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ORIGINAL RESEARCH

Subscribing to Specimens, Cataloging Subscribed Specimens, and Assembling the First Phytogeographical Survey in the United States

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Abstract

Throughout the late 1840s and the early 1850s, Harvard botanist Asa Gray (1810–1888) and his close friend George Engelmann (1809–1884) of St. Louis engaged themselves with recruiting men who sought to make a living by natural history collecting, sending these men into the field, searching for institutions and individuals who would subscribe to incoming collections, compiling catalogs, and collecting subscription fees. Although several botanists have noted Gray and Engelmann's bold experiment as having introduced America to a mode by which European naturalists had devised to organize scientific expeditions, historians of science have not taken the "subscription mode" seriously. I argue that it was specifically by undertaking the labor of cataloging species and charging subscription fees for the cataloged species that Gray established himself as a metropolitan botanist. One crucial consequence of Gray's rising profile was that he acquired sufficient "cataloging power" to secure his status as an authoritative cataloger of species, and as a kind of "mint" or "storehouse" (McOuat in Br J Hist Sci 34(1):1–28, 2001a) who produced well-pruned lists of American species to enable transactions between American and European botanists. But this essay is not focused on the Europeanization of American taxonomy. Drawing on work by scholars who place emphasis on how new forms of knowledge get produced when knowledge travels, my focus here is the evolution of the subscription mode when Gray and Engelmann adapted it to American natural history. My conclusion examines what historian of science Vanessa Heggie (Isis 105(2):318–334, 2014) identifies as the "danger of category dominance" in today's historiography of science and shows how a kind of "assemblage thinking" may help historians cope with this danger.

Keywords Botany · Biogeography · Asa Gray · George Engelmann · Subscription · Scientific Survey · Assemblage

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Introduction

In July 1842, 32-year-old Harvard professor Asa Gray (1810–1888) wrote to his close correspondent George Engelmann (1809–1884), a German immigrant and physician residing in St. Louis:

> Allow me therefore to say that yourself and your friend Lindheimer in Texas would render me, and also the cause of Botany in this country, the greatest aid (which I will take every opportunity of publicly acknowledging), if you will send me roots or seeds of any western plants, especially the rarer, and those not yet figured or cultivated abroad….[1]

Engelmann replied that Ferdinand Lindheimer (1801–1879) had recently contrived to render botanical collecting into a way of making a living. Gray was delighted.[2] He soon published short notices in *The American Journal of Science and Arts* and *The London Journal of Botany*, respectively, introducing the name of Lindheimer to the world of botany. "Dr. Lindheimer" was an "enterprising botanist," Gray wrote, who had decided to "devote a few years to the exploration of Texas," and his "collections of dried plants" would be offered to subscribers "at eight dollars (or £1,13s. 6d. sterling) per hundred [specimens]." Gray highly recommended that those who were interested in Texan botany apply to join Lindheimer's subscription list and promised that he himself would author a catalog of Lindheimer's collections for subscribers' reference (Gray 1843, p. 226). Soon afterward, also through Engelmann's introduction, Gray recruited another talented young man named Augustus Fendler (1813–1883) and sent him to collect in New Mexico with arrangements similar to those he had made for Lindheimer. Over the following decade, with the support of some 20 subscribers, the two collectors amassed a vast number of specimens, and Engelmann and Gray took responsibility for enumerating species, producing catalogs, grouping specimens into sets, distributing them to subscribers, and finally collecting subscription fees. Although it represents one of the boldest and most delicately conducted projects in history to contemporary botanists, the Gray–Engelmann–Lindheimer–Fendler collaboration was forgotten for the next century or so. It wasn't until the 1980s that several botanists began analyzing the specimens and catalogs that Gray and Engelmann produced and distributed among subscribers according to today's taxonomic standards. Thanks to their efforts, it is now clear that what these four men achieved was probably the first systematically conducted phytogeographical study of the American frontier in the history of American botany (Blankinship 1907; Goyne 1991; Reveal 2010; Shaw 1982, 1987; Soule 1970; Stieber and Lange 1986).

This essay aims to extend this line of inquiry by asking the following questions: How did the practices of subscribing to specimens and making a catalog of the

[1] Gray to Engelmann, July 26, 1842, Asa Gray (1810–1888) Papers, Archives of the Gray Herbarium, Harvard University (hereafter cited as ***AGPG***).

[2] Engelmann to Gray, January 18, 1843, Historic Letters, Archives of the Gray Herbarium, Harvard University (hereafter cited as ***HL***); Gray to Engelmann, February 13, 1843, *AGPG*.

subscribed specimens actually work in natural history? What was the role played by the "subscription mode" in associating botanists with collectors that thus made a systematic study of nature possible? How did Gray define his relationship with collectors and subscribers? Would he have considered the collectors to be "commercial" rather than scientific, given that they received money from subscribers to pursue their own entrepreneurial interests? Would Gray have regarded himself and those who joined the subscription mode in his charge as members of a gentlemanly scientific community who conducted a gift exchange of specimens between themselves? I put forth these questions for several reasons. The first is biographical. To be sure, although Gray is by no means unknown to today's historiography of science, our knowledge of this American botanist is largely confined to his role as a gatekeeper and interpreter for Charles Darwin's (1809–1882) evolutionary theory (Browne 2002, chs. 3–4, 2010; Desmond and Moore 2009, ch. 9; Dupree 1959, ch. 15; Irmscher 2013, ch. 4; Lurie 1988, chs. 7–8; Pauly 2000, ch. 1). This manner of defining Gray's life and career, as compared to a growing body of literature that uses "the life of the scientist as a scientific unit" (Porter 2006; see, for example, Bellon 2001, 2006; Browne 2002; Desmond and Moore 2009; Endersby 2008, 2011; Golinski 2016; Kohler 2008), suggests that our approach to Gray as an American botanist needs to be updated. This essay will show that Gray's implementation of the subscription mode before he became "a friend of Darwin" (Dupree 1959) has much to say about the history of American botany, particularly at a time when its practitioners were struggling to find their own niche in the face of their European colleagues' escalating authority in the realms of nomenclature and taxonomy.

Regarding how a nineteenth-century naturalist established his authority, the quintessential literature is Gordon McOuat's series of influential essays on "cataloging power" (1996, 2001a, b, 2009). After examining the copious notes left by John Edward Gray (1800–1875), a zoological curator at the British Museum, McOuat argues that J. E. Gray developed a "cynical" strategy for tackling the increasingly vexing "species problem" of the 1840s. In the face of the proliferation of "natural" systems, McOuat argues that J. E. Gray quietly and steadily revolutionized the way in which the British Museum cataloged its collections. In McOuat's words, J. E. Gray's revolution embraced two principles: First, "Species, not specimen, would form the fundamental currency of intercourse between naturalists"; second, "the British Museum had to be so constructed as to be the mint, the storehouse, for that currency" (2001a, p. 23; see also Bellon 2006; Endersby 2008).

If we place McOuat's arguments and Gray's notice from 1843 side by side, it is not difficult to see that Gray introduced the subscription mode from Europe in order to generate, consolidate, and exert his cataloging power over the taxonomy and nomenclature of the North American flora. Furthermore, as Philip J. Pauly observes, Gray was among American naturalists who, under the influences of scientific nationalism, sought to secure the priority of naming and describing species that were American (2000, pp. 25–33). But how could Gray have done so? After all, the Gray of the early 1840 s was a man of science located at an educational institution with no reputation in natural history and a professor with limited income and no research funding. His status in science was nothing compared to Gray's. In other words, while McOuat's analysis refreshes our understanding of an important epoch

in the history of taxonomy from the viewpoints of those who were settled comfortably at the center of the scientific community, this essay examines the same epoch from the viewpoints of those who struggled at the community's periphery. The evolution of the subscription mode when Gray adapted it to American natural history shall offer a lens to the understudied dimension of the species problem.[3]

My next theme also relates to McOuat's studies on cataloging power but concerns the ways in which a metropolitan naturalist like Gray identified himself, as well as his relationships with his field collaborators. Retrospectively, it is fair to say that problematizing the connections between metropolitan naturalists and their field collaborators has inspired some of the most influential studies in the history of science over the past decade. In the past, when historians of science dealt with a man of science like Gray, they assumed his status as a "professional naturalist," whereas those who supplied him with specimens and field information were merely "amateurs." Along the same lines, they also assumed that amateur collectors would attribute their findings to professional naturalists in exchange for the latter's patronage, or that they entrusted the latter to come up with a systematic view of nature. Historians of science no longer find such categorizations and characterizations satisfactory. The reason for this remarkable shift in focus cannot be made more explicit than in Desmond's essay entitled "Redefining the X Axis: 'Professionals,' 'Amateurs' and the Making of Mid-Victorian Biology": "Nowadays, we want to see professionalization in its making, not as it is retrospectively stamped from a twentieth century sociological vantage point" (2001, p. 4). As a result, historians of science have produced a series of sophisticated case studies showing that metropolitan naturalists like Gray did not necessarily consider themselves to be professionals, whereas those who furnished metropolitan naturalists with specimens did not regard what they were doing to be amateurish. The fact is that such "professionals" and "amateurs" exchanged critical scientific material in kind and on the basis of reciprocity, and in so doing, they all identified themselves and each other as members of an imagined community of amateurs (Allen 1994; Barton 2003; Bellon 2001; Browne 2002; Desmond 2001; Endersby 2001, 2008, 2011; Keeney 1992; Kohlstedt 1976a, b; Shapin 1989).

In the final part of my analysis, I draw inspiration from the remarkable body of literature on how gift exchange and other practices that associated metropolitan naturalists with their field collaborators gave shape to scientific culture in general, and to metropolitan naturalists' and field collectors' respective identities in particular. I will outline ways in which Gray identified himself and defined his relationship with his field collaborators as he gradually established the subscription mode as an efficient means by which to consolidate his cataloging power. Of importance here is that although Gray did not regard himself as a professional botanist, he did not regard collectors associated with the subscription mode as amateurs, either. Instead, not only did he make clear that the best collector ought to be "professional," he also used the subscription mode to professionalize the botanical collecting of his era. Even so, it should be noted that what Gray meant by a "professional collector" still

[3] For studies concerning the making of an authoritative botanical author, see Bellon (2001), Bonneuil (2002), Endersby (2001, 2008), Hoquet (2014), Müller-Wille (2003, 2007), and Stevens (1996).

bore essential differences from what scholars have defined as commercial collecting or specimen dealership (Adelman 2012; Andersen et al. 2012; Barrow 2000; Brandon-Jones 1997; Camerini 1996; Hoquet 2014; Kjærgaard 2012; Rieppel 2015; Ruskin 2015). In this regard, a close examination of the moral economy of the subscription mode and how it gave shape to such identities as "professional" and "amateur" will no doubt contribute to scholars' ongoing interest in redefining Desmond's "X Axis" (Barton 2003; Bellon 2001; Endersby 2008; Kohler 2002; Kohlstedt 1976b; Lucier 2009; Secord 1994a, b).

Altogether, this essay shows that the subscription mode does not fit well into the current literature on gift exchange, commercial collecting, professional collecting, specimen dealership, or surveying collecting. Yet, as an alternative to a schematic or typological approach, this essay utilizes a concept that has recently gained wide attention among anthropologists and human geographers: assemblage. Although at first glance assemblage thinking bears certain similarities with actor-network theory (ANT), scholars have identified the following three aspects that distinguish assemblage thinking from ANT while also rendering them compatible and complementary: 1. assemblage thinking highlights the agency of historical actors to pull together heterogeneous elements; 2. assemblage thinking attributes to human actors more agency as compared to nonhuman "actants"; 3. although what a historical actor did may seem revolutionary in hindsight, the assemblage thinking shows that "more often interventions are assembled from an existing repertoire, a matter of habit, accretion, and bricolage" (Li 2007, p. 265; see also Baird 2015; McFarlane 2009, 2011; Li 2014; Müller and Schurr 2016). Accordingly, to define what the subscription mode was and how it worked, it is necessary to begin the analysis not with the moral economy that defined it and how it differed from other means by which a metropolitan naturalist might acquire specimens and field information, but with the "existing repertoire" that Gray drew on as he tried to assemble a phytogeographical expedition to Texas in 1842.

