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Making Natural History: Doing the Enlightenment

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The image of the Enlightenment as an era has proved to be remarkably constant, repeatedly resisting protracted and subtle attempts to de-ideologize, pluralize, and reperiodize it. Historians have turned away from a pure history of ideas in favor of a cultural history of publishing and reading, a social history of intellectual sociability, and the situating of ideas within historical-political constellations.[1] The concept of a homogeneous, quasi-monolithic Enlightenment has been pluralized and parceled into a large number of geographically and thematically distinct Enlightenments.[2] At the same time, the chronological scope of research interests has been extended and refined. Whereas the decades of the high Enlightenment in Britain and France were the initial focus of interest, the phase of the radical early Enlightenment has since achieved a firm place in a total panorama that also takes account of chronologically different developments in various national contexts.[3] Nonetheless it is true, although necessarily a generalization, to say that the

[1]In this context special reference should be made to Roger Chartier's work on the cultural practices of reading in the eighteenth century: *Lectures et lecteurs dans la France d'Ancien Régime* (Paris: Editions du Seuil, 1987); Roger Chartier, *Au bord de la falaise: L'histoire entre certitudes et inquiétude* (Paris: Albin Michel, 1998); and to Robert Darnton's analysis of the economic dynamic of one of the largest publishing projects of the French Enlightenment: *The Business of Enlightenment: A Publishing History of the "Encyclopédie," 1775–1800* (Cambridge, MA: Belknap, 1979). Situating ideas within historical-political constellations was oriented above all by the Cambridge School. Three of Quentin Skinner's fundamental essays can be found in James Tully, ed., *Meaning and Context: Quentin Skinner and his Critics* (Cambridge: Polity, 1988). Cf. in addition, Quentin Skinner, *Visions of Politics*, vol. 1, *Regarding Method* (Cambridge: Cambridge University Press, 2002). On John Pocock's positions, cf. John Pocock, "The Concept of a Language and the métier d'historien: Some Considerations on Practice," in *The Languages of Political Theory in Early-Modern Europe*, ed. Anthony Pagden (Cambridge: Cambridge University Press, 1987), 19–38; John Pocock, "Theory in History: Problems of Context and Narrative," in *The Oxford Handbook of Political Theory*, ed. John S. Dryzek et al. (Oxford: Oxford University Press, 2006), 163–74.

[2]Reference should here be made to numerous studies of the Enlightenment in different countries. See Roy Porter and Mikulás Teich, eds., *Enlightenment in National Context* (Cambridge: Cambridge University Press, 1981); Siegfried Jüttner and Jochen Schlobach, eds., *Europäische Aufklärung(en). Einheit und nationale Vielfalt* (Hamburg: Meiner, 1992).

[3]See Margaret C. Jacob, *The Radical Enlightenment: Pantheists, Freemasons, and Republicans* (London: Allen & Unwin, 1981); Jonathan Israel, *Radical Enlightenment: Philosophy and the Making of Modernity, 1650–1750* (New York: Oxford University Press, 2001).

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interpretation of the Enlightenment as a whole concentrates on an "Enlightenment thinking" characterized as rational, critical of dogma, and systematic, and whose main emphases are seen as political ideas, philosophy, criticism of superstition, and the experimental sciences. The intention here is to focus on the aspect of active mass participation in the intellectual project of the Enlightenment and to supplement the image of an intellectual history centered on the triad of ideas, authors, and texts (more rarely books) with a perspective that focuses on learned practice.

So far, historians have mainly explored the Enlightenment with the aid of two paradigms: dissemination and popularization. An interest in the genesis and circulation of ideas was followed by attention to social and cultural history issues relating to the class, milieu, and gender of the protagonists and readers of the Enlightenment and, under the slogan "the rise of the public sphere," to new forms of intellectual sociability and an expanding media landscape.[4] The emergence and reception of this thinking has been pursued in two directions: first, via clandestinely circulating books, pamphlets, and manuscripts into the sphere of a radical underground of the Enlightenment;[5] and second, via the media and strategies of popularization into the world of those social groups that were the target of the Enlightened education project, namely, women and the rural population.[6]

With the help of the popularization paradigm, the Enlightened sciences, too, were anchored in the eighteenth-century public sphere, which they played a significant part in developing. The work of Larry Stewart and others has shown that holding (often spectacular) scientific demonstrations in public created new audiences for subjects such as Newtonian mechanics, chemistry, and electricity.[7] As Stewart points out, "Newton's prism experiments entered

[4]A selection of publications on these issues: Jürgen Habermas, *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society* (Cambridge, MA: MIT Press, 1989); Dena Goodman, *The Republic of Letters: A Cultural History of the French Enlightenment* (Ithaca, NY: Cornell University Press, 1994); Jack Censer, *The French Press in the Age of Enlightenment* (London: Routledge, 1994); Ernst Fischer, Wilhelm Haefs, and York-Gothart Mix, eds., *Von Almanach bis Zeitung. Ein Handbuch der Medien in Deutschland, 1700–1800* (Munich: Beck, 1999).

[5]A selection of relevant work: Ira O. Wade, *The Clandestine Organization and Diffusion of Philosophic Ideas in France from 1700 to 1750* (Princeton, NJ: Princeton University Press, 1938); Robert Darnton, "The High Enlightenment and the Low Life of Literature in Pre-revolutionary France," *Past and Present* 51 (1971): 81–115; Robert Darnton, *The Literary Underground of the Old Regime* (Cambridge, MA: Harvard University Press, 1982); and the essays published in the French journal *La lettre clandestine*.

[6]This theme has received special attention from German researchers under the heading "*Volksaufklärung*" (educating the people). See, among others, Holger Böning, ed., *Volksaufklärung. Eine praktische Reformbewegung des 18. und 19. Jahrhunderts* (Bremen: Ed. Lumière, 2007); Ursula Tölle, *Rudolf Zacharias Becker. Versuche der Volksaufklärung in Deutschland* (Münster: Waxmann, 1994).

[7]A selection: Larry Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660–1750* (Cambridge: Cambridge University Press, 1992); Jan Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760–1820* (Cambridge: Cambridge University Press, 1992); Oliver Hochadel, *Öffentliche Wissenschaft. Elektrizität in der deutschen Aufklärung* (Göttingen: Wallstein, 2003); Bernadette Bensaude-Vincent and Christine Blondel, eds., *Science and Spectacle in the European Enlightenment* (Aldershot: Ashgate, 2008).

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the realm of folklore."[8] While this explains the surprisingly wide dissemination of mechanical knowledge, most novices encountered this or other scientific subjects within the framework of a concept that, for didactic and/or commercial reasons, was based on the simplification of complex material. Science was staged for an audience of amateurs that had to be educated and entertained.

For the broad intellectual impact of the Enlightenment, popularizing in this sense was an important factor, but not the only one. This essay will concentrate on a different dynamic in the field of Enlightened science, one that redefined the status of the scientific amateur, had a participatory rather than a distributive function, and was based less on an individual writing and reading of the Enlightenment than on the collective and cooperative doing of the Enlightenment. This essay will address natural history during the second half of the eighteenth century in particular as an integrative intellectual project that, with the aid of a repertoire of learned practices, made it possible for a socially heterogeneous and geographically widely scattered group of people to participate in the collaborative creation of knowledge.

Natural history, often written by historians of biology, has long been presented in the form of analyses of the work of prominent scientists,[9] whose taxonomies could then be synthesized into a corpus of knowledge.[10] Under this premise, the history of natural history, especially botany, presents itself as a history of ideas or systems, which represents the field of investigation as a succession of texts. This also makes it possible to integrate the natural history procedure of classification into an interpretation of the Enlightenment oriented by rationalization and systemization.[11] Only relatively recently has a cultural history of science also turned to natural history. Three collections of essays, in particular, should be mentioned: *Cultures of Natural History*,[12] which for the

[8]Stewart, *Rise*, XXXII.

