"Refer to folio and number": Encyclopedias, the Exchange of Curiosities, and Practices of Identification before Linnaeus

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Imagine you are a natural historian in St. Petersburg in the 1730s. You are fascinated with botany and hope to enrich your garden with some exotic plants from the British Isles. You write to your acquaintances in London to send you some seeds, especially from the species named. . . . Well, yes, what is that species called? And even if you know its name, would your English correspondent call that British plant the same name? Or would he think that the name refers to another species? How can you make sure that you will receive the plant you were thinking of? In the period before the widespread acceptance of Linnaeus's binomial system, how do you establish a common system of communication that could ensure that your private identifications of plants are understood by your correspondents all around Europe?

Johann Amman faced exactly these difficulties as professor of botany and natural history at the St. Petersburg Academy of Sciences. The Swiss natural historian came to Russia in 1733 at the bright age of 26. He trained in Leiden during the 1720s and then worked in London for a few years as curatorial assistant in the collection of Hans Sloane, which was later to become the British Museum. Once he moved to Petersburg, Amman was responsible for the upkeep of the Academy's botanical garden. As part of the job, it was necessary that he actively participate in the international exchange of seeds and plants. His earlier travels had provided him with

sufficient contacts. He was a regular correspondent of the Dutch botanist Johannes Gronovius, who owned a small private garden in his house in Leiden, and he also exchanged letters regularly with the Oxford Sherardian professor of botany Johann Jacob Dillenius, and the English merchant collector Peter Collinson in London, among others. These correspondents provided Amman with seeds from their own gardens or from further contacts as far as Virginia. In return, they expected Amman to provide them with all sorts of curiosities from the vast expanses of the Russian empire.

For instance, Amman exchanged several letters with an ambitious Swedish scholar who resided in Holland in the period, Carolus Linnaeus.[1] Linnaeus was rather eager to acquire some plants from Russia. In 1737, he requested that Amman should send him some "*Ceratocarpus Buxbaumi* with dried flowers."[2] While *Ceratocarpus Buxbaumi* might appear a standard Linnaean, binomial proper name of a species, it was not. Linnaeus published his *Species plantarum,* which introduced the binomial system for plants, only in 1753. In Latin, *Ceratocarpus Buxbaumi* simply meant Buxbaum's *ceratocarpus,* i.e., the *ceratocarpus* plant that was described and named by the St. Petersburg naturalist Johann Christoph Buxbaum in his *Nova plantarum genera*.[3] Linnaeus's communication with Amman thus did not depend on a commonly established proper name. Instead, Linnaeus instructed Amman in shorthand to look up Buxbaum's works in his library, search for the plant *ceratocarpus,* and then send a specimen corresponding to Buxbaum's description and depiction.

Amman performed the task without a hitch. In response to Linnaeus's letter, he sent parts of the *Ceratocarpus* and also asked Linnaeus if he needed any more plants flowering in Russia. For those plants, Amman did not suggest that Linnaeus should identify them by a proper name either. He instructed Linnaeus to identify the specimens he wanted by referring to the relevant entries in Buxbaum's *Centuriae* or in Amman's own *Novi commentarii*, two works that described a large number of species in Russia.[4] If Linnaeus answered accordingly, Amman could again have opened these books at the right entry, read the description and checked the illustration.

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[1] On Amman and Linnaeus, see Margery Rowell, "Linnaeus and Botanists in Eighteenth-Century Russia," *Taxon* 29 (1980).

[2] Linnaeus to Amman, L0173, May 20, 1737, *The Linnaean Correspondence*, linnaeus.c18.net.

[3] Johann Christian Buxbaum, *Nova plantarum genera* (St. Petersburg: Academia scientiarum imperialis petropolitanae, 1728–29), 236.

[4] Amman to Linnaeus, L0220, November 26, 1737, *The Linnaean Correspondence*.

Then he would have selected the corresponding plant in the Academy's garden and sent it in a package to Holland with the first available ship.

In his correspondence with Collinson, Amman also relied on an encyclopedic publication to determine what specimens he was supposed to exchange. In 1738, Collinson offered to send some English bulbs to St. Petersburg but did not know which ones Amman wanted. He presumed that Amman surely owned "Parkinson's *Flower Garden*—from Him you may Pick out, those that have English Names and Refer to folio and number possibly then it maybe in my power to help you."[5] If both Amman and Collinson owned the same volume, they could use it as a trustworthy coding system for identifying plants. Amman would look up a plant in that volume, mark the folio number on which it was described and send the reference to England. Once Collinson received Amman's letter, he would open his own copy of Parkinson. Looking at the relevant entry, he would be able easily to decipher Amman's reference. Although this coding system might appear cumbersome, Collinson clearly preferred it to Linnaeus's revolutionary system of classification and identification. Linnaean taxonomy might have been useful for assigning species to higher *genera*, but it was not easy to identify a particular specimen with it. Collinson argued that sexual identification was not practical enough, for "most people know plants by their leaves, shoots, size, bark, colour, but the Linnean systeme confines the essential characters to those parts least known and only to be seen att certain seasons."[6] While you could be sure that your correspondents would know the color and shape of the leaves, it was much less certain that they would also be able correctly to check the number of pistils and stamens in each specimen.

As Amman's exchanges of plants suggest, early eighteenth-century natural historians relied on encyclopedias of natural history to facilitate the international commerce of *naturalia*. I use the term encyclopedia slightly anachronistically to refer to printed works that catalogued and described a large number of species. While plants circulated throughout Europe already in the sixteenth century, insects, seashells, and other mobile zoological curiosities also became favored collectors' items by 1700. After briefly reviewing the growing commerce in exotic specimens of natural history, I will

[5] Collinson to Amman, May 22, 1738, Archives of the Russian Academy of Sciences, St. Petersburg (*RAS*) R1 Fond 74A Dela 19. On Collinson, see Jean O'Neill, *Peter Collinson and the Eighteenth-Century Natural History Exchange* (Philadelphia: American Philosophical Society, 2008).

[6] Collinson to Amman, London, August 16, 1738, *RAS* R1 Fond 74A Dela 19.

explore how encyclopedias came to facilitate the exchange of zoological specimens in particular. I will argue that, in the course of the seventeenth century, a new genre of zoological encyclopedias appeared on the scene whose design was particularly well-suited for the purposes of identification, a key practice in long-distance exchanges. These novel works were eagerly taken up by collectors all around Europe. Before the introduction of Linnaeus's binomial system, Collinson, Amman, and their correspondents mostly relied on these works when trading specimens.

THE ADVENT OF COMMERCE

The exchange of botanical and zoological specimens radically increased knowledge about the natural world in the early modern period, and played an important role in the development of the scientific culture of facts.[7] Renaissance physicians scoured the hills and valleys around their towns to collect plants with medical qualities. Universities, hospitals, and private collectors established botanical gardens where curative roots, pleasant flowers or tasty fruits grew. Noble women, apothecaries, and naturalists sent and received *simplicia,* lemons or oranges throughout Europe.[8] As the sixteenth century drew to its close, exotic plants flooded the market from Turkey, America, and the East Indies. The tulip mania of 1637 was not a unique event, and was followed by a somewhat less exorbitant hyacinth mania a good century later.[9] By the age of Amman, Dillenius, and Collinson, plants,

[7] Recent work on the commerce of nature includes Harold John Cook, *Matters of Exchange: Commerce, Medicine, and Science in the Dutch Golden Age* (New Haven, Conn.: Yale University Press, 2007); Alix Cooper, *Inventing the Indigenous: Local Knowledge and Natural History in Early Modern Europe* (Cambridge: Cambridge University Press, 2007); Brian W. Ogilvie, *The Science of Describing: Natural History in Renaissance Europe* (Chicago: University of Chicago Press, 2006); Karen Reeds, *Botany in Medieval and Renaissance Universities* (New York: Garland, 1991); Londa Schiebinger and Claudia Swan, eds., *Colonial Botany: Science, Commerce, and Politics in the Early Modern World* (Philadelphia: University of Pennsylvania Press, 2005); Pamela Smith and Paula Findlen, eds., *Merchants and Marvels: Commerce, Science, and Art in Early Modern Europe* (New York: Routledge, 2002).