Nature Should Not Interfere with Business

The subscription mode that Gray definitely knew of in 1842 was a surveying project on the flora of North America initiated by Peter Collinson (1694–1768), a British cloth merchant, plant lover, fellow of the Royal Society in London, and probably the first naturalist to introduce the idea of subscription to American natural history. In the 1730s, Collinson got in touch with a farmer in Pennsylvania named John Bartram (1699–1777). Collinson expressed his eagerness to introduce American plants into his own garden and wondered if Bartram could help him achieve this goal. Bartram agreed, and in the following years, he diligently collected, selected, and shipped a wide variety of plant seeds to Collinson; Collinson, in return, sent Bartram a wide variety of goods from England (books and silks, for example) as well as scientific information. Late in 1735, however, tensions surfaced between the two men. Collinson received a letter from Bartram in which Bartram complained about Collinson's feigning ignorance about his financial situation in order to keep his collecting enterprise afloat. Collinson was taken aback. In reply, he revealed the rationale that had

guided his remuneration for Bartram's labor. "Nature should not Interfere with Business," he wrote, which was why he had not sent Bartram money but gifts instead. But now, he admitted, considering how much labor and time Bartram had devoted to unearthing the botanical treasures of Nature, there would be "Reason for thy making it thy Business because thee will have some gratification."[4] Months later, Collinson told Bartram that he had devised a new mode that should support Bartram's collecting enterprise. "I have Gott subscribed Twenty Guineas to Encouragement it will be Continued Annually, this is a pretty Sum in Sterling Money which I hope will Enable thee to supply thyself with Necessaries from Hence."[5] The new scheme worked well. For the next three decades, in the words of Bartram's biographer, Alan W. Armstrong, "under Collinson's promoting and guiding hand Bartram's trade flourished, as we can see from the list of subscribers Collinson maintained in a ledger: five in 1742, eleven by 1750, thirteen in 1765, three before Peter died" (2004, p. 39).

The correspondence between Collinson and Bartram clearly indicates that in the beginning, the subscription mode was a derived form of gift exchange of specimens. Although money got involved in defining the relationship between Collinson, Bartram, and subscribers, the money that circulated among the three parties was by no means a *payment* for what Bartram had collected—in other words, Bartram did not sell his specimens. In the words of Collinson, the money that Bartram received was a "gratification" in the hope of compensating or rewarding the collector's selfless devotion to science or his self-sacrifice for the cause of science. Still, we should not romanticize Bartram's character in the eyes of his contemporaries. As Collinson's letter of 1736 shows, once Bartram agreed to join the subscription mode, it became the logic of business instead of self-sacrifice that defined their relationship.

The second case that inspired Gray to experiment with the subscription mode took place about a century after Collinson devised it for Bartram's explorations of the North American flora. The collector was Thomas Drummond (1780–1835), a Scot who collected plants in Louisiana and eastern Texas from March 1833 to December 1834 sponsored by a subscription mode devised and maintained by Sir William J. Hooker (1785–1865), then Regius Professor of Botany at Glasgow University and a widely recognized expert on the North American flora. Before joining Hooker's collecting network, Drummond had been famous for his studies on mosses and for his participation in John Franklin's Second Overland North American Expedition (1825–1827). In the early 1830s, Drummond's reputation both as a bryologist and as an explorer caught Hooker's attention. "It occurred to Dr. Graham and myself," Hooker wrote afterward, "that such a person [Drummond] could not be more usefully employed in the cause of science than by investigating some of the less known parts of the *Southern* and *Western United States* of North America" (1834, p. 50). In 1834, Hooker drafted a plan to send Drummond into the field:

> The route proposed was to proceed from New York, early in the season, to cross the Alleghanies, and journey on to St. Louis on the Missouri, which

[4] Collinson to Bartram, February 20, 1736, Berkeley and Berkeley (1992, p. 22).
[5] Collinson to Bartram, April 21, 1736, Berkeley and Berkeley (1992, p. 27).

> place Mr. Drummond was to make his head-quarters for as long a time as he might feel necessary, and there derive in formation respecting the practicability of entering California or Mexico from that point: and, should circumstances not be favourable for that undertaking, to descend the Missisippi [*sic*] to New Orleans in the autumn, thence to transmit his collections to England, to form new ones, explore the country in that latitude to the westward, as much as possible; and, eventually, endeavour to reach the Mexican dominions near their northern boundary. (1834, pp. 50–51)

Hooker fixed the subscription rate at £2 per hundred specimens (roughly $10 U.S. per hundred specimens). By the standard of the 1830s and 1840s, this rate implied a significant amount of money (roughly today's £88–98). To put it differently, if a collector was collecting in a botanically rich region and had sufficient taxonomic knowledge to look for botanical novelties, he could readily earn $1000 (Gray's annual salary as a Harvard professor) by collecting specimens of some 10,000 species. Or he could adopt a safer strategy: He could focus on 500 species, collect 20 specimens for each species, and divide them into 20 sets. If Hooker could recruit subscribers to purchase these 20 sets, the collector could earn himself $1000 that way, as well. Under a rate so favorable to the collector, as Hooker often informed his subscribers, the collector would "meet in the fullest extent with the encouragement to which his great enthusiasm so justly entitles him" (1836–1837, p. 3).

With the rate and the plan thus set out, Hooker began to recruit subscribers for Drummond's expedition. The recruitment went well. As Hooker later remarked, Drummond's expedition owed its existence to some 22 subscribers, including independently wealthy naturalists such as George Bentham (1800–1884), university professors such as John Stevens Henslow (1796–1861), plant dealers such as nurserymen in Edinburgh, and scientific institutions such as the British Museum and the Manchester Botanical and Horticultural Institution. Backed by this immense network of support, Drummond arrived in New York in April 1831. He paid visits to John Torrey(1796–1873) and David Hosack(1769–1835), respectively. In a letter to Hooker dated April 28, 1831, Drummond reported that both Torrey and Hosack had been much "disposed" to render him "all the assistance in their power," especially by offering him introductory letters to local naturalists (Hooker 1834, pp. 57–58). After securing this final node of his support network, Drummond made his way to St. Louis to set up his headquarters for operations.

Drummond's collecting trip to the American southwestern frontier turned out to be a success. Though Drummond did not reach New Mexico, nor set foot in California, his collections made in Texas and Louisiana undoubtedly shed fresh light on what Hooker had regarded as "a country hitherto untrodden by the foot of any Naturalist" (Hooker 1834, p. 60). In May 1832, when Hooker received Drummond's first set of specimens collected in Louisiana, he promptly reported to subscribers that the specimens were in "excellent condition," containing some 700 species and probably one new genus (1834, p. 59). In July 1833, when receiving Drummond's second set of specimens, he informed subscribers that this set of specimens had completed Drummond's Louisiana collection, "amounting, Mr. Drummond reckons, in all (exclusive, however, of Cryptogamia) to 1000 species" (Hooker 1834, p. 184). Equally remarkable were Drummond's

Texas collections. Although Drummond encountered a wide variety of difficulties in Texas, ranging from the overflow of the Mississippi River to rampant cholera and local hostility toward a foreign collector, he successfully collected and shipped specimens of some 700 species to Britain. Again, Hooker cheerfully circulated the news to Drummond's subscribers (1835–1836, pp. 43–44).

To Drummond's subscribers, however, what made his collections almost invaluable was the tragic ending of his expedition. After a series of reports celebrating Drummond's success, Hooker abruptly announced the collector's death in *Companion to the Botanical Magazine*. "Little did I foresee," the botanist moaned, that "the painful duty would devolve upon me of recording his [Drummond's] death." While the world of botany had just begun to notice Drummond's achievements in the treacherous wilderness of the American frontier, Hooker noted, Drummond had died in Havana, Cuba, in March 1835 (Hooker, 1835–1836, p. 39). Hooker admitted that he had somewhat feared this tragic ending. Months previously, he recounted, he had received three boxes from Cuba, containing Drummond's "little personal property, clothes, bedding, &c.; together with a very few ill dried plants and insects, unaccompanied by any letter or even invoice." After rummaging through these items, Hooker wrote, "some fears for his [Drummond's] safety" had crossed his mind. Then a letter from Havana confirmed his worst fear: in it, Hooker wrote, he found a death certificate issued by C. D. Tolmie, the King's Consul in Havana (1835–1836, pp. 46–47).

Compared to the arrangements that Collinson made for Bartram's expeditions, the subscription mode in Hooker's arrangements had become less and less like a derivative form of gift exchange. Not only was there a subscription rate by which to calculate how much money Drummond should receive, but also those who joined Drummond's subscription list were aware that the collector was now selling his specimens. Still, it seems inappropriate to just categorize Drummond as a specimen dealer or as a commercial collector. Of importance here is that in the case of the subscription mode, those who agreed to subscribe to Drummond's expeditions had to put a significant amount of trust and faith in Drummond himself. After all, whereas in the case of specimen dealership, buyers received specimens immediately or shortly after they made payment, Drummond's subscribers had to wait months or even years because the financial transaction took place when Drummond had not yet even been to the field. In this light, we can also gain a sense of Hooker's role in the subscription mode. Although at first glance Hooker seemed to be a "messenger" between Drummond and his subscribers, in reality he served as an "underwriter" who ensured that subscribers' trust and faith in Drummond would not wear thin. Indeed, it is even fair to say that those texts that Hooker painstakingly copied, edited, rewrote, and published in scientific journals represent the botanist's "literary technology" (Shapin and Schaffer 1985) intended to manufacture subscribers' trust and faith.

I Know How All This Should Be Managed Now

In 1837, roughly 3 years after Drummond passed away, Hooker published a short notice in *Companion to the Botanical Magazine*:

> It gives us pleasure to be able to say that a botanical collector is about to proceed to Santa Fé, in North Mexico, under the auspices of Dr. Torrey of New York. His outfit is calculated at three hundred dollars currency. Those, who contribute to this, will receive plants at the rate of one hundred specimens for every five dollars. To those who purchase specimens on the return of the collector, without having contributed to his outfit, the price will be seven dollars per hundred. Considering the highly interesting character of the country to be explored, and the difficulty of getting access to it (the whole journey to and from St. Louis having to be made on horseback), the terms are certainly extremely moderate. (1836–1837, pp. 185–186)

"You know how deeply I feel interested in the Botany of all N. America," Hooker also wrote to Torrey. "Nothing could give me more pleasure than to hear that *you* will send a collector to the southern extremity of the Rocky Mountains & I rejoice particularly that *you* have fixed upon the person who is to be the collector" (quoted in Rodgers 1942, pp. 132–133).

The person whom Torrey attempted to "fix upon" was Peter D. Knieskern (1798–1871), a medical doctor with a high interest in collecting plants (Gray 1893, p. 90). Gray, who at this time was studying at Hooker's herbarium in Glasgow, was delighted that Torrey seemed to have secured the right man as a collector. "Can't Knieskern safely make the excursion to Sante [*sic*] Fé in the coming spring?" he wrote to Torrey. "If he can, and will work hard, he will make $1000 clear of expense! All the collectors make money."[6] The fact is that Gray had been pondering the issue of how to help a collector make money. In a journal entry dated February 2, 1838, he wrote:

> I am most clearly of the opinion that any person who will make extensive collections of North American plants, both Northern and Southern, and include also a good collection from Santa Fé, the Platte country, etc., have his sets named according to our work, and who would devote 4 or 5 years to the business, could, if he were really industrious and prudent, realize $1000 per annum (clear). He should continue my grass-book for one thing, giving loose sets only for the present price, and while from time to time he sells off collections as he can, should retain some fifty sets in all the most interesting genera or small families, get all the species, and publish them in monographic sets. Knieskern could make, with the aid we would gladly furnish, at least ten times as much money, as long as he lives, and he ever will at physic, besides being engaged in a much pleasanter way. I know how all this should be managed now. (1893, p. 135)

It turned out that Knieskern was unsuitable for an expedition to the edge of American civilization. Torrey's planned expedition to the American West never got off the ground, but Gray did not give up. As his notice of 1842 hints, his idea for Lindheimer's expedition to Texas was to put what he had learned about the subscription

[6] Gray to Torrey, December 12, 1838, Gray (1893, p. 90).

mode since 1838 into practice. Two elements made Gray's subscription mode different from what Hooker had done for Drummond's expeditions: First, Gray's experience of publishing what he called his "grass book"; and second, his conviction that "all collectors made money." These two elements are not as self-evident as they may seem and demand further contextualization.