[9]In the foreground are writers such as Linnaeus, Lamarck, and Buffon. A selection of work on Linnaeus: Frans A. Stafleu, *Linnaeus and the Linnaeans: The Spreading of Their Ideas in Systematic Botany, 1735–1789* (Utrecht: Oosthoek, 1971); Tore Frängsmyr, ed., *Linnaeus: The Man and His Work* (Berkeley, CA: University of California Press, 1983); Staffan Müller-Wille, *Botanik und weltweiter Handel. Zur Begründung eines natürlichen Systems der Pflanzen durch Carl von Linné, 1707–1778* (Berlin: VWB, 1999). On Lamarck, see Henri Daudin, *Cuvier et Lamarck: Les classes zoologiques et l'idée de série animale, 1790–1830*, 2 vols. (Paris: Felix Alcan, 1926); Ludmilla Jordanova, *Lamarck* (Oxford: Oxford University Press, 1984). On Buffon, see Giulio Barsanti, "Linné et Buffon: Deux visions différentes de la nature et de l'histoire naturelle," *Revue de Synthèse*, IIIe série, 113/114 (1984): 83–111; Jacques Roger, *Buffon: Un philosophe au Jardin du Roi* (Paris: Fayard, 1989); Thierry Hoquet, *Buffon: Histoire naturelle et philosophie* (Paris: Champion, 2005).

[10]See, for example, Ernst Mayr, *The Growth of Biological Thought: Diversity, Evolution, and Inheritance* (Cambridge, MA: Belknap Press of Harvard University Press, 1982); Peter F. Stevens, *The Development of Biological Systematics: Antoine-Laurent de Jussieu, Nature, and the Natural System* (New York: Columbia University Press, 1994).

[11]Cf. Tore Frängsmyr, J. L. Heilbron, and Robin E. Rider, eds., *The Quantifying Spirit in the Enlightenment* (Berkeley, CA: University of California Press, 1990).

[12]Nicholas Jardine, J. A. Secord et al., eds., *Cultures of Natural History* (Cambridge: Cambridge University Press, 1996); cf. also William Clark, Jan Golinski, and Simon Schaffer, eds., *The Sciences in Enlightened Europe* (Chicago: University of Chicago Press, 1999).

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first time opened up a spectrum of themes from natural history; *Colonial Botany*,[13] which addresses the imperial, colonial, and economic implications of a discipline of botany whose aim was to exploit exotic plants with an economic value; and *Wissen im Netz*,[14] on botanical correspondences as a medium of epistolary networking through the transfer of news and objects.

While a great deal of research on natural history continues to be published as journal articles or essays,[15] the monographs that have appeared recently follow one of two trends. The first group prefers to approach its subject via natural history collections, especially those held by individual institutions or well-known collectors.[16] The other approach is to interpret natural history as a cultural phenomenon reflecting crucial features of what Brian Ogilvie and Harold Cook have described as the *Zeitgeist*, Ogilvie in relation to the ideal of objectivity pursued by the Renaissance, and Cook with respect to the mentality of commerce in the Netherlands in the sixteenth and seventeenth centuries.[17] Both authors refer to aspects on which this essay will concentrate, namely, the practice and the material culture of natural history. Following Alix Cooper, who has drawn attention to the local dimension of natural history, doing natural history will be seen as a large-scale mobilization of practice, especially local practice, in the service of a global as well as national quest for knowledge.[18]

[13]Londa Schiebinger and Claudia Swan, eds., *Colonial Botany: Science, Commerce, and Politics in the Early Modern World* (Philadelphia: University of Pensylvania Press, 2005). Inspired by postcolonial studies, a focus of interest has for some time been developing around these themes. See, for example, David P. Miller and Peter H. Reill, eds., *Visions of Empire: Voyages, Botany, and Representations of Nature* (Cambridge: Cambridge University Press, 1996); Roy MacLeod, ed., *Nature and Empire: Science and the Colonial Enterprise* (Chicago: University of Chicago Press, 2000); Richard Drayton, *Nature's Government: Science, Imperial Britain, and the "Improvement" of the World* (New Haven, CT, and London: Yale University Press, 2000).

[14]Regina Dauser and Stefan Hächler, eds., *Wissen im Netz. Botanik und Pflanzentransfer in europäischen Korrespondenznetzen des 18. Jahrhunderts* (Berlin: Akademie Verlag, 2008).

[15]Cf. the following selection on innovative approaches: Staffan Müller-Wille, "Carl von Linnés Herbarschrank. Zur epistemischen Funktion eines Sammlungsmöbels," in *Sammeln als Wissen. Das Sammeln und seine wissenschaftsgeschichtliche Bedeutung*, ed. Anke te Heesen and Emma C. Spary (Göttingen: Wallstein, 2001), 22–38; Staffan Müller-Wille, "Joining Lapland and the Topinambes in Flourishing Holland: Center and Periphery in Linnean Botany," *Science in Context* 16, no. 4 (2003): 461–88; Anne Secord, "Science in the Pub: Artisan Botanists in Early Nineteenth-Century Lancashire," *History of Science* 32 (1994): 269–315; Anne Secord, "Botany on a Plate: Pleasure and the Power of Pictures in Promoting Early Nineteenth-Century Scientific Knowledge," *Isis* 93, no. 1 (2002): 28–57.

[16]Cf. Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley, CA: University of California Press, 1994); Emma C. Spary, *Utopia's Garden: French Natural History from Old Regime to Revolution* (Chicago: University of Chicago Press, 2000); Neil Chambers, *Joseph Banks and the British Museum: The World of Collecting 1770–1830* (London: Pickering and Chatto, 2007).

[17]Cf. Brian Ogilvie, *The Science of Describing: Natural History in Renaissance Europe* (Chicago: University of Chicago Press, 2006); Harold Cook, *Matters of Exchange: Commerce, Medicine, and Science in the Dutch Golden Age* (New Haven, CT: Yale University Press, 2007).

[18]Cf. Alix Cooper, *Inventing the Indigenous: Local Knowledge and Natural History in Early Modern Europe* (Cambridge: Cambridge University Press, 2007). This is by no means intended to deny

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While Deborah Harkness describes the phenomenon—to some extent comparable—of vernacular science in Elizabethan London as a genuinely urban approach to natural knowledge distinct from all other forms of scientific practice,[19] this essay will focus on the blanket coverage of doing natural science and its participatory, cooperative, and thus fundamentally integrative dimension.

I will first analyze how the enterprise of natural history, which aimed to achieve the worldwide registration, description, and classification of flora, fauna, and minerals, involved countless actors in collecting, naming, and describing mainly local natural objects. Doing natural history was not the same as writing natural history. The phenomenon of grassroots learnedness in natural history is to be located in the sphere of praxis, which cannot be reduced to learned authorship. Second, I will turn to the communicative practice of natural history. It is well known that doing natural history to a large extent consisted of exchanging specimens, which obliged all those involved to develop and cultivate networks of correspondences. I will focus on the local nature of the stock of objects whose exchange was the driving force behind the dynamic of a global natural history correspondence. As most of the practitioners of natural history had access to the natural specimens and publications available in their particular geographical area, they automatically had something of interest to offer others. The collecting and possessing of overwhelmingly local objects which, given the global claims of natural history, made communication and cooperation indispensable, opened up the system of natural history exchange to anyone who was interested and observed the elementary rules of participation. It resulted in people of different levels of education and learned standing coming into contact with each other. In conclusion, I will pursue the cooperative and participatory mode of natural history into the economic practice of cameralism, or to be more precise, the cameralist subfield of *technology*, where science and economics fused to fabricate progress. In this context we will locate an experimental practice in natural history and chemistry that invited participation in a collective effort, based on trial and error, to generate knowledge.

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During the second half of the eighteenth century in particular, different types of learned societies devoted themselves to natural history in general, or to its individual branches. Natural history could be treated either as a single subject, which

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the significance of long-distance expeditions for natural history, but it will not be discussed again here.

[19]Deborah E. Harkness, *The Jewel House: Elizabethan London and the Scientific Revolution* (New Haven, CT: Yale University Press, 2007).

