CHANGING BOTANY IN NORTH AMERICA: 1835–1860 THE ROLE OF GEORGE ENGELMANN[1]

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Although the history of a subject or of a time should treat the parts played both by the "great"—or by the well-known—and by lesser figures, it is generally true that there are some few persons who stand out amongst the others and who give definition to the subject and time.

Even the most cursory look at botany in North America during the nineteenth century shows pre-eminent the triumvirate—Asa Gray, John Torrey, and George Engelmann. There were other outstanding botanists at the middle of the century—one might mention W. S. Sullivant and Edward Tuckerman—but it was Gray, Torrey, and Engelmann who had the greatest effect upon their adopted field. Their combined careers as botanists cover nearly seventy years. During this time, botany in North America developed from the simple collecting of plants and amassing of data with consequent assignment of genera and species into Linnaean pigeonholes, into something like modern botany.

I think, too, that examination of events in any field of science cannot be usefully done unless seen against the background of contemporary political, social, and intellectual realities. It can be done neither for the present nor for what might seem to have been a simpler and less complicated time. In any case, developments in botany in the United States during the middle of the nineteenth century were pulled along by the political events, and I have chosen to consider this time by looking at the relationship of botany to exploration in the American west and at the part played by one man, who was in the proverbial "right place at the right time."

The subject is botany on the American frontier and for the first sixty years of the century, which is nearly equivalent to the whole of American botany. Each of the three had a well-defined role.

Each was originally trained as a physician, but only Engelmann maintained a medical practice. Torrey, the oldest of the three, earned his living by teaching chemistry—at West Point, at Princeton, and at the College of Physicians and Surgeons in New York. Although Torrey had close ties with many correspondents in Europe, he was, *par excellence,* a botanist for North America. He was from the 1820s involved with preparing the botanical reports for government-sponsored expeditions and until after the Civil War plants from such expeditions went to Torrey, who had the overall responsibility for them. He prepared, for example, the final report on the botanical collections made by the Boundary Commission, which operated after the Mexican War. Torrey was much less concerned than were Gray and Engelmann in direct dealings with the private collectors active during the 1840s, but for many years it was he who would have the most direct connection with any official in Washington who might be helpful to botany.

Gray I see as the organizer among the three. From his arrival at Harvard in 1842, he was at the center of botanical activities in the United States and he came to have the greatest breadth of interests. His first trip abroad in 1838–1839 allowed him to make contacts and to open channels of communication that made Gray the internationalist among American scientists—certainly among botanists. For thirty years Gray provided a one-man abstracting service—presenting in the American Journal of Science and Arts, "Silliman's Journal," information about botanical work in Europe—news and reviews and criticism of work current.

Engelmann was the active physician with a busy and demanding practice in St. Louis and would seem to have had the least time free for botany. Engelmann would later prepare finely done treatments of several very difficult groups of plants, but during the 1840s *he* was the man at the frontier. Engelmann had the most direct

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[2] The Gray Herbarium of Harvard University, 22 Divinity Avenue, Cambridge, Massachusetts 02138.

contact with collectors, both those operating privately and those in government employment or under government sponsorship; he gave advice and provided money, often his own, to men who might bring back plants. To him, the frontier was immediately at hand; writing in 1845 to Torrey [the letter quoted in Rodgers (1942)], Engelmann said, "You can have no idea how near we here consider ourselves now to Oregon & California; we mentally travel with those thousands of emigrants, and begin to think the Rocky Mts not much further off than the Alleghanies." And Engelmann could interpret the frontier to the colleagues back east, neither of whom would ever have any direct experience of the west in its frontier stage.

It has been suggested by the historian William Goetzmann (1966) in the introduction to "Exploration and Empire" that: "Exploration can be seen unfolding through major periods each characterized by a dominant set of objectives, particular forms of exploring activity, distinctive types of explorers, and appropriate institutions which governed these other factors."

The first of Goetzmann's periods runs from the expedition of Lewis and Clark (1804–1805) to about 1845; the second, from then to the start of the Civil War in 1861. The third is the time of the great multi-purpose, government-organized surveys after the War; King's Geological and Geographical Exploration of the Fortieth Parallel; Wheeler's Geographical Surveys of the Territories of the United States West of the 100th Meridian; Hayden's United States Geological Survey of the Territories; and Powell's exploration of the Colorado, which opened up the last bit of unknown territory in the continental United States. The "great surveys" were done by the end of the 1870s and exploration in the west was effectively complete. Ten years later the Report for 1890 of the Bureau of the Census declared that the continuous frontier was no more.

It seems, though, that so far as exploration that contributed to botany is concerned, it is more useful to think about four phases. For convenience I shall refer to "botanical exploration," with the understanding that we are dealing with exploration, for whatever proximate purpose, that brought back plants. The first period I shall recognize is Jeffersonian in conception and extends from the end of the Revolution to 1835; and it is not by chance that I've chosen to end this period the year in which George Engelmann settled in St. Louis to start his medical practice.

Although "manifest destiny" as a national slogan dates only from the 1840s, the idea that our national destiny lay in expansion westward to the Pacific, no matter that territories claimed by France, by Spain, and by England lay in the way, goes back at least to the beginning of the nation. For Thomas Jefferson, who combined great national pride with a passionate interest in natural history, the west was an area bound, someday, to become part of the United States, and during his presidency exploration west of the Mississippi was begun.