Gray's "grass book" was in fact the first publication in his long and productive career. The project began early in 1834, when Gray began thinking seriously about how to make a living as a botanist. To that end, he selected the best specimens from his collections of *Gramineae* and *Cyperaceae*, mounted them on good sheets of paper, gave each specimen a label indicating its distribution, scientific name, habitat, and other relevant information, bound them together, and then looked for persons or institutions who were interested in subscribing to such sets of specimens.[7]

Torrey supported Gray's publishing project wholeheartedly. In February, while Gray was busily selecting, mounting, and labeling specimens, Torrey wrote to his friend Constantine Samuel Rafinesque (1783–1840) about Gray's project. "Did I tell you my friend and assistant, Dr. Gray was about publishing 1st No. of his North American Gramineae and Cyperaceae?" he wrote. "Each number is to contain 100 good specimens fastened on handsome white paper bound in neat covers, with printed labels, title page, index etc. the price is 5 dollars per number…. I think his prices are low."[8]

Torrey's enthusiasm went so high that he mentioned Gray's publishing project to Sir William Hooker, a botanist whom Gray had long admired but had not had a chance to initiate correspondence with. Hooker was impressed. He promptly composed a notice about Gray's project and circulated it through his *Companion to the Botanical Magazine*. This was the first time that Gray's name was made known to scientific communities at large, and Hooker carefully set the stage to introduce Gray onto the scene. "If ever there was a period, when, more than at any other, a JOURNAL was required which might give an account of the progress of Botanical Science, it is surely the present," Hooker wrote passionately. "We are very happy to be able to announce that," he continued, Torrey's "valuable assistant" Dr. Gray had just published "Specimens illustrative of the Grasses and Cyperaceae of North America." Gray's volume might "fairly be classed among the most beautiful and useful works of the kind that we are acquainted with," and was "now on sale here, as well as in America" (Hooker, 1835–1836, p. 14).

Torrey's and Hooker's characterizations of Gray's project suggest further questions: Would Gray have been considered by botanists of the day a "specimen dealer"? Returning to Gray's journal entry of early 1838, when he wrote that Knieskern could continue his "grass-book" sponsored by the subscription mode in his and Torrey's charge, did he mean then that he wanted Knieskern to be a "specimen dealer"? To answer these questions, it is necessary to outline a critical element that defined mid–nineteenth-century American botanists' ideas of their practice: the "free and liberal interchange of specimens."

[7] For a taxonomic analysis of Gray's "grass-book," see Rickett and Gilly (1942).

[8] Torrey to Rafinesque, February 5, 1834, Reingold (1964, p. 44).

In his 1833 essay on plant collecting, senior botanist Charles Short (1794–1863) explained how much such a seemingly trivial manner mattered in American botany: "It should be the constant aim of every botanist not only to increase his own knowledge, by every possible opportunity, but to add something to the general stock; and this is most readily and effectually done, by a free and liberal interchange of specimens with other botanists.… In this way, you will contribute essentially towards the formation of that great desideratum in our Botany—AN ACCURATE AND COMPLETE FLORA OF THE AMERICAN UNION" (1833, pp. 73–74).[9]

Gray admired Short's words greatly. As he remarked in his *Elements of Botany* (1836):

> In collecting plants, a botanist should always bear in mind the probable wants of his friends and laborers in the same field of science. Thus not only will he have the high gratification of imparting what he knows will be joyfully received, and of contributing to the enlargement and diffusion of correct knowledge, in which all *true* naturalists have a common interest; but he will also by such means be certain of receiving, in exchange for his duplicates, the plants of those districts and countries which he might be unable to obtain by any other means; thus advancing his own attainments whilst promoting those of others. (1836, p. 403)

Besides relying on the medium of the textbook, Gray often took the opportunity of indoctrinating his epistolary correspondents with the importance of "free and liberal interchange of specimens." For example, in 1844, when he received a letter of thanks from Elizabeth Carrington Morris (1795–1865), a plant enthusiast in Philadelphia, for botanical specimens he had sent previously, Gray replied, "Surely I am glad the dried plants please you, and that the duplicates will allow you in part to share the pleasure I enjoyed;—in giving them away to your correspondents. This is really one of the pleasures of Botanists, who while glad to receive, are always 'ready to distribute.'"[10]

Against this backdrop, it is unsurprising that a botanist who failed to properly practice the free and liberal exchange of specimens could discover that his or her own correspondents could become nasty. The once intimate and supportive network of correspondence could be transformed into a spider's web, as it were, that entangled his or her botanical endeavors. Thomas Nuttall (1786–1859), arguably the most celebrated botanical explorer in the United States during the first half of the nineteenth century, was among those who got entangled in such a web by Gray himself. The incident took place late in 1840, when Nuttall had just completed a collecting trip across North America. In November, Gray came to the Academy of Natural Sciences in Philadelphia for herbarium research and happened to meet Nuttall there. He was impressed by Nuttall's new collections. But upon hearing Nuttall's public talk concerning botanical discoveries made during the collecting trip, he grew dismayed.

[9] See also Short to Rafinesque, September 7, 1834, Reingold (1964, pp. 47–48).

[10] Gray to Morris, April 24, 1844, Asa Gray Papers, 1840–1859 (MSS84489), Manuscript Division, Library of Congress, Washington, DC (hereafter cited as ***AGPL***).

Gray felt that Nuttall had utterly neglected his and Torrey's *Flora* and was announcing the discovery of a stunning number of "new" species. Worse, Gray found, Nuttall was selling these so-called new species for $10 per hundred specimens. In January 1841, Gray complained to Hooker about the matter. Unsurprisingly, considering Hooker's generous support for advancing knowledge of the North American flora, he wrote that Nuttall "ought to send all these to you, but his *amor pecuniae* [love of money] is rather strong."[11]

Gray must have made his dissatisfaction clear to Nuttall. In response, Nuttall packed up 118 specimens of *Compositae* and mailed them to Gray. He demanded that Gray examine the collection and then forward them to Hooker. Annoyed by Gray's criticism, Nuttall exclaimed that his collection had "cost a good deal of money, much time, and considerable risk in procuring, for which, what I set for specimens is not like to remunerate me." Regarding Gray's accusation of his simply making up many new species (thus making money by selling these "new species"), Nuttall fought back:

> I was, I had thought, in consideration of what I had done, not in the closet but in the field, entitled to expect, the same privilege of consulting Dr. Torrey's herbarium that you have of consulting the Herbarium of the Academy. It is now determined, I find, that I shall be obliged to work in the dark, and somebody will then come after and hold after my unavoidable errors and mistakes as a beacon on which to establish something de novo. (Quoted in Dupree 1952, p. 298)

Nuttall's words hit the bull's-eye. "Neither Dr. Torrey nor myself have ever refused you the privilege of consulting freely our collections," Gray replied in exasperation. "The insinuation that *somebody* wishes to oblige you to work in the dark, and then form a reputation for science by holding up your unavoidable errors… is as untrue as it is unworthy of you…. No botanist, living or dead, has reason to complain of me in this matter," he concluded.[12]

The Gray–Nuttall controversy clearly exemplifies the way in which Gray made his own distinction between specimen dealership and his grass-book project. First, he did not sell specimens—what he sold was a book filled with specimens. Second, what made Gray a book author instead of a specimen dealer was that he made his classifications in a well-furnished herbarium instead of out in the field. In this regard, we can gain a clearer view of what Gray meant by "all collectors make money," and how the subscription mode could enable collectors to do this legitimately. It is worth noting that a few years after he made this statement, Gray came up with a term for a particular type of botanical collecting that would allow its practitioners to make money: a profession. Gray's first mention of this characterization occurred in 1848, when he was corresponding with his collaborator George Engelmann regarding the

[11] Part of this letter can be found in Gray (1893, pp. 278–279). But the sentence about Nuttall's *amor pecuniae* is missing there. Fortunately, a typed copy of this particular letter remains at Gray Herbarium. Dupree (1952) made use of this typed copy in his remarkable essay on the Nuttall–Gray controversy.

[12] Nuttall to Gray, April 7, 1841; Gray to Nuttall, April 14, 1841, quoted in Dupree (1952, pp. 298–299).

best means by which to send the young and talented Augustus Fendler to collect in Santa Fe. "Let him stay two years, and if he is energetic he will reap a fine harvest for botany, and accumulate a pretty little sum for himself, and have learned a profession, for so that of a collector now is."[13] To Gray, a professional collector was essentially different from a commercial collector or specimen dealer: Like other professionals, a professional collector could make money, but the money accrued from his status as a botanical author, instead of his being a specimen dealer.

I Shall Not Be Idle Myself

But what were the goals that Gray attempted to achieve using the subscription mode? It turned out that the American botanist's goals reflected an anxiety that tormented the country's naturalists of the day. They were well aware that the United States of America was expanding and that they had to adjust their research scopes accordingly. Here, the changing attitudes of Moses A. Curtis (1808–1872; a rector and mycologist chiefly residing in Hillsborough, North Carolina, who began corresponding with Gray and Engelmann late in the 1830s) toward the Texas flora were illustrative. For a while, Curtis had refrained from touching upon any material not pertaining to what he had regarded as the flora of the entirety of the United States. As he told Engelmann in 1841, he had now decided to confine "my most careful attention only to plants of this State." Five years later, however, when Texas officially became part of the United States, he anxiously dispatched a note to Engelmann. "The S. Western part of the U.S. is almost terra incognita to me," he wrote. "You are now the only one west of the Alleganies, with whom I make exchange." Would Engelmann be able to spare some Texas specimens?[14]

Against this backdrop, American naturalists were dismayed when they learned that their European colleagues were now sending collectors to bring back unknown American species and publishing them, thus snatching away the credit that should be American botanists' due. "The actual fact is," influential American zoologist Augustus A. Gould (1805–866) wrote in a review article, "that as a general thing, the natural objects peculiar to this country have been better known and better described abroad than at home":

> There are collectors constantly employed in this country by foreign naturalists, who, in a quiet way, send across the water immense stores of all kinds of natural objects; and one is surprised when he sees the flood of such objects, collected at our doors and without our knowledge, in the public and private collections abroad. (1843, p. 6)

One issue that particularly stoked the rivalry between American naturalists and their European colleagues was the increasingly important role played by *The Rules*

[13] Gray to Engelmann, February 29, 1848, *AGPG*.

[14] Curtis to Engelmann, March 4, 1841, and July 31, 1846, Folder 2, Box 1, Correspondence of Moses Ashley Curtis, Wilson Library, University of North Carolina at Chapel Hill (hereafter cited as ***CMAC***).

of Zoological Nomenclature, a framework eagerly promoted by the prestigious British Association for the Advancement of Science (BAAS). American naturalists, although willing to accept *The Rules* as a standard in nomenclature, were particularly concerned with *The Rules*' "twelfth proposition" stating that "a name which has never been clearly defined in some published work should be changed for the earliest by which the object shall have been so defined" (quoted in Gould 1843, p. 4). In his review article mentioned above, Gould discussed the likely impacts that the twelfth proposition might have upon American naturalists. "Until lately," he noted, "the right of priority has been claimed where a man could not show, that, at some anterior period, he had given a name to a specimen in his cabinet, or had read a paper upon the object, and perhaps circulated specimens among his friends." It was high time for American naturalists to become more aware of their "superficial acquaintance with the works of naturalists, and an indifference to publication," Gould told his readers, for the twelfth proposition stipulated that "right of priority" could only be secured by "undertak[ing] the task of coning all the published works in which it were likely to find such objects noticed" (1843, p. 5).

The early and mid-1840s witnessed a rise in American naturalists' enthusiasm for submitting their discoveries to established societies in Europe for publication, in the hopes of showing that, as Gray's close correspondent Edward Tuckerman (1817–1886) put it, "we depend no longer on Europe; unless as Europe depends upon us, in natural his[tory]."[15] This enthusiasm soon grew so pronounced that some American naturalists became worried about how "low" their science might appear in the eyes of their European colleagues. In an essay concerning French naturalist Charles des Moulins's (1798–1875) criticism of American naturalist Issac Lea's (1792–1886) identification of the genus *Anodonta*, for example, Philip H. Nicklin (1876–1842), a retired bookseller and natural history lover, complained that American naturalists such as Lea were now "casting their mites into the general treasury of the world's knowledge" (1841, pp. 105, 107). Torrey, too, wrote to physicist Joseph Henry (1797–1878), "I hope that the account of [Hall] Sherwood's discovery did not reach the British Association, & thus expose us to ridicule before that noble body." The moment was coming, declared the botanist, when "we must do all in our power to put an end to quackery in our land."[16]

Gray also felt some urgency to put an end to those quackeries that he believed were severely tainting the reputation of American naturalists. As far as progress in compiling a complete flora of North America was concerned, he was particularly anxious to eliminate what was known in his scientific circle as "Rafinesquism," a term coined after the tendencies of Philadelphia-based naturalist Constantine Samuel Rafinesque for certain naturalists' unsavory fondness for novelty. Rafinesque had gained notoriety chiefly because of his enthusiasm for describing new species and publishing them in books at his own expense. In *Flora Telluriana*, for example, Rafinesque boasted that he would establish about 1000 "totally new genera," including some of those he had previously published. Then, in 1836, when

[15] Tuckerman to Gray, April 8, 1844, *HL*.

[16] Torrey to Henry, August [no day] 1838, *HL*.

