfgang von Goethe's *The Metamorphosis of Plants* (1790). Indeed, Goethe was deeply impressed by this young scholar's innate understanding of his own work.[54] After he completed his dissertation, he passed his state medical examinations and returned home to begin his medical career. Upon arriving home, he found his family was swept up by emigration "fever."[55]

Many Germans were immigrating because of economic and political instability and were influenced to move to the Mid-West of the United States by Gottfried Duden's travelogue, *Report of a Journey to the Western States of North America (Bericht über eine Reise nach den westlichen Staaten Nordamerika's*). [56] In 1824 Duden, a young lawyer from the Rhineland lived in Missouri for three years, farming the land he had

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[53] During this epidemic Engelmann learned valuable medical techniques to treat cholera which he used in the 1840–1850s outbreaks in St. Louis.

[54] Goethe intended to turn over his entire collection of unpublished botanical sketches and notes to Engelmann. This wish was never accomplished as Goethe died a few weeks later.

[55] Engelmann, "Instructions for the Collection and Preservation of Botanical Specimens," 505.

[56] Steven Rowan and James Neal Primm, *Germans for a Free Missouri: Translations from the St. Louis Radical Press, 1857-1862*, (Columbia, Mo: University of Missouri Press, 1983), 3.

bought. When he returned to his homeland in 1829 he published his *Report* as a series of letters about his experience, with recommendations for his fellow-Germans. In the twelfth letter of 26 October, 1824, he noted that the small population in St. Louis was surprising "considering the splendid location…the fertile soil near the city is not at all utilized and that food products are almost procured from the east bank, from the state of Illinois… [F]ew own property, and some of the married ones did not even bring their wives along because they consider their stay here to be transient."[57] Duden's *Bericht* portrayed an idyllic and hopeful picture of a prosperous life in the Mississippi Valley.[58] Perhaps influenced by Duden's promise, Engelmann's uncle asked his nephew to investigate "the possibilities of investment in Illinois and western lands."[59] With no career commitments in Frankfurt, he accepted the proposal. For Engelmann, a young doctor with no ties, this was quite the proposal. As he travelled across the Atlantic Ocean, he may have been inspired and excited by the possible Humboldtian adventures that awaited him in the New World.

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[57] Gottfried Duden, *Report on a Journey to the West States of North American and a Stay of Several Years Along the Missouri (during the years 1824, '25, '26 and 1827)*, ed. James W. Goodrich. Translated by George H. Kellner, Adolph E. Schroder, and Wayne Senner, (Columbia, Missouri State Historical Society 1980), 52.

[58] Following Duden's lead, newspapers and journals carried the message of New World opportunities directly into German homes. Two periodicals aimed specifically at the potential immigrant were the *Allgemeine Auswanderung Zeitung* of Rudolfstadt and *Der Deutcsche Auswanderer* of Frankfurt. Articles such as "On the Upper Mississippi" and "The North American Free state of Illinois" further supported Duden's report on cheap, fertile lands. The periodicals were filled with advertisements for tickets that would provide full passage all the way from their villages in Germany to the towns of the Midwest, backing up a shipping agent's claim that a man could board a ship in Bremen on 1 January and be working on his new farm in Wisconsin one month later! Mark Wyman, *Immigrants in the Valley: Irish, Germans and Americans in the Upper Mississippi Valley Country, 1830–1860*, (Chicago: Nelson-Hall, 1984), 58.

[59] Engelmann, "Instructions for the Collection and Preservation of Botanical Specimens," 505.

Engelmann Travels to the New World

In December 1832, Engelmann arrived in Baltimore and immediately left for Philadelphia. He met some of the city's leading naturalists, including Thomas Nuttall, newly returned from his trip out West, and Samuel Morton, naturalist and phrenologist. Soon he left for the German settlement of Belleville, Illinois and lived with relatives just outside the town. While trying to find suitable investments for his uncle he indulged in "geologizing and botanizing."[60] Although he was slowly running out of funds, it was an exciting time for Engelmann and his companions as they discussed all manner of intellectual, political and scientific issues. Engelmann and his close friend, Gustav Körner (1809–96),[61] a young lawyer, displayed their belief in factual truth and attention of detail when they criticized Duden's depiction of Missouri.[62] Duden's *Report* had drawn many Germans to Missouri; but this was not the New Rhineland Duden had portrayed. With harsh cold winters and blistering hot summers they became very disgruntled.

In response to this, Engelmann began to record daily temperatures and other meteorological observations. Throughout his lifetime he made daily measurements in the hopes that a predictable pattern would emerge. After tabulating data of over fifty years, he found that no pattern was apparent. This was pure Baconian science; observation over time would enable clear patterns to emerge, revealing an orderly and organized natural world. During this colonial stage, a peculiarly American version of botany began to evolve. Isolation from the wider scientific community meant that many scientists were

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60 Michael Long, "George Engelmann and the Lure of Frontier Science," *Missouri Historical Review*, 89 (3) (April, 1985), 256.

61 Körner eventually became lieutenant governor of Illinois and was a friend of Abraham Lincoln.

62 In 1834, Körner published his *Illumination* of Duden's *Report* in Germany. In Steven Rowan, *Gustav Körner Attacks Gottfried Duden in 1834: Illinois against Missouri?* Paper presented at the 33rd Annual Symposium of the Society for German-American Studies, 17 April 2009.

cut off from the new ideas from both the east coast and across the Atlantic. The scientific activities that occurred amongst these "islands" began to become self-limiting as the century progressed.

After two years living a wandering lifestyle he was soon penniless.[63] He needed to make money and decided to move to St. Louis with its larger population holding more potential for an out-of-work physician. According to Rowan and Primm, many well-educated Germans were attracted to the city between the years 1833 and 1837.[64] This influx of educated German immigrants gave St. Louis a distinctive German character. Engelmann was one of many university-trained Germans with a strong tradition of elite organizations. German-language schools and newspapers began to take root alongside musical and debating societies. Primm noted that before the Germans came, public music was sadly neglected in the city. In 1845, Dr. John Woesselhoef, organized the Polyhymnia Society, primarily to encourage classical instrumental music (Engelmann and Wislizenus were members).[65]

As his financial situation improved, he had more available time for purposeful scientific research. Engelmann continued to be drawn to plants with curious or odd-looking features, including those that lacked obvious morphological characteristics that would help divide them readily into species. One such group was dodders (*Cuscuta*). He first discovered this twining vine-like parasitic plant in St. Louis. He noticed that their were differences within the local species, determining that there were three distinct species of dodder (*Cuscuta cephalanthi*, *C. coryli*, *C.*

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63 Engelmann, "Instructions for the Collection and Preservation of Botanical Specimens," 505.
64 Rowan and Primm, *Germans for a Free Missouri,* 4.
65 Primm, *Lion in the Valley: St. Louis, Missouri, 1764–1980, 3rd Ed.,* 194.

polygonorum). He soon discovered that only one species, *Cuscuta Americana* was "noticed in botanical works."[66] Engelmann knew there were thousands of unnamed plants in the West, many as curious as the dodders. He was aware of the desperate urgency to begin to systematically cataloguing these plants as the expansion westward progressed and the influx of immigrants increased to the United States. Engelmann knew that farming and other forms of land use were changing the extent and nature of native plant communities.

Indeed, Bradbury in 1810 observed that white clover, introduced from Europe, was covering huge areas of land noting that "frequent pasturing seems to give those plants a predominance over all others."[67] Engelmann wrote to Asa Gray, his long-term scientific collaborator, that they needed to be ever more "careful observers of such plants as are apparently common to both continents... [M]any European plants, now common weeds east of the Alleghany Mountains, have not yet found their ways to the Mississippi valley, but undoubtedly will arrive in a short time…It behooves us therefore to note the progress of these intruders, and distinguish from them the true natives….*Naturalized plants* [are] spreading with the progress of civilization."[68]

Classifying plants, however, was a complex procedure which required access to many aids. Before the professionalization of botanical science, this time-consuming activity could only be carried out by those individuals who had numerous leisure hours at

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[66] George Engelmann, "A Monography of the North American Cuscutineae," *American Journal of Science*, Vol. XLIII, No. 2 (October, 1842), p.59.

[67] John Bradbury, *Travels in the Interior of America, in the Years 1809, 1810, and 1811; including a Description of Upper Louisiana, together with the states of Ohio, Kentucky, Indiana, and Tennessee, with the Illinois and Western Territories and containing remarks and observations useful to persons emigrating to those countries,* (London: Sherwood, Neely, and Jones, 1817), 45.

[68] George Engelmann to Asa Gray, 30 August, 1849 (GEPMBG).

their disposal. Classifiers needed a means of collecting plants in the field, or at least need to have the funds to hire someone do it for them. Without government subventions the few botanists working on plant classification had no choice but to do it in their own time and at their own expense.[69] The plants needed to be examined under a microscope for morphological features (characteristics) that enabled the classifier to identify the plant. The current literature was checked to see if someone else had previously described the plant earlier. To accomplish this, the classifier needed to have a private library, or access to one. Once the botanist was satisfied that the plant at hand was unknown, it could be described, named and drawn. This new species was published for those competent to judge and confirm it. As a result of this lengthy process, it became possible to insert each newly discovered type of plant into a framework of all known plants.

By the 1830s this framework was Jussieu's natural method. Jussieu's method maintained that the theory that the plant world formed a continuous series, from simple (lower) to complex (higher), imperfect to perfect. As plants were discovered they could be placed within this linear sequence. He was convinced that the continuity of the natural order ensured that any one organism, not just plants, was an integral part of a seamless whole of nature. Any divisions in these series were the work of man, not of nature. Eventually these gaps would be obliterated by the discovery of intermediates. These plants were essential for the very discovery of the natural order. By classifying every living organism, from flora to fauna, eventually a natural series or sequence would emerge. The assertion that the limits of higher taxa

[69] Frederick Brendel, "Historical Sketch of the Science of Botany in North America from 1635 to 1840," *The American Naturalist*, Vol. 13, No. 12. (Dec 1879), 761.

(that is, groupings of genera into families and families into classes etc.) were as a consequence matters of human convenience.[70] Engelmann used this practical method to classify his plant specimens, i.e., using multiple characters to define a group but did not adhere to Jussieu's philosophy of continuity in nature. Engelmann worked below the family level trying to discern characters that would make genera organized into natural plant groupings. He treated each group as discrete and separate entities, not part of a sequence. The idea that a scientist could carry out original research whilst remaining atheoretical seems to be counterproductive. Stevens, however, stated that plant systematists have long distrusted theory, and have considered classification a theory-free "empirical" operation.[71] For Engelmann classifying plants was a way to create order out of the seemingly chaotic and disorganized floral world, he did not need an encompassing theory for this task. Engelmann knew that he could not work in isolation, and without the encouragement, discussion and recognition of his peers, his original research was meaningless. It did not take long for Engelmann to instigate a formal organization. The Western Academy of Science became the first scientific institution in the City.

The Western Academy of Science

Engelmann and six other professional men (mostly physicians) initially formed the St. Louis Association of Natural Sciences. In February 1837, the association applied

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[70] Peter F. Stevens. *The Development of Biological Systematics: Antoine-Laurent de Jussieu, Nature and the Natural System*. (New York: Columbia University Press. 1994), 15.