The second phase is, if the analogy be extended, Grayian in conception and continues from the 1830s through the end in 1848 of the Mexican War and includes the post-Mexican War boundary surveys; these were significant both for their scientific results and for bringing into the field the first concentration of botanical collectors—Charles Wright, John Bigelow, George Thurber, Arthur Schott, and Charles Christopher Parry—each man having other duties, but collecting plants as well.

The third period covers the years of the Pacific railroad surveys, which during the 1850s tied the newly acquired territory to the old United States; this period, for several reasons, ends at the end of the decade. The last phase is Goetzmann's period of "Great Surveys," up to the start of the twentieth century.

The two middle periods, 1835 to 1860, provide the background for the major changes in American botany and for the changes in the way in which exploration was carried out. It is exactly during this time that Engelmann was botanical gatekeeper, advisor, banker, and holder-of-hands for collectors setting out from St. Louis, or acting under his direction. But by the end of the 1850s the direction of Engelmann's botanical activities had changed; he had met Henry Shaw and in 1856 left St. Louis to spend more than a year in Europe visiting herbaria and buying specimens and books for Shaw's botanical garden. And the end of the 1850s marked the end of one phase of western exploration.

I think that a strong case can be made for recognition of 1860 as the time of a major shift in scientific activities in this country, and specifically, in botany. It is the historical divide between botany that was a continuation of a tradition eighteenth century in origin and botany that shows clearly the first signs of growth into its modern form.

There were several forces operating to change

botany in the United States. For twenty years the slow movement of science into the hands of professionals, i.e., people whose livelihood was gained from science, had been going on. The botanist as professional in this country can be dated from the appointment of Gray in 1842 to Harvard. But the event that had the most immediate effect upon botany was the passage by Congress of the Morrill Act of 1862, which founded the system of land-grant colleges that were required to specialize in "agricultural and mechanic arts." These colleges arose quickly after the Civil War, and following the requirement for agricultural arts, gave in their curricula a prominent place to botany. So, a crop of young botanists appeared, who were aware of, and eager to learn and use, new techniques from Europe. Indeed, some of them went to Europe for study and to acquire the degree of doctor of philosophy not then given in this country. When they returned, there were opportunities for them in the new universities, which, in contrast to the older ones, were unencumbered by the inertia of programs already established and sometimes a bit old-fashioned (Pauly, 1984). Quite suddenly botany diversified from collecting and taxonomy into a peacock's tail of possibilities.

The nature of exploration changed, too. During the Civil War little was done except in California, but then came the four great surveys. Although two, King's exploration of the fortieth parallel and Wheeler's surveys west of the 100th meridian, were under army sponsorship, they were civilian-organized and their goal was not mere military reconnaissance but the organized acquisition of scientific information. The parties were accompanied by men who were along, not to be an "assistant computer" as was Charles Wright, or a surgeon/naturalist, as was John Bigelow, but to be scientists. And one should add to this the changes brought by the increase in population, the appearance of foci of settlement in the west—Salt Lake City was founded in 1847 and Denver in 1858—and by railroads. People interested in plants were, more and more, in situ and travel was becoming easier and safer.

THE BOTANICAL FRONTIER IN 1835: PHYSICAL AND INTELLECTUAL

It is tempting to offer up the west of 1835 as a *tabula rasa* upon which its botanical story would be written during the next twenty-five years, but this would be quite wrong.

People's views of the west have been varied; it could be a place to live, a place to exploit, and a place to explore; and this last in two senses, the adventurer's desire to see what lay over the next hill, and the scientist's desire to have in his hands and under the microscope whatever lay over the next hill. The west initially offered seemingly unlimited opportunities for exploration, and for Thomas Jefferson it was a rich mine to disprove the claims then current and popular in Europe that America was a rude and miserable wasteland, degenerate and monstrous, noteworthy only for the poor quality of everything placed here by the creator (see, for example, de Pauw, 1768–1769).

After some unsuccessful attempts to get explorers into and across the west, Jefferson, as President, was able in 1804 to send Merriwether Lewis and William Clark up the Missouri and eventually to the mouth of the Columbia River, and they would bring back the first American-made collections of natural history materials. The plants were not the first from the west—in 1786 Jean-Nicolas Collignon with La Pérouse's expedition had sent back to France seeds of *Abronia umbellata* collected in California. Collignon and his shipmates died in the Solomon Islands, but the *Abronia* flowered in the Jardin des Plantes and was described as a new genus by de Jussieu. And still before 1800 Taddeus Haenke with the Malaspina expedition and Archibald Menzies with Vancouver's expedition had visited the west coast (McKelvey, 1955).

The greatest contributions to the botany of the west were made by Thomas Nuttall, of whom Gray said, ". . . no botanist has visited so large a portion of the United States, or made such an amount of observations in the field and forest. Probably few naturalists have ever excelled him in aptitude for such observations, in quickness of eye, tact in discrimination, and tenacity of memory" (Gray, 1844).