[8] Florike Egmond et al., eds., *Carolus Clusius: Towards a Cultural History of a Renaissance Naturalist* (Amsterdam: Koninklijke Nederlandse Akademie van Wettenschappen, 2007); Alisha Rankin, "Becoming an Expert Practitioner: Court Experimentalism and the Medical Skills of Anna of Saxony (1532–1585)," *Isis* 98 (2007).

[9] Anne Goldgar, *Tulipmania: Money, Honor and Knowledge in the Dutch Golden Age* (Chicago: University of Chicago Press, 2007).

and knowledge about their curative and culinary qualities, circulated widely.[10]

The commerce of zoological specimens was a more recent development in seventeenth-century Europe.[11] Next to spices and silk, the ships of the Dutch and English India companies also carried monkeys, parrots or ostrich eggs.[12] Yet animals, especially live ones, were much more expensive than plant seeds or dried herbaria. Parrots cost roughly sixty guilders in late seventeenth-century Amsterdam. The rhinoceros brought to London in 1683 was sold for 2320 pounds.[13] Despite the cost, exotic animals slowly gained ground in European collections. In the Netherlands, roughly a dozen anatomical theaters had been established by the 1650s, many of which also sported rare animals as exhibition objects.[14] The Leiden anatomy theater had not only bits and pieces of a hippo, but also remoras, flying fish, corals, and other marine life from the East Indies by 1628. By the second half of the century, Amsterdam boasted of at least 70 cabinets of naturalia. More than a dozen could be reported for Paris, and the number increased significantly in the eighteenth century.[15] Menageries provided an opportunity for the larger public to become acquainted with larger beasts. Hansken, the elephant commemorated by Rembrandt's drawing, plodded through much of Europe in the 1620s as part of a traveling exhibition. In Amsterdam, the menagerie of Blauwe Jan was established in the 1680s and soon became a

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[10] These circuits were obviously not universal, and were often governed by social, gendered, and racial expectations. See, for instance, Londa Schiebinger, *Plants and Empire: Colonial Bioprospecting in the Atlantic World* (Cambridge, Mass.: Harvard University Press, 2004); and Daniela Bleichmar, "Training the Naturalist's Eye in the Eighteenth Century: Perfect Global Visions and Local Blind Spots," in *Skilled Visions: Between Apprenticeship and Standards*, ed. Cristina Grasseni (Oxford: Berghahn, 2007).

[11] Louise E. Robbins, *Elephant Slaves and Pampered Parrots: Exotic Animals in Eighteenth-Century Paris* (Baltimore, Md.: Johns Hopkins University Press, 2002).

[12] Roelof van Gelder, "Arken van Noach: Dieren op de schepen van de VOC," in *Kometen, monsters en muilezels: Het veranderende natuurbeeld en de natuurwetenschap in de zeventiende eeuw*, ed. Florike Egmond, Eric Jorink, and Rienk Vermij (Haarlem: Arcadia, 1999).

[13] The buyer had to default after the payment of £500, however. Ingrid Faust, *Zoologische Einblattdrucke und Flugschriften vor 1800* (Stuttgart: Hiersemann, 2003), 5: 24, 692.1.

[14] J. A. M. Slenders, *Het theatrum anatomicum in de noordelijke Nederlanden, 1555–1800* (Nijmegen: Instituut voor Geschiedenis der Geneeskunde, 1989); H. L. Houtzager, "Dieren in Delft," *Gewina* 2 (1979).

[15] Renée Kistemaker and Ellinoor Bergvelt, eds., *De wereld binnen handbereik: Nederlandse kunst- en rariteitenverzamelingen 1585–1735* (Zwolle: Waanders, 1992); Krzysztof Pomian, *Collectors and Curiosities: Paris and Venice, 1500–1800* (Cambridge: Cambridge University Press, 1990).

popular spot for entertainment, as its fees were affordable for many of the city's inhabitants.[16]

The collection and exchange of plants and animals were based on solid commercial thinking. While profit was not always the primary concern of collectors, they were all loath to suffer financial losses in these transactions. In 1706, the English pharmacist James Petiver ordered some plants from the Gdansk naturalist Johann Philip Breyne. Probably responding to a now lost letter of Breyne, he assured his correspondent that if "the Contrayeerva is *that Figured in Hernandez* then I should be glad to see a sprigg of it [emphasis mine]." In this letter, Petiver laid down explicit rules for trading natural curiosities and books:

> I am willing where money is not to be had, to exchange what I do for the like value, in other books of that kind, which Curious persons have often duplicates of, or at leastways can easily procure, and if they will or cannot do it, I am willing to traffic with the Booksellers in your parts, on the same Accounts, viz. Barter or Exchange for your Fathers acceptible works, your own or any others published in Dantzick or near you, or otherwise even for Collections of Naturall things, them selves or other Curiosities, if they value them not to dear.[17]

Breyne probably understood Petiver's financial concerns well. He himself was an active producer of pineapples and camphor trees that he was selling to the Russian court in St. Petersburg. Although many curiosities circulated as gifts, some naturalists drew a significant income from selling them for money. Amsterdam apothecary Albertus Seba regularly traded seashells and other *exotica* with customers in Germany and Russia, while Maria Sibylla Merian considered repaying the debts incurred during her voyage to Suriname by putting her collection of insects and snakes on sale.[18]

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[16] Florence F. J. M. Pieters, "The Menagerie of 'the White Elephant' in Amsterdam, with Some Notes on Other 17th and 18th Century Menageries in the Netherlands," in *Die Kulturgeschichte des Zoos*, ed. Lothar Dittrich, Dietrich von Engelhardt, and Annelore Rieke-Müller (Berlin: Verlag für Wissenschaft und Bildung, 2001); Angela Vanhaelen, "Local Sites, Foreign Sights: A Sailor's Sketchbook of Human and Animal Curiosities in Early Modern Amsterdam," *Res: Journal of Anthropology and Aesthetics* 45 (2004).

[17] Petiver to Breyne, April 10, 1706, Forschungsbibliothek Gotha (*Gotha*) Chart B. 787.

[18] On Seba, see especially H. Engel, "The Life of Albert Seba," *Svenska Linné-Sällsk. Årsskrift* 20 (1937). On Merian, see Tomomi Kinukawa, "Art Competes with Nature: Maria Sibylla Merian (1647–1717) and the Culture of Natural History" (PhD dissertation: University of Wisconsin-Madison, 2001).

If material value was a significant concern, plants and animals needed to be correctly identified. Before the Linnean system turned into a universal language (long after Linnaeus's death), pragmatic solutions were sought that could bridge the distance between the pharmacies of Amsterdam and the Academy of Science in Petersburg. A comprehensive dictionary was sorely needed that could translate between the local languages of natural historians in different parts of Europe. In the field of botany, Caspar Bauhin's *Pinax* of 1623 performed exactly this function.[19] Bauhin compared his collection of plants with the encyclopedias of natural historians, and established synonyms. By the early eighteenth century, however, Bauhin's work was rather outdated. Botanists had to compile their own personal dictionaries of plant names to ensure proper identification. In his copy of Sebastien Vaillant's *Botanicum parisiense*, for instance, the Leiden professor Hermann Boerhaave carefully noted a large number of synonyms for each entry.[20] Some valiant naturalists also attempted to compose a new *Pinax* that could replace Bauhin in its entirety. William Sherard, erstwhile English consul at Smyrna, devoted no small effort to the project but died in the process. The task was left to Dillenius, Sherard's *protégé*, who soldiered on for over a decade. Upon his death, the manuscript *Pinax* contained sixteen volumes and was still unfinished.

In the absence of a universal language or one comprehensive and trustworthy dictionary, naturalists turned to a multitude of encyclopedias as the best alternative for establishing successful long-distance communication. This might not appear a particularly surprising development. As Daniela Bleichmar has noted recently, illustrated encyclopedias played a prominent role in the training and field work of natural historians. Dillenius himself was guided by such works during a herborizing trip to Wales in 1726. Throughout the journey, he constantly consulted Leonard Plukenet's *Phytographia* and his own, recently published edition of John Ray's *Synopsis*. On July 17, for instance, Dillenius noted that "upon Brent Down, which lyes over against Uphill, we searcht after *Cistus humilis Alpinus durior,* & c., Pluk. 342. [i.e. Plukenet] & found it in plenty on the rocks that lye South & West, after you are past the middle of the Down." The next day,

[19] Brian W. Ogilvie, "Encyclopaedism in Renaissance Botany: From *Historia* to *Pinax*," in *Pre-Modern Encyclopedic Texts: Proceedings of the Second Comers Congress*, ed. Peter Brinkley (Leiden: Brill, 1997).