Rafinesque published the first part of the *New Flora* (1836–1838), botanists were further shocked to learn that Rafinesque had not only achieved this goal but had far exceeded it. Besides 1000 "totally new genera," Rafinesque declared, the *New Flora* included "nearly 500 additional or revised new genera, and 1500 additional or corrected new species"![17]

Those who had grown irritated by Rafinesque's "most foolsome and disgusting manner of speaking in one's own praise" (Warren 2004, pp. 60–61), might have felt somewhat relieved when his death eventually prevented Rafinesque from describing and publishing more new species. In October 1840, Gray wrote to Benjamin Silliman (1779–1864), Yale geologist and chief editor of *The American Journal of Science and Arts*: "Do you know that Rafinesque is dead? If I cannot prevail upon Dr. Torrey to prepare a notice of his life & writings I shall do it myself." In November, Gray informed Silliman that he had decided to write a review article on Rafinesque's life and work.[18] In this, one of his earliest review essays, Gray acknowledged Rafinesque as one of the pioneers in American botany to be "acquainted with natural affinities" and in fact as the "only person in this country, who had any pretensions to that kind of knowledge." Unfortunately, Gray noted, Rafinesque's research was "by no means well grounded in structural and systematic botany," and a careful reader could easily detect a "gradual deterioration" in Rafinesque's botanical writings "from 1819 to about 1830… when the passion for establishing new genera and species, appears to have become a complete *monomania*." Gray then argued that Rafinesque's unparalleled ability to produce new genera and species did not derive from his insistence on the natural system but rather from his lamentable views on species and variety:

> According to his [Rafinesque's] principles, this business of establishing new genera and species will be endless; for he insists, in his later works particularly, that both new species and new genera are continually produced by the deviation of existing forms, which at length give rise to new species, if the foliage only is changed, and new genera when the floral organs are affected. He assumes 30 to 100 years as the average time required for the production of a new species, and 500 to 1000 years for a new genus. (1841b, pp. 238–239)

Torrey and Gray's resolution to put an end to such scientific quackeries (Rafinesquism, in particular) and to align American botany with European standards soon manifested itself in the newest volume of *A Florsa of North America* (Torrey and Gray 1841). For botanists of the day, the publication of this particular volume was a landmark—not only because it exhibited the two botanists' resolution to carry on with their formidable project, but also because it included sections on such troublesome botanical tribes as *Asteroideae* ("the terror and stumbling-block of American botanists," British botanist John Carey would comment in a review essay; see Carey 1841, p. 279). "Those botanists who are most familiar with our *Asters*," Torrey and

[17] The quotations are from the title pages of Rafinesque (1836; 1836–1838). For a notable account of Rafinesque's life and career, see Endersby (2009).

[18] Gray to Silliman, October 5, 1840; November 15, 1840; December 31, 1840, Asa Gray Papers, 1838–1887 (Mss.B.G78), American Philosophical Society, Philadelphia, PA.

Gray noted, "in their native situations, and with the changes produced by difference of soil, exposure, season, &c., will not be greatly surprised at numerous reductions of species, which others may think unwarranted." Still, the two botanists insisted "it is better, perhaps, to hazard the occasional reduction of even true species to varieties, than to multiply species which we are confessedly unable to define" (Torrey and Gray 1841, p. 104). Once this principle had been set forth, Torrey and Gray put it audaciously into practice. Of particular note was their diagnosis of *Aster laevis* Linn (now known as *Symphyotrichum laeve*), which reduced some 13 species into 11 synonyms and 2 varieties and placed them all together under the name *A. laevis* (Torrey and Gray 1841, p. 116). Torrey and Gray's bold reduction of the number of American species impressed their European colleagues. John Carey (1797–1880), a British botanist specializing in *Carex* (a tribe as troublesome as *Asteroideae* in the eyes of contemporary botanists), remarked in a review that Torrey and Gray's *Flora* definitely constituted "a sound physiological work." "We feel convinced," wrote Carey, "that the onward progress of science will have a tendency rather to diminish than increase the number of orders, which have been so largely multiplied since the days of Jussieu" (1841, p. 278).

Gray's contribution to publishing "an accurate and complete flora of the American Union" made his name. On November 10, 1841, he was elected to the American Academy of Arts and Sciences. However, his financial status worsened. In March 1842, Gray could not help expressing his despair to Hooker about how difficult it was to be a botanist in the United States: "Having no income for the last 2 years, I have been greatly embarrassed, and have struggled through great difficulties, I scarcely know how."[19]

The Fisher Professorship in Natural History at Harvard College rescued Gray from such embarrassment. Late in 1841, when Gray learned of the position, he contacted Benjamin D. Greene (1793–1862), a wealthy Bostonian and plant lover. Greene responded to the inquiry by inviting Gray to visit Boston. In January 1842, Gray set foot in Boston for the first time. He met Harvard president Josiah Quincy (1772–1864) and a circle of local botanists at a dinner party arranged by Greene. Three months later, in April 1842, the Harvard Corporation offered the Fisher Professorship to Gray with an annual salary of $1000 (Appel 1992; Dupree 1959, chs. 5–6).

His close friends sent their warm regards to the newly appointed Fisher Professor Asa Gray. "I am sure that you will have both the power & the will to render essential service to American Botany there," Hooker told Gray. Curtis, too, congratulated Gray, saying that he was delighted that Gray had been "provided for in one of the Atlantic States," and that he hoped Harvard would guarantee "a good salary." William S. Sullivant (1803–1873) of Columbus assured Gray that "Harvard is the place." "If I judge aright Botany receives rather feeble attention in that quarter—in this respect there is room for action—considering all things—you have made a

[19] Gray to W. Hooker, March 30, 1842, J. L. Gray (1893, pp. 282–283).

lucky hit—go ahead—take care of your health & I will underwrite results will be as they should be."[20]

Gray did feel encouraged. He immediately sent numerous letters to his close correspondents, asking to exchange specimens or to introduce qualified persons who could serve as his collectors.[21] Among the replies he received, Gray found the one from Engelmann particularly interesting. Engelmann wrote that his friend Ferdinand Lindheimer had decided to "devote a few years entirely to the exploration of Texas and the collection of plants there, and intend to make at least his living by it." To achieve this, Engelmann wrote, he and Lindheimer had agreed to "offer their collections for sale, by Centuriae." He assured Gray of Lindheimer's extraordinary specimen-making skills. While Lindheimer devoted himself to collecting and preserving plants, Engelmann proposed that he and Gray should serve as gatekeepers or quality-controls for Lindheimer's collections. "We would guarantee… the good preservation and careful selection of the specimens and that only the rarest plants of the western and southwestern county would be contained in their collection. That therefore only two to four Centuriae in 1 year could be furnished… [and] the price could not be under 8 to 10 dollars…. What do you say to that plan?" Engelmann asked.

> If you approve of it, and think it feasible, you will do me a favour to publish an advertisement in Silliman's Journal to that effect, and botanists who wish to obtain a collection, may apply to you or to me; it would be well to say in the Journal also a few words, referring to the advancement and to publish the same also in England—I will take care to put it in French and German journals. In that way we would encourage adventurous and ardent botanists, would get a better knowledge of distant and little known countries, and obtain full sets of good specimens therefore.[22]

Gray replied: "I note with interest what you propose in regard to Lindheimer's collections for sale in Centuriae, fall into your plans, and will advertise in 'Silliman's Journal' (and in 'London Journal of Botany') when all is arranged. Pray let him get roots and seeds for me. I will do all I can for him."[23] In fact, Gray was delighted by Engelmann's "discovery" of Lindheimer and was so impressed by Lindheimer's specimen-making skills that he thought perhaps Lindheimer could contribute to North American botany in general instead of solely to Texas botany (Fig. 1). "If the Oregon bill passes, a party under Lieutenant Frémont, or some one else, will go through the Rocky Mountains to Oregon; and parties of emigrants or explorers with go also. So why not send Lindheimer in some of these? Probably the government party would afford him protection, and probably he might be formally

[20] W. Hooker to Gray, November 10, 1842; Curtis to Gray, August 1, 1842; Sullivant to Gray, April 19, 1842; *HL*.

[21] Gray told Engelmann that he was now "imploring correspondents in every part of the country to send me all they can"; Gray to Engelmann, September 26, 1842, *AGPG*. See also Sullivant to Gray, November 21, 1842, *HL*; Curtis to Gray, November 7, 1843, *HL*; Gray to Morris, December 5, 1842, Box 1, Folder 3, *AGPL*.

[22] Engelmann to Gray, January 18, 1843, *HL*.

[23] Gray to Engelmann, February 13, 1843, *AGPG*.

attached to the party." In addition to the Texas flora, Gray pointed out, "the interesting region (the most so in the world) is the high Rocky Mountains about the sources of the Platte, and thence South!!" Accordingly, he clarified the deal that he could offer for Lindheimer's expedition: If Lindheimer decided to go to the Rocky Mountains, he would "warrant ten dollars per hundred for every decent specimen"; but if Lindheimer preferred to remain in Texas, Gray believed that "eight dollars per hundred [specimens] is enough."[24]

However, Engelmann replied that Lindheimer's "predilections, his health and the very proper wish" would cause him to "prefer Texas to any other field of operations." He again invited Gray to join him to serve as the gatekeeper, quality-controller, and catalog-compiler for Lindheimer's incoming collections.[25] This time, Gray agreed. "When you get sufficient collections of any of these botanists for distribution," he replied, "you will please forward me a set, with your own critical remarks." Although he noted that he had "excessively" disliked studying special collections compared to his systematic, family-by-family survey of the North American flora, Gray agreed that by supporting Lindheimer's collecting enterprise, they would encourage "adventurous and ardent botanists" to "get a better knowledge of distant and little known countries, and obtain full sets of good specimens therefore."[26]

The first botanical expedition sponsored by the subscription mode under American botanists' charge had begun.

Your Loyal *Famulus Botanicus*

Ferdinand Lindheimer was a German immigrant residing in Houston. He had received the best scientific training before setting foot on American soil in 1834; however, Lindheimer shifted from one job to another, at various points working as a planter of bananas and pineapples in Mexico, as a soldier in General Sam Houston's army, and as a truck farmer in Houston. Participating in the subscription mode supervised by Gray somewhat disturbed the casual wandering life that Lindheimer had previously enjoyed. He began receiving frequent letters from Engelmann pressing him to get out of the Gulf Coast, reach San Antonio, and push forward "north to the Sierra Madre and west to the Rio Grande." Lindheimer was annoyed. He thought that his patrons, residing comfortably in St. Louis and Cambridge, were ignoring what he considered to be a most conspicuous fact: Traveling in Texas demanded cash, of which he had little. "I could have collected three times more beyond what I actually did, or four times, and much better material, had I not lacked even a few dollars," Lindheimer complained.[27]

Engelmann advanced Lindheimer money from his own pocket to help him get going on his travels. After a series of failed attempts to get himself to the destinations

[24] Gray to Engelmann, February 13, 1843, *AGPG*.
[25] Engelmann to Gray, March 9, 1843, *HL*.
[26] Engelmann to Gray, January 18, 1843, *HL*.
[27] Lindheimer to Engelmann, August 10, 1843, Goyne (1991, p. 67).