[71] Peter F. Stevens, "Classification and System in Flowering Plants: Historical Background," in *Plant Systematics, A Phylogenetic Approach*, 2nd Ed., Walter S. Judd, Christopher Campbell, Elizabeth A. Kellogg, Peter F. Stevens, Michael J. Donoghue, (Massachusetts: Sinauer Associates, Inc. 2002), 42.

for a charter from the state legislature and changed its name to the Western Academy of Natural Sciences. The Academy had lofty and ambitious goals for "the intellectual improvement of its members and a general diffusion of scientific information throughout the State of Missouri."[72] It was the first society west of the Mississippi devoted "exclusively to the cultivation of the Natural Sciences"[73] and joined a handful of scientific institutions in the United States, including the Academy of Natural Sciences of Philadelphia (1812) and the New York Academy of Science (1817).

In January 1837, Henry King of the Medical Department of St. Louis University was elected as the first president. The Academy was divided into specialties with each member focused on developing one particular aspect of science. Engelmann focused his attention on mineralogy, chemistry and botany—evidence of his diverse scientific interests and talents. The Academy had converging interests; the utility of the natural resources found in Missouri and the value of intellectual activity. Members knew that to gain support for their research they had to promote the economic value of science and its national importance. The Academy offered a unique opportunity to non-members. In exchange for free analysis of any mineral sample sent to them from the region, the academy kept the same and enlarged its collection.[74] The Academy, therefore, was of immense utility to the ordinary person and would assist the state to utilize the "abundant supply of the most precious as well as useful products." Indeed, if the "reports of the

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[72] *Act of Incorporation, Constitution and By-Laws of the Western Academy of Natural Sciences in St. Louis*, 3.

[73] *Act of Incorporation, Constitution and By-Laws of the Western Academy of Natural Sciences in St. Louis*, 5.

[74] Long, Michael, "Enterprise and Exchange. The Growth of Research in Henry Shaw's St . Louis." In: *St Louis in the century of Shaw: A View Beyond the Garden Wall.* Edited by Eric Sandwiess,(University of Missouri Press, 2003), 144.

hunters and trappers" who were experts in the field were true: "The utility to man of many of the vegetable productions of this country may rival either as articles of medicine or of diet any of those yet introduced into use in civilized life."[75] This fusion of scientific and monetary wealth was essential for the Academy to succeed as the members were not paid to study science.

Members met monthly to discuss the latest scientific developments, read scientific literature, collate data sets on weather, and begin to create a cabinet of specimens for taxonomic research. The Academy attracted a variety of men of science. William Greenleaf Eliot, a Unitarian minister, saw the moral advantage in the Academy and other such societies in St. Louis. In an industrial city, the working class where prone to immoral and ill behavior; access to the Academy could elevate the masses and help them forget "that there is something real in the world, besides money."[76] Although there was no direct objection to any man joining the Academy, it attracted like-minded men and remained an unintentional elite organization.[77]

Engelmann was an energetic member. He focused his attention on creating a herbarium for the Academy. Sourcing local plant-enthusiasts, he quickly found Nicholas Riehl (1808–1852) and Jean-Baptiste Duernick (1809–1857). Riehl had opened the first plant nursery just outside the city limits in Carondelet. They exchanged herbarium specimens, and Engelmann gave Riehl seeds, living plants and roots to grow. They formed a long-lasting friendship. Duernick, a Jesuit missionary from Belgium, had

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[75] *Act of Incorporation, Constitution and By-Laws of the Western Academy of Natural Sciences in St. Louis*, 6.

[76] William G. Eliot, *Address Delivered before the Franklin Society of St. Louis on the Occasion of its First Anniversary, January 7th, 1836*. (St. Louis: Charless & Pascjall, 1836), 20.

[77] At the start of the 19th century, scientific institutions were mostly limited to men.

moved to the town in 1834. He exchanged his plants, which were collected within the environs of St. Louis, with the Academy. Engelmann was wholly aware of the importance of science in Europe and began to make connections on behalf of the Academy, including, sending a thousand plants to the Senchenberg Institut, where he had attended lectures prior to medical school.[78]

Within a few years the Academy had an impressive collection of zoological, botanical, geological and conchological specimens. They purchased five-acres to develop a botanical garden, Long noted that it was the first of its kind in St. Louis. The Academy became known nationally and internationally, and particularly Engelmann came to the attention of prominent men of science. Visiting explorers, who used the frontier town as a launching point, sought his advice. Joseph Nicolas Nicollet (1786–1843), the French cartographer, found it "gratifying" to meet Engelmann, who was "not only a gentleman" but such a "learned man."[79] Engelmann was "warmly disposed to assist" in outfitting Nicollet with scientific equipment, medicine, and local knowledge of the landscape before he headed out west.[80]

In the early 1840s, the Academy in St. Louis was in excellent company. Other American cities began to form organized institutions for scientific research: National Institute for the Promotion of Science (1840), Academy of Science in Cleveland (1845), the Smithsonian Institute (1846- formerly the National Institute) and in 1848, the American Association for the Advancement of Science. In this period where science was

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[78] Long (2009) noted that six boxes were exchanged, filled with enough specimens to start a small museum: a frog, six hundred insects, salamanders, a skeleton of a young bison and a skull of a young black bear.

[79] Martha Coleman Bray, *Nicollet and His Map*, (Philadelphia: American Philosophical Society, 1980), 76.

[80] Engelmann's meteorological data collection was so reliable that Nicollet compared his own reading in the field with Engelmann's to determine altitudes.

beginning to become incorporated into American culture, St. Louis was not so fortunate and the Western Academy was beginning to fail.

Demise of the Academy

There were many reasons for the demise of the Western Academy which lead to it being disbanded in 1843. The Academy was always dogged financially. The academy was funded mainly from members' dues. It was never financially secure to pay for the basics, such as the rent for the meeting hall. Due to the lack of space, members kept their collections in their own homes and office. This made it extremely inconvenient for anyone to study the whole collection and defeated the main purpose of the Academy. Engelmann had envisioned a wealthy patron, such as Pierre Chouteau Jr., to donate large sums of money to support the Academy. The academy however failed to convince "the heavy men of our city," as Engelmann called them, to donate money. When the Panic of 1837 hit St. Louis, any possible chance of a donation completely withered away. The Academy petitioned the Missouri legislature and the United States government for financial support. Their requests were denied.

Long argued that the busy full-time positions of the members, coupled with the growth of western exploration, worked to paralyze the academy. Members had to spend their spare time analyzing the collections which limited their productivity for original research. Long concludes that there was "too much science spread among too few practioners."[81] Certainly the commitment of the members was reduced because of their

[81] Long, "George Engelmann and the Lure of Frontier Science," *Missouri Historical Review*, 89 (3) (April, 1985), 148.

careers; it cannot explain its demise entirely. Engelmann worked his entire life as a physician and was highly productive, even by today's publication standards of the scientific world. Hendrickson argued that the academy disbanded because within a few years the organization lost several key members.[82] King moved to the east coast in 1839, Benjamin Brown left for California, Engelmann left briefly to get married in 1840, and eventually Wislizenus would leave for Santa Fe.

While these reasons certainly culminated towards the Academy's demise, the Academy's lofty goals were also factor in its demise for two reasons. First, St. Louis was an industrial smog-filled city with a high proportion of working class Americans, Irish and Germans. In attempting to raise the intellectual tone of the city, the Academy failed to accomplish their main aim to diffuse science in the city and state. The very nature of the style of research the members wished to carry out isolated the very citizens it wished to embrace. It unintentionally became an elite organization. So although the citizens of St. Louis may have delighted at the general idea of a scientific institution in their city, few were sufficiently impressed by the need for such a cultural ornament to improve its chances for success by donating long-term financial support. Indeed, with such a large population of working class men (and women), members that were physicians, such as King and Engelmann were kept very busy with the epidemic outbreaks of cholera and yellow fever that they themselves had little time to fund-raise for the Academy.[83] Engelmann by nature was a very pragmatic man, and was unable to comprehend the

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[82] Henrickson, Walter B. "Science and Culture in the American Middle West," *ISIS* 64, September (1973): 330.

[83] In 16 March, 1853 Engelmann wrote to Gray, "I ought never to have been a physician or never a botanist," (AGPHUA).

"soft-soaping so common in the West…A man who had no real scientific zeal or knowledge who must be got to do things by diplomacy…I cannot do much with."[84]

While the exact cause of the Academy's demise may never be clearly understood, it certainly was a culmination of these factors that lead to its failure. The long-term impact for this small scientific community was in building for the first time a national and international reputation for science in St. Louis, and particularly for Engelmann. For the first time, St. Louis was attempting to compete with east coast centers of science. Engelmann was the leader for a small group of intellectuals who began to establish the consciousness of being a member of a special group for the "attainment of professional aims."[85]

After having lived for five years in this small town, he reached his thirtieth year financially stable, and decided that it was time to marry his long-time sweetheart, Dora Horstmann. In January 1840, Engelmann left St. Louis bound for Germany where he married Dora on 11 June 1840. On their return voyage, they stopped off in New York. Engelmann met Asa Gray, who was but one year younger. Whereas, Nuttall and Bradbury were ill-matched, in Gray Engelmann found his equal. A common bond in their acceptance in Jussieu's natural system and their belief that American plants should be named by America-based botanists was matched by their deep preoccupation with taxonomic and systematic research, and an inability to sit still. They embarked on a forty-year intellectual relationship in the quest to put Latin names on every North American plant.

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[84] George Engelmann to Asa Gray, 10 April, 1860 (GEP-MBGAMC).

[85] George H. Daniels, "The Process of Professionalization in American Science: The Emergent Period. 1820–1860," *Isis* Vol. 58. No. 2, 156.

Chapter 3

Comprehending minds

At the time Engelmann met Gray, he had also recently returned from Europe. Gray was in Europe on behalf of the University of Michigan who had offered him a position as Professor of Botany. He spent his time visiting all the leading botanists, herbaria and botanical libraries in Europe to establish academic relationships. Gray realized that European herbaria held few specimens representing the flora of western North America. There were large areas of the United States, such as the Southern Rocky Mountains, that remained unexplored by botanists. He deduced that "on both sides of the mountains" were "goldmines" for botanists.[86] When he met Engelmann, he was about to embark on the second volume of *A Flora of North America* with John Torrey, and wished to have more plant specimens from the West.

They knew of the immense potential in collaborating with the other. Within months of meeting each other, Gray wrote, "You see you would be of much use to us. Meanwhile you will give me pleasure if you will tell me how I can serve you."[87] Engelmann was in the perfect location to be the "gatekeeper for all scientists going into the wilderness."[88] Gray was the source for information about botanical developments in Europe. Gray wished for Engelmann to partake in classifying the flora of the United States. This was a long-term scientific project and Engelmann felt it was a most suitable

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86 A. Hunter Dupree, *Asa Gray, 1810–1888*, (Cambridge: Harvard University Press, 1959), 98.
87 Asa Gray to George Engelmann 17 May, 1841 (GEP-MBGAMC).
88 Asa Gray to George Engelmann, 12 Sept, 1841 (GEP-MBGAMC).

academic venture. For the ensuing decades, Gray, Engelmann and Torrey worked on one of the most ambitious botanical task, the American flora.[89]

Neither Gray nor Engelmann were wealthy, and both had duties other than the uninterrupted study of plants. They needed access to specimens to continue original research; neither could afford to fund their own expeditions. Engelmann suggested an ingenious plan to Gray; if willing men were found to go collect out west, duplicate specimens they collected could be sold, thus making the endeavor self-sufficient.[90] Engelmann would train, outfit, and manage the collectors and specimens, while Gray could then sell the specimens through his Harvard connections. They could both "guarantee the genuineness, the good preservation and careful selection of the specimens."[91] Gray instantly accepted Engelmann's proposal. In the absence of funding, Engelmann and Gray formed a unique collaboration as patrons of botanical science.