[20] "The Boekvercopers Verbeek hebben in de Auctie van de Boeken van Boerhaven gecogt het exemplaar van Vaillant's Botanicum Parisiense, daar de heer Boerhaven seer veel by geschreven had, het geen wat synonyma en verder niets te beduyden had." Gronovius to Breyne, September 20, 1740, *Gotha* Chart B. 786.

they were less fortunate. They "loock for 3 & more hours for Dr. Pluk. *Polygonum folio circinato,* mentioned grow near Weston supra mare, but could find nothing than *Alsine* 12, Syn. p. 351 [i.e. Ray's *Synopsis*] which may be Dr. Plukenet mistoock for a *Polygonum*."[21]

I would suggest that it was especially the possibility of long-distance communication that led Dillenius to identify plants by reference to a page number. The *Journey to Wales* was a social manuscript that widely circulated among Dillenius's friends.[22] It was probably consulted by Samuel Brewer, who joined Dillenius for the trip and later corresponded about their findings. The Yorkshire physician Richard Richardson also perused the work and provided extensive comments in a letter.[23] This intended readership might explain why Dillenius eschewed private terms of identification throughout the *Journey to Wales*. He did not refer to plants by saying "this is the plant that grows by the wall in my garden in Oxford," or "this Welsh plant I have att home, amongst the herbaria on the bottom shelf in my study." He instead used rigid descriptors that everyone could understand provided that they possessed the right encyclopedias.

The *Journey to Wales* thus occupied the same interpersonal space through which information and specimens were exchanged among naturalists. Its exact references were no different from the rest of Dillenius's correspondence. In 1728, he sent out a query regarding certain plants' times of flowering. The query identified plants by name and page reference, e.g., "*Alchimilla* 2. p. 158." The system worked. Richardson duly noted that the Alchimilla flowered in June and July. While he was not certain about the "*Orchis* 24 p. 382," he could acquire and send a specimen later.[24] On another occasion, he used the same system of identification for sending Sherard "specimens of *pedicularis major angustifolia ramosissima labello purpureo* Syn. Edit. tert."[25] This way, he could ensure that Dillenius knew what particular plant his patron was about to receive.

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[21] George Claridge Druce, *The Dillenian Herbaria* (Oxford: Clarendon Press, 1907), xlv.
[22] For the concept of social manuscripts, see Elizabeth Yale, "Manuscript Technologies: Correspondence, Collaboration and the Construction of Natural Knowledge in Early Modern Britain" (PhD dissertation: Harvard University, 2008).
[23] On Richardson, see Dawson Turner, *Extracts from the Literary and Scientific Correspondence of Richard Richardson* (Yarmouth: C. Sloman, 1835).
[24] Richardson to Dillenius, February 8, 1726/27, in Druce, xc–xci.
[25] Richardson to Dillenius, Preston in Lancashire, February 16, 1726/27, in Druce, lxx-xiii.

RENAISSANCE ENCYCLOPEDIAS AND THEIR HISTORIOGRAPHY

If the exchange of *naturalia* relied on encyclopedias, it might also have contributed to the transformation of this genre. The wide-ranging topics discussed in Renaissance encyclopedias were often somewhat irrelevant for the purposes of "reference by folio and number." As commerce grew, newer works increasingly focused on providing succinct textual and visual information on the *appearance* and the *geographical origin* of a species. Entries mostly discussed a select number of external features by which the species could be easily differentiated from related specimens. With the help of these works, identification and long-distance exchanges were easier to perform. This slow transformation of the encyclopedic genre strongly resembles Foucault's description of the epistemic shift from Renaissance representation to Enlightened taxonomy.[26] In recent years, historians of science have dissected and refined Foucault's original observations, especially in the field of botany. Brian Ogilvie has shown how printed botanical illustrations turned from Dürerian naturalism to idealized simplicity by 1600.[27] David Freedberg has pointed out that the members of the *Accademia dei Lincei* were intent on differentiating and classifying specimens with water colors. For zoology, Sachiko Kusukawa and Laurent Pinon have observed similar developments for the seventeenth century.[28]

In this historiographic tradition, scholars have debated whether taxonomy grew out of a philosophical desire to establish the natural order of plants, or from the more pragmatic concerns of having to catalogue a large number of newly discovered plants.[29] I would argue that the long-distance, commercial, and gift exchange of specimens played an important role in effecting this shift. The commerce of *naturalia* would not have been able to function properly without the help of the new, encyclopedic catalogues of nature. In this respect, botany and zoology show a striking similarity to the

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[26] Michel Foucault, *The Order of Things* (London: Tavistock, 2000).

[27] Brian W. Ogilvie, "Image and Text in Natural History, 1500–1700," in *The Power of Images in Early Modern Science*, ed. Wolfgang Lefèvre, Jürgen Renn, and Urs Schoepflin (Basel: Birkhäuser, 2003); David Freedberg, *The Eye of the Lynx: Galileo, His Friends, and the Beginnings of Modern Natural History* (Chicago: University of Chicago Press, 2002).

[28] Sachiko Kusukawa, "The *Historia Piscium* (1686)," *Notes and Records of the Royal Society* 54 (2000); Laurent Pinon, *Livres de Zoologie* (Paris: Klincksieck, 2000).

[29] See Phillip Sloan, "John Locke, John Ray, and the Problem of the Natural System," *Journal of the History of Biology* 5 (1972); John L. Heller, "The Early History of Binomial Nomenclature," *Huntia* 1 (1964).

eighteenth-century textile trade. As William Reddy argued more than twenty years ago, that business also depended on a particular type of encyclopedia.[30] Quality fabrics were expensive and often available only in limited quantities. Small differences in their appearance could hide large differences in quality and price. One needed to be a connoisseur to make a proper distinction and successfully deal in such objects. Encyclopedias of commerce served to develop and aid this skill. They listed the distinctive features, the provenance, and general value of each kind of cloth. As a result, readers could easily identify any textiles they were trading. A few steps of feature analysis sufficed to determine whether the dealer was indeed selling precious Burgundy silk or a cheap replica.

One could argue that the encyclopedic works of natural history similarly became useful reference books in the commerce of curiosities. Printed and water color tulip books, including the charming series of Crispijn de Passe, were probably among the first to be used as trade catalogues in botanical exchange.[31] In the field of zoology, this transformation probably happened in the latter half of the seventeenth century, when the trade in some exotic animals exploded. The first specialized zoological encyclopedias focused on insects and seashells, the most fashionable collectibles of contemporary *curiosi*. As classic encyclopedias were replaced by conchological and entomological works, their structure, readership, and function changed significantly. In the following section, I will mostly focus on conchology, but similar observations could be made for the development of entomology in the period between Johannes Goedart and August Rösel von Rosenhof.

In order to appreciate the innovations of commercialization, it is necessary briefly to summarize how the classic works of Renaissance naturalists were structured. These books systematically compiled all available information on most recorded animals throughout history. Their entries on well-known animals, e.g., the cow or the horse, provided an exhaustive, philological evaluation of all textual sources available on the topic. In his three-hundred-page-long entry on cattle, Aldrovandi reviewed all ancient sources. He discussed how cows looked, what they ate, how they were used in agriculture, whether they were ever employed in a war, what ritual func-

[30] William M. Reddy, "The Structure of a Cultural Crisis: Thinking About Cloth in France before and after the Revolution," in *The Social Life of Things: Commodities in Cultural Perspective*, ed. Arjun Appadurai (Cambridge: Cambridge University Press, 1988). Bleichmar draws similar conclusions for natural history.