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could thus confer its name on the society, or as part of a wider spectrum of themes comprising *Naturkunde* ("investigation of nature"), which could also include physics and chemistry, as well as mathematics, pharmacology, and technical subjects.[20] Economic and patriotic societies also concerned themselves with natural history, in particular, the botany of economically useful plants and the geology of mineral resources.[21] It is not possible to present an overall picture here, but previous attempts to draw up inventories reveal that apart from a number of pioneering enterprises,[22] societies devoted to natural history and natural science were created all over Europe from the 1740s on, that the pace of foundations accelerated in the 1770s, and that societies of this type were particularly concentrated in the German-language area. With programmatic founding statutes, regular meetings, fixed memberships (sometimes including external and corresponding members), and often their own journals, these bodies formed local centers of a privately organized scientific practice. In the German-language area with its fine-meshed network of societies, many of those who pursued natural history were integrated into this institutional structure. One of the earliest foundations, the *Naturforschende Gesellschaft* (Natural History Society, hereafter NG) founded in 1743 in Danzig, counted about

[20]A survey of the English-language literature on seventeenth- and eighteenth-century scientific societies is provided by James McClellan III, "Scientific Institutions and the Organization of Science," in *The Cambridge History of Science: Eighteenth-Century Science*, ed. Roy Porter (Cambridge: Cambridge University Press, 2003), 87–106, 87–92. See also Roger Hahn, *The Anatomy of a Scientific Institution: The Paris Academy of Sciences, 1666–1803* (Berkeley, CA: University of California Press, 1971); Daniel Roche, *Le siècle des Lumières en Province: Académies et académiciens provinciaux, 1680–1789* (Paris: Mouton, 1989; original Paris: École des hautes études en sciences sociales, 1978); H. E. Lowood, *Patriotism, Profit, and the Promotion of Science in the German Enlightenment: The Economic and Scientific Societies, 1760–1815* (New York: Garland, 1991); Holger Zaunstöck, *Sozietätslandschaft und Mitgliederstrukturen. Die mitteldeutschen Aufklärungsgesellschaften im 18. Jahrhundert* (Tübingen: Niemeyer, 1999); Detlef Döring and Kurt Nowak, eds., *Gelehrte Gesellschaften im mitteldeutschen Raum, 1650–1820*, 3 vols. (Stuttgart: Hirzel, 2000–2).

[21]On this, see esp. Lowood, *Patriotism, Profit, and the Promotion of Science*; Rudolf Vierhaus, ed., *Deutsche patriotische und gemeinnützige Gesellschaften* (Munich: Kraus, 1980).

[22]Cf. the Scholarly Societies Project of the University of Waterloo Library (Canada) that does justice to the European character of the association movement, at <http://www.scholarly-societies.org>; Lowood, *Patriotism, Profit, and the Promotion of Science*, 31 (table 2), 209 (table 17); and James E. McClellan, *Science Reorganized: Scientific Societies in the Eighteenth Century* (New York: Columbia University Press, 1985), 6–7, 261–91. In particular, see Anke te Heesen, "Vom naturgeschichtlichen Investor zum Staatsdiener. Sammler und Sammlungen der Gesellschaft Naturforschender Freunde zu Berlin um 1800," in *Sammeln als Wissen*, ed. Heesen and Spary, 62–84; Holger Zaunstöck, "Untersuchungen zur Struktur Naturforschender Gesellschaften im 18. Jahrhundert. Die Sozietäten in Halle, Leipzig und Jena," in *Naturwissenschaften um 1800. Beiträge zur Wissenschaftskultur in Weimar*, ed. Olaf Breitbach and Paul Ziche (Weimar: Böhlau, 2001), 155–78; Paul Ziche, "Die Jenaer Naturforschende Gesellschaft und ihre Bedeutung für die Naturforschung in Jena," in *Gelehrte Gesellschaften*, ed. Döring and Nowak, vol. 2, 107–32. One of the first natural history societies whose foundation is attested to is the *Società Botanica Fiorentina*, established in Florence in 1716. In the German-language area, the *Prüfende Gesellschaft zu Halle* (1735) was followed by the Naturforschende Gesellschaft in Danzig (1743), and then the Naturforschende Gesellschaft in Zurich (1746).

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forty permanent members, whereas the NG in Zurich had grown to seventy members after fifteen years. By the turn of the century, the NG Halle, the *Linnéische Societät* (Linnaean Society) in Leipzig, and the NG Jena had 179, 107, and just under 400 members respectively.[23] Although the socio-professional composition of societies varied, in most cases the majority of locally resident members were university graduates—medical doctors, clergy, administrative officials, professors, and teachers—or students. In the NG Halle, whose statutes specified that a basic knowledge of natural history was a prerequisite for membership, this group made up ninety percent of the members. At the same time, merchants and craftsmen, including several apothecaries, a bookseller, and a master baker, accounted for another six percent.[24]

So far, historians have discussed Enlightenment societies from two main points of view: as products of an increasingly state-directed organization of science, and in terms of the social background and professional stratification of their members.[25] James McClellan in particular has developed a progress-oriented line of interpretation that sees state sponsorship as the central feature of the eighteenth-century association movement and professionalization as one of its main outcomes. This is certainly correct as far as the academy movement is concerned, but it leaves the phenomenon of private learned societies as the site of Enlightened scholarliness largely untouched.[26]

This essay will therefore ask different questions in relation to natural history societies. What form did membership of these sorts of societies take? What types of learned practice did members engage in? What did they do there? Most of the societies defined their objectives as collecting, describing, classifying, and archiving flora, fauna, and minerals, both local and regional. For example, the *Berliner Gesellschaft Naturforschender Freunde* (Berlin Society of Friends of Natural Science) was founded in 1773 "with the primary purpose, common to all its members, precisely to identify the phenomena and peculiarities of nature as far as is in our power, diligently to study the whole of natural history but especially the natural history of our country with the assistance of a good scientific theory, and to make it the main object of its meetings."[27]

[23]A list of members organized by date of joining can be found in E. Schumann, "Geschichte der Naturforschenden Gesellschaft in Danzig, 1743–1892," Schriften der naturforschenden Gesellschaft in Danzig, new series 8, no. 2 (1893): 75–112. Cf. *Abhandlungen der Naturforschenden Gesellschaft in Zürich* 1 (1761): 56. For an analysis of the memberships of the natural history societies in Halle, Leipzig, and Jena, cf. Zaunstöck, "Untersuchungen," 155–78.

[24]Cf. Zaunstöck, "Untersuchungen," 160–2.

[25]This approach dominates the German-language literature. See, for example, Zaunstöck, *Sozietätslandschaft*.

[26]See McClellan, "Scientific Institutions"; and McClellan, *Science Reorganized*, 233–51.

[27]"... vornämlich im gemeinschaftlichen Bestreben aller Mitglieder, die Erscheinungen und Merkwürdigkeiten der Natur, so viel in unserer Gewalt ist, genau zu erkennen, die Naturgeschichte in ihrem ganzen Umfange, besonders aber die Naturgeschichte unserer Lande, mit Beyhülfe einer

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The NG in Zurich, founded by Johannes Gessner in 1746, was "most concerned with investigating the natural history of our regions precisely." The Linnaean Society in Leipzig, founded in 1789, was devoted to the "methodology of natural history" and "encouraging a knowledge of the natural history and geography of Saxony," while the NG founded in 1793 in Jena set itself the task of producing a "complete description of the natural world of Jena by the members who live there." In the same way the *Société d'histoire naturelle*, founded in 1790 in Paris, focused its program on the area around Paris.[28]

Complementing the concept of learnedness put forward by a historiography oriented by ideas and texts, this locally informed repertoire of natural history practices and their connections (which will be discussed later) proves to be an intellectual activity that did not impose the necessity of becoming an author. Natural history mobilized large numbers of enthusiasts in the service of a learned practice which allowed them to take part in a global quest for knowledge, for systematizing flora, fauna, and minerals worldwide required the accumulation of specimens from all over the world. These were by no means collected only by spectacular overseas expeditions. The natural history "collecte du monde,"[29] undertaken by expeditions sent out for the purpose of collecting, were exceptions with only a few participants on account of the cost of equipping them and the risks involved. But at the same time the project of natural history motivated large numbers of protagonists to "collect" Europe right where they lived.