Fig. 1 One of the earliest specimens Lindheimer collected in Texas as a fulltime collector showing the species *Cirsium filipendulum* Engelmann. (Courtesy of the Gray Herbarium, Harvard University, Cambridge, MA, USA.)

that Gray and Engelmann had stipulated, Lindheimer decided to combine his botanizing enterprises with his fellow Germans' colonizing endeavors. In April 1845, he traveled with some 500 German immigrants to Comal Spring. He promptly wrote to Engelmann upon his arrival, expressing his delight at being enveloped by nature's

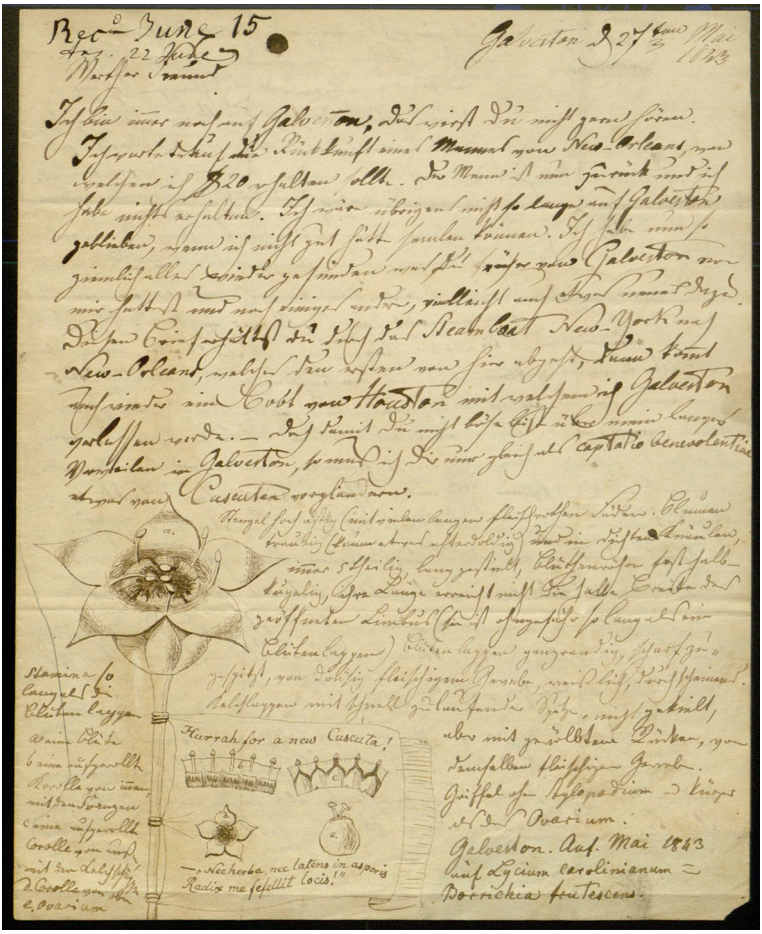


Fig. 2 In a letter to Engelmann in May 1843, Lindheimer proudly wrote, "Hurrah for a new Cuscuta! … Nec herba, nec latens in asperis Radix me fefellit locis (Neither a plant nor a root lurking in rough places escaped my notice)!" (quoted in Goyne 1991, p. 61). (Courtesy of the Peter H. Raven Library, Missouri Botanical Garden, Saint Louis, MO, USA.)

pure beauty and fecundity.[28] In the year that followed, while struggling alongside his fellows to turn "the best hunting grounds of the mighty Comanches" into their new homeland, Lindheimer further refined his collecting style.[29] He did not agree that profitable collecting required him to travel to the most remote regions and grab as many novelties as possible. "Collecting without a house produces little for one's purse," he told Engelmann matter-of-factly. "In two months (without a house) I could only have a yield of 1500 plants which, with all the deductions taken from

[28] Lindheimer to Engelmann, April 18, 1845, Goyne (1991, p. 112).

[29] This quote can be found in Lindheimer to Engelmann, April 18, 1845, Goyne (1991, p. 113).

that, would surely not bring more than 15 × 8 dollars = $120. That does not cover the cost of such an expedition." But if he collected with a house, he told Engelmann, the equation would be radically altered: "If I could devote my time to botanizing, from 5 in the morning until dark in the evening, then I [could] preserve, switch around, and put in order 100 to 200 plants daily in good weather." Also, the collector pointed out, with a house to serve as his headquarters, he could produce specimens of top-notch quality, along with detailed information about the specimens' habitats, habits, characteristics, and the like, which he believed would be of great use to Engelmann and Gray.[30]

Soon Gray and Engelmann buried themselves in Lindheimer's specimens and field notes, trying to turn the dried stuff into cash (Fig. 2). Engelmann took responsibility for numbering each specimen, grouping specimens according to species, describing characteristics according to his observations of the specimens and Lindheimer's field notes, mounting specimens on paper, printing labels for each specimen, and finally sending grouped specimens to Gray along with his notes. As for Gray, he served as quality-controller of the subscription. His tasks included checking reference books to see whether Engelmann had made the correct species identification, detecting and describing any new species that might have appeared in Lindheimer's collections, revising and rewriting Engelmann's notes, publishing this text in the form of a catalog, sending Lindheimer's specimens to subscribers along with the catalog, and finally collecting the subscription fee at the rate of eight dollars per hundred specimens (Fig. 3).[31]

The first publication made by this chain of production was a pamphlet entitled "Plantae Lindheimerianae: An Enumeration of the Plants Collected in Texas, and Distributed to Subscribers, by F. Lindheimer; with Remarks, and Descriptions of New Species, &c.," which was published in *Boston Journal of Natural History* in 1845 (Fig. 4). In it, Gray and Engelmann enumerated 318 species and varieties, including 39 new species (six of which were named after Lindheimer) and two new genera (*Thysanella* and *Brazoria*). Early in 1846, Gray began sending sets of Lindheimer's 1843–1844 specimens to subscribers along with copies of *Plantae Lindheimerianae*. Henry Borron Fielding (1805–1851) was impressed, writing:

> In the autumn I received your paper on Lindheimer's collections shortly after my share had been forwarded to me. Thus it was rendered doubly welcome, as enabling me at once to affix the name to the specimens, before laying them into my Herbarium. I thought them very interesting, and beautifully dried, which was far from being the case with those of Drummond, with which collection many of the species are identical, I should be highly gratified to hear, if

[30] Lindheimer to Engelmann, July 8, 1846, Goyne (1991, pp. 159–161).

[31] Negotiations taking place between Engelmann and Gray regarding how to run the subscription mode effectively and efficiently can be found in the following letters, all of which are part of the *HL* collection: Engelmann to Gray, January 8, 1844; Engelmann to Gray, February 17, 1844, Engelmann to Gray, April 8, 1844; Engelmann to Gray, October 5, 1844.

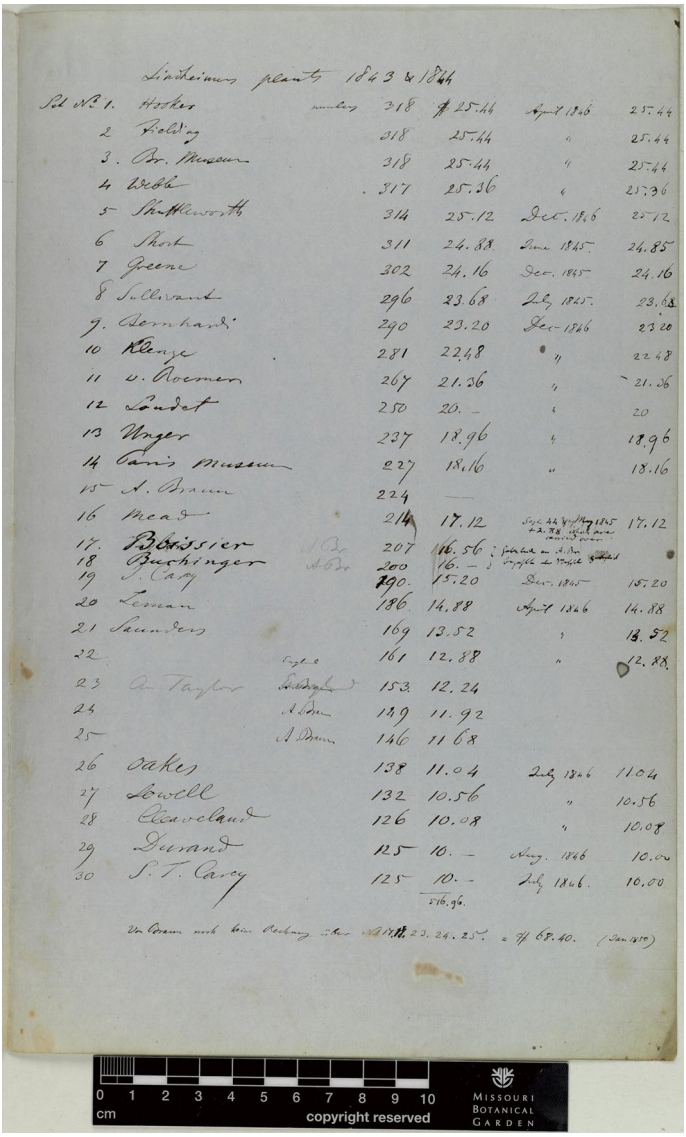
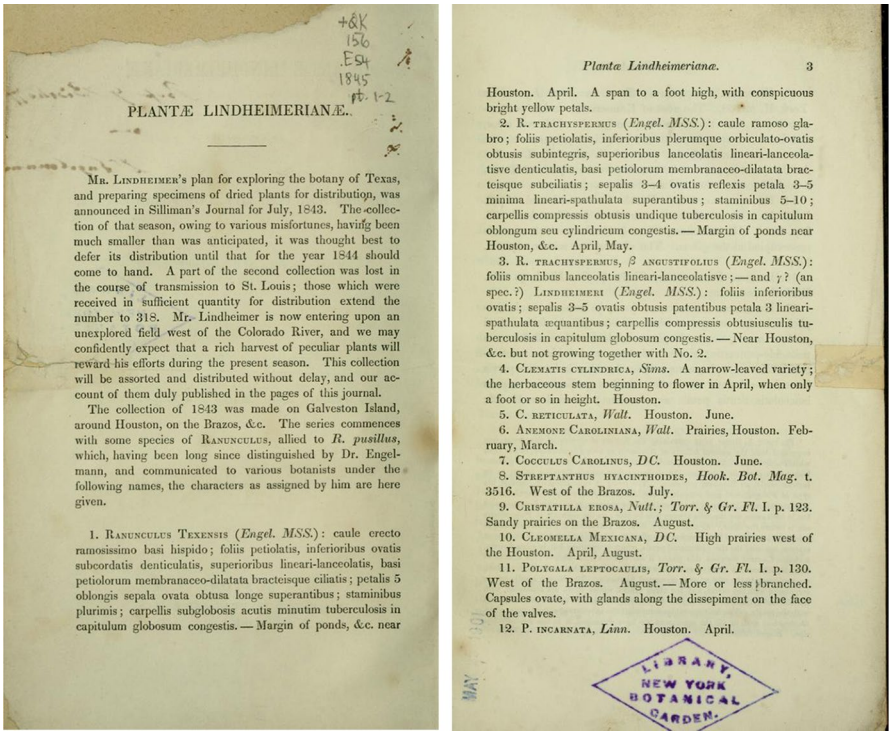


Fig. 3 The "distribution list" for Lindheimer's collections made in 1843–1844. (Courtesy of the Peter H. Raven Library, Missouri Botanical Garden, Saint Louis, MO, USA.)

you have an hour to spare that he continues his collecting, and that it has met its reward in the discovery of many new and rare plants.[32]

The publication of *Plantae Lindheimerianae* brought Gray and Engelmann new credit as American botanists and proved that American botanists could handle the

[32] Fielding to Gray, August 8 1846, *HL*.



PLANTÆ LINDHEIMERIANÆ.

Mr. Lindheimer's plan for exploring the botany of Texas, and preparing specimens of dried plants for distribution, was announced in Silliman's Journal for July, 1843. The collection of that season, owing to various misfortunes, having been much smaller than was anticipated, it was thought best to defer its distribution until that for the year 1844 should come to hand. A part of the second collection was lost in the course of transmission to St. Louis; those which were received in sufficient quantity for distribution extend the number to 318. Mr. Lindheimer is now entering upon an unexplored field west of the Colorado River, and we may confidently expect that a rich harvest of peculiar plants will reward his efforts during the present season. This collection will be assorted and distributed without delay, and our account of them duly published in the pages of this journal.

The collection of 1843 was made on Galveston Island, around Houston, on the Brazos, &c. The series commences with some species of Ranunculus, allied to *R. pusillus*, which, having been long since distinguished by Dr. Engelmann, and communicated to various botanists under the following names, the characters as assigned by him are here given.

1. Ranunculus Texensis (*Engel. MSS.*): caule erecto ramosissimo basi hispido; foliis petiolatis, inferioribus ovatis subcordatis denticulatis, superioribus lineari-lanceolatis, basi petiolorum membranaceo-dilatata bracteisque ciliatis; petalis 5 oblongis sepala ovata obtusa longe superantibus; staminibus plurimis; carpellis subglobosis acutis minutim tuberculosis in capitulum globosum congestis. — Margin of ponds, &c. near

Plantæ Lindheimerianæ. 3

Houston. April. A span to a foot high, with conspicuous bright yellow petals.

2. R. trachyspermus (*Engel. MSS.*): caule ramoso glabro; foliis petiolatis, inferioribus plerumque orbiculato-ovatis obtusis subintegris, superioribus lanceolatis lineari-lanceolatisve denticulatis, basi petiolorum membranaceo-dilatata bracteisque subciliatis; sepalis 3–4 ovatis reflexis petala 3–5 minima lineari-spathulata superantibus; staminibus 5–10; carpellis compressis obtusis undique tuberculosis in capitulum oblongum seu cylindricum congestis. — Margin of ponds near Houston, &c. April, May.