Nuttall as a young man emigrated from Yorkshire to Philadelphia in 1807 or 1808, and over the next twenty-five years wandered across the United States as it then was, and far beyond, protected, it seems, by innocence and a blazing and consuming interest in plants. He made three trips into the west. In 1810 Benjamin Barton of Philadelphia enlisted Nuttall to go to the Great Lakes, then northwest to Winnipeg, and return by the Missouri and Mississippi. Nuttall traveled during 1810 and 1811, part of the time with another Englishman, John Bradbury, whom he

had met in St. Louis, and got as far as Fort Mandan, North Dakota.

The second trip in 1818 and 1819 took Nuttall down the Ohio and up the Arkansas into eastern Oklahoma. In 1822 Nuttall was appointed curator of the botanical garden at Harvard, but after eleven years resigned to join an expedition headed up the Missouri and on to the Columbia. On this trip Nuttall again passed through St. Louis, but Engelmann was not yet settled there. Once on the west coast Nuttall made two trips to Hawaii and became the first "American" to collect in California, returning in 1836 to the east. This was his last trip; in 1842 Nuttall returned to England to take up a bequest that required him to spend most of his time at home (Graustein, 1967).

Indeed, by 1835 a map of areas from which plants were known would point—and this list is far from inclusive—to the following botanically-productive forays.

In 1819 and 1820 Stephen Long's "Yellowstone Expedition," with William Baldwin (who died en route) and then Edwin James, as botanist, did not get to the Yellowstone, but did make a great loop up the Missouri and North Platte rivers into eastern Colorado, and back to Missouri through the Texas panhandle, Oklahoma, and Arkansas. During the 1820s there was also botanical activity on the California coast, visited in 1826/1827 by Collie and Lay with Beechey's expedition; and in the northwest John Scouler and David Douglas (of the fir) collected in Washington and Oregon. By the end of the 1820s Jean Louis Berlandier was working in eastern and southern Texas (see McKelvey, 1955).

A bit later (1830–1832) Douglas was in California, as were Thomas Coulter and Nuttall, while another Thomas, Drummond, was collecting in east Texas. The northwest, still under British control, was visited by English collectors. To the south, plants were being collected in Oklahoma and Arkansas by two army surgeons, Zina Pitcher and Melines Leavenworth. During the 1820s a new kind of visitor to the west appeared—the European explorer, Humboldtean and romantic. The botanist among these was Prince Maximilian zu Weid-Neuweid, who during 1833 traveled up the Missouri to Fort McKenzie in Montana. Maximilian is best known as an ethnographer, and his trip is better known for the beautiful watercolors done by Karl Bodmer, but Maximilian did collect plants that were written up by Nees ab Esenbeck.

So the map shows that by 1835 we knew something of plants of the upper Missouri, of the northwest, of coastal California, and of parts of Texas, Oklahoma, and Arkansas. What the map shows *untouched* is more significant—the great unknowns of the Great Basin and the southern Rockies and of the lands to east and west—from San Antonio westward to San Diego; and the desire to fill in this blank would drive Asa Gray, and through him, American botany for the next fifteen years.

In 1835 anyone who wished to do serious work on American plants would have had to go to England, where so much of the material from the northwest and from California was, and to Geneva where de Candolle was working on the "Prodromus." North American botany was not well-known; but neither was it unknown, for there were several floristic works, some "national" in scope, others regional or local in coverage.

The first "national" flora was André Michaux' "Flora Boreali-Americana" published in France in 1803. Michaux had himself seen much of the United States; he and his son, François André, had traveled and collected in the southeast; and Michaux had made a remarkable trip north to Lake Mistassini in Quebec, at the latitude of the southern end of James Bay. The next was "Flora America septentrionalis" (1814), published in London by Ferdinand Pursh, pirate and plagiarist, who had helped himself to plants collected by Lewis and Clark, to the plants of Nuttall and Bradbury, and to whatever else lay at hand.

Four years later Nuttall's "Genera of North American Plants" was published and it marks a change. It is, for one thing, in English. The floras by Michaux and by Pursh are in Latin, and each uses the Linnaean sexual system of classification, with no indication that anything else is possible. Nuttall's "Genera" is also Linnaean in arrangement, but he notes in the introduction that he much prefers the "natural" system, but only for convenience uses the Linnaean.

The natural system had been first presented in 1815 to the American botanical community when the Abbé Correia da Serra gave a series of lectures on "elementary and philosophical botany" at the Academy of Natural Sciences in Philadelphia. To accompany the lectures, Correia offered a "reduction" of the genera of Muhlenberg's "Catalogus Plantarum Americae septentrionalis" arranged among Jussieu's 100 families. The lectures seem to have had little impact, and Correia was in Philadelphia, not to guide American botany

into the new age, but as ambassador from Portugal. American botanical works stuck with the Linnaean sexual system until 1826 when John Torrey turned to the natural system in publishing on plants collected by Edwin James on the "Yellowstone Expedition"; even he had used the Linnaean system in his "Compendium of the Flora of the Northern and Middle States," which appeared earlier that year.

Use of the natural system by the young man who rapidly was becoming America's most respected botanist marked the intrusion of modernity into a botany that had been developing in an isolated way for several years. During the early years of the nineteenth century there were, in addition to the collectors I've earlier mentioned, many active botanists in the United States—Bigelow and Oakes in New England; Beck, Eddy, Hosack, and Mitchell in New York; Barton, Darlington, Muhlenberg, and von Schweinitz in Pennsylvania; Charles Short in Kentucky; Elliott in South Carolina;—and Rafinesque—are a few. An amazingly long list of them is found in the "Historical Sketch" in Rafinesque's "New Flora and Botany of North America" (1837).