[31] For a discussion of these books, see Sam Segal, *De tulp verbeeld: Hollandse tulpenhandel in de 17de eeuw* (Hillegom: Museum voor de Bloembollenstreek, 1992).

tions they fulfilled in different religions, and what monstrous cows were born throughout the ages. In each case, he painstakingly assessed all available evidence. For instance, Aristotle, Varro, and Sotion could not completely agree at what age it was best to castrate a bull, and Alrovandi had a hard time deciding whom to trust.[32]

Chapters on exotic animals, never seen by the author, functioned somewhat differently. These entries tended to be shorter than those on common, domestic species. Learned travelers, printed broadsheets, and personal acquaintances provided most of the available information. For instance, Aldrovandi based his eleven-page discussion of the rhinoceros on Samuel Purchas, Martin Frobisher, Thomas Burton, Peter Martyr, and Jacques Chartier, among others.[33] While much of the available information focused on the appearance of the animal, Aldrovandi also attempted to discuss other topics whenever possible. For ostriches, he painstakingly recorded how they could be hunted and what parts of them were edible. For both exotic and common animals, Renaissance natural history therefore attempted to provide an exhaustive account of a species. Aldrovandi's interest went beyond the identification of animals. Whatever the ancient and more recent authors wrote, it was worth inclusion and evaluation.

CONCHOLOGY AND COMMERCE

In the course of the seventeenth century, Renaissance encyclopedias of zoology were supplanted by other genres. Next to writing anatomical monographs on a particular animal, naturalists increasingly published catalogues, a new type of encyclopedia that provided only summary information on a large number of species. This shift can be best perceived in conchology, a field that was especially strongly influenced by commerce. Since shells are small, do not rot, and can be transported easily, they became one of the most important exotica of the seventeenth and eighteenth centuries.[34] Ex-

[32] Ulisse Aldrovandi, *Quadrupedum omnium bisulcorum historia* (Frankfurt am Main: Zunner, Haubold and Rotel, 1647), 93.
[33] Ibid., 878–89.
[34] Recent work on early modern conchology includes Bettina Dietz, "Mobile Objects: The Space of Shells in Eighteenth-Century France," *British Journal for the History of Science* 39 (2006); Karin Leonhard, "Shell Collecting. On 17th-Century Conchology, Curiosity Cabinets and Still Life Painting," in *Early Modern Zoology: The Construction of Animals in Science, Literature and the Visual Arts*, ed. Karl A. E. Enenkel and Paul J. Smith (Leiden: Brill, 2007); Bert van de Roemer, "Neat Nature: The Relations between Nature and Art in a Dutch Cabinet of Curiosities from the Early Eighteenth Century," *History of Science* 42 (2004); Emma Spary, "Scientific Symmetries," *History of Science* 62 (2004).

otic seashells entered the European market in many different guises. Some of the most frequent and most exquisite items of early modern cabinets and craftsmanship were the decorated, engraved nautilus shells that were produced in Central Europe in the sixteenth and seventeenth centuries. Art and nature competed, imitated, and played with each other in these curiosities. Other seashells were polished by Dutch artisans, though not engraved, in order to acquire their characteristic luster. In turn, some collectors preferred that seashells come unpolished without any artisanal interference.[35] The price of these curiosities was considerable. The German-Dutch naturalist Georg Eberhard Rumphius recorded that nautilus shells fetched one rixdollar apiece in the East Indies, and larger ones could be sold for eight rixdollars.[36] In the 1720s, an Admiral seashell cost 1020 French *livres* to a merchant in Amsterdam.[37] Cheaper specimens were omnipresent. They were the most frequent exotica to be found in Amsterdam cabinets, and soon became a fashion among French, English, and Italian collectors.[38]

The commerce of seashells was accompanied by the appearance of the new, specialized conchological encyclopedias. A significant portion of Aldrovandi's work was already devoted to the discussion of shells. The *De reliquis animalibus exanguibus libri quatuor* from 1606 differed in many respects from the rest of Aldrovandi's work.[39] It was peppered with illustrations mostly based on specimens in the author's collection. Although the volume still provided an elaborate philological, contextual, environmental, and historical narrative, personal observation obtained an equally important role. Large parts of the text were devoted to the differentiation of particular species based on the careful examination of external features. Aldrovandi's readers not only needed to know what the ancients thought about shells; they also had to be able to distinguish one shell from another in their own collections.

The heyday of conchological encyclopedias came in the 1680s. The seminal works of this decade signaled collectors' and dealers' interest in correctly identifying specimens. The Italian Filippo Buonanni published his *Ricreatione dell'occhio e della mente* in 1681. The first and third books of the *Ricreatione* maintained the classical framework of Aldrovandi. Culled

[35] Edmé F. Gersaint, *Catalogue raisonné de coquilles et autres curiosités naturelles* (Paris: Flahault et Prault Fils, 1736).
[36] Georg Eberhard Rumpf, *The Ambonese Curiosity Cabinet* (New Haven, Conn.: Yale University Press, 1999), 94. 1 rixdollar was worth 2.5 Dutch guilders.
[37] Gersaint, *Catalogue raisonné de coquilles*, 18.
[38] Kistemaker and Bergvelt, *De wereld binnen handbereik*, 368.
[39] Ulisse Aldrovandi, *De reliquis animalibus exanguibus* (Bologna: Bellagamba, 1606).

from ancient authors, but also increasingly buttressed by experimental evidence, Buonanni philosophically investigated how seashells reproduced, lived in their natural habitat, and especially how they could produce dyes.[40] *Books II* and *IV*, however, aimed at the identification and differentiation of shell species. *Book IV* published illustrations of more than 400 specimens that were described and identified in *Book II*. Most entries were based on specimens kept in the museum of the Jesuit polymath Athanasius Kircher, where Buonanni served as a curator, and were later republished in the *Musaeum Kircherianum*.[41] These seashells came from a large network of collectors and merchants all around the world. Buonanni received shipments from the Netherlands, from Syracuse, from Portugal, from Brazil, and also from the Indies through the services of a Dutch merchant.[42]

To facilitate identification, the seashells in *Books II* and *IV* were arranged in three major groups according to external features: univalves, bivalves, and turbinates. Each entry consisted of an image and a short text that focused on a few distinctive features for easy identification. Buonanni identified each seashell by providing information on its color, place of origin, shape, appearance, and decorative patterns. Among the turbinates, the description of Entry 15 thus claimed that the shell was "not dissimilar from the other one described in Entry 1, indeed shaped like a pear." It came "from the Indian sea, having a brittle and delicate shell, distinguished by an elegant, net-like decoration, having a wine- or flesh-like color and some disorderly, weasel-like spots." The next seashell, in turn, "imitated the candor of snow and appeared to be made of a paper-like, but not pliable substance." It could be "distinguished by small semi-circular grooves, and its almost flat hollows were decorated with golden spots."[43] The constant repetition of the words "distincta" and "distinguitur" emphasized the usefulness of features like decorative pattern, color, and geographical origin in identifying a particular species. On several occasions, Buonanni also discussed how rare a seashell was so that readers could know how likely it was that they could acquire a specimen.[44] The illustrations also focused on differentiation. Each representation was uniformly lit from the upper right

[40] I will be referring to the Latin translation. Filippo Buonanni, *Recreatio mentis et oculi in obseruatione animalium testaceorum* (Rome: Varesi, 1684).
[41] Filippo Buonanni, *Musaeum Kircherianum* (Rome: Plach, 1709).
[42] Buonanni, *Recreatio,* III/3 for the Netherlands, III/157 for Portugal, III/40 for Syracuse, III/332 for Brazil.
[43] Buonanni, *Recreatio,* III/15 and 16.
[44] Buonanni, *Recreatio*, III/18 was "sed rara," and III/374 "ea summo pretio ducitur, quia raro invenitur," whereas a turbo from p. 118 III/40 was "frequens."

corner. Similar seashells were placed next to each other on each leaf so as to facilitate the appreciation of minor differences. The images were "deprived of any particular beauty" as extensive attention to detail was not part of Buonanni's project of identification by features.[45]

The *Ricreatione* was intended for *curiosi* who were willing to invest in the commerce of curiosities. Its introduction claimed that "the knowledge of nature and animals stimulates men's curiosity and desire for knowledge, and therefore many notable people decided to spend precious work, time, gold and expenses on it."[46] Buonanni wrote the text originally in Italian to reach out to local collectors without a strong command of Latin. He also encouraged readers to acquaint themselves with real specimens. At the end of *Book I*, he provided a list of museums and collections that were worth a visit. Actual readers often paid special attention to *Books II* and *IV*. The German collector Michael Bernhard Valentini, for instance, prepared a concordance that provided ancient and contemporary German nomenclature for the entries.[47]

The first parts of Martin Lister's *Historiae conchyliorum* appeared in England in 1685.[48] This publication departed even more radically from the traditions of Renaissance zoology; and it might better be called a visual catalogue than a full-blown encyclopedia. The *Historiae conchyliorum* opened with a taxonomical tree based on a few external features, and entries were grouped accordingly. The rest of the work contained several hundreds of illustrations with practically no textual information. Only short captions were provided that stated the Latin name, shape, color, and provenance of the shell. While Lister offers little explanation in the *Historiae conchyliorum* as to his aims with the book, his other publications reveal a conscious strategy to facilitate the process of identification and differentiation for collectors of natural history.