3. R. trachyspermus, β angustifolius (*Engel. MSS.*): foliis omnibus lanceolatis lineari-lanceolatisve; — and γ? (an spec.?) Lindheimeri (*Engel. MSS.*): foliis inferioribus ovatis; sepalis 3–5 ovatis obtusis patentibus petala 3 linearispathulata æquantibus; carpellis compressis obtusiusculis tuberculosis in capitulum globosum congestis. — Near Houston, &c. but not growing together with No. 2.

4. Clematis cylindrica, *Sims.* A narrow-leaved variety; the herbaceous stem beginning to flower in April, when only a foot or so in height. Houston.

5. C. reticulata, *Walt.* Houston. June.

6. Anemone Caroliniana, *Walt.* Prairies, Houston. February, March.

7. Cocculus Carolinus, *DC.* Houston. June.

8. Streptanthus hyacinthoides, *Hook. Bot. Mag.* t. 3516. West of the Brazos. July.

9. Cristatilla erosa, *Nutt.*; *Torr. & Gr. Fl.* I. p. 123. Sandy prairies on the Brazos. August.

10. Cleomella Mexicana, *DC.* High prairies west of the Houston. April, August.

11. Polygala leptocaulis, *Torr. & Gr. Fl.* I. p. 130. West of the Brazos. August. — More or less branched. Capsules ovate, with glands along the dissepiment on the face of the valves.

12. P. incarnata, *Linn.* Houston. April.

Fig. 4 "Plantae Lindheimerianae, Part 1" (Engelmann and Gray 1845), the first fruit ripened from Gray and Engelmann's long-term collaboration to explore the American West. (Courtesy of the Peter H. Raven Library, Missouri Botanical Garden, Saint Louis, MO, USA.)

subscription mode as effectively as their European colleagues. Lindheimer's collections sold well as a result. On September 1, 1846, Engelmann wrote to Gray with relief: "All the sets of Lindheimer are now sold, at least all in this county and England; there may be some 2 or 3 unsold in Germany."[33]

Still, as the nexus that connected Gray to Lindheimer, Engelmann was constantly worried about whether the collector had been sufficiently remunerated for his labor. "I am afraid his last two years work will bring him hardly more than 300 dollars," Engelmann informed Gray in January 1845.[34] Gray was concerned as well, and immediately began searching for what he called "gentlemen with public spirit" to make Lindheimer's subscription list longer. He soon exclaimed to Engelmann that "we have broken the ice!" John A. Lowell (1798–1881), a successful banker, ardent horticulturalist, and enthusiastic plant lover, had agreed to join Lindheimer's subscription list and expressed his interest in subscribing to any other botanical

[33] Engelmann to Gray, September 1 1846, *HL*.

[34] Engelmann to Gray, January 11, 1845, *HL*.

expedition that Gray and Engelmann wanted to organize.[35] They were encouraged by this, and after informing Lindheimer that Lowell would subscribe to his enterprise in the form of "stipends," the two botanists recruited a second German immigrant, Augustus Fendler, and sent him to collect in New Mexico. "As soon as he is in the field, and shown by his first collections that he is deserving," Gray told Engelmann, "I can get much more money advanced for him." Engelmann also celebrated what he and Gray had achieved. "I began to hope a little more from this country for science!!" he replied.[36]

Fendler, the second collector to join Gray and Engelmann's subscription mode, was a German immigrant from East Prussia. As he recalled afterward, his interest in this particular enterprise dated back to 1844, when he briefly returned to Germany and paid a visit to Koenigsberg. There he met a botany professor named Ernst Meyer and learned that "a certain number of sets of dried specimens of plants for the herbarium might be disposed of at a reasonable price."[37] Upon returning to the United States, Fendler began collecting in St. Louis to see if Professor Meyer's words would hold true. Soon he contacted Engelmann. He wondered if Engelmann could introduce him to interested persons so that he could sell his St. Louis collection. Engelmann replied that Fendler's proposal was improbable. He suggested that Fendler study more particularly the flora of St. Louis's neighborhoods and then go to collect in some more distant region. Fendler accepted Engelmann's suggestion. He soon picked Santa Fe as his destination and planned to botanize there in 1847. Then, coincidentally, Gray's letter came suggesting an expedition to Santa Fe. Expecting that the Santa Fe expedition would constitute a watershed moment in his career, Fendler sold his property for $75, outfitted himself, recruited his young brother as an assistant, and told Engelmann that he was ready to go.[38]

On August 1, 1847, Fendler departed for Santa Fe, with $170 and "full written instructions" prepared by Engelmann about plant collecting and note-taking. Fendler returned to St. Louis in September, exhausted and penniless. He had used up all his funds during his stay in Santa Fe and had been forced to sell his watch, gun, and other personal items to get his luggage and collections delivered back to St. Louis by Mexican traders.[39] Engelmann immediately applied himself to sorting Fendler's specimens into sets. "All my leisure time has been devoted to assist him in arranging his collections," he told Gray in October. "I am just putting out a collection for Fendler, for you and for myself, the rest to be distributed first to the few subscribers who have paid before hand."[40]

[35] Gray to Engelmann, February 3, 1845, *AGPG*; Gray used the term "gentlemen with public spirit" in a letter sent to Hooker, dated February 28, 1843 (see Gray 1893, p. 299).

[36] Gray to Engelmann, July 15, 1846, *AGPG*; Engelmann to Gray, August 2, 1846, *HL*.

[37] Fendler's autobiography can be found in Canby (1885); the quotation is from p. 288.

[38] See Engelmann to Gray, July 3, 1846, *HL*.

[39] Fendler to Gray, July 25, 1848, *HL*.

[40] Engelmann to Gray, October 31, 1847, *HL*.

Gray got hold of Fendler's plants in December. "The specimens are perfectly charming!" he exclaimed to Engelmann. "All Fendler's collection will be sold at once, no fear, such fine specimens and so many good plants."[41] However, partly because Fendler's specimens (which, according to Engelmann's estimation, numbered some 12,000 pieces), were not in a good order, and partly because neither Gray nor Engelmann could spare the time to make Fendler's "good plants" truly saleable (that is, arranged in a taxonomic order, mounted on good sheets of paper, printed and with labels attached to each sheet, and so on), it wasn't until November of the next year that Gray sent *Plantae Fendlerianae Novi-Mexicanae* (including some 462 species and varieties) to the American Academy of Arts and Sciences to be published in the Academy's *Memoir*. Gray understood that his enumeration of Fendler's collection was far from complete (he had finished it up to *Compositae*), but he felt obliged to get it published immediately. Beyond the imperative of securing priority for naming and describing new species, he considered *Plantae Fendlerianae Novi-Mexicanae* an advertisement for Fendler's future expeditions. "It is greatly to be wished that he should receive patronage, in the form of additional subscriptions for his collections, which may enable him to reengage in this arduous undertaking under more favorable circumstances than before" (Gray 1849, p. 2). The advertisement worked. Gray soon reported to Engelmann that he could probably advance some $300 for Fendler's next expedition to Santa Fe, and probably a trip to Salt Lake, as well.[42] Fendler embarked on his second botanical expedition under Gray and Engelmann's aegis in March 1849.[43]

European naturalists could hardly allow their American counterparts to monopolize the chance of making new discoveries. In 1845, Carl Ferdinand von Roemer (1818–1891), a well-trained professor of geology at the University of Berlin, set sail for Texas with a letter of introduction from Alexander von Humboldt (1769–1859). Roemer's expedition, under the auspices of the Berlin Academy of Science, was commissioned to survey Texas natural history in general and its geology in particular. Early in 1846, Roemer reached New Braunfels and immediately set out to seek Lindheimer, the plant collector (Roemer 1935, pp. 106–107). Engelmann grew worried upon learning of Roemer's expedition. "Are you aware," he wrote to Gray, "that,—[in] Bonn, Germany a society has been formed for the exploration of the nat. his. of Texas, which will publish a large work…. We must keep ahead of this!"[44] "We will keep ahead of the Bonn people," Gray replied. "By the close of next summer (Deo favente) we may hope to have the botany of Texas pretty well in our hands."[45]

However, an unexpected incident occurred. Roemer, eager to secure scientific priority for his discoveries in Texas, recruited a number of competent naturalists to help him enumerate his own natural history collections. As for the botanical collections,

[41] Gray to Engelmann, December 20, 1847, *AGPG*.

[42] Gray reported the financial support he had secured for Fendler in two letters, dated November 18, 1848 and November 30, 1848, respectively, both of which are in *AGPG*.

[43] Engelmann to Gray, March 28, 1849, *HL*.

[44] Engelmann to Gray, 10 December 1846, *HL*.

[45] Gray to Engelmann, 5 January 1847, *AGPG*.

he placed them in the hands of George Heinrich Adolf Scheele (1808–1864), a pastor-botanist at Heersum. In 1848, Scheele began publishing a catalog of Roemer's collections in *Linnaea* (which he did until 1852). At first, neither Gray nor Engelmann were aware of Scheele's publishing project. In May 1849, however, Gray sent a note to Engelmann in haste, exclaiming that "one Scheele has been getting hold of Lindheimer's yet undistributed coll. of plants, and has been playing the deuce with them." Engelmann and Gray's failure to secure scientific priority to name and describe the new species also included in Lindheimer's collections provoked some uneasiness among American botanists. "Has this [publication of Scheele's] made any mischief in nomenclature?" Torrey inquired of Gray.[46]

In Gray and Engelmann's view, Scheele did make much "mischief" in nomenclature. "I to-day got two more nos.—with more abominable stuff of the same kind," Gray told Engelmann in November." Annoyed, he decided to send "a list of real names" along with Scheele's catalog to Diederich Franz Leonhard von Schlechtendal (1794–1866), editor of *Linnaea*. He would ask Schlechtendal to "admit no more of it into Linnaea."[47] Scheele's "mischief" may also be what provoked Gray to publish a review of Louis Agassiz's (1807–1873) *Nomenclator Zoologicus* (1842–1846) in *The American Journal of Science and Arts*. Gray translated a specific paragraph of *Nomenclator Zoologicus* to inform readers about a group of people who "deserved" naturalists' "censure." Agassiz had said, Gray wrote, that "we [naturalists] brand with infamy those impudent parasites who prowl about museums to pick materials for their *opuscula*, without mentioning the sources whence they have derived their spoil, and sometimes even furtively described the species, the names of which they claim." Gray told his readers that he absolutely concurred with Agassiz's "censure." In actuality, he added, "not less blameworthy are those who purposely pass by, instead of courteously adopting, appropriate names under which naturalists often distribute their species in advance of publication." Such a case constituted a "felony" and was "more atrocious" than Agassiz's "impudent parasites," expostulated Gray, "because remediless, and to be prevented by no rule except that of courtesy; for the public good requires that priority should be conceded to actual publication alone" (1847, pp. 305–306).

Partly because of Scheele's "felony" and his "atrocious" behavior, it was not until 1850 that Gray submitted "Plantae Lindheimerianae, Part II" to the Boston Society of Natural History for publication. In this article, he desperately waged a war over scientific priority against Scheele. Besides deriding Scheele's diagnoses of species, Gray aggressively reduced the German botanist's "new" species to varieties or synonyms of known species. His general opinion of Scheele's classifications was made clear when he reduced one of Scheele "new species" to his and Torrey's *Filaginopsis multicaulis*: "No great reliance can be placed on this writer's [Scheele's] determination" (Gray 1850, p. 224).

But the damage had already been done. With "Plantae Lindheimerianae, Part II" ready, Gray and Engelmann sorted Lindheimer's 1845–1848 collections into 40

[46] Gray to Engelmann, 2 May 1849, *AGPG*; Torrey to Gray, May 23, 1849, *HL*.
[47] Gray to Engelmann, November 7, 1849, *HL*.

sets, each of which contained some 300 species. Then the two botanists tried their best to "drum up" enthusiasm among Lindheimer's previous subscribers to purchase these sets.[48] This time, Lindheimer's collections were not well received. By the end of 1849, about 10 sets still remained unsold.[49] In other words, the whole four-year labor of collecting plants had earned Lindheimer less than $720 before deducting necessary expenses.[50]

The 1840s and 1850s also marked a turning point in Augustus Fendler's collecting career. Late in March, Engelmann informed Gray that Fendler would soon embark on a botanical expedition to Salt Lake with the Army. What came next was so unexpected and happened so fast that both Engelmann and Gray could scarcely respond. In May, Engelmann informed Gray that Fendler had left for Salt Lake. In July, he informed Gray that "Fendler had been obliged to give up the expedition" because an unsuccessful attempt to cross a river had cost Fendler's entire outfit. In August, Engelmann informed Gray that Fendler had returned to St. Louis and found that the recent Great Fire in that city had devastated all of his [Fendler's] belongings, including his botanical specimens, "except the plants of Santa Fe now in your hands or on their way to England."[51]

Engelmann began to think that maintaining a collector in the field using the subscription mode was a "bad business."[52] After finishing the distribution of Lindheimer's 1845–1848 collections (about 15,000 specimens), he asked Rudolph Friedrich Hohenacker (1798–1874) of Esslingen to oversee Lindheimer's collecting enterprise. He informed Gray of the new arrangement in March 1850.