Many of these American botanists were known and respected in Europe, but they were all Linnaeans by training and inclination. By the 1820s botany in Europe was becoming firmly based upon the natural system, laid out by A. L. de Jussieu in "Genera Plantarum" (1789) and built upon by Brown and Ventenant and Jaume St. Hilaire. The principles of a natural system had been lucidly described and explained by A.-P. de Candolle in "Théorie élémentaire de la botanique" (1813, 1819), and were being followed by de Candolle in his "Prodromus," but in this country botany still was Linnaean pigeon-holing and that, too, was the botany being taught.

There had been earlier textbooks of botany in the United States, but from 1817 on, *the* textbook was Amos Eaton's "Manual of Botany for the Northern States" which by 1840 had gone through eight editions. Eaton was an unrepentant Linnaean and for twenty years this hugely popular textbook inculcated the Linnaean system into students of botany. There was, in addition, Almira Hart Lincoln's "Familiar Lectures in Botany," first published in 1829 (see Rudolph, 1984). Mrs. Lincoln (later Mrs. Phelps) was Eaton's protégée and the "Familiar Lectures" included the sexual system toned down for young people.

Mrs. Lincoln, in particular, sounded the trumpet of militant Americanism—". . . although Europe may boast of more brilliant stars than appear in our firmament of letters, shining with greater lustre, contrasted with the darkness and ignorance by which they are surrounded; we may justly feel a national pride in that more general diffusion of intellectual light, which is radiating from every part, and to every part of the American republic" (Lincoln, 1829). This commendable wish to spread learning throughout the republic meant, though, that Eaton and his disciples would continue to use the Linnaean system because they perceived it as being much easier to learn and much less likely to bring about uncertainty and confusion in the tyro botanist.

During the 1820s John Torrey, still a very young man, rose to the top of the botanical heap. Torrey learned his botany directly from Eaton and in his early publications followed the Linnaean system. Torrey had ambitious plans for himself; he had started in 1819 with a catalogue of the plants growing within thirty miles of New York City; in 1824 he published the first volume of "A Flora of the Northern and Middle Sections of the United States," and two years later the "Compendium" of the flora of the same area. But then in writing up James's plants, Torrey turned to the natural system and introduced it into use in America. The second volume of the Flora of 1824 never appeared—perhaps revising it into the natural system was more than Torrey chose to do. But in 1831 he presented an American edition of John Lindley's "Introduction to the Natural System of Botany," and American botany turned away, with some reluctance and with some exceptions, from the Linnaean system.

Torrey's boundaries had been much widened. He had by now set upon doing a "Flora of North America" and in 1833 went to England and to France to visit herbaria and to discuss with William Hooker his "Flora Boreali-Americana," already under way, which would cover the plants of British America. He had, too, a likely co-worker, young Asa Gray from upstate New York, showing great promise. When Torrey returned from Europe, he was prepared to go forward with his most comprehensive work in botany, the "Flora of North America," but in 1835 the State of New York resolved to organize a survey of natural history of the state and Torrey was placed in charge of the botany. He was, though, reluctant to leave the "Flora" and suggested to Gray that he begin work on some families. After initial reluctance Gray agreed and the first two parts of

the Flora were published in 1838. It was reviewed by William Darlington, physician-botanist of West Chester, Pennsylvania. Darlington had been converted to the natural system, and pointed out that, "The authors of the Flora have, of course, adopted the *natural system* as being the only one consistent with a truly scientific arrangement . . ." (Darlington, 1838).

The natural system, the modern botany of the time, was at last in place in the United States. A textbook, Gray's "Elements of Botany" (1836), following the natural system, rather than presenting it as something too complicated to learn, was available for use and would soon displace Eaton in the colleges. And an American-produced flora using the natural system was at hand.

A few years before, Torrey in Lindley (1831) had written, "The catalogue which I have prepared, embraces a considerable number of genera and species which are not described in the latest general Floras, but it is by no means asserted to be complete. There are extensive districts in North America which have never been visited by a Botanist, and even in the United States there are large spaces which are but little known or very imperfectly explored."

American botany was now ready to tackle the last major problems of the west.

George Engelmann

Although each of the three was trained as a physician, only Engelmann devoted his professional life to the practice of medicine; and this makes the more amazing the quantity of botanical work he accomplished. He was far from being a home-grown doctor who had done the botany then required in medical curricula and had retained some interest in plants. There were in the 1830s dozens of such people in this country and some interest in plants was almost de rigueur for medical men. Engelmann came to this country with a background that would have allowed him to step directly into the very top level of botanical activity—had it worked out that way. It is ironic, but quite appropriate, that it was Engelmann, coming with his sophisticated intellectual background out of the political ferment in post-Napoleonic Europe, who settled on the frontier.

He was born in 1809 at Frankfurt-am-Main, the oldest in a family of thirteen children whose parents were in the rather progressive profession of running a school for young women. The family school came on hard times and was given up in 1825 or 1826, but young Engelmann received from the congregation of the family church a scholarship that allowed him to enter in 1827 the university at Heidelberg. He was already attracted by botany for he noted in a short autobiographical sketch written in 1880 for his son that, ". . . I then began in my fifteenth year to become greatly interested in the study of plants" (Engelmann typescript at MO).