German Collectors on the Frontier

Engelmann did not have to look far to find suitable field collectors in St. Louis. He selected German-speaking immigrants, some his close friends. The Engelmann-Gray alliance engaged five immigrants as field collectors; Academy-member Karl Andreas Geyer; the newly arrived Samuel Loeders; Ferdinand Jacob Lindheimer, a friend of from his hometown and university days; his medical partner, Wislizenus; and lastly Augustus Fendler who was "engaged here [St. Louis] in the fabrication of spirit gas." Their goal

89 *The Flora of North America* project continues today and encompasses descriptions of 20,000 species.
90 Long,. "Enterprise and Exchange. The Growth of Research in Henry Shaw's St Louis," 150.
91 Asa Gray to George Engelmann 17 May 1841(GEP-MBGAMC).

was simply to "ravish" the West of unknown plants for systematic botany and the advancement of science in the United States.[92]

As there were no guides or manuals on the craft of field collecting, Engelmann personally trained his collectors. His instructions offer a rare glimpse at the methods of field collecting and preservation of botanical specimens during the nineteenth century. He insisted that no plant "whether showy or unsightly" was to be neglected.[93] Numerous specimens of the same plant were to be collected, to gain accuracy in morphological characteristics at different states of growth and for bartering with other botanists. The most important part of the plant was "the *flower* and *fruit.*"[94] To prevent confusion, if a specimen was larger than the 17 inch portfolio paper, bend the stems or break at an acute angle and was "better than cutting…as these might become separated and much confusion ensure from this cause."[95]

Once a specimen has been put in paper and pressed, the paper needs to be changed as soon as they "become damp from the moisture absorbed from the plant…this ought to be repeated daily." Engelmann suggests a convenient way to carry the specimens, in a box or "in a fresh skin of some animal (hair inside) which will harden and shrink and form an easily handled and safe package." And lastly, do not forget to label them, noting the locality, date, and "every thing you can ascertain." These simple instructions guaranteed the quality of the specimens.

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92 Asa Gray to George Engelmann, 5 January, 1847 (GEP-MBGAMC).
93 Engelmann, "Instructions for the Collection and Preservation of Botanical Specimens," 504.
94 Engelmann, "Instructions for the Collection and Preservation of Botanical Specimens," 504.
95 Engelmann, "Instructions for the Collection and Preservation of Botanical Specimens," 504.

Geyer, a surly but passionate collector, was Engelmann's first field collector.[96] He managed to get Geyer attached to the Frémont expedition in summer 1841. Geyer's first collection of plants was damaged when the canoe in which they were being carried filled with water. Engelmann, however, was able to salvage some of the specimens from the expedition and add them to his herbarium. A similar tragedy happened Loeders; his entire collection was swept away on the Columbia River. He decided to discontinue his service with Engelmann after this incident. Geyer's second collection, from Illinois, consisted of 3,000 plant specimens. As Engelmann sorted and catalogued this large collection, he began to feel the burden of such an undertaking, and complained to Gray that "packing and labeling" was "more trouble than expected."[97]

Due to the practical nature of their collaboration, unexpected curatorial issues were resolved easily. Gray found Engelmann's labeling system for the sets was too confusing. He suggested that Engelmann should not print labels "but distribute the sets by numbers only… a list is published. You can have sets of numbers printed off from 1 to ------ at a trifling expense – and so can distribute the sets…only making sure that your own set, and your Mss. is numbered accordingly."[98] Engelmann was delighted by this new system, which made his task simple and saved his valuable time. When it came to authorship in the naming of the plants, Engelmann proposed a plan whereby the plants described by Gray would read "Gray and Engelmann" and those described by Engelmann

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[96] John Charles Frémont, *The Expeditions of John Charles Frémont*, Ed. Donald Jackson and Mary Lee Spence. (Urbana: University of Illinois Press, 1970), 58.

[97] George Engelmann to Asa Gray, 27 July, 1843. Asa Gray Papers, Harvard University Archives (hereafter known as (AGPHUA).

[98] Asa Gray to George Engelmann, 13 March, 1844 (GEP-MBGAMC).

would be called "Engelmann and Gray."[99] Gray agreed. This kind of collaboration was extremely rare in the nineteenth century. Engelmann, however, had to deal with the many of the difficulties that arose in connection with in managing their collectors.

The Slowness of Returns

Engelmann's role as manager of these collectors was a highly stressful position. The collectors were going through extremely dangerous areas of uncharted territory and at times it took a considerable physical and psychological toll. He was always aware of the real possibility of losing them, due to these dangers and the lack of income while they were in the field. He felt personally responsible for the welfare of his fellow immigrants. For months when he did not know where Fendler was, he worried that "must be in a bad situation, and I fear that the whole undertaking may prove a failure. It will be hardly possible for a single man to explore secluded spots from Santa Fe without danger of life."

The collectors depended on their specimens being sold, so for months at a time they had little to no income. Many times Engelmann gave some of his own income to support the collectors, trusting them for the return of this funding. Selling the sets of plants was painfully slow, and although they could earn significant amounts "the difficulty consists in the slowness of returns."[100] For nearly two years, Lindheimer had little income. Engelmann advocated for Lindheimer and asked Gray about the possibility of Gray providing Lindheimer with a yearly salary to collect live plants and seeds for the Harvard Botanical Garden. "His zeal would be instigated when he sees that he can earn

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[99] George Engelmann to Asa Gray, 17 February, 1844 (AGPHUA).
[100] George Engelmann to Asa Gray, 17 December, 1849 (AGPHUA).

with his collections so much that he can extend his investigations further into the interior."[101] Gray had some funding to hire Lindheimer on an annual salary but Fendler was not as fortunate.

Fendler left St. Louis for Santa Fe in 1847. Finding that everything, from sugar to soap was sold at exorbitant prices; he eventually sold his watch and gun in order to live. Engelmann was unaware of his dire straits, and it was not until he returned to St. Louis that he learned Fendler had "not received any letter from [him] nor any money, and was obliged to leave after having exhausted all his means."[102] Fendler's collections were so impressive that Gray pressed Engelmann to encourage Fendler to "go back, and without delay, he makes unrivalled specimens. If he will stay and bide his time, he can get onto the mountains, and must try higher ones, especially those near Taos."[103] Fendler, however, no longer wanted to serve the scientific interests of Gray and Engelmann. He explained to Gray how he simply does not wish to be economically exploited any further, "When I came back to St. Louis I had to sort about 17,000 plants…With this kind of work I was occupied till the beginning of April, during which time I could do nothing else to earn any thing to pay my current expenses, and I was therefore obliged to borrow money to keep from starving."[104] In giving up "a business in which [he] was doing well" it had placed him in irrevocable debt. Although his sets of the Rocky Mountains sold quickly, earning approximately $1000 for the year in Santa Fe, Fendler simply refused to return west. Engelmann and Gray could do nothing to change his mind. Fendler never

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101 George Engelmann to Asa Gray, 11 January, 1845 (AGPHUA).

102 Hunter A. Dupree, *Asa Gray, 1810-1888*, (Cambridge: Belknap Press of Harvard University Press, 1959), 163.

103 Asa Gray to George Engelmann, 20 December, 1847 (GEP-MBGAMC).

104 Dupree, *Asa Gray, 1810-1888*, 163.

collected again, frustrated by the "rich gentlemen in the East…under the happy impression that the enjoyment of the fruits of my labor would soon compensate for all."[105]

Engelmann also dealt with Gray's complaints, which tried Engelmann's patience. It was apparent that Gray had never carried out long-term field work and was ignorant of the conditions in the West. Once again, Engelmann defended his collectors, "You ask me why Lindheimer has not done much more? He is rather slow, besides he has had misfortunes, and then travelling is and was for the last 3 or 4 years very unsafe in Western Texas. He has made a start now under the protection of a large German colony…I think I have roused him sufficiently."[106] When Gray complained that the specimens were messy, Engelmann explained that "in travelling and in putting up plants in a cart, it is not easy to obtain the neatness required by a closet botanist."[107]

One of the major difficulties was obtaining living specimens, particularly of the cacti that Engelmann studied. Engelmann explained to Gray, "of the extreme difficulty of preserving and transporting specimens, it is almost impossible to obtain materials for their study."[108] Keeping the collectors happy was foremost in Engelmann's mind but, along with losing them as field collectors was the loss of plant collections. Most of Geyer's first collection was lost. The Engelmann-Gray alliance lost two more collections.

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105 Augustus Fendler to Asa Gray, 27 July, 1847, as quoted in Dupree, *Asa Gray, 1810-1888*, 163.
106 George Engelmann to Asa Gray, 13 May, 1845 (AGPHUA).
107 George Engelmann to Asa Gray, 13 May, 1845 (AGPHUA)..
108 Dupree, *Asa Gray, 1810-1888*, 98.

Scheeling Specimens

Geyer's third trip with William Drummond Stewart's 1843 expedition through the Upper Midwest was his last trip for the Engelmann-Gray alliance. They waited expectantly for his return, predicting that his Oregon collections may "prove unusually choice and valuable."[109] Geyer never returned to St. Louis and Engelmann soon found out that Geyer had left taking "all his collections to England." Engelmann was mystified as to this sudden departure and complained to Gray that, "He sends nothing, nothing but a short, insolent letter for all my troubles, which I have had with him, and the 150 dollars which it has cost me to fit him out! So much for honesty and gratitude."[110] Gray was disturbed by this change of plan, "I am sorry Geyer has turned out dishonest. I had hoped better of him."[111]

They soon found out that Geyer had sold the right to distribute the collected sets, 9,-10,000 specimens and 340 to 350 packets of seeds, to Sir William Jackson Hooker, Director of the Royal Botanic Gardens at Kew. Hooker published the catalogue of plants for sale in *The London Journal of Botany* in 1845. Hooker, a close botanical colleague but also their rival, offered neither excuse nor a set of plants to Gray or Engelmann. Gray and Engelmann did not dispute the ownership of these plants, perhaps because Hooker was such an important botanical colleague. Engelmann, however, was very disappointed and even more so when Gray deemed it necessary that he purchase a set of Geyer's plants from Hooker.[112] Gray's letter to Hooker explains that he "cannot well afford it…(but) it is very important that there should be a set of these plants in the country, accessible to Dr.

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109 Asa Gray, *American Journal of Science and Arts,* 1843, 226.
110 George Engelmann to Asa Gray, 22 November, 1843 (AGPHUA).
111 Asa Gray to George Engelmann 11 December, 1843 (GEP-MBGAMC).
112 Asa Gray to George Engelmann, 23 September, 1845 (GEP-MBGAMC).