> Mr. Hohenacker in Esslingen offers at my request to undertake the distribution and sale of Lindheimer's cheap collections but at what conditions!—L. is to pay freight and insurance to Esslingen; He is there to distribute the plants, print the labels and sell the plants, pay all further expenses, and to receive in recompensation one complete set and the third of the excerpts—Is that fair?—But how do better?—I can not go into the distribution of these distributions—have absolutely no time for it.—If Lindheimer can collect 400 species a year in 40 or 50 specimens he may sell them for $5.00 a hundred, but not make as much as $500 on them—but that is doing better than he is doing now.—But I shall I think propose him to accept.—He must first get more independent, and then he may undertake larger further expeditions.[53]

[48] The term "drum up" appeared in Gray to Engelmann, February 25, 1849 (J. L. Gray 1893, p. 362).

[49] See Engelmann to Gray, December 21, 1849, *HL*.

[50] For example, the best set of Lindheimer's was sold for the price of $38.50. See a letter from Engelmann to Gray, undated but postmarked March 10, 1850, *HL*.

[51] This paragraph is based on letters sent by Engelmann to Gray in 1849, dated March 28, May 13, July [undated], and August 6; all letters are in *HL*.

[52] The phrase "bad business" appears in a letter from Gray to Engelmann, dated June, 1, 1847, which can be found in *AGPG*.

[53] Engelmann to Gray, March 27, 1850, *HL*.

Engelmann also tried to persuade Fendler to send his specimens to Hohenacker.[54] "I hope you will trouble yourself not too much about the money affairs of Lindh. & Fendl.," he told Gray, and instead "save your valuable time for your studies."[55]

The Moral Economy of the Subscription Mode

Gray did not give up the hope that a well-maintained subscription mode would furnish him with the critical material needed to achieve such goals as compiling a North American flora according to European standards, professionalizing botanical collecting, and securing priority of naming and describing new American species. Early in the 1850s, when his collaboration with Engelmann, Lindheimer, and Fendler ended, Gray immediately recruited a Yale graduate and long-term Texas resident named Charles Wright (1811–1885) and sent him to collect in Texas via the subscription mode (see Gray 1852, 1853). Gray decided to take this step because he had figured out the moral economy to ensure that the subscription mode would function smoothly. To begin with, it is necessary to unveil a basic revision that Gray made in 1848 as to how the ideal subscription mode should be structured: authorship.

Authorship

As noted above, in 1838 Gray had believed that the central figure who ran a subscription mode should be a professional man of science, which meant someone who was capable of gathering plants in the field, undertaking detailed taxonomic work in a well-furnished herbarium, publishing his diagnoses of species along with specimens, and figuring out the best way in which to get this book of specimens sold. By the early 1850s, however, Gray had resolved to maintain the authorship of "Botany in this country" firmly in his own hands. Gray's resolution had everything to do with an element that McOuat (2001a) identifies as one of the foundations of metropolitan naturalists' cataloging power: A catalog accompanying distributed specimens should be a catalog of *species* instead of specimens. That is to say, species—and species alone—should be regarded as the unit that deserved a distribution number marked in a catalog, and therefore that species were the units by which to evaluate a given collection's scientific and monetary value and to calculate the subscription fee.

It took some time for this idea to infiltrate American botanical circles. In 1844, when Engelmann took charge of enumerating a collection made by Charles A. Geyer (1809–1853) in Illinois and Missouri, what he produced was a catalog of specimens (including varieties and "hybrids of different species of Verbena"; Engelmann 1844, p. 99). The first part of *Plantae Lindheimerianae* was mostly a catalog of specimens, as well. In it, Gray and Engelmann enumerated some 35 varieties and assigned each variety an independent distribution number. But when preparing *Plantae*

[54] Engelmann to Gray, May 18, 1850, *HL*.
[55] Engelmann to Gray, February 6, 1851, *HL*.

Fendlerianae Novi-Mexicanae (1849), Gray and Engelmann decided to follow the European standard and compile a catalog of species. It was Engelmann who came up with the proposal. In February 1848, busily sorting through Fendler's Santa Fe collections, he suggested what he thought was the appropriate format for *Plantae Fendlerianae Novi-Mexicanae* to Gray:

> I propose to follow Hooker's plan in the Plantae Geyerianae, namely to mention in the printed catalogue every plant collected, whether there are specimens enough for distribution or not. Even the commonest plants are interesting from a geographical point of view, and the rare or new ones ought not be passed by, even if they can not be distributed.[56]

"I like the plans you suggest about mentioning all the plants collected, whether enough to distribute or not," Gray replied.[57] The incoming *Plantae Fendlerianae Novi-Mexicanae* would no longer be a catalog for a particular collection made in certain places during a certain period of time; it would be a synopsis of the flora of the entire region, with species serving as its essential unit of categorization.

Against this backdrop, it is easy to see why a well-prepared catalog of species could not only satisfy botanists' intellectual interests but also enhance the value of collections. In 1854, for example, when Gray managed to persuade Charles Short to pay $400 to purchase Jean-Louis Berlandier's Mexican collection, he informed Engelmann of how this transaction went. "The specimens are mostly poor and rubbishy; but they are important as being mostly under the numbers that sets of them were distributed [here Gray added the word "sold"] in Europe—which numbers are quoted in D.C. Prodr. [Augustin Pyramus de Candolle's *Prodromus Systematis Naturalis Regni Vegetabilis*] and elsewhere—so that we may identify a great many published species with certainty."[58] To botanists of the mid-nineteenth century, then, a collection without a well-researched and published catalog of species was but piles of dried *stuff*. No matter how exquisitely a collection was made, it would hardly be worth $5 per hundred specimens (as in Hohenacker's arrangements with Lindheimer and Fendler). Of course, for a botanist like Gray who had long been thinking about the professionalization of botanical collecting, authoring catalogs for collectors' collections became an essential means by which he could bring these ideas to fruition. In a well-maintained subscription mode, the making of a botanical author and the making of a professional collector were two sides of the same coin.

Thus, running the subscription mode would help Gray amass "social capital," securing his reputation as a respected botanical author and allowing him to command an army of professional collectors. Once his status in the world of botany was secured, Gray would become extraordinarily "rich" by getting hold of many complete sets of specimens. After all, botanists of the day were living in a world where species of plants (not specimens) were widely regarded as currency. Engelmann, for example, paid John A. Lowell for a copy of Gray's *Genera Florae Americae*

[56] Engelmann to Gray, February 15, 1848, *HL*.
[57] Gray to Engelmann, February 29, 1848, *AGPG*.
[58] Gray to Engelmann, August 1, 1854, *AGPG*.

Boreali-Orientalis Illustrata by giving him a collection containing 210 species. Fendler, upon learning of this particular means of exchange, asked Gray to send him natural-history books and other useful items. Fendler told Gray that he should be able to pay for them using his (Fendler's) collections, then at Gray's disposal.[59]

Role Models

But being a metropolitan botanist serving as the link between collectors and subscribers required more than large libraries, herbaria, and social networks. In the late 1840s and early 1850s, when running the subscription mode had given rise to such tricky issues as scientific priority and how to fairly remunerate collectors' labor, Gray had two role models who guided his actions: Sir William Hooker and Augustin Pyramus de Candolle (1778–1841). For American botanists of the mid-nineteenth century, Hooker's unparalleled capability to recruit "private collectors" to join his subscription mode was legendary. In Hooker's voluminous publications, based on collectors' botanical labor, botanists got a clear sense that no matter how much time and attention this distinguished botanist had given to planning the expedition, advising the collectors, distributing collections, and enumerating species, he did not charge any fee either to subscribers or to collectors. Here it is useful to note that Hooker himself was by no means rich. As a professor in botany, a relatively low position by Victorian standards, Hooker in the 1830 s was always in search of patronage through which he could make a decent living. At times, in fact, Professor Hooker had to stand outside the door of his classroom to collect students' attendance fees.[60] But insofar as the running of the subscription mode was concerned, Hooker never thought to get paid for his labor. As a nexus connecting collectors with subscribers, he aimed only to prove his trustworthiness and his disinterestedness. He did not behave as an agent who sold specimens on behalf of a collector and charged a commission. Nor did he act like the specimen dealers who, as was often the case, exhibited a strong tendency to multiply the number of the species in their collections to extract more money from buyers (and thus became known as "species mongers"). According to Hooker's definition, a botanist in charge of a subscription mode ought to be a trustworthy gentleman of science. Hooker believed that in spite of (or perhaps because of) his entirely secular role in running a subscription mode, a botanist ought to envelop himself in an aura of disinterestedness by distancing himself from specimen dealers and species mongers alike. "The single-mindedness with which he gave himself to his scientific work, and the conscientiousness with which he lived *for* science while he lived *by* it, were above praise," Gray would comment in Hooker's obituary (Gray 1866, p. 9).

The way in which Gray fashioned de Candolle as a role model for American botanists related to the reception of the natural system of classification in the United States. Developed and refined by Antoine Laurent de Jussieu (1748–1836) and de

[59] Engelmann to Gray, September 1, 1846, *HL*; Fendler to Gray, October 23, 1853, *HL*.

[60] My ideas regarding Hooker's social status are based on Endersby (2008, pp. 8–12).

Candolle, the natural system highlighted a more physiologically or "naturally" based classification in contrast to Linnaeus's artificial system.[61] On the other side of the Atlantic, it was Rafinesque who eagerly promoted the superiority of the natural system. In his 1820 lecture on botany at Transylvania University, he argued that the Linnaean system produced "many anomalies and irregularities," thus prompting the "best botanists" to familiarize themselves with the "natural method or classification" (quoted in Boewe 2005, p. 125).

To Gray, although he appreciated Rafinesque's effort in introducing de Candolle's natural system to American audiences, he was worried that the natural system would fan what he considered to be the severest one of all "quackeries" in science: Rafinesquism. As a result, besides ridiculing Rafinesque's classification in the botanist's obituary, he tried to convince his readers that although everyone could be a collector of facts, he or she should present the collected facts to competent "men of research" like de Candolle and rely on them to generalize a view of nature. For example, in 1844, when the world of science was agitated by the transmutationist and materialist views of nature advocated by the anonymously published *Vestige of the Natural History of Creation*, Gray threw the following question to readers of *The North American Review*: "Why, we ask, should not the unprofessional reader rely upon their independent testimony, in respect to facts which they are the most competent witnesses of, and inferences of which they have the best means of judging?" His answer to this question was that the reader should not. "Who but the men of research have ever established sound and comprehensive views of nature or have made stable generalizations in any branch of science? Did Newton, Herschel, Laplace, Cuvier, Davy, De Candolle, or Humboldt, give to the world mere naked facts, the germs of great views that had to fall into other minds ere they were developed or grew fecund?" (1846, p. 506). Then, in a book review (and also an obituary) of de Candolle's posthumous *Mémoires et souvenir* (1862), Gray noted that what made the Swiss botanist a great natural philosopher had everything to do with de Candolle's manners in maintaining his collecting networks:

> To De Candolle's credit it must be said, not only that his career was remarkably free from controversies about priority and reclamations, but that his example and precepts, his scrupulous care to render due credit to every contributor, his respect for unpublished names communicated to his own or recorded in other herbaria, and the like, have been most influential in establishing both the law and the ethics which prevail in systematic botany (more fully, or from an earlier period than in the other departments of natural history), and which have secured such general coöperation and harmonious relations among its votaries. (1863, p. 6)

As he grew more deeply involved in the subscription mode, Gray tried to adhere to "the law and the ethics" exemplified by Hooker and de Candolle. When

[61] For the history of the natural system and de Candolle's role therein, see Peter F. Stevens's influential *The Development of Biological Systematics: Antoine-Laurent de Jussieu, Nature, and the Natural System* (1994).

enumerating and publishing collectors' or correspondents' collections, for example, he always used quotation marks and italics to emphasize his collectors' and collaborators' contributions. "I am quite ready to duly credit any one who sends me plants," he once told Engelmann. "This small notoriety is all that incites some of these people to collect; and so good to science comes out of these evil passions even."[62] In this regard, it is fair to say that when Gray distributed these specimens along with his authored catalogs, his intentions went beyond disseminating his own judgments about American species, enhancing scientific and monetary values of the distributed collections, and so on. Equally important, the distributed catalog was now also a piece of evidence showing that Gray, a humble professor who had to "live by science," could also produce good science because he was a man of science as good as such naturalists as Hooker and Augustin Pyramus de Candolle. In this regard, if assistants working at a seventeenth-century laboratory were deemed "invisible" (Shapin 1989) because they got paid for a means of making a living considered unacceptable in gentlemanly science, then in nineteenth-century natural history, assistants who helped metropolitan naturalists to come up with a good judgment of species had to be made visible, on the grounds that metropolitan naturalists needed such visibility to demonstrate that their own judgments were not distorted by "evil passions."