At Heidelberg he met Alexander Braun and Karl Schimper and these were men with whom he maintained life-long connections. He seems, however, to have become involved with student activists, pushing for a unified Germany, and after only one year at Heidelberg, he moved to the university at Berlin for two years, and then on to Würzburg where he graduated in 1831. The medical degree required presentation of an inaugural dissertation and Engelmann's thesis, "De Antholysi Prodromus," was a remarkable production for a young student of medicine. Engelmann was interested in morphology and the thesis deals with some teratological phenomena in plants; the word "antholysis" he explains as referring to the breakdown of—or loosening of controls over—normal developmental pathways in flowers.

After receiving the degree in medicine Engelmann went to Paris in 1832 where, as he said, ". . . in place of medical studies I found only the cholera. Still Braun, Agassiz, Constadt, and other friends were there and we led a glorious life in scientific union" (Engelmann typescript). A few years earlier some of Engelmann's cousins had been lured to settle in Belleville, Illinois, by the enthusiastic reports of a fertile midwest in Gottfried Duden's "Report of a Journey to the Western States of North America"; and the family decided that young Englemann should be sent to the new country to investigate possibilities for investment. The prospects for adventure and the opportunity to look at plants of a whole new world must have been appealing to young Engelmann.

Engelmann arrived in 1833 at Belleville and stayed in that area until the spring of 1835 when, restless, he set out through the then southwest, traveling in Missouri, Arkansas, and Louisiana, returning to St. Louis where he opened his medical practice in November 1835. Clearly this was an attractive setting for Engelmann, a small German community already established and St. Louis already recognized as the "gateway" to everything that lay beyond. So at 26, Engelmann with

the best formal training in botany—no doubt of that—on this side of the Atlantic, grounded in the modern botany of the time and with an established network of correspondents, was settled in St. Louis. Even though occupied with seeing his practice established, Engelmann continued to collect and made a point of sending plants to his correspondents in Europe.

For the rest of his life Engelmann carried on a medical practice that became so successful that by 1856 he could leave it for two years of study and travel in Europe. The medical practice, although less intensive in later years, is always there and must be regarded as background to his botany. Years later Asa Gray wrote, "They [Engelmann's publications] are the more remarkable as being the result of studies and labors aside from the preoccupations and toils of a well-filled professional life, the fruit of which would naturally have been devoted to recreation and needful rest" (Trelease & Gray, 1887). The words are those of the elderly Gray being a bit ponderous, but the point is made.

It was inevitable that Engelmann, by the twin virtues of his botanical talent and his location on the frontier, soon would joint the Torrey-Gray partnership. By 1836 Gray had become an equal partner with Torrey in preparation of the Flora of North America. Two years later came the opportunity for Gray to visit England and the continent. Gray had been appointed professor of botany at the new University of Michigan and his first commission was to buy books and scientific equipment for the university. This he did, but his own interests lay in seeking out botanists and their herbaria.

So much of the available material of American plants lay, unseen by American botanists, in European herbaria. Gray had two goals; he would get a firm grip upon this mass of botanical information that had to be mastered for the Flora, and he would open lines of botanical communication between the two sides of the Atlantic (see Dupree, 1959: 74). His first botanical call was upon William Hooker in Glasgow; here he saw a richness of plants from Canada and from the northwest and became fully aware of the great blank on the botanical map. To fill it in would be a goal for the next ten years. And Gray "met" in Europe his future friend and partner; he spent nearly a month working in the herbarium at Berlin and here he saw plants from the American midwest, collected by a Dr. Engelmann of St. Louis (Gray, 1840).

When Gray returned he was effectively unemployed for the University of Michigan was having financial problems, and the regents asked him to serve without benefit of salary, but in April of 1842 Gray was appointed Fisher Professor of Natural History at Harvard, with responsibility for the botanical garden and the promise of some freedom for research. The Flora of North America was not yet finished—it still isn't—and it would always be a weight hanging over Gray, who saw completion of the Flora as a distant goal to be reached. However, there were always other attractions, responsibilities, and opportunities not to be missed. And the partnership now was ready to go ahead.

Engelmann, Gray, and Torrey met for the first time in New York in 1840 when Engelmann was returning from Germany where he had been married. The meeting seems to have been a success; soon after Engelmann returned to St. Louis, Gray asked (12/X/1840) if it would be acceptable to name as *Engelmannia* a genus of Compositae.

Of course, there never was any kind of formal agreement among the three, but over the next thirty years there was a loose working relationship that functioned effectively. Each man had in it his place; my concern here is to examine the part played by George Engelmann during the years 1840 to 1860.

It was clear that the west already was changing. In 1839 Frederick Wislizenus, Engelmann's good friend and fellow physician of St. Louis, traveled with a fur-trading party into the Rockies and reported, "It is perhaps only a few years until the plow upturns the virgin soil, which is now touched only by the light-footed Indian or the hoof of wild animals. Every decade will change the character of the country materially, and in a hundred years perhaps the present narratives of mountain life may sound like fairy tales" (Wislizenus, 1912). George Catlin, active in the west during the 1830s, had seen with his painter's eye even more—". . . the grand and irresistible march of civilization . . . this splendid juggernaut rolling on and beheld its sweeping desolation" (quoted in McCracken, 1959).