Accordingly, natural history societies organized excursions to their close and more distant surroundings. The yield of these excursions, mostly in the form of

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guten Naturlehre, fleißig zu studieren und zum vorzüglichen Gegenstand ihrer Zusammenkünfte zu machen." "Gesetze der hiesigen Privatgesellschaft Naturforschender Freunde nach den Verbesserungen vom 3ten May 1774," *Beschäftigungen der Berlinischen Gesellschaft Naturforschender Freunde* 1 (1775): xxvii. On the chronology of the change in name, see <http//:www.scholarly-societies.org/history/1773bgnf.html>. Lowood uses the term "local science" in a different sense, namely, as the English translation of "Landeskunde"; see Lowood, *Patriotism, Profit, and the Promotion of Science*, 205–61.

[28]On Zurich, see *Abhandlungen der Naturforschenden Gesellschaft in Zürich* 1 (1761): v. See, in addition, Eduard Rübel, *Geschichte der Naturforschenden Gesellschaft in Zürich, 1746–1946* (Zurich: Fretz, 1947). On Leipzig, see *Nachricht von der am 31. Januar 1789 gestifteten naturforschenden Privatgesellschaft zu Leipzig* (Leipzig: n.p., 1799), 30, 39. On Jena, see Max Steinmetz, ed., *Geschichte der Universität Jena, 1548–1958* (Jena: G. Fischer, 1958), 298 (quote); and cf. Paul Ziche, "Die Grenzen der Universität. Naturforschende, physikalische und mechanische Aktivitäten in Jena," in *Universität Jena. Tradition und Innovation um 1800*, ed. Gerhard Müller et al. (Stuttgart: Steiner, 2001), 221–37. The *Société d'histoire naturelle* grew out of the *Société Linnéenne*, founded in Paris in 1787; see Pascal Duris, *Linné et la France, 1780–1850* (Geneva: Droz, 1993), 69–87.

[29]Marie-Noelle Bourguet, "La collecte du monde: Voyage et histoire naturelle, fin XVIIe siècle-début XIXe siècle," in *Le Muséum au premier siècle de son histoire*, ed. Claude Blanckaert and Claudine Cohen (Paris: Ed. du Muséum National d'Histoire Naturelle, 1997), 163–96. Raymond John Howgego provides an overview in *Encyclopedia of Exploration to 1800: A Comprehensive Reference Guide to the History and Literature of Exploration, Travel, and Colonization* (Potts Point: Hordern House, 2003). See also Schiebinger and Swan, eds., *Colonial Botany.*

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botanical and mineralogical specimens, was presented at meetings, identified, and described, and thereafter integrated into each society's own collection. The statutes of the Société d'histoire naturelle in Paris, for example, had a separate paragraph specifying that excursions of this sort into the environs of Paris were to take place every ten days so that, in time, a complete picture of the natural history of the area could be assembled. At the same time the Société resolved to institute a collection of local species, and instructed individual members to preserve and catalog the natural objects collected on these excursions.[30] The Berliner Gesellschaft Naturforschender Freunde laid down a different procedure. At every meeting, one of the members either had to give a lecture on a topic relevant to the society's local and regional interests or present an object from his personal collection, which would then be discussed.[31]

The fact that minutes of meetings and letters received by the society have been preserved in the case of the NG Halle, founded in 1799, allows us to gain a rare and detailed insight into the society's actual activities. The weekly meetings were held on Saturday afternoons, lasted about four hours, and were at first divided into two sessions. The first was devoted to the reading out of treatises written by members. The following *Gesprächsstunden* (discussion hours) were used to discuss the lecture and to study and identify the natural objects that had either been collected on excursions to the area around Halle, brought in by individual local members, or sent in by external members; thereafter, the natural objects were integrated into the society's collection. The course taken by the eleventh meeting, held on September 11, 1780, is representative of this early phase: "Mr. [Johann] Fabri the elder opened the session by reading . . . a treatise," followed by a second reading. "After these treatises were read, opinions on them were given, and these were discussed. Hereafter, a start was made on examining the insect cabinet, and in the class of beetles we got as far as . . ."[32] Over time, the lectures became less important, while the practice of natural history centering on joint work with objects grew in significance. Thus the minutes of the meeting held on April 1, 1781, noted that the whole time had been spent ordering the herbarium and identifying unknown plants according to the Linnaean system.[33] It was noted about four meetings held between the end of April and the beginning of June of the following year

[30]Cf. Procès-verbaux de la Société d'Histoire Naturelle (Bibliothèque Centrale du Muséum d'Histoire Naturelle Paris, manuscript 464).

[31]Cf. "Gesetze der hiesigen Privatgesellschaft Naturforschender Freunde," *Beschäftigungen der Berlinischen Gesellschaft Naturforschender Freunde* 1 (1775): xxvii.

[32]"Herr Johann Fabri der ältere eröffnete die Session mit Vorlesung einer [. . .] Abhandlung. [. . .] Nach Vorlesung dieser Abhandlungen wurden Urteile darüber gefällt, und über diese disputiert. Hierauf wurde mit Examinierung des Insectencabinets der Anfang gemacht und man kam in der Klasse der Käfer bis zu [. . .]." Archive of the *Deutsche Akademie der Naturforscher Leopoldina* in Halle, 90/3/4 14r, "Die ersten Protokolle der Halleschen Naturforschenden Gesellschaft."

[33]Ibid., 90/3/4 39r.

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that "these four sessions [can] easily be brought together [in the minutes], as they were largely spent identifying a number of plants, and with botanical and mineralogical excursions."[34] At the same time the letters of external members, or aspiring members, reflect the significant place of natural history practice in the lives of those who could not devote themselves to it in a full-time, professional capacity. A teacher, for example, described natural history as "a delightful occupation in addition to my real and important professional work,"[35] and a member of the Prussian buildings administration called it his "favorite study . . . in addition to far-reaching professional business."[36]

* * *

The registration of nature locally was a basic prerequisite for natural history's global project and resulted in closer connections between venues on the periphery and the centers of natural history, their institutions, and the scholars who lived there. Diverging from the well-known trickle-down model of Enlightened knowledge, natural history also shows knowledge circulating in the opposite direction: local knowledge in the form of specimens, data, and descriptions was transferred from below to above or, literally, from the grass roots to the centers,[37] where the material was integrated into larger collections and brought together in more comprehensive publications.

As the process of producing large natural history publications, for example, on regional or national flora, required the physical presence of as many of the featured objects as possible, authors had to ensure a supply of material sufficient for the scale of their project. This process fundamentally depended on the participation of a large number of collaborators who had the relevant knowledge to put together collections of natural objects and information on the spot, and then communicated them to "centers of calculation," to use Bruno Latour's term.[38] This form of mobilizing natural history practice will be demonstrated

[34]"... diese vier Sessionen können bequem im Protokoll zusammengezogen werden, da wir uns größtenteils mit Bestimmung mancher Pflanzen und mit botanischen und mineralogischen Exkursionen beschäftigt haben." Ibid., 90/3/4 43r.

[35]Letter from Georg Friedrich Götz in Hanau (Hessen) to the NG Halle, July 18, 1783, ibid., 90/4/2.

[36]Letter from Friedrich Wilhelm Siegfried in Berlin to the NG Halle, ibid.

[37]Sensitized by postcolonial studies, the history of science has so far studied the periphery-center dynamic of natural history and the related question of the significance of local knowledge primarily in relation to collecting expeditions in non-European regions or within colonial settings. Cf. among others, Schiebinger and Swan, eds., *Colonial Botany*; Paula Susan De Vos, "Natural History and the Pursuit of Empire in Eighteenth-Century Spain," *Eighteenth-Century Studies* 40, no. 2 (2007): 209–39.

[38]Bruno Latour describes the focuses of data-collecting projects as centers of calculation, to which material collected at the periphery is delivered for processing. See Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Cambridge, MA: Harvard University Press, 1987), 232–57.