While using Sir William Hooker and Augustin Pyramus de Candolle to exemplify how a metropolitan naturalist ought to behave, Gray also disseminated what he considered to be moral codes for "professional collectors." I have noted that from the beginning, Gray had planned to use the subscription mode to professionalize botanical collecting, and that his original scheme was to train a botanical collector who would be capable of making money not by selling specimens, but by selling books made of specimens. However, influenced by other metropolitan botanists' attempt to standardize nomenclature and taxonomy, Gray had no choice but to keep botanical authorship firmly in his hands. This caused Gray to question what being a professional collector meant and how such a collector should behave. Did a professional collector who lacked botanical authorship merely become a commercial collector who sold specimens? To answer this question, it is worthwhile to examine how Gray joined forces with such metropolitan naturalists as Augustin Pyramus de Candolle and Alphonse Pyramus de Candolle (1806–1893) to ruin the reputation of a collector named Jean-Louis Berlandier (1803–1851).

Born in Fort-de-l'Ecluse, France at the turn of the eighteenth century, Berlandier studied with Augustin Pyramus de Candolle in Geneva in the early 1820 s. At the time, de Candolle was troubled by the "lack of success" of Heinrich Wydler's (1800–1883) expedition to Mexico under his charge.[63] In light of this, after witnessing Berlandier's enthusiasm both in the herbarium and in the field, de Candolle

[62] Gray to Engelmann, July 14, 1853, *AGPG*.

[63] According to Alphonse Pyramus de Candolle, Wydler got yellow fever upon his arrival in Puerto Rico, and could only send back a small number of specimens of poor quality; see de Candolle (1862, p. 337).

believed that he had found the man capable of carrying out Wydler's unfinished expedition.[64]

De Candolle then built a support network for Berlandier, paying 16,000 francs for Berlandier's outfit and offering him a salary for 3 years (1826–1829). In fact, the Swiss botanist's influence was so far-reaching that the Mexican government agreed to appoint Berlandier as botanist to the Mexican Boundary Commission (Muller 1980, pp. xi–xii). In December 1826, Berlandier disembarked at Pánuco near Mexico.[65] Over the following years, however, besides sending de Candolle a limited number of specimens, together with a note expressing his discontent with de Candolle's associates in Geneva, Berlandier hardly corresponded with de Candolle. De Candolle felt betrayed. In his *Mémoires et souvenirs*, published posthumously in 1862, de Candolle enumerated how much he and his associates had done for Berlandier's expedition. In his opinion, only a few collectors had ever received support and training as complete as Berlandier's. But "Berlandier profited poorly from these advantages," the botanist complained. Berlandier's "foolishly ambitious, restless, vain, and independent character," he added, "was not pleased with some teasing from the one among us who was charged with the details of the voyage and he left already badly disposed." Worse, de Candolle wrote, Berlandier only sent back "dry plants in small numbers, badly chosen and badly prepared." In fact, concluded de Candolle, "at the end of some time he [Berlandier] even neglected to write us, to such a point we questioned for a long time whether he was dead or alive." Berlandier's failure "disgusted us," de Candolle wrote. "We found ourselves then having spent about 16,000 francs for some dry plants which were scarcely worth a quarter of that sum" (quoted in Muller 1980, pp. xvii–xviii; see also de Candolle 1862, pp. 336–337).

In case Augustin Pyramus de Candolle's words had not been harsh enough, Alphonse de Candolle attached a footnote in *Mémoires et souvenirs* further disparaging Berlandier's character:

> Berlandier, ashamed of his conduct, pretended he was dead. I discovered in Paris that he had written a letter to the Museum to offer his services, on the date of December 20, 1838, twelve years after his departure. I learned later that he had become, on his own authority, a doctor of medicine, that he had been employed by a Mexican general on boundary concerns… finally he perished (truly) in crossing the river of San Fernando in the summer of 1851. (Quoted in Muller 1980, pp. xx–xxi; also see de Candolle 1862, pp. 337–338)

Although it went unremarked by the two de Candolles, it was Asa Gray who supplied essential information that completed their attack on Berlandier's reputation. In 1851, after Berlandier had perished in the river of San Fernando, Darius N. Couch, a United States army officer, purchased Berlandier's specimens and some manuscripts from his widow. He tried to sell them to the Smithsonian Institution but failed, for the

[64] For a biographical account of Berlandier, see Muller (1980).

[65] For a thorough introduction of Berlandier's frequent expeditions to South and West Texas and northeastern Mexico, see Muller (1980, pp. xv–xvi).

Institution was low on funding. Couch then sought for other buyers. Charles Short, upon Gray's suggestions, purchased Berlandier's collection for $400. Short knew from Gray that Berlandier was notorious for making poor specimens, but he regarded this purchase to be worthwhile, largely because Gray would take the responsibility of sorting Berlandier's specimens into sets and enumerating the species.[66]

But when Short came to examine his set of Berlandier's specimens, he was disappointed. In a letter to Gray dated May 9, 1855, Short described the collection that had cost him $400 as "French trash" and the "mess of rotten rubbish." "Seriously," he continued, "would it not be best for us still to throw these Pests Berlandierianae into the fire?"[67]

If Berlandier's specimens were "too great eye-sores to you," Gray replied, "don't commit them to the flames, but present them to the herb. of the Academy of Nat. Sciences of Philadelphia."[68] He told Short that he himself had been forced to develop a great deal of patience toward specimens in poor quality and was as not troubled by Berlandier's poor specimen-making skill as Short appeared to be. What annoyed him more was Berlandier's apparent misconduct in ticketing and distributing specimens:

> I see ample evidence that Berlandier was not only a lazy lout, but a great scamp, as you say. I find he used to collect a quantity of a plant all at one and the same time, and distribute only a part under one number—and afterward give the rest under another number—Sometimes the same stock was distributed and sold under 3 or 4 numbers![69]

In a letter to Engelmann in December 1855, Gray again remarked Berlandier's misconduct:

> You know what a scamp Berlandier was.—He collected a great stock—distributed a portion 1 year—say no. 993—the rest next year, say 2423. &c.— &c…. His original tickets enable me to ascertain that he proceeded systematically with this knavery year after year,—sometimes selling specimens gathered from the same tree 3 or 4 times over, under as many difft. numbers.[70]

A collector under the subscription mode also had a certain moral code to follow. He should never attempt to enumerate his own collections or to name any new

[66] For a concise account of the negotiations among Gray, Short, Couch, and the Smithsonian Institution, see Muller (1980, pp. xxviii–xxxv). In a letter to Charles Wright dated September 20, 1854, Gray wrote: "I am distributing, as I get spare hours…. The great mass of Berlandier's collections of plants (bought by Short) off into sets. They are mostly singular Texan things—gathered 20 years ago. It is a great job" (Gray to Wright, September 20, 1854, *AGPG*). To Engelmann, he wrote: "For Dr. Short has purchased the five large boxes of plants left by Berlandier, which Lieut. Couch bought of Berlandier's widow—and five great boxes are sent to me—with instructions to put the fullest set, with original memoranda into my own herbm. as most useful for American science" (Gray to Engelmann, August 1, 1854, *AGPG*).

[67] Short to Gray, May 9, 1855, *HL*; see also Muller (1980, pp. xxxii–xxxiii).

[68] Gray to Short, May 21, 1855, Coker (1941, pp. 143–144).

[69] Gray to Short, May 21, 1855, Coker (1941, p. 144).

[70] Gray to Engelmann, December 10, 1855, *AGPG*; also see Muller (1980, pp. xxxi–xxxii).

species. He should place his full confidence and trust in the metropolitan botanists and let them take charge of these matters. Most importantly, no matter how much physical hardship and mental turmoil he might suffer in the field, a professional collector must always remain committed to his subscribers, keeping them well-informed and ensuring that his own personal suffering did not damage the value of the subscription. A collector under the subscription mode, in short, needed to be a trustworthy gentleman of science. He should never behave like those "species mongers" who had a penchant for multiplying the number of species to extract more money from buyers. And it was the metropolitan botanists' duty to draw a fine line between professional collectors and species mongers.[71] If a collector could behave according to this moral code, he would not only receive credit but also rewards from the scientific community in the form of money calculated at a rate as high as eight dollars per hundred specimens. With a disinterested, trustworthy metropolitan naturalist standing between him and the scientific community, a professional collector should not ever sink to the level of a commercial collector.

Conclusion

Throughout the late 1840s and the early 1850s, Harvard botanist Asa Gray and his close friend George Engelmann of St. Louis recruited men who sought to make a living by natural-history collecting, sent these men into the field, searched for institutions and individuals to subscribe to incoming collections, compiled catalogs, and collected subscription fees. Although several botanists have noted Gray and Engelmann's bold experiment in terms of introducing to the U.S. a mode that European naturalists had devised to organize scientific expeditions, historians of science have not taken their "subscription mode" seriously. Given the popularity of the subscription mode in nineteenth-century natural history, combined with the fact that we still subscribe to a wide array of objects and services in modern times, this essay suggests that the subscription mode merits scholars' further attention as much as gift exchange, specimen dealership, commissioned expedition, patronage, surveying, and so on.

Gray's interest in the subscription mode can be traced back to the 1830s, when he was a budding American botanist experiencing the enthusiasm prevailing in European botanical circles for plants coming from North America. In his original scheme, Gray expected that running a subscription mode would turn a botanical collector into a botanical author; that is, this collector would hunt down botanical novelties in the field, gather necessary field information about them, make good specimens of them, publish these specimens in book form, and sell this book himself. To Gray, only by achieving this could a botanical collector make a respectable living. But Gray soon abandoned this scheme. Because of—or perhaps in spite of—British naturalists' attempts to generate and consolidate their "cataloging power," Gray began

[71] An important reference for understanding the moral codes in Gray's mind regarding the "professional collector" can be found in Gray (1862).

using the subscription mode to build a social world in which he himself constituted the intersection among professional collectors, amateur botanists, and subscribers as a metropolitan botanist comparable to those European botanists with large libraries and herbaria. I then delineated the moral economy that defined the professional collector, the amateur botanist, and the metropolitan botanist as the three critical pillars that would secure Gray's status when American botany entered into an age of surveying collecting. Of great importance here is Gray's definition of the professional collector. Although a body of literature has teased out this category, I argue that it is misleading for scholars to treat the professional collector as if he were another guise for the commercial collector. The fact is that in Gray's view, what mattered had less to do with whether or not a collector got paid; what concerned him was whether or not a collector got paid according to the metropolitan naturalists' judgment. In a subscription mode, the amount of money that a collector received in return for his collections was calculated on the basis of rates such as eight or ten dollars per hundred specimens. A collector who collaborated with metropolitan naturalists to figure how many species were contained in his collections could be regarded as a respected professional collector.

Thanks to the pioneering works of Secord (1994a), Endersby (2001, 2008), and Barrow (2000), scholars have been able to use the original material as criteria to categorize a scientific practice in question and then conduct their analyses accordingly. However, what kind of conclusions would scholars derive if they applied this approach to examining the subscription mode? First, if a scholar were to unreflectively use Barrow's work as a reference for examining the subscription mode, he/she would be likely to conclude that the subscription mode is but a variation on specimen dealership because those who supplied specimens also did get paid. Second, if a researcher examines the subscription mode via Secord's framework, he/she may believe that the mode could not have been functional if subscribers had not placed a great deal of trust in those who supplied the specimens, and thus that it seems reasonable to characterize the subscription mode as a rather peculiar manner of conducting a gift exchange. This essay demonstrates that both characterizations are problematic. Drawing on a growing body of literature in human geography and anthropology on "assemblage thinking," I argue that it is better to view the subscription mode as "a collection of relations between heterogeneous entities to work together for some time" (Müller and Schurr 2016, p. 218). While it may be reminiscent of Bruno Latour's actor-network theory as it might be, in the words of these geographers, assemblage thinking "hint[s] at the fluidity and ephemerality of assemblages and at their unpredictability" (Müller and Schurr 2016, p. 218). This essay shows that considering assemblage thinking can help historians of science avoid the danger of Vanessa Heggie's (2014, p. 329) "category dominance," adjust taken-for-granted categorical thinking, and prepare themselves to better answer a fundamental question in the history of science: How is scientific collaboration made possible?

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