However the changes came about, new opportunities to seize the plants of the west would develop. From 1840 onwards there was a real effort made by the three to be aware of what was happening in terms of travel in the west and to see which of the travellers might be induced to collect plants. Sometimes plants arrived almost without notice. In November of 1842 Torrey wrote to Gray that he had received a letter from "a Lt. Fremont in the U. S. service" who was

sending a box of plants from the Rocky Mountains (18/XI/1842). Torrey sent the Compositae to Gray who liked them well enough and wrote back to Torrey, ". . . Lieut. F. must be *indoctrinated* & taught to collect both dried spec. & seeds. Tell him he shall be *immortalized* by having the 999th Senecio called S. Fremonti . . ." (5/XII/1842). Such immortality was a carrot that could always be dangled before a collector.

Engelmann's immediate "job" was to keep open an eye for likely collectors on the spot—whether rich Englishmen shooting buffalo, young Germans eager to see the west, adventurers, or members of military parties. He was to watch for people; he should persuade them that collecting of plants was a good thing and might even bring a little fame—perhaps a *Senecio* named after one; and Engelmann was to show and tell the recruits how collecting was best done. So in the spring of 1841 Gray wrote to Engelmann, "You see you may be of much use to us. Meanwhile you will give me pleasure if you will tell me how I may serve you" (17/IV/1841).

Engelmann was eager, too, to make his own contributions to botany and soon became involved with *Cuscuta,* first in a long line of difficult groups that Engelmann would study over the next forty years. His interest in such groups seems to be the intellectual continuation of his early work on morphology. Current works on botany recognized in the United States only the Linnaean *Cuscuta americana,* but just in the vicinity of St. Louis Engelmann had observed several species. His first botanical publication in this country was "A Monography of the North American Cuscutineae" (1842) followed the next year by some additions and corrections. Engelmann would always be interested in these plants, although by 1849 he was writing to Asa Gray that the time had come to ". . . go at *Cuscuta* and not cease until I finish them. The thought of them is like an incubus to me—and I am almost astonished that I have not yet dreamed of a *Cuscuta* coiling itself about my limbs, etc., etc." (26/X/1849).

The system for encouraging collectors in the west went into full swing during 1843. Engelmann saw that it was necessary for a private collector to be self-supporting by his collecting and suggested to Gray that sets of plants from two such men could be offered for sale (18/I/1843). Engelmann would guarantee the quality of the specimens, which would be only of the rarest plants, and would, therefore, have to sell at eight to ten dollars per hundred. The collectors were Ferdinand Lindheimer who was farming, but not too successfully, in Texas and Karl Geyer. Geyer had been collecting in Illinois and in Missouri and now was preparing to set out for the "western and northern country." If Gray liked the plan he should place an advertisement in Silliman's Journal. Gray did like it and in the April–June number of Silliman's it was advertised that three botanists (the third was Friederich Lüders) were preparing to explore "the most interesting parts of the *far West* . . . ."

Both Lüders and Geyer would disappoint Engelmann and Gray, but Lindheimer was the most productive of the collectors active during the 1840s; dealing with his plants occupied countless hours of Engelmann's time and he wrote dozens, quite literally, of pages of descriptions and notes about the collections for Gray.

Gray was not always an easy colleague—he was impatient—he drove himself unceasingly—and he wanted more and more from the men in the field. Then, too, Gray did have field experience, but not in the west, and for Gray, comfortable on Garden Street in Cambridge, it sometimes was difficult to understand the realities of collecting on the very edge of civilization. Engelmann had to deal with Gray's demands and he simply coped with Gray's impatience by being patient with it. Occasionally there comes a hint of asperity. Writing about Lindheimer's plants, Engelmann pointed out to Gray, "Perhaps they ought to be more pressed. But in travelling and in putting up plants in a cart it is not easy to obtain the neatness required by a closet botanist. The specimens are at least as complete as possible . . ." (13/V/1845).

There was, too, competition—not here, but in Europe. During 1846 Lindheimer had a visitor, Ferdinand Roemer, from Germany, with whom he collected. 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 and indifferent botanist, who described the new species, one hundred and thirty-nine of them, in a series of papers in Linnaea. Engelmann was angry and scornful; "And how characteristic for those persons, who seek notoriety and name with their 'mihi'—'Linum berlandieri mihi' [mihi = Scheele] and others" (Engelmann to Gray, 13/V/1849). Each article in Linnaea struck a nerve in Engelmann; he really was not interested in priority, but he *did* believe that, so far as practicable, new plants should be described in the country where discovered. On

15 February 1850, he wrote to Gray, "I think we should classify the new ones [of Lindheimer's plants] at once, so as to prevent any 'Scheeleing.'"