As Robert Unwin has recounted, the visual regime of Lister's works was marked by a taxonomizing bent from early onwards.[49] In a publication

[45] "Priuantur quidem praecipua venustate." Buonanni, *Recreatio*, 86.

[46] Buonanni, *Recreatio*, ad lectorem.

[47] "Ik vinde dat hy omtrent de Hoorns en Schulpen een admirabel werk gedaan heeft, dewyl hy een catalog gemaakt heeft van alle de Schulpen en Hoorns van Bonannus en die benaamt met de ouwerwetse en Hedendaagse duitsche namen, dat is so als de Liefhebbers sederd 100 jaren de selve genaamt hebben." Gronovius to Breyne, May 30, 1742, *Gotha* Chart B. 386.

[48] Martin Lister, *Historiae Conchyliorum liber primus [-liber IV]* (London: by the author, 1685–92).

[49] Robert W. Unwin, "A Provincial Man of Science at Work: Martin Lister, F.R.S., and His Illustrators 1670–1683," *Notes and Records of the Royal Society* 49 (1995).

on snails, Lister publicly avowed that the best method for analysis in natural history was comparison, and he repeated ten years later in his *English Spiders* that his aim was to find "likeness and unlikeness of things." Both works were based on Lister's personal collection of snails and spiders, as well as on his familiarity with other naturalists' collections. In designing illustrations for the *English Spiders*, Lister emphasized the importance of identifying the *differentia specifica* of each spider. Egg-sacks and the eyes were especially useful features. For instance, the egg-sacks of the eight-eyed spider in Entry 14 were "like a lentil and reddish in colour," whereas the one in Entry 15 had five eggs "in an egg-sac which is very small, shaped like a small lentil-seed, and made out of a very white membranous or linen-like material." The same spider also had "four middle eyes [. . .] arranged in a quadrangular plan, standing equidistant from each other, and on either side are two pairs placed more closely together;" while the eight eyes of the spider in Entry 16 "cannot be seen except with the help of the best microscope [. . .] and can be seen shining like amber."[50] Additional external features included the shape of the legs and the abdomen, the color of the body, and any particular decorative pattern.

When preparing the illustrations for the *English Spiders*, Lister paid special attention to the visual representation of *differentiae specificae*. In communicating with the draughtsman for the work, Lister pointed out "with my finger the characteristics of each species that I most particularly wished to have depicted," which would allow these objects to be "more readily and accurately recognized by other people."[51] The illustrator, in turn, consulted Lister extensively about the visual depiction of particularly important distinctive features. He wanted to make sure that the illustrations were sufficiently large to "serve for your particular history and [had] room enough to express the order of the eyes, a manner of the egg bagg," and sent a draft sketch for approval.[52] The illustrations of the *English Spiders* therefore uniformly concentrated on a select number of distinctive features, were grouped in *genera* to emphasize similarity and difference, and were less exactingly executed when insignificant details were concerned. Lister's *Historiae conchyliorum* closely followed the visual regime established in the *English Spiders*. Although the images were mostly based on specimens in the author's or his acquaintances' collections, both the original drawings and the final engravings focused only on a few distinctive features. The

[50] Martin Lister, *English Spiders* (Colchester: Harley Books, 1992), 107–9.
[51] Ibid., 48.
[52] Lodge to Lister, August 21, 1674, *Bodleian Library* MS Lister 34, f. 170.

manuscript drawings were small, lacked coloring, and indicated shape with the help of just a few strokes. The final publication closely followed the manuscript and presented an abstracted version of each particular specimen.

"HE SELLS SEASHELLS FROM THE SEASHORE"

The taxonomical orientation of the new conchological encyclopedias facilitated their use in the long-distance exchange of specimens. Some of these works were explicitly prepared for the commerce of curiosities. In the 1720s, for instance, James Petiver intended to prepare a shell catalogue of the British Isles. This work was not a simple taxonomical treatise. It was supposed to be offered "with the shells themselves."[53] The text itself was a companion volume to an actual collection. Once readers have received the package, they could use the catalogue correctly to identify and learn about their newly acquired specimens.

While not all encyclopedias were written for the explicit purpose of commercial exchange, readers often transformed them according to their preferences. In the *Amboinsche Rariteit-Kamer,* the German-Dutch Georg Eberhard Rumphius originally planned to offer an extensive, descriptive history of the marine life surrounding Ambon. It first circulated as an illustrated manuscript among naturalists residing in East Asia, and was later published by Simon Schijnvoet in the Netherlands.[54] Some naturalists considered relying on Rumphius's work to manage their long-distance commerce. When Albertus Seba sent a package of shells to Johannes Scheuchzer in Zurich, he intended to use the *Amboinsche Rariteit-Kamer* to identify them. Yet this task was lengthy and burdensome, and Seba did not have enough time to spare. He therefore decided to send the specimens without any explanatory note. After all, Scheuchzer could do the job of identifying them upon receipt.[55]

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[53] "I hope in a little time to finish a Catalogue of the English shells, I have hither to observed, the land ones may exceed 20, the fresh water ones not more, but those on our Sea Coaste already near 100, and of these last many more I believe are yet to be discovered, the whole List you shall have by the next, with the shells themselves, if you desier them." Petiver to Breyne, April 10, 1706, *Gotha* Chart B. 787.

[54] On Rumphius in Asia, see Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650–1900* (New York: Macmillan, 2007).

[55] "Ich war in willens diejenige stücke, so mitzo senden werde und in Rumphio stehen nach ihre rechte pagin. zu beschreijben, aber die zeit wil es mir nicht zulassen, und werden Ihro Excellenz selbsten die mühe nehmen solches nach zu sehen." Seba to Scheuchzer, December 28, 1723, Bibliotheek van de Universiteit van Amsterdam, Ef 151.

Other readers, especially abroad, were less satisfied with the *Amboinsche Rariteit-kamer*. The lengthy descriptions were of little use to collectors who required only basic information on the external features of each species to exchange their actual specimens. For instance, Peter Collinson did not spend much time on Rumphius in his correspondence. He claimed that Lister's *Historiae conchyliorum* was the universally accepted authority for the trade of seashells, and wrote that "ye Virtuosi att Paris rangge their Cabinetts by it."[56] Similarly, when James Petiver bought a copy during his travels in the Netherlands, he complained that "the Figures are indeed very well done, contained in more then 60 Tables, but the misfortune is this, their History, and descriptions are printed in Dutch, a Language I very little understand."[57] He therefore decided to arrange for an English translation, and a fragmented manuscript of the *Amboina Rarity-Chamber* still survives which contains an English version of only the first 28 chapters.[58] Maybe his translator quit. But more probably, Petiver realized that Rumphius's text was not really useful for identifying and exchanging specimens. Instead of finishing the translation, Petiver decided to publish a selection of the images from Rumphius with a minimum amount of text that provided vernacular names for each specimen.[59] Importantly, Petiver did not think it necessary to perform similar translations and transformations with the work of Bonanni. When he noted that the shipment of "Father Bonanni's shells [was] rec'd march 27, 1704/5," he simply used the Italian priest's *Ricreatione* to identify them. Using the "folio and number" system, he started his list of the newly acquired specimens with the entry "Pinna Ital. muricata Bon 101. fig. 24."[60]

The long-distance commerce of seashells was not solely conducted through the means of private correspondence. After the death of a collector, dealers of curiosities often organized auctions to dispose of the collection. Such events were often advertised internationally with the help of printed catalogues. Potential buyers could peruse these works, and then ask a local agent to purchase the desired lots. The Gdansk collector Johann Philippe Breyne, for instance, sent Hans Sloane in London a sales catalogue of the late Dr. Christoph Gottwald's museum. Unfortunately, it was delivered to

[56] Collinson to Beurer, February 7, 1744/45, Trew Correspondence, Universitätsbibliothek Erlangen (*Trew*).
[57] Petiver to Breyne, April 10, 1706, *Gotha* Chart. B 787.
[58] *The Amboina Rarity-Chamber*, British Library (*BL*) MS Add. 3324, f. 146–67.
[59] James Petiver, *Aquatilium animalium Amboinæ, &c. icones & nomina* (London, C. Bateman, 1713).
[60] *BL* MS Add. 3324, f. 62.