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here by examining the process by which Albrecht von Haller put together his description of Swiss flora, *Historia stirpium indigenarum Helvetiae* (Berne, 1768). His reputation as one of the most prominent botanists of the second half of the eighteenth century was based on this work. Haller worked on his *magnum opus* for almost thirty years and documented the process of its creation in a sequence of publications, all of which illustrates the necessity of procuring material, the progress made, and—the subject of interest to us here—the logistics of this process which went on for decades. He got his material either by mounting his own expeditions or, on a much larger scale, by outsourcing the work of collecting to a network of colleagues and assistants, and exchanging the yields of others' excursions, as documented in his correspondence.

Haller's own botanical collecting activities in the Swiss Alps began in the late 1720s. Almost annually from 1729 to 1741 he roamed through one or more Swiss regions, including a number of massifs, wrote descriptions of plants on the spot, and perfected a herbarium that he cultivated for decades, thus creating the material basis and the intellectual justification for his botanical oeuvre.[39] The yield of these excursions was not only the result of Haller's own activities, but also of intense cooperation. Haller was often accompanied: at the beginning by his friend, the Zurich botanist and physician Johannes Gessner;[40] Emanuel König, professor of medicine and botany at Basel; or various students and protégés. The type of cooperation that was agreed with individuals for these excursions cannot be established with certainty, but Haller's statements and the letters of his traveling companions show clearly that they had assumed the role of botanical informers who collected over the entire country. Often they made available to Haller, or gave him outright, the plant collections that they had amassed on their own excursions, including descriptions of individual specimens. The foreword to *Enumeratio methodica stirpium Helvetiae indigenarum* (1742), Haller's first publication covering the whole of Switzerland, does justice to this specific form of collective authorship. It presents a list of collaborators that records the precise contribution made by every individual to the creation of the work, from those who accompanied excursions and assistants who procured material to the botanists consulted to identify individual species.

To complete his stock of plants, Haller conducted a collecting enterprise with more than ten collaborators.[41] He dispatched collecting agents to the regions of

[39]On Haller's botanical activity, but with emphasis on different aspects, see Luc Lienhard, "'La machine botanique.' Zur Entstehung von Hallers Flora der Schweiz," in *Hallers Netz. Ein europäischer Gelehrtenbriefwechsel zur Zeit der Aufklärung*, ed. Martin Stuber and Stefan Hächler (Basel: Schwabe, 2005), 371–410. Haller's Herbarium is held by the manuscript department of the Bibliothèque centrale du Muséum d'histoire naturelle in Paris.

[40]Urs Boschung, *Johannes Gessner, 1709–1790. Der Gründer der Naturforschenden Gesellschaft in Zürich* (Zurich: Naturforschenden Gesellschaft, 1996).

[41]Mainly Swiss doctors, including Jean-Jacques Châtelain, Johann Jakob Dick, Johann Caspar Füssli, Abraham Gagnebin, Johannes Hofer, Johann Jacob Huber, Werner La Chenal, Achilles

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Switzerland whose vegetation he had not yet recorded, or sent them out to find specific plants missing from his collection, a practice that reached a climax in the 1750s and 1760s, until his *Historia stirpium* was published in 1768. This system of delegating Alpine excursions required the recruitment of suitable collecting agents. Candidates had to be physically robust enough to cope with the exertions of mountaineering expeditions lasting several weeks; have a good knowledge of botany; make modest claims for payment, which Haller met from his personal means; follow his instructions concerning what to look for; and hand over the botanical yield of their journey to Haller in a well-preserved state. Thus those who came under consideration were mostly budding botanists, often medical students or young doctors who sought contact with Haller as one of the highest-ranking botanical authorities of the time, and for whom cooperation with Haller, acknowledged by name, was an honor.

Werner de La Chenal (1736–1800), who traveled for Haller until the publication of the *Historia Stirpium* and became one of his most important collaborators, fulfilled all these criteria at the time he became acquainted with Haller. In 1759 he had sent Haller a copy of his dissertation, published in the same year, about a number of species of Basel flora that had not yet been definitively identified.[42] Haller acknowledged receipt with an appreciative letter, in which he also made his first request. He would be happy, he wrote, if La Chenal could send him some of the rare plants discussed in his dissertation.[43] During the first year of their correspondence Haller suggested that La Chenal undertake two excursions through the Swiss Alps on his account and at his expense: in July 1760 and 1761, first through the Valais to the Little St. Bernhard Pass, then via Lucerne and Altdorf through the Ticino.[44] After La Chenal and his traveling companion, Chatelain, had accepted the conditions offered, Haller gave them a detailed plan that specified the route and precise length of stay at each place.[45] La Chenal, whose services as a botanical collecting agent fully lived up to expectations, composed his first report to his employer en route. In it,

Mieg, and Jacob Christoph Ramspeck. Information on this circle can be found in G. R. de Beer, "Haller's Historia Stirpium," *Annals of Science* 9 (1953): 1–46; Urs Boschung, Barbara Braun-Bucher et al., eds., *Repertorium zu Albert von Hallers Korrespondenz, 1724–1777*, 2 vols. (Basel: Schwabe, 2002).

[42] *Specimen inaugurale observationum botanicorum, quod [...] publice defendit Wernerus de La Chenal* (Basel, 1759).

[43] Letter, Albrecht von Haller to Werner de La Chenal, April 21, 1759, printed in Hermann Christ, "Der Briefwechsel der Basler Botaniker des 18. Jahrhunderts Achilles Mieg, Werner de La Chenal und Jakob Christoph Ramspeck mit Albrecht von Haller," *Verhandlungen der Naturforschenden Gesellschaft in Basel* 29 (1918): 1–59, 33 (my own translation of the Latin original).

[44] Cf. letter, Albrecht von Haller to Werner de La Chenal, September 14, 1759, ibid., 37.

[45] Letter, Albrecht von Haller to Werner de La Chenal, May 25, 1760, ibid., 41 (my own translation of the Latin original).

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he described what they had found and the exact location, whereupon Haller immediately proposed another expedition for the next summer.[46]

* * *

The wider circulation of local objects and information was achieved by means of huge communicative activity which was an essential element of everyday natural history practice, and allowed both more and less prominent natural historians to establish contact with unnamed collectors in the field. The protagonists of natural history were linked by a network of letter-writing, whose subject was the exchange not only of natural specimens but also of scientific literature. Doing natural history required establishing contact with as many like-minded people as possible, not only as a prerequisite but as a permanent aspect of learned practice, in order to compensate for the limitations of one's own material basis by exchange. For this reason, natural history proves to be one of the biggest generators of contact and communication in the eighteenth century, as reflected in particular in the extended botanical correspondences carried on by Linnaeus, Haller, Buffon, and Banks.[47] The dynamic of the international exchange of natural specimens was, to a large extent, dictated by the specific local resources available to those who participated in it. As all naturalists primarily possessed material that had been collected in their closer or more distant environs, they could offer what, as a rule, people who lived in another country, a different type of landscape, or a different climate zone lacked. The local and thus unique quality of the botanical specimens on offer opened up the market for a broad spectrum of protagonists who, on this basis, had the chance to establish contact with, among others, the great names of their discipline.

Linnaeus's status first as one of Europe's leading botanists, and then as *the* leading botanist in Europe, plus the global scope of his classificatory project placed him at the center of a monumental botanical correspondence. Scholars from all over Europe expressed opinions, by letter, on aspects of his system of classifying plants while establishing or cultivating an exchange relationship. They included numerous botanists of modest learned standing: those at the beginning of their careers, whose activities were limited to their local or regional

[46]Letter, Werner de La Chenal to Albrecht von Haller, July 21, 1760, ibid., 42f. After his return, a precise balance was drawn up. Cf. letter, Werner de La Chenal to Albrecht von Haller, August 13, 1760, ibid., 44. Letter, Albrecht von Haller to Werner de La Chenal, August 20, 1760, ibid.

[47]Cf. the Linnaean correspondence, an electronic presentation edited by the Swedish Linnaeus Society, Uppsala, and the *Centre international d'étude du XVIII siècle, Ferney-Voltaire* <http://linnaeus.c18.net>. For Haller's correspondence—ca.13,300 letters from 1,200 addressees—reference is again made to Boschung, Braun-Bucher et al., eds., *Repertorium*; Stuber and Hächler, eds., *Hallers Netz*. Cf. Henri Nadault de Buffon, ed., *La correspondance de Buffon*, 2 vols. (Geneva: Slatkine, 1971). Cf. the new edition of Banks's correspondence: Neil Chambers, ed., *The Scientific Correspondence of Sir Joseph Banks*, 6 vols. (London: Pickering & Chatto, 2007).