Englemann had become truly an American; when Gray returned from his 1850/1851 trip to Europe, Engelmann welcomed him back to "our side of the big pond" (18/IX/1851). This loyality to the adopted country made the more objectionable actions such as those of Scheele, and Engelmann reacted with annoyance to unreasonable demands made by European botanists for American plants for study. In the same letter urging action to forestall Scheele, Engelmann noted that he had earlier ". . . forgot to mention that Dr. C. H. Schultz 'Bip.' as he calls himself . . ." wished the Compositae for study; "From his letters he must be a vain and presumptuous person . . . ." Gray replied that Schultz Bip. had done good work, but Engelmann replied back, that although that might be, ". . . he is, I believe a vain and not very scientific man . . ." (17/III/1850).

In light of this it is surprising that Engelmann seems not to have complained, at least not to Gray, about Gray's inability to publish beyond the Compositae. This was Gray's favorite family, so his treatment of some collector's material always would be complete through the Compositae. But in the Candollean sequence which Gray used, the Compositae fall early among the sympetalous families, so that most of the sympetalous groups, all of the monocotyledons, and the gymnosperms, would not be written up. Gray and the others did indeed publish on many of the new things in these groups, but the unpublished families still were ripe for plucking by anyone who had access to the widely distributed sets of plants.

Lindheimer was a pleasing success as a collector—but only in Texas—and Gray yearned for the unknown plants of the southern Rockies and the Great Basin. As early as 1843 Gray had suggested that Lindheimer should be sent part way up the Oregon Trail then to work his way southward, but Engelmann gently explained that Lindheimer's home base was Texas. Gray then wanted Lindheimer to move farther westward into Texas and, perhaps, even to Santa Fe; into territory, ". . . where I trust many of his plants will have no Latin names until we christen them" (Gray to Engelmann, 3/II/1845). Lindheimer stayed in east Texas and even married; Gray fumed, "Send me the new Lindheimer plants as soon as you get them and *stir him up*. Can't you send a collector to Santa Fe?" (Gray to Engelmann, 27/II/1846).

However, within a few months' time, the second great success as a collector would be in the field. War with Mexico was declared in May 1846, and Gray saw at last an opportunity to send a collector to Santa Fe with the army. For a moment Gray might have considered going himself, but Engelmann was commissioned to find in St. Louis a collector. He found Augustus Fendler who received free passage with the army and Engelmann saw this as a good sign for science in the United States (Shaw, 1982). Engelmann was always a republican, but he doubted whether a republican form of government was best suited for the promotion of science.

Fendler spent several months in Santa Fe and returned with beautiful material that pleased Gray very much. But Engelmann again had to devote hours of the time left from his medical practice, to work with Fendler in arranging the sets for sale, and to deal with Fendler himself.

The Texan plants from Lindheimer were described by Engelmann and Gray as "Plantae Lindheimerianae," the first part published in 1845 and the second in 1850. The third part would not appear until 1907 (Blankinship, 1907). The amount of work done by Engelmann on Lindheimer's material truly is amazing—during the middle years of the 1840s he sent to Gray dozens of closely written pages of descriptions and of notes on the plants. There was, in addition, the labor involved in sorting out the material into sets and then the worst, perhaps, of all, acting as banker.

One goal, after all, was to sell or exchange sets of plants in the hope that the collector could be nearly self-sufficient. Gray in the east served as "distributor" of the sets and dunned the purchasers for payment. So Gray to Engelmann in December 1849, "I have written a *very strong* letter to Brown [Robert Brown] (who was in Ireland at last accounts) to send on the cash for Fendler—I think he can neglect no longer—but he is a slow and indolent old sinner." The monies eventually received would then go to Engelmann who saw that they reached Lindheimer or Fendler, but often Fendler would be living on what Engelmann could afford from his own pocket.

Lindheimer and Fendler were the collectors

who occupied most of Engelmann's free time during the 1840s, but he was also involved with Josiah Gregg, Fremont, Gordon, and collectors of lesser significance. At times Engelmann despaired of doing all that he wished; he wrote to Gray, "How often have I thought as you, if I could only multiply myself to do all that I have before me—how often cursed those numberless fellows, who do not know how to kill their time—which would be so eminently valuable to others!" (11/II/1847).

Fortunately, after Lindheimer and Fendler, collectors and their plants made fewer demands upon Engelmann's time—times, in fact, were changing. From the mid years of the 1840s collecting in the west turned from the hands of private individuals, such as Lindheimer and Fendler, to those of government-sponsored collectors and of military men. In 1846 Major William Emory made a reconnaissance from Fort Leavenworth to San Diego, and although Engelmann helped with botanical preparations, the plants went to Torrey and Gray. Charles Wright collected in Texas during the 1840s and then went with the post-Mexican War Boundary Commission, but his botanical contact was Asa Gray and the overall botany of the Boundary Survey was finally prepared by John Torrey. During the 1850s collecting in the west was done by the parties carrying out the railroad surveys and, again, those plants went to Torrey.

Torrey and Gray saw that Engelmann's botanical abilities were being wasted by the drudgery of sorting out plants and writing lists and wrapping parcels; and Torrey in particular urged Engelmann to concentrate upon some genus or few genera that he might prepare for the Flora of North America. No matter how much time was taken by the flood of material from the west the unfinished Flora still made its own demands. In 1850 Engelmann remarked to Gray, "I am glad to see that both your northern flora and textbook are in our bookstores and are bought—But you forget the flora of N. America!!" (16/IV/1850).