Sloane "long after the sale of the museum which was mentioned upon the title page of it or else I had sent to desire you to have bought me some of them."[61] Consequently, the collection was purchased by agents of Tsar Peter the Great to enrich the recently established Kunstkamera in St. Petersburg. For these auction catalogues, the correct identification of items on sale was crucial. Buyers in distant countries had to be certain that they knew what they were spending their money on. Since it would have been exceedingly costly to print a detailed description and illustration for each entry, sales catalogues also relied on encyclopedias. When the Paris dealers Helle and Rémy organized the auction of the recently deceased M. le ***, they informed their readers that they identified those lots "that are figured in Monsieur Dargenville's *Conchylologie* by mentioning *the Plate and Letter*, we have also cited Rumphius on occasion [emphasis mine]."[62]

The reception of Rumphius's verbose encyclopedia was therefore lukewarm. While Seba was in principle eager to employ it, Collinson often preferred the more taxonomically-oriented works of Lister and Buonanni, which were easier to use in the commerce of shells. French collectors opted for the encyclopedias of their countrymen and used the *Amboinsche Rariteit-Kamer* sparingly. Petiver went a step further, and published an abridged English version of the Dutch original. Rumphius's work also underwent a similar transformation in the hands of Arnout Vosmaer, a devout collector, amateur naturalist, and keeper of the Orange family's menagerie. In the 1750s, Vosmaer developed his own system of shell classification, based on a few external features. Shells were divided into *conchae* and *echini marini*. *Conchae* consisted of *univalvia* (*spirales* and *non spirales*) and *valvata* (*bivalves* and *multivalves*). *Echini marini* consisted of *crustacea anus ori oppositus* and *crustacea anus ori infra*. In developing the system, Vosmaer created a handwritten folio album that described the distinctive features of the 32 classes of his taxonomy.[63] Each class was described with the help of a page-long description and illustrated with visual representations of the various species in each class. These images were not drawn after Vosmaer's specimens. They were taken mostly from Rumphius's encyclopedia, and

[61] Sloane to Breyne, March 15, 1714, *Gotha* Chart. A 788.

[62] "Nous annonçons celles [i.e. those lots on sale] qui se trouvent gravées dans la Conchylologie de Monsieur Dargenville en marquant la Planche et la Lettre; nous avons aussi cité quelquefois Rumphius." Helle and Rémy, *Catalogue raisonné d'une collection considerable de coquilles* (Paris: Didot, 1757), ix.

[63] Arnout Vosmaer, *Systema Testaceorum,* Nationaalarchief Den Haag Inv. 2.21.271 No. 71.

also from Michael Bernhard Valentini's *History of the Indies*. Unhappy with the *Amboinsche Rariteit-Kamer,* Vosmaer literally cut up the atlas with the help of a pair of scissors. In Rumphius, each leaf of illustrations contained several images of shells. Vosmaer cut out each representation separately. He reordered these small fragments according to his new taxonomy, and pasted them onto new sheets of paper. The resulting manuscript was a transformation of Rumphius for the purposes of identification and classification.

Vosmaer's new taxonomy was not a simple quest after the order of nature. It was a method for facilitating identification in the commerce of curiosities. The first printed version of the manuscript was published in 1764 as part of a sales catalogue that Vosmaer prepared for auctioning a friend's collection.[64] The catalogue included a taxonomical tree and a short description of each of the 32 classes, followed by the list of specimens on sale. Each shell was identified by name, a brief description, and a reference to the corresponding image in Rumphius "by folio and number." The ideal buyer therefore prepared for the auction by adopting Vosmaer's taxonomy first. He looked through the list of specimens on sale and identified them with the visual, but not textual help of the *Amboinsche Rariteit-Kamer*. Once he had found some interesting shells, he could register his interest and bid for the lot.

The identification of specimens by encyclopedias and catalogues was omnipresent in the early eighteenth-century commerce of naturalia. In the previous sections, I have primarily focused on plant seeds and shells, but other specimens were also exchanged with the help of the "folio and number" system. To enrich his entomological cabinet, Peter Collinson systematically went through Rösel's *Insects*. He identified which items he was missing and requested "when Duplicates happen shall be greatly obliged for a Specimen of Each Fly wee have not."[65] Probably not unrelated to their use in the commerce of insects, many encyclopedias of entomology also underwent the transformation toward taxonomy observed in the case of conchology. Instead of lengthy descriptions, works on insects often chose briefly to summarize the appearance of the animal with the help of distinctive featured, and provided an abstracted image for the purposes of identification.

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[64] Arnout Vosmaer, *Beredeneerde en systematische catalogus van eene verzameling* (The Hague: Van Os, 1764).
[65] Collinson to Beurer, February 7, 1744/45, *Trew*.

LINNAEUS AND ENCYCLOPEDIAS

When Linnaeus began his groundbreaking work on taxonomy, he was working in the company of the naturalists cited above. He corresponded and exchanged specimens with Amman, Breyne, Dillenius, Gronovius, and Sloane, among many others. There is no need to rehearse Linnaeus's interest in this commerce of *naturalia*. As Lisbet Koerner and Staffan Müller-Wille have recounted, Linnaeus spared no effort in importing foreign plants to Sweden in order to revitalize the nation's economy.[66] John Heller and Müller-Wille have also shown that the Linnean reforms of taxonomy and nomenclature were based on the Swedish author's practical involvement with the collection and close examination of specimens, as well as on his expertise in cataloguing and referencing books.[67]

The artificial system introduced in the *Systema naturae* thus followed in the footsteps of the conchological encyclopedias, yet differed in important details. When discussing plants, Linnaeus did not identify them according to their external features. Instead, he relied on observing their sexual organs. While this system might have worked well for the purposes of taxonomy, some collectors found that it was ill-adapted for the practice of exchanging specimens. As we have seen, Collinson complained bitterly that many people could not correctly identify the pistils and stamens of a plant. The visual culture of Linnaean taxonomy was also an extension of the previous generation's reforms. The conchological encyclopedias, however lavish they might have looked, primarily offered an abstracted, diagrammatic view of nature. Collectors used these images primarily for the purposes of identifying their specimens. The *Systema naturae* brought this tendency to its natural conclusion by appearing practically without illustrations.[68] After all, the determination of a species could best proceed by employing a short, textual description of the defining characteristics of a plant. According to Linnaeus, engraved images in encyclopedias, e.g., the works of Buonanni,

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[66] Lisbet Koerner, *Linnaeus: Nature and Nation* (Cambridge: Harvard University Press, 1999); Staffan Müller-Wille, "Walnut Trees in Hudson Bay, Coral Reefs in Gotland: Linnean Botany and Its Relation to Colonialism," in *Colonial Botany: Science, Commerce and Politics in the Early Modern World*, ed. Londa Schiebinger and Claudia Swan (Philadelphia: University of Pennsylvania Press, 2005).

[67] Staffan Müller-Wille, "Collection and Collation: Theory and Practice of Linnaean Botany," *Studies in History and Philosophy of Biological and Biomedical Sciences* 38 (2007); Heller, "The Early History of Binomial Nomenclature."