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surroundings, who had only small publications to their credit, or whose practice of natural history did not aspire to, or achieve, book form. The circulation of natural objects, indispensable for the process of creating knowledge in natural history, legitimated establishing contact.

Thus the German botanist Christian Gottlieb Ludwig (1709–1773), who was to become professor of medicine at the University of Leipzig in 1747, used the publication of his first work as an opportunity to start a correspondence with Linnaeus. In a letter dated 1736, he announced that he was sending Linnaeus his work about aquatic plants, *De vegetatione plantarum marinarum*, and followed this up with a request:

> If you can find any aquatic plants . . . could you please let me have those that you do not need yourself. I myself possess some, as you will see from my small treatise, but I lack many that are probably quite common where you are, and would therefore not be expensive.[48]

Soon thereafter he thanked Linnaeus for a consignment of fossilized plants that he had received, and promised an adequate quid pro quo.[49] The correspondence based on exchange that started thus was maintained by both sides for more than twenty-five years. Other correspondents offered plants or minerals from their particular geographical area for exchange, thus allowing Linnaeus to complete his capital of botanical and mineralogical specimens. In exchange, Linnaeus sent either Swedish material, or seeds or dried specimens from his international holdings, depending on what his correspondents requested. The correspondence that the Turin botanist Carlo Allioni (1725–1804) maintained with Linnaeus for almost thirty years was devoted to the genesis of Allioni's work on the flora of Piedmont.[50] Allioni asked questions about the identification of individual species and frequently sent Linnaeus packets containing northern Italian plants and seeds. In exchange he requested—and received—any duplicates that Linnaeus might have, or seeds or plants from Lapland, Siberia, Spain, and Asia.[51] From Ferdinando Bassi (ca. 1710–1774), director of the botanical garden in Bologna, Linnaeus received the botanical finds of his collecting expeditions through the Apennine mountains and the Italian Alps.[52] Johann

[48][Christian Gottlieb Ludwig], *De vegetatione plantarum marinarum [. . .]: Disserent praeses Christianus Gottlieb Ludwig respondens Michael Morgenbesser* (Leipzig, 1736). Letter, Christian Gottlieb Ludwig to Linnaeus, December 10, 1736, in <http://www.linnaeus.c18.net/Texts>, L0121 (my own translation of the Latin original).

[49]Letter, Christian Gottlieb Ludwig to Linnaeus, January 14, 1737, <http://www.linnaeus.c18.net/Texts>, L0135 (my own translation of the Latin original).

[50]Carlo Allioni, *Flora Pedemontana Sive Enumeratio Methodica Stirpium Indigenarum Pedemontii*, 3 vols. (Turin: Briolus, 1785).

[51]See, for example, the letters from Carlo Allioni to Carolus Linnaeus, August 13, 1757, and April 17, 1761, in <http://www.linnaeus.c18.net/Texts>, L3898, L2901.

[52]See the letters from Ferdinando Bassi to Carolus Linnaeus, December 13, 1767, and April 26, 1771, ibid., L4012, L4598.

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Albrecht Gesner, a German botanist, successfully initiated a correspondence based on exchange with Linnaeus for a number of years when he offered him minerals from Württemberg and other parts of Germany in exchange for similar material from Sweden, Norway, and Russia.[53] From Wolffenbüttel in Lower Saxony (Germany), the collector Franz Ernst Brückmann offered minerals from the region and other parts of Germany in exchange for various of Linnaeus's publications.[54]

The socio-professional spectrum of Linnaeus's exchange partners also included merchants, members of the army, and women. From Altdorf, Germany, a wine merchant by the name of Johann Friedrich Bauder sent Linnaeus his brief treatise about local marble containing fossils and offered to send him rock samples if he was interested.[55] In 1771 Anna Blackburne, an Englishwoman, sent Linnaeus a chest containing birds and insects.[56] While Linnaeus replied to these two attempts to make contact either not at all, or only briefly, a correspondence that continued for more than twenty years developed between Linnaeus and Christian Ludwig Krause, a gardener who had a plant and seed business in Berlin. Their relationship, which was at first primarily a commercial one—Linnaeus was one of Krause's customers—soon expanded through the ritual of an exchange of botanical gifts, which incorporated Krause into Linnaeus's network.[57]

The dense network of correspondents based on the exchange of local and regional materials not only served to transfer natural specimens, but also facilitated the mutual exchange of scientific literature. Thus a system was created that was able to compensate for a fundamental problem of the contemporary book market, namely, that beyond the local region, and certainly internationally, most publications, even those by the most famous authors, were available through the book trade only with great delays or not at all. For example, when Linnaeus's early writings, including the first edition of his *Systema naturae* (Leiden, 1735), were published in the Netherlands, their international availability was by no means assured, contrary to what is usually tacitly assumed. In 1737 the Leipzig botanist Ludwig was able to find neither the *Bibliotheca botanica* nor the "tabulas synopticas methodorum novarum" in Leipzig,

[53]See the letter from Johann Albrecht Gesner to Carolus Linnaeus, March 26, 1743, ibid., L0487.

[54]See the letter from Franz Ernst Brückmann to Carolus Linnaeus, September 18, 1737, ibid., L0199.

[55]Johann Friedrich Bauder, *Relation des fossiles découverts depuis quelques années dans les environs d'Altdorf* (Altdorf, 1772). See the letter from Johann Friedrich Bauder to Carolus Linnaeus, July 10, 1773, in <http://www.linnaeus.c18.net/Texts>, L4703. No answer from Linnaeus is recorded here. In addition, four letters from the German merchant and botanist Johann Christian Cuno are documented; <http://www.linnaeus.c18.net/Texts>, L1415, L1550, L1603, L1986.

[56]See the letter from Anna Blackburne to Carolus Linnaeus, October 14, 1771, <http://www.linnaeus.c18.net/Texts>, L4561.

[57]See the letters from Christian Ludwig Krause to Carolus Linnaeus from the years 1748–1769, ibid.

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host to the book fair.[58] Thus he wrote to Linnaeus, with whom he had been corresponding for some time, and asked him to send him the books:

> I have had only a brief glimpse of your *Bibliotheca botanica* and the synoptic tables of your new method. You can see, therefore, that I have only an inadequate notion of your method. I have not been able to find your writings in the Leipzig bookshops, and if I ask the booksellers to order the books from Holland, they push the prices up too much. If you could therefore please send me a copy of everything you have published so far, you would be doing me an extraordinary service. . . . I hope you will forgive my boldness. I will let no opportunity pass to serve you in any way I can.[59]

Ludwig seems to have received what he requested. In a second letter he builds on the successfully initiated exchange relationship. From now on the two corresponding authors do not simply exchange book for book, but they ask for books in the names of others. Ludwig requests the work of the Swedish zoologist Peter Artedi on the natural history of fish, which Linnaeus revised and edited, for the Danzig naturalist Jakob Theodor Klein; announces the imminent publication of his own treatise *de sexu plantarum*; asks Linnaeus to pass a copy on to a certain Andrew; and includes two works by Anton Wilhelm Platz about roots and seeds.[60] In 1742 the German naturalist and collector Franz Ernst Brückmann wrote to Linnaeus from the university town of Göttingen in Lower Saxony that he had not so far been able to find his *Flora Lapponica*, published in 1737, in the bookshops. He said that he had sent off the books by the German anatomist and surgeon Lorenz Heister that Linnaeus had requested. At the same time he expressed a desire for minerals from Lapland and Sweden.[61] With an earlier letter, Brückmann had sent Linnaeus his most recent publication, a mineralogical work about the region around the German town of Goslar, and

[58]Caroli Linnaei, *[. . .] biliotheca botanica recensens libros plus mille de plantis huc usque editos* (Amsterdam, 1736). Letter, Christian Gottlieb Ludwig to Linnaeus, January 14, 1737, in <http://www.linnaeus.c18.net/texts>, L0135. What remains unclear is which text is meant: Carl von Linné, *Systema naturae, sive, regna tria naturae systematice proposita per classes, ordines, genera & species* (Leiden: de Groot, 1735); or *Caroli Linnaei Sveci Methodus juxta quam physiologus accurate & feliciter concinnare potest historiam cujuscumque naturalis subjecti, sequentibus hisce paragraphis comprehensa* (Leiden, 1736); or both. The second through the ninth editions (1740–56) of *Systema naturae* contained the *Methodus* as *Methodus demonstrandi animalia, vegetabilia aut lapides*. Cf. Basil H. Soulsby, *A Catalogue of the Works of Linnaeus, and publications more immediately relating thereto, preserved in the Libraries of the British Museum*, 2nd ed. (London: British Museum, 1933), no. 40.