Torrey and myself, and I have concluded that I can afford to purchase them."[113] Engelmann was frustrated that he had obtained nothing, and he was out of pocket from funding Geyer, "I am astonished that Geyer should not have written me at all from England…Do you hear anything about his doings? He could not have done less than offer a set of his collections."[114] Engelmann took this incident very personally.

During 1846 Lindheimer was visited in St. Louis by a German colleague, Ferdinand Roemer and spent some time collecting around the area. Roemer returned to Germany with his own collections and a set of those made that year by Lindheimer. The plants, including Lindheimer's, were turned over by Roemer to Adolph Scheele, a clergyman, who described one hundred and thirty-nine new species in *Linnaea*. Engelmann was angry and scornful, "[A]nd how characteristic for those persons, who seek notoriety and name with the 'mihi [mihi=Scheele]." Scheele published his findings serially and each article struck a nerve in Engelmann, who apparently was not much interested in priority but did believe that, so far as practicable, newly named species to science should be described in their native country. He wrote to Gray, "I think we should classify the new ones at once, so as to prevent any 'Scheeling.'"[115]

A Botanical Success

Despite such difficulties, the Engelmann-Gray alliance was a botanical success. Plants were collected as far west as the Rocky Mountains, Texas, New Mexico, and northern Mexico. Their alliance had placed Lindheimer further west than any previous

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113 Asa Gray to William Jackson Hooker, 14 October,1845, Feb 28 1846 (AGPHUA).
114 George Engelmann to Asa Gray, 6 March, 1845 (AGPHUA).
115 George Engelmann to Asa Gray, 15 February, 1850 (AGPHUA).

collector. Five German immigrants had collected over 50,000 plant specimens.[116] Each set arrived at Engelmann's office in St. Louis where he organized, labeled, and named them before sending sets to Gray at Harvard. Engelmann and Gray published seven papers, in which, 1,170 species new to science were described for the *Flora of North America* project. Gray noted in *Plantae Fendleriane Novi-Mexicanae* (1849) that "several families of the ensuing enumeration, such as the Cactaceae…&c., have been elaborated by Dr. Engelmann, of St. Louis upon whom a large share of the labor and care incident to this enterprise has fallen."[117]

Splitters and Lumpers

The Engelmann and Gray herbaria began to bulge with so many unprocessed specimens. The movement of plants from St. Louis to Harvard and vice versa was weekly. Thus classifying the plants was in motion, literally and scientifically. When more of a particular kind of plant came in, it was added to a defined group or it questioned the limited of that original grouping. Classifying was not a mere bookkeeping and pigeonholing of species. Gray and Engelmann named plants using the same method, choosing multiple characters to define each species. But they viewed this method at a slightly different angle. The literature has repeatedly misinterpreted Gray's jibe to Engelmann in a letter he sent 18 November, 1848. Gray wrote, "Never fear I shall not like your criticisms or be offended—the more the better— I think we are needful to each

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[116] This is a very conservative number based off the surviving correspondence. Exact numbers are difficult to ascertain as the collectors did not keep accurate notes on the sets they collected.

[117] Asa Gray, *Plantae Fendlerianae Novi-Mexicanae: an account of a collection of plants made chiefly in the vicinity of Santa Fe, New Mexico, by Augustus Fendler; with descriptions of the new species, critical remarks and characters of other undescribed or little known plants from the surrounding regions*, (Boston 1848), 3.

other, & act as good checks on each other. You incline to split a little too much. I am apt to lump, especially where a genus is a good deal confused already."[118] [Underling is Gray's] Whereas Gray makes less species, Engelmann generates more. Historians have interpreted this as a failure of Engelmann's method of classification but rarely analyze the research of the se (and other) botanists any further. The literature is sparse on the history of systematics in the United States with an overall assumption that because both men were botanists, they viewed nature in the same way: there was one nature and one method to classify it. This assumption fails to encompass the relationships that the users and makers of classifications had about the natural world and the role of classification.[119]

In analyzing Engelmann and Gray's research, it reveals that they had very different approaches for the same end product– simplifying plant groupings. In his *Revision of the North American of the Genus Juncus* (1868) Engelmann analyzed over a thousands specimens from all over the United States. He carefully dissected the flowers and fruits that enabled him "to place the proper value on the characters derived from the different organs of these plants, and to arrive at definite conclusions in regard to their species…and their affinities among themselves."[120] Of the fifty species he circumscribed, he placed them within eleven subgroups. This was Engelmann's particular approach to taxonomy. In his *Systematic Arrangement of the Species of the Genus Cuscuta* he stated that "*Cuscuta* naturally arrange themselves in three large groups, distinguished by their

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[118] Asa Gray to George Engelmann, 18 November, 1854, (GEP-MBGAMC).

[119] Stevens observed that no fewer than twenty-four classification systems were produced during the British botanist, Robert Brown's (1773–1858) lifetime.

[120] George Engelmann, "Revision of the North American of the Genus Juncus," *Transactions of the Academy of Science in St. Louis*, Volume 2, No. 2 (1868), 425.

styles and stigmata."[121] He was not splitting the genus into multiple genera as is suggested in the literature. Gray, on the other hand, would lump many of these individuals together and not make so many subgroups. It was their close collaboration and attention to minute details that enabled them to make sure they were not creating species at a whim. Elizabeth Shaw stated with clarity that "Engelmann never just poured out new species." His monographs and revisions are a careful effort to array the species in some pattern of relationships, based on numerous characteristics. As more specimens became available, he revised his groups always trying to make his determinations as unambiguous as possible.

Many historians, such as Greene, view plant taxonomy and systematics as static and uniform. Botanists merely named, classified and described specimens as they were collected. It is assumed that all botanists had the same theory and practical approach to grouping plants. Indeed, systematics is discussed as if there was *one* nature and *one* gradually improving system of classification. Perhaps its is an uninteresting problem to historians or due to the rapid changes in biology during the nineteenth century and the bewildering array of terminology and concepts merely adds too much confusion as to what exactly was occurring.[122] By ignoring the scientific traditions of these men (and later of women) of science, the local character of science is lost. For example, Engelmann and his cousin Theodore C. Hilgard, who arrived in St. Louis in the 1850s.

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[121] George Engelmann, "Systematic Arrangement of the Species of the Genus Cuscuta," *Transactions of the Academy of Science in St. Louis*, Volume 1, (1856–1860), 517. In plants, the style is the "female" structure, a single structure down which the pollen tube grows; the stigma is the part of the "female" structure which receives the pollen grains. Definition from Stevens, P. F. (2001 onwards). Angiosperm Phylogeny Website. Version 12, July 2012.

[122] Peter F. Stevens. *The Development of Biological Systematics: Antoine-Laurent de Jussieu, Nature and the Natural system*, 6.

They were both German nationals, but were separated generationally and academically. They had clear and very different philosophies in their approach to taxonomic studies. Engelmann strictly worked under the assumption that plant groups were discrete whereas Hilgard thought nature was one continuous series. Engelmann used numerous characters to define genera into families, whereas Hilgard was investigated the interlocking networks of families and higher groups. Hilgard was not interested in the genus level directly. Science was evolving throughout the nineteenth century and both men were products of the time and location they trained and were active within.

An evolving alliance

Engelmann continued to work diligently on his botanical researches. Although by the late 1840s his initial set of collectors decided to find other employment, Engelmann continued to obtain specimens from other collectors, since he was by then known as a great expert on western plants in general, and on many particular groups of plants. Josiah Gregg, author of *Commerce of the Prairies*, sent him 1,500 specimens collected in Arizona and Mexico. Charles Wright, engaged by Asa Gray to collect around El Paso, sent numerous samples of living cacti to Engelmann. He planted these in his home and office gardens. As he catalogued his plants with Gray, the Western Academy was slowly disbanding. The botanical community was growing in the United States and the federal government began to send out scientific expeditions to map and make collections of the western lands, some newly acquired.

Engelmann met with leaders and the scientific members of the expeditions, such as John Frémont and the botanist Charles Christopher Parry. He established close

scientific bonds with many leading botanists that lasted through his lifetime. Gray, now the preeminent botanist in the United States, invited Engelmann to assist him in cataloguing the new collections that flowed into his office from the Government surveys. Engelmann accepted and continued to be highly productive in botanical science. He published twelve papers on government expedition collections, all the time continuing his work as a doctor. The population in St. Louis suffered numerous outbreaks of cholera in 1849 and 1850. Much to his disappointment it was clear to Engelmann that he would always be a part-time botanist.

From Frontier Town to Metropolitan City

During this early period, from 1843 to the early 1850's, botanical activity in St. Louis rested in Engelmann's hands. His botanical publication list is truly astounding for an evening botanist. By the mid-1850s Engelmann was joined in his botanical activity by the return of his second cousin Theodore C. Hilgard (1838–1875). He had recently returned from Europe upon completion of his medical degree. Theirs was a relationship greatly impeded by a generation gap. Between 1830 and 1860, the population of St. Louis jumped from 16,469 to 190,524. Engelmann wished for it to take its place as "the most civilized place on earth."[123] In 1853, the California Academy of Sciences was founded, and Engelmann knew that St. Louis was falling behind. After ten years in the town, he was aware that "persons residing in the West, who are disposed to pursue original investigations in science, must look to libraries of the East for their works of reference,

[123] George Engelmann to Asa Gray, 9 February, 1851(AGPHUA).

and thus they are compelled to labor under many disadvantages."[124] The scientific community in St. Louis needed to compete and not fall to the wayside.

[124] Benjamin F. Shumard, Report of the President, on the progress of the Academy during the year 1857. *The Transactions of the Academy of St. Louis*, Volume 1 1856–1860. (St. Louis: George Knapp & Co., 1860), 109.

Chapter 4

As the Third City Ought To

By the 1850s, St. Louis was a flourishing industrial city with a growing population. The influx of uneducated Irish and German immigrants brought an immense desire from established St. Louisans to raise the intellectual tone which "the third city of the United States ought to and will occupy."[125] St. Louis, however, was being surpassed scientifically by other cities in the West who had established scientific institutions: Cleveland Academy of Natural Sciences (1845), California Academy of Science (1853) and eventually Chicago Academy of Science (1857). The established community felt that "a city of the importance and fame of St. Louis, and of those of her citizens who claim to be progressive men" needed to aid in the development of the Academy.[126] This community did not know "enough of science" [127] and quickly turned to Engelmann who had "a great reputation…as a man of science, a naturalist."[128] Once again, Engelmann spearheaded organizing an academy of science. Engelmann wished to prove "that out here, on the banks of the Mississippi, here in the vast community of business men, some at least find inclination and leisure to prosecute the more abstract but none the less important and useful study of science."[129]

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[125] George Engelmann, 6 January 1878, Academy Meeting, *Transactions of the Academy of St. Louis*. Vol. III (1868–1877), xxxii.

[126] George Engelmann, January 3 1881, Academy Meeting, Academy Meeting, *Transactions of the Academy of St. Louis*. Vol. IV (1878–1886), lx.

[127] Marshall Snow, Inaugural Exercises and Address, 61.

[128] Henry Shaw to William Jackson Hooker, 10 August 1856,in NAL, XLIV, 360.

[129] George Engelmann, Annual Address to the Academy of Science in St. Louis, *Transactions of the Academy of Science in St. Louis,* Vol. IV(1868–1877), 569.