A group that appealed to Engelmann, with his keen eye for the interesting and the difficult, was the cacti now coming in great numbers from the west. From 1846 he published on the cacti of every collector and expedition and by 1856 Engelmann had prepared a "Synopsis of the Cactaceae of the Territory of the United States and Adjacent Regions," in which he recognized 117 species where only a few years before "scarce half a dozen had been known." The cacti were the best group Engelmann could have chosen—he was close to the field, so that plants, including living ones that could be grown in the family garden, could be sent directly to St. Louis. And Engelmann knew where problems lay; "The study of the Cactaceae has been too much in the hands of gardeners and amateurs" (Engelmann to Gray, 13/IV/1855).

The 1840s were an exhausting time for Engelmann with botany piled upon his medical practice, especially when cholera swept through the city. During the winter of 1848/1849 and into the autumn of 1849 the epidemic of cholera was especially severe. In May Engelmann told Gray that, "We are in a state of war here; day and night on our legs—fighting the great destroyer, the cholera—of course no room for anything else, not even for sleeping or eating comfortably—like soldiers before the enemy. I like the excitement which it is for me" (12/V/1849). Yet the very next day, he wrote again to Gray, filled with annoyance about the shoddy work of Pastor Scheele on the plants of Roemer and Lindheimer.

Eventually, though, the strain showed. In the summer of 1851 Engelmann took off from medicine for a few days to attend the AAAS meetings in Cincinnati; and as he told Gray (29/VII/1851) it was, after eleven years of "slavery" in St. Louis, a marvelous break—making new friends and meeting again old ones—Louis Agassiz, for one—nearly twenty years after the summer of 1832 in Paris. Gray was concerned and asked when Engelmann could retire from medicine—for the greater good of botany.

The reply was, of course, that his patients needed him, but Engelmann had started to think about change. When the railroad survey parties were set up in 1853 he considered seeking an appointment with one, but decided against it. "I should probably prefer to be independent" (Engelmann to Gray, 4/VI/1853). The thought lingered though, and a year later Engelmann "half thought" about going with Major Emory to Sonora, but he had heard about it too late; he told Gray though that, "I must have some relaxation and reanimation after a steady medical practice for 14 years" (Engelmann to Gray, 18/IX/1854).

Fortunately the change was not far away. In May of 1856 Engelmann mentioned to Gray that he had met Henry Shaw. Shaw, intending to found a garden in St. Louis, had asked Sir William Hooker to recommend someone who might

organize the garden and Hooker replied that the very best man was right at hand in St. Louis. Engelmann had already planned a visit to the east and on to Europe and in November 1856 the family sailed. During the fifteen months abroad, Engelmann bought books and the Bernhardi herbarium for Shaw's garden and studied *Cuscuta* and cacti, so that in 1859, *Cuscuta* was at last laid to rest with a "Systematic arrangement of the species of the genus Cuscuta, with critical remarks on old species and descriptions of new ones."

Engelmann practiced medicine to the end of his life, but after the trip of 1856–1858 at a more leisured pace. Exploration, too, had changed very much, and Engelmann no longer had to deal with the privately operating collectors. The consequence was that during his last twenty-five years Engelmann was able to carry on with the kind of carefully done and detailed work begun with *Cuscuta* and the cacti, and even to travel with the chance to see his plants in the field. Again, this list is not inclusive, but after 1860 Engelmann was able to produce major works on *Vitis,* on which he would publish nearly to the end; on *Yucca* and *Agave,* on *Isoetes,* on *Euphorbiaceae* and *Asclepidaceae,* and, most elegantly done, treatments of *Quercus* and of conifers. He could also produce, to the tune of forty pages' length, "A Revision of the North American Species of the Genus *Juncus* with a Description of New or Imperfectly known Species." The paper opens with one of the longer, but most appealing sentences in any systematic work, and one which tells much about the man.

> The difficulty I found in arranging the species of *Juncus* of my own herbarium, the doubts in which the authors left me by incomplete and unsatisfactory descriptions, and by confusion in names and synonyms, the want of confidence which all my correspondents, even such as had paid a good deal of close attention to it, seemed to place in themselves and their own judgement when this genus was under dicussion—all this induced me to enter upon a critical study of our *Junci.*

Engelmann tended to be a splitter—often Gray would chide him for splitting, while admitting that he, Gray, tended to lump, but Engelmann never just poured out new species. And conspicuous in his monographs and revisions is a careful effort to array the species in some pattern of relationships. Certainly he was not always successful, but Engelmann sought always to present a finished product. The kind of work that Engelmann did is impressive, and the happy combination of quality and quantity of his work is amazing. After Engelmann's death, Henry Shaw asked Gray and William Trelease, then director of the Garden, to prepare a collection of his botanical publications (Trelease & Gray, 1887). The collection, which is not quite complete, produced a book three inches thick.

Engelmann arrived just as the frontier was moving beyond St. Louis, and he spent only a few more than ten years being directly involved in the "processing" of plants coming from Lindheimer and Fendler. His contributions, though, during the 1840s toward making the west botanically known were substantial, and he was the perfect frontier collaborator for Gray—patient, willing to spend the hours needed for turning bundles of plants into specimens for an herbarium and then into publications; and a very good botanist. Valuable as was this work, though, his contributions to American botany through his monographic and revisional publications are still more important—these set for young systematists a standard of American-produced taxonomic excellence.

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