[59]C. G. Ludwig to Linnaeus, January 14, 1737, in <http://www.linnaeus.c18.net/texts>, L0135 (my own translation of the Latin original).

[60][Anton Wilhelm Platz], *Historiam radicum exponit [. . .] Antonius Guilelmus Plazius* (Leipzig, 1733); Anton Wilhelm Platz, *De plantarum seminibus*, 2 vols. (Leipzig, 1736–7). Letter, C. G. Ludwig to Linnaeus, October 22, 1737, in <http://www.linnaeus.c18.net/texts>, L0210.

[61]Carl von Linné, *Flora Lapponica exhibens plantas per Lapponiam crescentes, secundum systema sexuale collectas in itinere impensis Soc. Reg. Litt. et Scient. Sveciae a. 1731 instituto* (Amsterdam: Salomon Schouten, 1737). Letter, Franz Ernst Brückmann to Carolus Linnaeus, May 4, 1742, in <http://www.linnaeus.c18.net/texts>, L0463.

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announced the imminent publication of a larger work.[62] From Frankfurt an der Oder Linnaeus received another request for a copy of his *Flora Lapponica*. In return, the medical doctor and botanist Carl August von Bergen sent a number of dissertations written at German universities on natural history subjects.[63]

Not only like for like was exchanged. Sometimes natural specimens were exchanged for books, or books for information. The indispensability of this system committed all involved to observing a code of behavior governing exchange relations that sanctioned any non-fulfillment of obligations arising out of such relations with a loss of honor and exclusion from the network by which material was acquired.[64] This is why, especially among correspondents who had not known each other for long, it was necessary to reassure each other that they were reliable in observing the obligations arising out of an exchange relationship. The botanical correspondence of the eighteenth century documents this on a large scale. Obligations had to be fulfilled; failure to do this was considered an affront that put a strain on an exchange relationship, damaged it, or ended it. Thus Linnaeus, for example, had to defend himself against the complaint made by Nikolaus von Jacquin, a leading botanist from Vienna, that he had not answered any of his letters for a year, and had thus betrayed the trust placed in him. In his apology, Linnaeus pointed to the huge volume of correspondence that he received. Day and night were not long enough for him to reply to all the letters he received.[65]

Doing natural history committed its practitioners to communicate. It becomes clear that the centrality of objects in the process of creating knowledge in natural history generated a correspondence that linked both leading scholars and unpublished or little-published practitioners in a fine-meshed network. To a considerable extent it was the yield of local and regional practice in the form of specimens and publications that drove the integrative dynamic of this supra-regional and international contact.

* * *

An interest in natural history, however, was not limited to the sphere of "pure" scholarship but also diffused into the economic practices of Enlightened

[62]Letter, Franz Ernst Brückmann to Carolus Linnaeus, January 23, 1738, <http://www.linnaeus.c18.net/texts>, L0231.

[63]Cf. the letters from Carl August von Bergen to Carolus Linnaeus, June 24, 1743, ibid., L0493; and March 16, 1747, ibid., L0790.

[64]On the basic work on the culture of gift exchange, see Marcel Mauss, "Essai sur le don: Forme et raison de l'échange dans les sociétés archaïques," *L'Année Sociologique 1923–1924*, no. 1: 30–186. See also Staffan Müller-Wille, "Nature as a Marketplace: The Political Economy of Linnean Botany," *History of Political Economy*, Suppl. 35 (2003): 155–173.

[65]Letter, Carl von Linné to Nikolaus Joseph Jacquin, October 16, 1764, in *Caroli Linnaei epistolae ad Nicolaum Josephum Jacquin, ex autographis edidit C. N. J.eques a Schreibers* (Vienna, 1841), 79–81.

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absolutism. In conclusion, we will situate the making of natural history in the field of cameralism, where scientific practice merged with economic ambition in doing the Enlightenment. The main aim of the cameralist sciences was to develop measures to increase the state's economic efficiency, and in the eighteenth century they increasingly concentrated on agriculture, trade, and manufacturing.[66] In addition to *Polizey-Wissenschaft*, which corresponded roughly to the administrative sciences, this complex of knowledge centered on the disciplines of agriculture and technology, the latter understood as the science of the crafts and trades, their materials, and methods. In these two production-oriented fields of knowledge, natural history assumed a central role which has already been discussed in relation to agriculture,[67] but which has largely been ignored in the case of technology. In what follows, we will address the interaction among technology, natural history, and a second science, chemistry, in the project of fabricating progress. It appealed to civil servants and a broad spectrum of practitioners alike, and was essentially characterized by the activity that it set in motion. From the point of view of doing the Enlightenment, one of the most prominent subfields of cameralist technology, the craft and science of dyeing textiles, leather, and other materials, known in German as *Färbekunst*, will be analyzed as the generator of an intense experimental practice investigating the properties of native plants that could be commercially exploited with the technological help of chemical processes.

In 1775 a programmatic text was published under the title *Versuche mit einheimischen Färbematerien zum Nutzen der Färberey* (Experiments with Native Dyeing Materials for the Use of the Dyeing Trade) in which a medical doctor from Thuringia, Ambrosius Michael Sieffert, reported on the outcome of his experimental work.[68] On the basis of systematic experiments, he wrote in his introduction, he wanted to contribute to answering the question, central to manufacturing, of which native plants were most suitable for extracting pigments from, and which had the potential one day to replace highly valued and expensive imported pigments such as indigo. Sieffert proceeded as follows: creating extracts by mixing boiling water with the bark, wood, roots, and leaves of fifteen common native plants that grew in several local regions, including apple and cherry trees, the poplar, and one variety of willow; and

[66]For a selection of literature on this topic, see Hamish Scott, ed., *Enlightened Absolutism: Reform and Reformers in Later Eighteenth-Century Europe* (Ann Arbor, MI: University of Michigan Press, 1990); Marcus Sandl, *Ökonomie des Raumes. Der kameralwissenschaftliche Entwurf der Staatswirtschaft im 18. Jahrhundert* (Cologne et al.: Böhlau, 1999); Guillaume Garner, *État, économie et territoire en Allemagne: L'espace dans le caméralisme et l'économie politique* (Paris: Ed. de l'École des Hautes Études en Sciences Sociales, 2006).

[67]On this, see esp. Lisbet Koerner, *Linnaeus: Nature and Nation* (Cambridge, MA: Harvard University Press, 1999); cf. also Drayton, *Nature's Government*; Spary, *Utopia's Garden*.

[68]Ambrosius Michael Sieffert, *Versuche mit einheimischen Färbematerien zum Nutzen der Färberey* (Altenburg: Richter, 1775).

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then mixing the extracts, one after the other, with a number of different chemicals. In each of the solutions thus created, he dyed a specimen piece of wool, which was dried in the sun and then rinsed with water. The success or failure of every single stage of this standardized procedure was recorded: what color was achieved from which plants, how it changed under the influence of which chemicals, whether the wool absorbed the color, and how well it withstood the effects of sun and water. The aim was to subject the entire native flora to suitability tests of this sort in order to put together a repertoire of technically effective and thus economically relevant pigment-bearing plants in a relatively short time. At the same time, by systematically combining plant extracts with as broad a range of chemicals as possible, he aimed to establish the composition of the most effective dyeing solution in each case.