In 1856, the Academy of Science in St. Louis was founded on the principles of "discovery and usefulness." For the first time in St. Louis since the dissolution of the Western Academy of Science, Engelmann had a place to discuss all manner of scientific research. He was no longer an isolated botanist, finding excellent company in his fellow university-trained immigrants. This younger generation of scientists brought new ideas and methods from Europe, including Charles Darwin's theory of evolution. The academy was the place of contention and revolution.

Tapeworms and Theory

The Academy was founded on the 10 March, 1856, in the Hall of the Board of Public Schools, in the presence of seven physicians, five professors, an engineer, a judge, and local businessman.[130] The Academy was modeled very closely on the earlier Western Academy of Science; its main objective remaining the "advancement of Science, and the establishment in said city of a Museum and Library for the illustration and study of its various branches."[131] With renewed energy they focused their goals once again on building biological collections of "[s]pecimens illustrative of the various departments of Science," a "Library of works relating to the same" and "the instruments necessary to facilitate their study, and to procure original Papers on them."[132] Science for science's sake was not the only use for the academy. Charter member and engineer James Eads saw a higher motive in the Academy, he considered that "a more intelligent comprehension of the power and wisdom of the Creator will develop a more enlarged and effective

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130 Charter of the Academy of Science in St. Louis, In *The Transactions of the Academy of Science of St. Louis*, Volume 1 (1856-1860), (George Knapp & Co. 1860), 15.

131 Charter of the Academy of Science in St. Louis, 5.

132 Charter of the Academy of Science in St. Louis, 5.

philanthropy Science [sic], while this leading man upward and onward to the very threshold of omnipotence, will inspire him with a holier love of God and humanity."[133]

Engelmann was once again heavily involved in the Academy and was elected as President sixteen times over the 28 years from its formation in 1856 to his death in 1884. At bimonthly meetings, members presented unusual and unknown specimens, where they wrestled over explaining these curiosities: an abnormal growth in twelve ears of corn, newly discovered fossils or bison stomach hair balls. Engelmann seems to have relished these meetings. At the very first meeting he brought a specimen of tapeworm (*Taenia solium*). He explained that he had never seen any in the natives of Missouri, being found only in immigrants from Europe, and also in some Texans after a long captivity in Mexico.[134]

Engelmann was instrumental in ensuring that the members did not have to send their manuscripts elsewhere to be published. The Academy's *Transactions of the Academy of Science in St. Louis*, was established with a rigorous system of peer-review; in it were the published the results of any member's or corresponding member's researches. Engelmann took full advantage of this journal. Since most of his collectors were now retired, he included notices at the end of his papers requesting "botanists in different parts of the country" to "communicate specimens" from their vicinity.[135] This local journal enabled Engelmann and others to disseminate their research quickly. Science was transitioning into the domain of professionalism and the Academy members

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[133] James B. Eads, Remarks to Mr. Harris, In *The Transactions of the Academy of Science of St. Louis*, Volume III (1868–1770), 730.

[134] George Engelmann, Academy Meeting April 4, 1859. In *The Transactions of the Academy of Science of St. Louis*, Volume 1 (1856-1860), (George Knapp & Co. 1860), 334.

[135] George J. Engelmann, A Monograph of North American *Cusuctaceae*, *American Journal of Science*, Vol. XLIII, 1842.

were introduced to many new ideas and concepts coming from new immigrants to the City. Some ideas were readily accepted; some outright rejected.

Hilgard's Pentagram

Engelmann continued to work on plant groups with "considerable doubt of the limits of the species" producing impressive treatments on North American oaks, cacti and rushes.[136] He had an incredible capacity to decipher characters and find what he deemed natural groupings, but rarely did he enter into discussions of a theoretical nature. With a similar predilection as Engelmann for difficult groups, Hilgard moved away from flowering plants into the study of other groups, such as plants without obvious flowers: mosses, fungi, and lichens (known as cryptogams). Hilgard's research centered on two related fields: phyllotaxis and classification. Unlike Engelmann it was highly theoretical.

Hilgard explored the relationship between the mathematical distribution of leaves and their development. He published *Phyllotaxis – its numeric and divergential law explicable under a simple organological idea*, in the first volume of *Transactions* (1856). Hilgard's work was heavily influenced by the German naturalists Alexander von Humboldt, Lorenz Oken and Herman Schacht's microscopy studies. Hilgard was searching for an overarching theory to connect plant development to an organic law. Phyllotaxis, introduced earlier in the century by Engelmann's close friends Braun and

[136] George Engelmann, "Notes for the Genus *Yucca*," In *The Transactions of the Academy of Science of St. Louis*, Volume 1 (1868–1877), (George Knapp & Co. 1860), 36.

Schimper, was a line of investigation that persisted with other scientists for the rest of the century albeit without reaching much in the way of conclusions.[137]

One of Hilgard's most significant insights was in classification. His investigations of cryptogams led Hilgard to conclude that the existing classification and nomenclature system for the classifying these organisms was inadequate. Many were being classified poorly because of a lack of understanding of their growth patterns that lead to too many apparently distinct kinds to be given separate names. Unlike Engelmann, he was interested in the higher taxa (family, order, class) and made highly elaborate schemes based on theoretical considerations. At an Academy meeting of 27 July 1857, Hilgard "made some highly interesting remarks upon the subject of Systematic Botany…He maintained that a connected series throughout from the lowest to the highest order might be established."[138] He firmly believed in the continuity of nature.

One month later, in 24 August, he read a short paper on "The Idea of Species" and eventually his proposed paper, *Exposition of a Natural Series by Immediate Catholic Affinities in the Vegetable Kingdom* was published that year in the *Transactions*.[139] His paper defined "the idea of the 'species'," i.e., type of individuals, "is made coordinately to comprise the whole subject once more. A certain character being once conceived as obtained in respect of one group of species, if the same character holds which are closer and those further away." Hilgard presented a pentagram classification based on female components. He managed to "thread the file of Dicotyledons back to its

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137 Peter F. Stevens, *The Development of Biological Systematics: Antoine-Laurent de Jussieu, Nature and the Natural System*.,185.

138 Theodore C. Hilgard, Academy Meeting, July 27, 1857. In *The Transactions of the Academy of Science of St. Louis*, Volume 1 (1856–1860), (George Knapp & Co. 1860), 99.

139 Theodore C. Hilgard, Academy Meeting, October 19, 1857. In *The Transactions of the Academy of Science of St. Louis*, Volume 1 (1856–1860), (George Knapp & Co. 1860), 125.

Monocotyledonous connections" producing an elegant natural series. Hilgard was the first scientist in St. Louis to use detailed descriptions of the anatomy of the cell, he suggested that the "tissue-development in Cryptogamae parallelism with the …development of the sees can be conceived."[140] This was significant leap from just using the gross morphology to create a classification. His remarkable system 5-armed classification shaped like a star was an incredible hypothetical relationship between taxa. It was quite similar to arrangements presented by European scientists at this time, but Hilgard seems to have developed this system quite independently. He gained significant attention for his work on classification systems in Europe.

Hilgard's research was too philosophical and hypothetical for many of the Academies members, who concentrated their efforts on purely on data collection. This was certainly not Engelmann's type of research; his main drive was to aid in completing the *Flora*. It is curious that Engelmann never entertained Hilgard's hypothesis as understanding how to define a species was the main activity of his studies. Stevens stated that major ideas of life and nature, at the heart of what Hilgard was aiming to achieve, had so little obvious effect on the research of those who so laboriously classified plants.[141] Goldstein pointed out that Hilgard's highly theoretical and at times romantic contributions were both mystifying and incomprehensible to members.[142] Hilgard's methodology was based on the German metaphysical philosophy that sought for correspondences between humanity and nature as the most effective tools for

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[140] Theodore C. Hilgard, "Exposition of a Natural Series by Immediate Catholic Affinities in the Vegetable Kingdom," In *The Transactions of the Academy of Science of St. Louis*, Volume 1 (1856–1860), 156.

[141] Peter F. Stevens. *The Development of Biological Systematics: Antoine-Laurent de Jussieu, Nature and the Natural System*. (New York: Columbia University Press. 1994), xxi.

[142] Daniel Goldstein, *Midwestern Naturalists: Academies of Science in the Mississippi Valley, 1850–1900*, (Yale University: Ph.D. Dissertation, 1989), 130.

understating the laws of nature, an approach known as *Naturphilosophie*. Hilgard speculated that plants which are not regarded as distinct species may have shared a common ancestor.[143] There was change or evolution in nature. Hilgard's romanticism is more suggestive of Lamarck's transmutation of species than Darwinian evolution. While it seems that Hilgard may have regressed to an older theoretical frame by retuning to phyllotaxis, in many senses he was trying to grasp at a clear structure that brought cryptograms and flowering plants together. His quinary relation was a natural series, where there were no discontinuities between groups. The discovery of this underlying "thread" was proof of the organization of nature and proof of the "general attainments and intellectual heights" of human progress.

Hilgard represented a younger generation of university-trained scientists trained in some of the newer ideas about botanical and biological science. While his approach was in some ways antiquated, his attempt at a unifying theory followed the European trend in trying to link all species together. It was difficult for the older generation of scientists to understand his approach and methods. Hilgard did not remain long at the Academy, but nevertheless was a very active member. He helped organize the library for the *Humboldt Institut*, a German language European based school system in St. Louis, but poor health shortened his scientific career. In the 1860s, Hilgard joined his brother Julius in Philadelphia, eventually moving to New York where he died 5 March, 1875. During

[143] Hilgard, "Exposition of a Natural Series by Immediate Catholic Affinities in the Vegetable Kingdom," 312-314.

his lifetime he collected over 12,000 plant specimens, of which a few hundred remained in St. Louis.[144]

Engelmann seems to have been influenced by the species concept of this younger scientist. In a rare entry into such theoretical considerations, he added a section "What constitutes a species?" in his *Juncus* Monograph (1866).[145] He presented his ideas, based on the much earlier ones of de Jussieu that species distinctions lie not in "any single organ of the plant, however essential it may be." Species can be defined only by "sufficient and corresponding differences in a series of organs." This was a very practical and useful way of viewing species—one that maintained that correlated characteristics could best be used to define a group. Thus the gross, or outside, morphology was enough to classify into groups. Engelmann remained highly conservative in his approach to systematics, and did not wish to be bogged down in theory, especially Darwinism. It was another British scientist who would shake the Academy and "the most enlightened circles of Christendom….with our ideas of the power and wisdom of the Creator."[146]

Riley Leads the Academy Astray

Charles Valentine Riley (1843–1895) was born in London and travelled to the United States at the age of seventeen. Riley became Missouri State entomologist in 1868, joining the Academy as an associate member 20 April, 1868. Riley was an obsessive and

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[144] George Yatskievych, "A History of Floristic Botany in Missouri," in *Steyermark's Flora of Missouri*, (Jefferson City, Missouri: Missouri Conservation Department with Missouri Botanical Garden Press, 1999), 11.

[145] George Engelmann, *A revision of the North American Species of the Genus Juncus, with a Description of new or imperfectly known Species* (1866), In *The Transactions of the Academy of Science of St. Louis*, Volume II (1861–1868), 456.