[68] He did provide one illustration by Georg Ehret on his sexual system, but no single species was depicted in its entirety.

Lister, and Rumphius, were both superfluous and expensive for students of natural history.[69] The Linnaean system could be best expressed in language, and not through images.

Given its relationship to the previous generations' work, it is no surprise that some of Linnaeus's contemporaries interpreted the *Systema naturae* simply as a useful addition to previously existing encyclopedias. It was one more work to facilitate the practice of collecting. Gronovius wrote to Amman that "since Linnaeus hath printed his Systema naturae, Dr Lawson and I were very curious to have the specimens belonging to the Regnum Lapidum," and requested minerals from his colleagues in St. Petersburg and in Gdansk.[70] Yet the Linnaean system did not immediately become universal. The *Systema naturae* was often interpreted as "just another encyclopedia." As curator of the botanical garden of the Royal Museum in Florence, for instance, Attilio Zuccagni arranged his collections according to a mixed system of classification, basing himself on the Swedish taxonomist, the garden theorist Antoine-Joseph d'Argenville and many others.[71] In his long-distance correspondence, even Gronovius opted to use other works next to Linnaeus in the process of identification. When Breyne inquired about sea animals seen on the Dutch coast, he wrote the "*vitulus marinus* or walrus that was seen here recently, is the *Rob*, or *zee hond* that Linnaeus calls *phoca dentibus caninis inclusis.* You can find the same described and also illustrated in the *Acta Erud. Caesar. Norib. Vol. I. obs. 93.*"[72] To ensure that identification did not misfire, Gronovius decided to use Linnaeus, vernacular names, and a journal article in the *Acta eruditorum*. On its own, the *Systema Naturae* was not robust enough just yet.

Over time, Linnaeus's work transformed itself from "just another encyclopedia" into a truly universal system of biological communication. The binomial nomenclature introduced in the 1750s gained increasing recognition as the proper method of referring to plants and animals. Yet the practice of identification by encyclopedias survives in other disciplines where the order of nature cannot be captured so succinctly. One such field is the study of prints. The identification and exchange of early modern woodcuts,

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[69] John L. Heller, "Linnaeus on Sumptuous Books," *Taxon* 25 (1976).
[70] Gronovius to Amman, January 27, 1739, *RAS* R1 Fond 74A Dela 19. Gronovius to Breyne, September 20, 1740, *Gotha* Chart B. 786.
[71] Simone Contardi, "Linnaeus Institutionalized: Felice Fontana, Giovanni Fabbroni, and the Natural History Collections of the Royal Museum of Physics and Natural History of Florence," in *Linnaeus in Italy: The Spread of a Revolution in Science*, ed. Marco Beretta and Alessandro Tosi (Canton: Science History Publications, 2007).
[72] Gronovius to Breyne, April 20, 1745, *Gotha* Chart B. 786.

etchings, and engravings is a cumbersome process. Imagine you want to arrange for the loan of two prints for a temporary exhibition: Maarten de Vos's series of the *Four Continents* and Nicolas Stoer's *The Giraffe*. You first hope to send an email to major print collections, asking if they own a copy of these works. Unfortunately, de Vos designed two subtly different versions of the *Four Continents,* so the name of the prints won't suffice. Instead, you will have to look up de Vos's Hollstein number. Hollstein is the name of a monumental catalogue that contains a record of most sixteenth-century prints. It is not a high-quality, exquisitely printed album for admiring the beauty of prints. The quality of the illustrations might be poor, but it offers a good enough reproduction for the purposes of identification. Short descriptions highlight the differences between similar prints. You can go to Hollstein, check the prints' ID numbers (296–299), and then send that number to your correspondent. Unfortunately, Hollstein does not provide a universal language. Prints by German artists, whose name starts with the letters S-Z are not yet fully covered. For inquiring about Stoer's *The Giraffe,* you will therefore have to consult Geisberg's catalogue of sixteenth-century German woodcuts. *The Giraffe* is in that catalogue, identified as G.1359. You can now send your email to your correspondents: "please let me know if I can borrow de Vos's *Four Continents* (Hollstein 296–99) and Stoer's *Giraffe* (Geisberg 1359)." They will know what you mean. While no complete taxonomy exists, a combination of encyclopedias allows you to communicate and exchange objects with your long-distance correspondents.

Northwestern University.

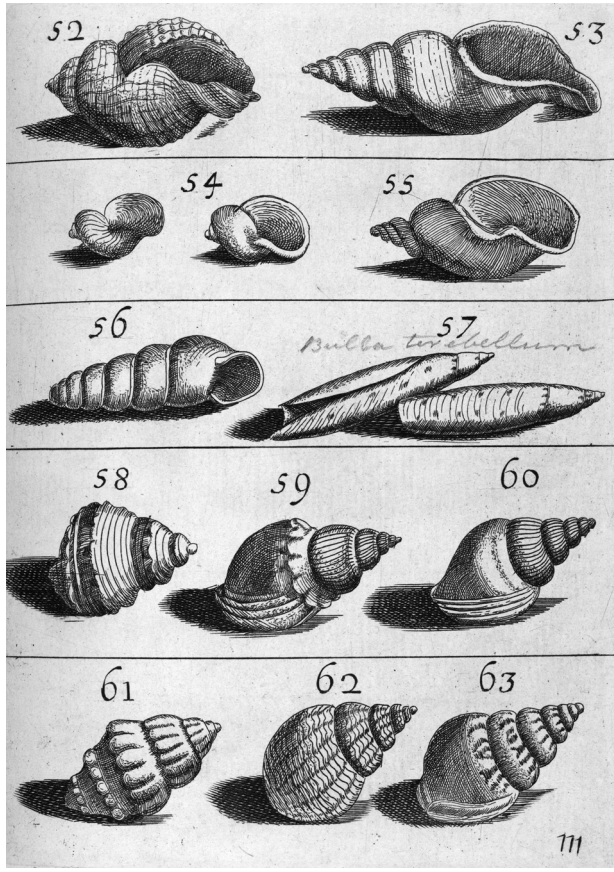

FIGURE 1. Filippo Buonanni, *Recreatio mentis et oculi* (Rome: Varesi, 1684). Images 52–63. Wellcome Library, London.

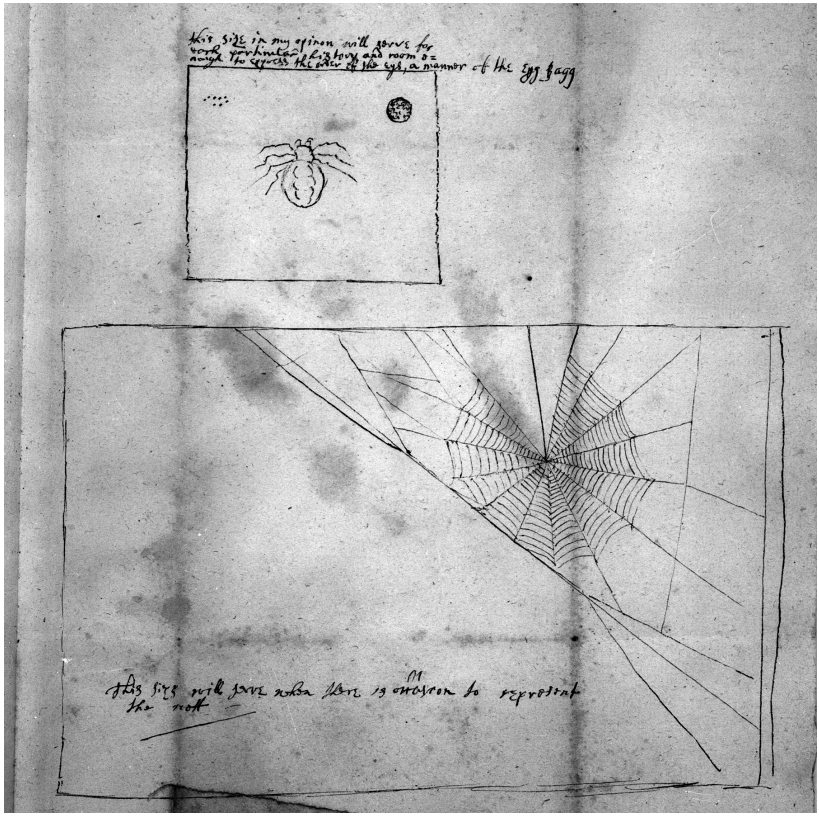

FIGURE 2. William Lodge. Drawing of a Spider. The Bodleian Library, University of Oxford. MS. Lister 34 fol. 170r.