This sort of project could only be undertaken cooperatively by involving as many experimenters as possible in a process of generating knowledge based on trial and error. As a result, appeals for people to do experiments and reports of experiments undertaken or witnessed are a constant presence in the technological literature of the eighteenth century. Sieffert refers to promising experiments by unnamed experimenters which he attended, and concludes that "it [is] highly unlikely that nothing useful for dyeing should be found in so many of our plants that have not yet been adopted for use in the dyeing trade."[69] Krünitz's *Oekonomische Encyclopädie* sums up: "It is not easy to find another mechanical art ... in which reflection and untiring experimentation and efforts result in such beautiful and useful inventions."[70] Dyers in particular proved to be innovative experimenters. Nicolaus Kulenkamp from Bremen, who had risen from the ranks of the *Schönfärber* (members of this guild dyed woolen materials) to become a silk manufacturer succeeded, on the basis of his experiments, in writing three prize-winning essays on relevant competition questions posed by the Academy of Sciences in Göttingen. In 1756, 1757, and 1767 his response to questions such as "Whether any material can be found that provides a yellow dye that is as long-lasting as that from madder" won the gold medal.[71]

Unsuccessful experiments were as worth reporting as those that were successful, for only in this way could others profit from individuals' experiences, avoid

[69]Ibid., 8.

[70]Article "Das Färben," in Johann Georg Krünitz, *Oekonomisch-technologische Enzyklopädie*, 242 vols. (Berlin: Pauli, 1773–1858), vol. 12 (1777), 56.

[71]Nicolaus Kulenkamp's prize-winning essay of 1767, published in *Hannöverisches Magazin* 39 (1773): 609–620. See also Nicolaus Kulenkamp,"Vom Baue des Seeländischen Krappe, und wie diese Pflanze in den zunächst an der See gelegenen Gegenden mit Nutzen gebauet werden könne," *Hannöverische nützliche Sammlungen* 3 (1757): 17–37 (prize-winning essay of 1756); and Nicolaus Kulenkamp,"Die Art und Weise aus dem Waid eine dem Indigo nahe kommende Pflanze zuzubereiten," *Hannöverische nützliche Sammlungen* 14 (1758): 209–217 (prize-winning essay of 1757).

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dead-ends, and pursue promising leads further. Carl W. Pörner's *Chymische Versuche und Bemerkungen zum Nutzen der Färbekunst* (Chemical Experiments and Comments on the Uses of the Art of Dyeing) appealed explicitly to a specific target group, namely, craftsmen and manufacturers, when he explained in the introduction that descriptions of experiments that had been unsuccessful were included "so that practitioners … do not … undertake experiments in vain."[72] Countless essays with titles such as "*Versuche über einige Benutzungen der Rosskastanie*" ("Experiments with Various Uses of the Horse Chestnut"), and "*Vorschläge von Erfindung neuer Farbstoffe*" ("Suggestions for the Invention of New Dyestuffs"),[73] exhorting their readers to repeat, vary, or develop experiments further can be found in the practice-oriented periodicals of the second half of the eighteenth century. The authors of these essays present themselves not as individual inventors, but as anonymous participants in a collective effort to produce useful knowledge to be made generally available. As a result, in their essays they frequently report not only their own experiments, but also, mostly without mentioning names, those that had taken place in their personal surroundings.

* * *

This experimental program extended into the curricula of *Kameralwissenschaft* as taught at German-language universities, where future civil servants were made aware, as students, of the need to research the potential of native flora. A general introduction to natural history was a fixed element in the study of Kameralwissenschaft, and as a rule, it was followed by a course in "economic botany," which looked at the agricultural and commercial uses of natural products. Teaching in this practical subject was not limited to the lecture room, but often took place in gardens laid out specially for the purpose, in which predominantly native plants with economic potential were grown, and where the optimum conditions for their cultivation were sought. In a number of cases, these gardens were assigned a laboratory where, as part of the teaching program, experiments were carried out on the plants in the garden whose cultivation the cameralist improvement project encouraged. This work included identifying commercially viable native plants that could provide pigments, fibers for paper and textile production, and substances useful in the tanning of leather, as well as the application of chemical procedures to maximize the technical efficiency of these substances.

[72]Carl Wilhelm Pörner, *Chymische Versuche und Bemerkungen zum Nutzen der Färbekunst* (Leipzig: Weidmann, 1772), 2.

[73]"*Versuche über einige Benutzungen der Rosskastanie*," published in *Bemerkungen der kurpfälzischen physikalisch-ökonomischen Gesellschaft* (1780). "*Vorschläge von Erfindung neuer Farbstoffe*," published in *Monatliche Beyträge zur Naturkunde* 5 (1752): 364–69.

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The *Hohe Kameralschule zu Lautern* (cameral university at Lautern) in the Palatinate had a garden of this type, and Georg Adolph Suckow, professor of natural history, chemistry, and agriculture, wrote a pioneering textbook on economic botany on how to use this garden in the framework of academic teaching.[74] It listed the plants cultivated in the garden by their Latin names, included a brief Linnaean description of their botanical features, and divided them into categories according to the purposes they could be used for, such as "animal feed plants," "plants for use in dyeing," and "plants for use in tanning leather." The listing for each plant contained comments on its commercial use, and for those plants that were useful for the production of textiles and paper and for dyeing, they referred to the experiments that had produced this knowledge, or were intended to extend it. In the case of plants with established commercial value, such as *Färberröte* (dyer's madder), which could be used to produce intense red shades, up to fifteen experiments are listed;[75] in other cases, such as the plum tree and sorrel, whose potential had only recently been discovered, we read that they "deserve to be further investigated and used in dyeing,"[76] or that they "also seem to produce good colors, but this has not yet been experimentally confirmed."[77]

As the carrying out of such experiments is not documented for the cameral university at Lautern, reference will here be made to another institution, the *Theresianum* in Vienna, described by contemporaries as exemplary.[78] In 1775 the journal *Kaiserlich-königliche privilegierte Realzeitung der Wissenschaften, Künste und Kommerzien* published a series of articles that described the Theresianum's economic garden, the buildings that went with it, and the section of the curriculum that was taught there.[79] In addition to the obligatory bed for plants used for dyeing, this garden also had a *Küche für die Wirthschaftschymie und die Färbereyen* (kitchen for commerical chemistry and dyeing), that is, a laboratory for carrying out the botanical and chemical experiments on obtaining and optimizing pigments that the cameralist literature constantly called on teachers, students, and practitioners to undertake. Aspiring civil servants were trained here in a practice for which they were to serve as multipliers and promoters in their future administrative positions.

[74]Georg Adolph Suckow, *Oekonomische Botanik, zum Gebrauch der Vorlesungen auf der hohen Kameralschule zu Lautern* (Mannheim: Schwan, 1777).

[75]Cf. ibid., 373.

[76]Ibid., 358f.

[77]Ibid., 382.

[78]See Johann Schwarz, "Geschichte der k.k. Theresianischen Akademie von ihrer Gründung bis zum Curatorium Sr. Exzellenz Anton Ritter von Schmerling, 1746–1865," *Jahres-Bericht über das Gymnasium der k.k. Theresianischen Akademie in Wien für das Schuljahr 1890* (Vienna, 1890): 3–110.

[79]*Kaiserlich-königliche privilegierte Realzeitung der Wissenschaften, Künste und Kommerzien* (1775, no volume numbers): 536–541, 549–552, 564–566, 580–581, 628–629, including a plan.

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Conclusion

Natural history mobilized a large-scale commitment to a learned practice that formed an essential part of the common experience of doing the Enlightenment. Activities tied to objects—collecting, classifying, and exchanging natural objects and experimenting with them—supplemented the well-known repertoire of practices such as reading periodicals, using lending libraries, and frequenting salons or Freemasons' Lodges, which were part of a written culture and a culture of conversation. The phenomenon of a grassroots learnedness was localized in this sphere of practice, which did not commit those involved to aspire to scientific authorship. Natural history generated an integrative intellectual project that made it possible for a heterogeneous group of protagonists to participate in the collaborative creation of knowledge.

INDEPENDENT HISTORIAN

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