[146] James B. Eads, Inaugural Address of the President, 3 January, 1872, In *The Transactions of the Academy of Science of St. Louis*, Volume III (1868–1877), 694.

gifted entomologist; a scientist who "could never forget his work," and "too serious in his address and manners to win many warm and cordial friends."[147] Riley presented his support for Darwin's theory of evolution at many meetings and was consistently met by resistance. When Riley explained mimicry in plants and insects by the mechanism of natural selection, Academy member and businessman, Mr. C.C. Whittelsey responded "that the only way to account for such phenomena was to attribute them to design. There was but one force in the universe, and this is will– human will and design, or Divine will and design."[148] Riley was persistent. In 1875, Riley remarked in a November meeting that the devastation by locusts last spring revealed changes "none were more interesting that the wide-spread appearance of a grass unnoticed in ordinary seasons." Engelmann had informed him that this grass *Vilfa vaginaeflora* [now *Sporobolus vaginiflorus*], an annual, was "common from the Atlantic to the Rocky Mountains." Riley explained that "in ordinary seasons…it is smothered and choked down by other plants. It was a beautiful illustration of what Darwin has called 'the struggle for existence.'"[149] Engelmann agreed it was interesting, but explains it as simply the effect of unusual weather patterns. Judge Nathaniel Holmes vehemently rejected this idea stating "as if a plant could struggle."[150]

On the 6 Feb meeting, Engelmann brought specimens of the weedy mallow plant. Riley inquired of Engelmann "why so many weeds naturalized here but not over in Europe." Engelmann replied "that no theory was necessary, as such as state of things was

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147 John Green, Academy meeting memorial to Charles Valentine Riley, 4 November, 1895. In *The Transactions of the Academy of Science of St. Louis*, Volume VI (1894-1897), 51.

148 C.C. Whittelsey, Academy Meeting, 3 April, 1871, *The Transactions of the Academy of Science of St. Louis*, Volume III (1868-1877), (George Knapp & Co. 1878), 51.

149 Charles Valentine Riley, Academy Meeting, 15 November, 1875, *The Transactions of the Academy of Science of St. Louis*, Volume III (1868-1877), 824.

150 Nathaniel Holmes, Academy Meeting, 15 November, 1875. In *The Transactions of the Academy of Science of St. Louis*, Volume III (1868-1877), 824.

to be explained by the fact that some plants are more vigorous than others." Riley cannot resist explaining this in terms of "the greater competition and struggle for existence that had gone on in Europe under the civilized conditions of man, their species were, many of them, better able to thrive under similar conditions here than our own indigenous species." He "feared such theories would lead us astray." Wislizenus added to the discussion, he "attributed the greater increase of European plants when introduced into this country to the fact they had more room here than in their native soil." These exchanges revealed equally Riley's intention to inject Darwinism into academic discussions and Academy members' basic hostility to such a view. If any theoretician was accepted by the Academy, it was Engelmann's old school friend, Louis Agassiz. The Academy felt he was the most influential man of science. Upon his death, Eads, as President, stated Agassiz "owed much to the favor of Alexander von Humboldt in early life. Side by side Linnaeus, Cuvier, Humboldt, the name of Agassiz is destined to shine. With him has passed away the most potent personal influence in Science since Alexander von Humboldt."[151]

Engelmann's refusal to explore Darwin's ideas reflected the views of a German man educated, primarily as a physician, in the early part of the nineteenth century. Progress in the biological sciences has always depended on the introduction of new ideas, and Darwin's *Origin* was a conceptual powerhouse. Engelmann represented an older generation, one that almost chided the younger generation for spending their energy on these new time-wasting theories. Interestingly, Gray was one of the first supporters of

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[151] James B. Eads, Inaugural Address of the President, 5 January, 1874, In *The Transactions of the Academy of Science of St. Louis*, Volume III (1868–1877), 763.

Darwin in the United States. In the extant letters of his forty year correspondence with Engelmann, Gray mentioned Darwin but once. In a letter of 3 December, 1858, Gray wrote "Darwin asks me to find out if you medical men have ascertained or noticed any difference in liability to take fevers of warm climates –say yellow fever– between light-complexioned and dark-complexioned people of the Caucasians race. If you know personally anything about it– or where anything is published bearing on this point, kindly let me know."[152] [Underlining is Gray's.] Engelmann can offer little information to Gray, he wrote 16 December, "As to your medical question. I can not say much. Yellow fever I know personally only from worst cases carried up here by steamboat."[153] There is one suggestive hint that Riley may have influenced Engelmann's thinking. In his monograph on North American Oaks (1876), he discusses the difficultly in explaining hybrids,[154] noting that they seem to be "crowded out in the struggle for existence." These Darwinian words perhaps stem from Engelmann pondering Riley's logic. Engelmann never got to meet the man who completed Riley's task of bringing Darwinism to St. Louis, Dr. William Trelease, Director of the Missouri Botanical Garden.

The Academy Struggles

Many academy's in the Mid-west struggled with membership and being financially solvent to continue publishing and creating museums and herbaria.[155] The Academy of Science in St. Louis was no different. Throughout the nineteenth century, it desired a patron of science to help keep it afloat. One of the main issues for the Academy

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152 Asa Gray to George Engelmann, 3 December 1858 (GEP-MBGAMC).
153 George Engelmann to Asa Gray, 16 December, 1858 (AGPHUA).
154 A hybrid is the offspring from (genetically) different species.
155 Goldstein, *Midwestern Naturalists: Academies of Science in the Mississippi Valley, 1850-1900*, 143.

was the lack of suitable rooms for research and their collections. Having a central meeting space was paramount for intellectual discourse, and the Academy suffered from the lack of this necessity. Riley, as Academy president, often drew the member's attention to the lack of a permanent building, being "so essential to our prosperity."[156] In April 1857, anxious to enter the established national stage of east coast institutions, extended an invitation to the American Association of Arts and Science to hold it next annual meeting in the City. The Academy had boasted that it was the centre of Western science and the invitation was eventually accepted. In 1878 the Annual meeting was held in St. Louis. The Academy had organized a conference with talks, field trips and informal meet-ups. The lack of a suitable building was the cause of great embarrassment. As crowded into the small rooms at the Polytechnic Institute, they asked "Where is your museum? Where the centre of natural science in the West?" [157] Although the meeting "had a great affect" (notwithstanding the highest temperatures recorded for an August in St. Louis) [158] the Academy members realized the handicap they were working with in not having a building.[159]

One major issue within the Academy which may explain the reason why the Academy did not have a permanent building was that most members who were carrying out original research did not use the museum or herbarium for their research. Members preferred instead to work in the comfort of their own homes or offices with their private collections. Thus, although they genuinely wished to develop these necessary aids for

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[156] Charles Valentine Riley, *Transactions of the Academy of Science of St. Louis*, Volume IV (1886), ccl-ccli.
[157] Goldstein, *Midwestern Naturalists: Academies of Science in the Mississippi Valley, 1850-1900*, 143.
[158] George Engelmann, Annual Presidential Address of the Academy, 6 January, 1879. *Transactions of the Academy of Science of St. Louis*, Volume IV (1886), 880.
[159] *Transactions of the Academy of Science of St. Louis*, Volume IV (1886), xxxiii.

research, there was little incentive for scientists to invest all their time in its development. Matters were not helped when, in 1869, fire swept through the Academy's room at Pope's Medical College in downtown St. Louis. Although most of the library books and publications were saved, nearly all the plant, mineral and animal specimens were destroyed. The loss of such a collection of was considerable and the Academy struggled for years to recover.

By the 1870s, the Academy was in poor shape. Many of the founders had died, by 1870, only Engelmann and Wislizenus were still active. Engelmann commented that the greatest difficulty of the Academy was the lack of a new generation "to take up the work when the pioneers of this Academy will have departed."[160] With the founder's mostly busy physicians, they were unable to mentor potential scientists. At this time, Chicago had surpassed St. Louis to become the largest and most dynamic Mid-West city. Engelmann seemed acutely aware of the fate of the Academy and wished not to be elected to the Presidency. Engelmann (and Wislizenus) knew they needed to allow a younger generation to take over the Academy. At his request, the members elected a new group of officers under a new President, John B. Johnson, M.D. The changing of the older guard for a new generation enabled the Academy to gain new vigor, but it failed to last. The new members brought Darwinism to the Academy which continued to be staunchly rejected. This failure to embrace and encourage the younger generation severely cut the Academy off from progressing academically.

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160 *Transactions of the Academy of Science of St. Louis*, Volume III (1888-1877), xxxviii.

The lack of new scientists in the city meant that there was no inheritance of the scientific tradition. The Academy, (and later on, Missouri Botanical Garden) should have been a natural venue for Engelmann and his fellow members to have met potential mentee's, such as Riley, but the aims of these venues were never realized in his lifetime. Science depends on creativity and new ideas. Most east coast botanical science developed through the pioneering research of one main botanist: Torrey in New York, Gray in Cambridge, and Barton in Philadelphia. Being attached to universities enabled these men to have graduate students. Engelmann's isolation as a full-time physician meant that he was not passing on his taxonomic legacy to graduate students or mentee's. During the 1880s, the Academy of Science in St. Louis became a professional society. When the founding generation died it was replaced by a new generation of professionals from the faculty and students in the growing science program at Washington University. The Academy began to serve as a link to other professionals, and most importantly as a local journal for publications. The botany department at Washington University had been endowed by Henry Shaw, a local British entrepreneur, four years before he died in 1889. Shaw's relationship with botany had begun thirty years earlier with a mere idea for a botanical garden in St. Louis and a letter to Engelmann.

The Mississippian Kew

In 1856, as Engelmann was busy organizing the Academy of Science in St. Louis, Henry Shaw, the retired British businessman wrote to Engelmann requesting his assistance in creating a botanical garden. Engelmann was already aware of whom he was. Engelmann had written to Gray in April 1856 about this "very rich Englishman…and old resident and a bachelor, who concluded to devote his whole time and fortune to the founding of a botanic garden and collection, Kew in miniature, I suppose."[161] Engelmann and Gray were excited about this new botanical venture in the Midwest. At once, they set about forming an alliance to ensure the direction of the Gardens included botanical research. Engelmann needed to persuade Shaw to invest in a museum building for a herbarium and a library.

Shaw was slow in addressing these needs, spending his time and money developing the grounds. Engelmann was aware that he "must be very cautious in approaching him…The herbarium to him is a very secondary thing to the garden."[162] It was difficult for him to deal with Shaw, who was "energetic and businesslike –would that he had more scientific education or taste!" Shaw continued to be busy with the building the infrastructure of Gardens but "does not know enough and is in many things a little narrow-minded."[163] Indeed, Engelmann was annoyed over the pettiness Shaw displayed in naming the grounds, "I suppose in imitation to English parks; he is puzzled about the superscription, which I found was to be Hort. Bot. Missouriensis. I advised him to have it

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161 George Engelmann to Asa Gray, 9 April, 1856 (AGPHUA).
162 George Engelmann to Asa Gray, 30 October, 1858 (AGPHUA).
163 George Engelmann to Asa Gray, 17 October, 1859 (AGPHUA).

in English, Missouri Botanical Garden, as less word illegible – and not to abbreviate the principal words. – You see how trifles occupy him (and us!)."[164]

Shaw did build a museum. Engelmann, however, complained to Gray, "the rooms, one for the library and a second for herbarium, are too small and there is no working room in the whole business if it be not the basement." Although Engelmann was bitter over the herbarium, he ultimately was frustrated with working with Shaw. Whereas Shaw was the ideal patron of science; Engelmann considered himself the wrong man for the task, "I have not yet seen much of Shaw, and am unfortunately not the proper person in address and diplomacy, etc., to work upon him—still I hope for the best; he seems very zealous. Get [William Jackson] Hooker to encourage him!"[165] Engelmann was successful, however, in persuading Shaw to buy the first books for the library and, of great importance, the 60,000 specimens of the recently deceased Johann Jakob Bernhardi herbarium while Engelmann was in Europe. This purchase gave the Garden the largest herbarium in the States at that time, and brought many real treasures for study in St. Louis. Subsequently, the Bernhardi herbarium was augmented by Nicolas Riehl's herbarium collection, of 3,356 specimens.