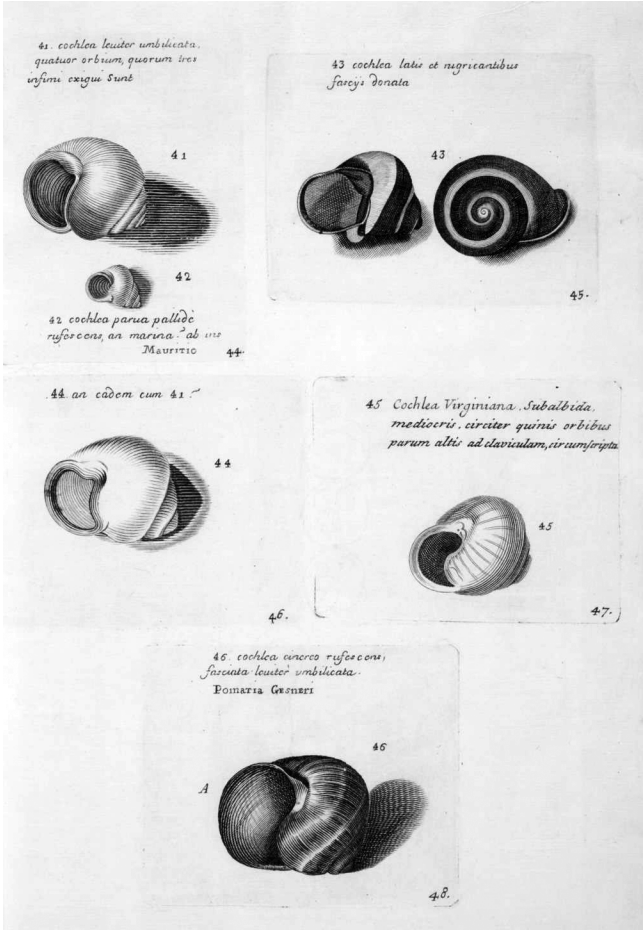

FIGURE 3: Martin Lister, *Historiae sive synopsis conchyliorum* (London: by the author, 1685–92). Images 41–48. University of Chicago Library Special Collections Research Center.

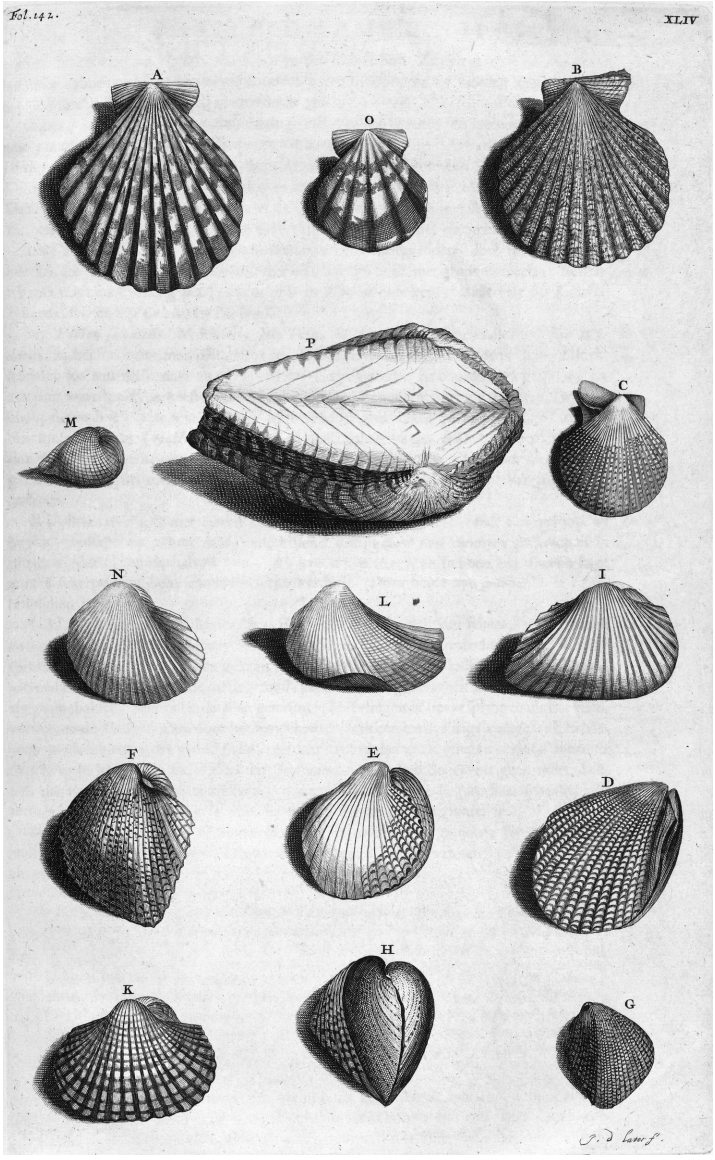

FIGURE 4: Georg Eberhard Rumphius, *D'Amboinsche Rariteit-kamer* (Amsterdam: Halma, 1705). Plate XLIV. Wellcome Library, London.

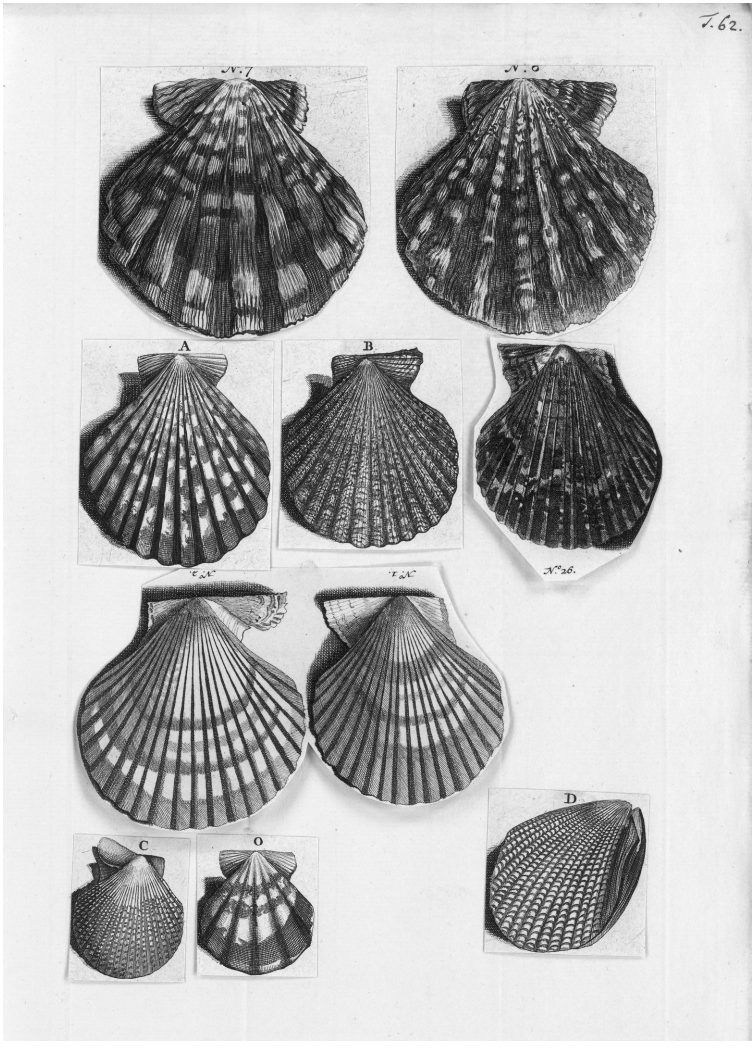

FIGURE 5: Arnout Vosmaer. *Systema testaceorum*. Nationaalarchief Den Haag Inv. 2.21.271. No 71. T. 62.