Gray suggested that perhaps Shaw would buy his specimens and thus employ him "with a decent salary, you could reside up there, throw physic to the dogs, or only take a share in consultations, and have time to do yourself justice in botany."[166] All the while, Engelmann saw limited botanical possibilities for himself. [167] Although living but four miles from the developing Garden, Engelmann had little "leisure to go out" and

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164 George Engelmann to Asa Gray, 28 September, 1858 (AGPHUA).
165 George Engelmann to Asa Gray, 30 October, 1858 (AGPHUA).
166 Asa Gray to George Engelmann, 6 June, 1859 (GEP-MBGAMC).
167 George Engelmann to Asa Gray, 30 December, 1859 (AGPHUA).

investigate its progress.[168] Gray suggested that Engelmann begin to arrange his specimens on the same size paper as used in Shaw's herbarium and look to an eventual combination, either in Shaw's lifetime or subsequently. Engelmann was skeptical over the value Shaw gave his specimens and was reluctant at first to agree to Gray's proposal. When the Garden opened on 16 July 1859, it was an instant success; an impressive ornamental garden in the thriving industrial city of St. Louis. Elizur Wright in the *Boston Commonwealth* remarked "Would that Boston had such a Shaw!"[169]

In late 1860, Shaw finally succumbed to the repeated urgings of Engelmann and Gray and hired Augustus Fendler as curator of the collection.[170] Fendler arranged the Bernhardi collections, but being a man gripped by wanderlust, stayed at the Garden only one year.[171] Shaw was dismissive of the possibility of hiring a new curator. In June 1860, Engelmann wrote again that Shaw was working hard at his project but that he did not see much of him. "We are very good friends but I am afraid we did not hitch well together. Scientific botany is secondary or tertiary with him, while I cannot get up an enthusiasm for what interests him most." At times Engelmann felt he was being too hard on Shaw writing on 1 November 1860 (as the national election of the century was in process), "Shaw has the ornamental as much at heart as the scientific, which I think is very well to popularize his establishment."[172] Engelmann's role in the Gardens lessened as he devoted increasing amounts of time to his own research.

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168 George Engelmann to Asa Gray, 15 April, 1859 (AGPHUA).
169 Quoted in William Barnaby Faherty, *Henry Shaw: his Life and Legacies* ,180.
170 George Engelmann to Charles Christopher Parry, 24 January, 1861 (GEP-MBGAMC).
171 Fender's name no longer appears in Shaw's ledgers after 20 December 1861.
172 George Engelmann to Asa Gray, 1 November, 1860 (GEP-MBGAMC).

Shaw's Garden

The Gardens matured as a beautiful Victorian Garden, but was considered by Engelmann as just a garden. Scientists in St. Louis, those who performed original research, did so independently of both the Academy and Garden. Engelmann had created and maintained his own herbarium and library, and perhaps used the Academy for any resource he did not have at hand. He used the Garden as a place to plant some of the seeds and living plants he received, but did not utilize the herbarium. During this early period, Engelmann and Riley, although they butted heads over Darwinism, began to collaborate on ground-breaking research.

Engelmann's *Yucca* and Riley's Darwinian Moth

Engelmann had amassed quite a complete collection of living plants and herbarium specimens of the species of *Yucca*. He published his *Notes of the Genus Yucca* in 1873. *Yucca* enticed Engelmann because of "difficulty in the characters" and "considerable doubt of the limits of the species." [173] Engelmann had had "his eye on them for years and investigated them in European herbaria." These plants fruited abundantly, unlike in Europe.[174] Engelmann was convinced that this sterility in Europe was due to the lack of pollination, probably connected with the lack of an appropriate pollinator. Engelmann exhibited specimens of *Yucca* at an Academy meeting stating "that

[173] Engelmann, "Notes for the Genus *Yucca*," *Transaction of the Academy of St Louis*, Vol. III, no. 1, 1873, 36.

[174] Engelmann, "Notes for the Genus *Yucca*," 39.

plants of this genus must rely upon insect agency for fertilization." [175] Riley at once took up the study of this subject.

Riley availed himself of Engelmann's herbarium specimens and found remnants of larvae in half eaten seeds. After studying living plants in the Missouri Botanical Garden, Riley published his paper on the *Yucca* moth (*Tegeticula (Pronuba) yuccasella*) in the same volume of *Transactions* as Engelmann's *Notes*. Riley noted that there seems to be a single species of moth that can pollinate this plant. This was significant as he discovered the interdependence of moth and flower. In his publication, he revealed the intricate and almost unbelievable intimate details of the behavior of the moth. Always the Darwinian, Riley stated "the way the male and female mate with this flower as perfect adaptation in the struggle for life." Riley was "indebted" to Engelmann for "drawing [his] attention to the fact that the plants of this genus must rely on some insect or other for fertilization." This interdisciplinary approach was unique and their symbiotic collaboration via Engelmann's herbarium specimens meant that together they were able to produce valuable original research. Their next academic venture rescued the vineyards of France.

Grape-Vines for France

Academy members George Clinton Swallow and Engelmann began to publish descriptions of the grapes of Missouri recognizing and characterizing a dozen species, which became of "no small importance to grape growers, both in this country

[175] Green, Academy meeting, 4 November, 1895, In *The Transactions of the Academy of Science of St. Louis*, Volume VI (1894-1897), 51.

and in Europe."[176] In 1861, Engelmann wrote Gray that he was investigating diseases on local grapes.[177] He used his herbarium specimens from earlier collections in the 1830s and 1840s to determine the pathology of the disease.

During this time, French vineyards were being attacked by an unknown pest. At an Academy meeting in 16 October, 1871, Riley presented an abstract on the native grapevines in the region. He explained how European vines have "so generally failed in the eastern half of the United States" due to being infected by a plant-louse, *Phylloxera*, a gall-producing insect. This was identical to a grape-root insect which was "causing so much alarm in the south of France." Riley deduced that "there is every reason to believe that it was originally taken there from this country, where it is indigenous on our wild vines."[178] Many years earlier, plants collected in the United States and sent to France, for herbaria and French gardens, had brought this infectious insect to Europe.

The French government sent a scientist to St. Louis to consult with Riley and Engelmann, who recommended the crossing of French and American grapes for durability, as the Missouri vines in the wild were resistant to these insects. Riley and Engelmann arranged to have thousands of small shoots and seeds of a species of a wild grape, *Vitis riparia* that grew around St. Louis collected and shipped to France. The American species became the rootstock for the French vines. In 1875, Riley was awarded the French Grand Gold Medal from France for his efforts to save the French wine-industry. This was the first academic study in biological control.

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176 George Swallow, "Grape Culture in Missouri," In *The Transactions of the Academy of Science of St. Louis*, Volume I (1856-1860), 1858, 521.

177 George Engelmann to Asa Gray, 17 August, 1861, (AGPHUA).

178 Charles Valentine Riley, Academy Meeting, 16 October, 1871, In *The Transactions of the Academy of Science of St. Louis*, Volume III (1868-1877), 687.

An American-German Botanist

Engelmann was never a man to wait around when there was botanical work to be done. He continued to work in his own herbarium and became busy as a charter member of the National Academy of Science (NAS) in 1863. The NAS was founded on providing independent and objective advice to the nation on matters related to science. Scientists were elected by their peers to the NAS for their long-term and outstanding contributions to research. In 1874, Engelmann finally got a chance for adventure; he travelled out West to Colorado. Here he studied Rocky Mountain conifers and led him to separate firs, spruces and pines from each other. After living nearly fifty years living in St. Louis and producing a very substantial volume of excellent scientific work, Engelmann died in February 1884. Sadly, Engelmann would never get to see the fruits of his labor with Shaw.

In the 28 years it was open to the public, there was only a semblance of scientific research in the Garden, the one year that Fendler was curator. Curiously, Shaw now in his eighties began to write on the topic of botanical science. In 1880, he wrote a small treatise called "*Gardens and Botanical Gardens*." Shaw defined botany as the branch of natural history that related to the vegetable kingdom, included the naming and classification of plants, their external form, their anatomical structure, their functions, their distribution over the globe, and their uses. Shaw saw seven constituents of a botanic garden including; (1) a systematic arrangement of classified plants (6) a botanical museum; and (7) a library of books on botany and natural history and especially books of

the great masters of natural science.[179] Shaw's small pamphlet is written by a man moving closer to his death. It seems that with the passing of Engelmann he was reminiscing over what the Gardens should have been, but as Director of the Garden, he had not put this mission into action until he passed away.

Kleinman stated that "from the mid-1850s on indicate[d] that the philanthropist [Shaw] had to be groomed to be a prophet."[180] Kleinman presented an in depth analysis of the "three pillars" of the Garden's mission: display, research, and education. He recognized that Shaw was the first and most important member of the lay public and explained how the retelling of Shaw's legacy omits the thirty years where the gardens was just a display garden. In the words of the eccentric essayist-historian, Lytton Strachey (1880–1932), "ignorance is the first requisite of the historian." The author of this thesis believes that Shaw, upon opening the Gardens and receiving such rave reviews, felt he had completed his task. In many senses he wished for nothing more than a Victorian pleasure garden, reflective of his status and his legacy in the city. Much like Chatsworth estate, the seat of the Duke of Devonshire, the Garden was a symbol for his success in the New World. Shaw transitioned from his merchant roots into a distinctly American nobility.

Near the end of his life, he may have realized with a genuine heart that he could implement Engelmann and Gray's scientific wishes. In 1884 when Shaw wrote to Gray for assistance in writing his will he was surprised. Gray wrote to Joseph Dalton Hooker, "Something induced him to ask my advice, and to let me know the very ample fortune

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[179] William Barnaby Faherty, *Henry Shaw: his Life and Legacies*, (Columbia: Missouri University Press, 1987), 297.

[180] Kim Kleinman, *The Museum in the Garden: Research, Display and Education at the Missouri Botanical Garden since 1859*. (Cincinnati, Ohio: Ph.D. dissertation, Union Institute College of Graduate Studies, 1997), 24.

with which he is to endow the garden, when he dies. I was in doubt whether all this was likely to be wasted." Once Gray met with Shaw and saw the reasonable condition of the Garden and stipulations of the will he was convinced that "none of the provisions he has made will hinder the right development of the Mississippian Kew which will hardly be Kew in a corner."[181] Gray recommended Dr. William Trelease, his former graduate student, as director of the projected school, the Henry Shaw School of Botany. Upon his death, his will ensured that the Garden, known as Shaw's Garden when he was alive, would become the botanical institution its name proclaimed.

William Trelease and The Henry Shaw School of Botany

Trelease accepted the position of Engelmann Professor of Botany of the Henry Shaw School of Botany at Washington University in 1885. He was the first generation of American-born and American-university trained botanists in St. Louis. Trelease trained to be a scientist, not a physician like Engelmann and other earlier botanists. Trelease attended Cornell University, receiving a bachelor's degree in Natural History in 1880. Trelease moved to Harvard University and spent one year studying parasitic fungi under Farlow and systematic botany under Gray. Exposed to the newer developments in science, he came under the influence of such eminent entomologists as John H. Comstock and Hermann A. Hagen. His scientific interests at the time were shaped largely by the writings of Charles Darwin and the original research in the pollination of flowers by Herman Mueller. Leaving Harvard, Trelease took up a position as instructor in botany at

[181] Asa Gray, *Letters of Asa Gray*, Volume II., Gray, Jane Loring, (Ed.), (Cambridge: Houghton, Mifflin, and Company, 1894), 793.

the University of Wisconsin, and rose to the rank of professor in four years, obtaining his Ph.D. from Harvard during the same years. In 1884, he completed his doctorate on the *Observations of zoogloea and related forms*, a cryptogrammic bacterium. Trelease was part of a cohort of who took the lead in developing a "new botany." This was a new approach to systematics, the integration of microscopy and ecology into classifying plants.

Trelease was a kind and gentle man, known for his infectious sense of humor.[182] When he arrived at the school, however, he was determined, as Engelmann and Gray had been, to train a new generation of students in both "practical and scientific" matters. On 6 November, 1885, Trelease, at the age of twenty-eight, he gave his inaugural speech at Washington University. He presented a clear vision that, "the new School of Botany is representative of the nineteenth century, the hope of its founder that it may not only advance the science of botany, but prove useful in…practical life…what a wonderful interdependence there is between plants and certain animals, chiefly insects…called Darwinian subjects….they are within the reach of any person with good powers of observation"[183]

In his rousing speech, Trelease looked to Europe and particularly Germany who set "an example of national liberality in the encouragement of education in all its branches, that has not a little to do with the prominent place it holds and is destined to hold in the progress of the world…[T]he advantages of such a system, upon the intelligent and conscientious development of which much largely rest her future…Botany

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[182] J. Christian Bay, *William Trelease, 1857–1945, Personal reminiscences*, (Chicago: Privately printed, 1945), 9.

[183] William Trelease, *Annual Report of the Missouri Botanical Garden*, Volume 1, 1890, 66.

is one of branches of widest applicability in the arts and manufactures." Trelease promoted the need for botanical trained professional who are familiar with "not only the grosser botanical characters of medicinal plants, but their minute structure."[184] He recognized scientists, such as Engelmann, who led the way in botany through the field of medicine.

Trelease taught numerous classes at the University with his fellow instructors: Alfred Spear Hitchcock (detailed from the Garden for partial service); William Townsend Porter, M.D.; and Amand N. Ravold, M.D. Trelease would regularly combine his teaching with field expeditions, going to the Azores, the West Indies, and Madeira. He worked hard to bring the relationship between the University and the Garden close and functional allowing "advanced students…the privilege of consulting, under certain restrictions, the excellent herbarium and library of the Botanical Garden."[185] The School was equipped with a library, herbarium and laboratory. Trelease focused on getting his students on "the solution of some of the many problems that await the investigation of specialists."[186] He introduced microscopy, bacteriology, mycology and the pollination of into the school and to St. Louis city.

The school was extremely very successful. In the first year, forty students took classes, including fourteen medical students in a course in bacteriology. Their first graduate student was Miss A. Isabel Mulford, who focused her Ph.D. dissertation on *Agave*. She gained full access to Engelmann's collections. Mulford opened her dissertation stating that "Engelmann's able paper still remains the only monograph

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[184] Trelease saw, among other goals, the development of a love for nature and plants and certain animals, especially, the human animal.

[185] Trelease, *Annual Report of the Missouri Botanical Garden*, Volume 1, 1890, 99.

[186] Trelease, *Annual Report of the Missouri Botanical Garden*, Volume 1, 1890, 100.

specially devoted to our species, and is still the most complete and best authority concerning them…his manuscript notes and drawings…forms one of the many monuments of his skill and patient industry."

Chapter 5

New Botany in a New Century

Oaks "are so numerous, and authorities have so poorly distinguished them…close microscopically study…[and] so confused by botanists that [Engelmann] had given the matter much study for the purpose of bringing order out of chaos"

15 June, 1874
Academy of Science in St. Louis meeting

Science, at one time, belonged to the few–the learned
15 January, 1877, Academy Annual Presidential Address.
Charles Valentine Riley

When Shaw died in 1889, Trelease was named Director of the Missouri Botanical Gardens. He began his tenure by initiating a strong research and teaching program at the Gardens, expanding into such fields as histology, parasitological, entomology, mycology, medical botany and taxonomy. He quickly and effectively began expanding the library and herbarium. His background was partly in systematics and he knew that the herbarium was deeply important for such studies. He recommended to the board that the Garden hire Albert Spear Hitchcock as First Assistant in the Gardens. Hitchcock, a graduate of Iowa State College, began to publish his original research of trees in the *Transactions.* Trelease managed to send Hitchcock on a natural history cruise of the Caribbean during November and the succeeding months, with the specimens collected going to the Garden. This trip was significant for two reasons. First, it yielded the first plants collecting undertaken by a member of the Garden staff, and second, the first collectors sent to the

field from St. Louis since Engelmann was active in doing so. Trelease sponsored many subsequent expeditions while he was director of the Garden.

In 1890, the Trustees authorized fifteen hundred dollars for the purchase of books –the first book purchase made for the garden Library since 1858. Trelease donated his personal library of five hundred books and three thousand pamphlets to the Garden. Trelease employed Jens Christian Bay to catalogue and organize the library. Bay would not only be instrumental in organizing and indexing the monumental Dr. E. Lewis Sturtevant's collection of early botanical works that had been acquired in 1899 by Sturtevant's will. Bay was to be of great use to English-speaking Americans, as he translated many articles and papers from French, German and Danish.

In 1887, Trelease began editing a series of "Contributions from the Shaw School of Botany" to be published in the *Transactions*. Between 1887 and 1890, six papers were published. He personally still found time to publish. Although a microbiologist by degree, he is remembered for his work in the field of systematic botany. He continued to build on the knowledge of Engelmann's favorite groups and produced a monograph of another difficult group of plants, the willow herbs (*Epilobium*) of North American. It was the first botanical publication from the Garden. He was a prolific writer across numerous biological disciplines.

Although Trelease, in his own lifetime, was an extremely well known and respected systematist, few historians have analyzed his tenure. Indeed, there is no authoritative biography of Trelease. This is curious as Trelease was deeply involved in botanical research becoming President of the Botanical Society of America in 1897, amongst many other scientific societies. Trelease resigned from the directorship in 1912,

because of serious disagreements with the Board of Trustees over the role of scientific activities relative to horticultural activities.[187] When Shaw had written his will he named three scientists as trustees of the Garden: George Engelmann, Asa Gray and Spencer F. Baird (1827–1887) of the Smithsonian Museum in Washington, D.C. All three predeceased Shaw and were not replaced but the board with other scientists. The remaining trustees were business colleagues or friends of Shaw. This unfortunate split has not been analyzed and certainly contributes to the historical inaccuracies presented in the literature on the history of the Missouri Botanical Garden.

A Botanical Legacy

In 1889, when Trelease became Director, the Gardens were in disrepair and there was little to no research.[188] Trelease's decision to focus on research changed the course of the Garden for the twentieth century. In his first ten years of his directorship, he built a herbarium of 340,350 specimens, including several thousand wood specimens. The library which consisted of fewer than 2,000 volumes when Trelease became director grew to 253,747 volumes during the same decade, largely because of an aggressive program of exchanging literature with European institutions that Trelease initiated.[189] Trelease initially published through the *Transactions* and eventually created the *Missouri Botanical Garden Annual Report*.

As the nineteenth century drew to a close, Trelease proved to be the ideal person to implement the Shaw-Engelmann-Gray vision of the Missouri Botanical Garden. They

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[187] In St. Louis, even today, the Gardens is fondly called Shaw's Garden. When Alfred Russel Wallace (1823–1913) visited in April 1887 he called it the "Trelease Botanical Garden."

[188] Trelease, *Annual Report of the Missouri Botanical Garden*, Volume 1, 1890, 91.

[189] William Trelease, *Annual Report of the Missouri Botanical Garden*, 1900, 16.

all could exult in directing what a contemporary magazine called "the finest institution of its kind in the country."[190] Trelease had laid the foundations for the Missouri Botanical Garden to become a world renowned institution. It was Trelease's vision that sealed St. Louis city's fate as a place of botany built on nearly a century of botanical activity. During his tenure as Director from 1889-1912, Trelease continued to develop education, research and public displays at the Gardens. His focus on original research quickly gained an international reputation for the Garden as authoritative botanical institution. Throughout the twentieth century, the tradition of taxonomic and systematic botany continued. Subsequent directors, such as George Moore and Peter Raven, balanced the desires of the Board and the public for a display Garden and the necessity of original research.

A Century of Botany

From Engelmann's discovery that Buffalo grass (*Buchloë dactyloides*) had male and female reproductive parts on separate individuals (dioecious) to Trelease's explanation, illustrated on a blackboard, that the mitotic division of Sarsaparilla (*smilaceas*) cells was similar to animal cells. The cultural and scientific mark that Engelmann left in St. Louis cannot be overemphasized. As historian and biologist, Emmanuel A. Rudolph stated, "Engelmann's importance in the development of

[190] Quoted in William Barnaby Faherty S.J., Henry Shaw His Life and Legacies, (Columbia: University of Missouri Press, 1987), 230.

professional botany in this country is related to his support of western botanical exploration and his establishment of a center for botanical studies in St. Louis."[191] Therefore, the input of this community to the culture of American science should not be shelved behind other broader narratives.

Elizabeth Shaw stated with eloquence that "even the most cursory look at botany in North America during the nineteenth century shows preeminent the triumvirate– Asa Gray, John Torrey and George Engelmann." [192] She recognized that these three men "had the greatest effect upon their adopted field."[193] As the twenty-first century unfolds, Engelmann's legacy continues and the Missouri Botanical Garden is one of the finest botanical institutions in the world. With students and professional scientists from all over the world studying at the gardens, in association with Washington University, the University of Missouri-St. Louis and Saint Louis University, it has become a force in conservation biology and plant systematics. Today the herbarium is one of the worlds most vital and outstanding research resources for specimens and information on plants and mosses. As of 1 January, 2011, the collection contained 6,231,759 specimens and continues to grow.[194] From the amount of attention the St. Louis receives today as a botanical center in the United States, it is surprising that its development in the nineteenth century has been forgotten.

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191 Rudolph, Emmanuel A. "One hundred Years of the Missouri Botanic Gardens." *Annals of the Missouri Botanic Gardens,* 78(1) (1991),13.

192 Elizabeth A. Shaw, "Changing Botany in North America: 1835–1860 The Role of George Engelmann," *Annals of the Missouri Botanical Garden*, Vol. 73, No. 3 (1986), 508.

193 Shaw, "Changing Botany in North American: 1835–1860 The Role of George Engelmann," 508.

194 http://www.mobot.org/MOBOT/Research/herbarium.shtml

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