

EMPIRICISM AND COMMUNITY IN EARLY
MODERN SCIENCE AND ART: SOME COMMENTS
ON BATHS, PLANTS, AND COURTS

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Stressing the nonquantitative aspects of science, this collection challenges a traditional historiography of science. History of science of the early modern period has tended to concentrate on physics and astronomy, most familiarly in accounts of the “Scientific Revolution.” Emphasis on figures such as Bacon, Descartes, Kepler, and Galileo has also led to concentration on mathematics, on processes of reasoning, on induction, and on the role of experiment. Because of this focus on the quantitative, which is sometimes said to have marked the shift from earlier modes of “pre-” or “nonscientific” thinking, the role in the development of “science” of other aspects of investigation that might be called qualitative has been little noted. As a result, other sorts of observational processes have been understudied, other aspects of empiricism or an empirical approach ignored, and, finally, other sciences marginalized.¹

The present paper responds to these issues as epitomized by Paula Findlen’s and Katharine Park’s essays in this volume. Park directly challenges some traditional emphases in her assertion of the importance and priority of medicine at the dawn of the Renaissance. For, with certain notable exceptions,² medicine has not usually received its due. Where its relation to the Scientific Revolution has not been simply neglected, the role of medicine has vexed rather than attracted historians of science.³

Findlen offers another, albeit implicit, challenge to an older “internal” historiography of science that tended to limit concerns to issues of method, theory building, or the accumulation of knowledge as an independent process. She follows the current of a few earlier treatments of the social or sociological parameters of scientific investigation that had also suggested that the definition of what constitutes science itself may change according to the societal circumstances in which its activities are pursued.⁴ In this way the self-definition of science can be linked to the development of a scientific community. Findlen suggests how the change in conception of science may be related to the establishment of a scientific community in sixteenth-century Italy and to specific modes of community building.

The scope of both arguments can be expanded. While Park's and Findlen's papers may be situated in a more general historiographic context, they can of course first be considered in relation to the challenging work that both scholars have already produced. For example, in her book on early Renaissance medicine, Park establishes a distinction between the practice of empirics and the creation of medical theory by scholars at universities.⁵ She characterizes the medical profession as one that contained both a small group of university-trained, and accordingly theoretically oriented, doctors and a whole collection of folk healers and other sorts of empirics. The world of early Renaissance medicine provided many contacts between these two disparate groups, and in this world practical therapeutics outside of the accepted academic medical tradition were demonstrably important for the historical development of medicine.

In her essay in this collection, Park extends her examinations further in place and time. Examining physicians not in Republican Florence but at the courts of northern Italy ca. 1400, she finds traces of activities and interests that, while not the same as those of seventeenth-century science, seem to anticipate them. These include most significantly an interest in the causal study of natural phenomena, and therefore in actual observed particulars. According to Park a new tradition of empirically based knowledge is to be found already in "one of the first attempts by philosophically trained European writers to develop a method of natural inquiry based on the study of particular natural phenomena"—in balneological treatises. The study of baths was undertaken for aristocratic patrons: some treatises were written in response to explicit request. These circumstances provide a much different social context for the empirical study of natural phenomena than does either Republican Florence or the Italian university and the *doctrina* promulgated therein.

Park's concern with this sort of question not only provides a link between some of her interests and Findlen's approach but also opens up a further line for inquiry that draws near to Findlen's topic. Like Findlen, Park mentions a nascent community of inquirers working together to accumulate and collate new information. It was this community that would determine the empirical validity of observation. But this community and its court connections may be related to another sort of investigation of nature, one that took place in many of the same places, at much the same time, and involved many of the same sorts of scholars and patrons who were concerned with balneology. Moreover, those engaged in this enterprise also had an obvious interest in particulars, as well as in an accumulation of observations.

This was the tradition of the herbal book, which is in fact also central to Findlen's concerns. Physicians would have been interested in both sorts of

information, balneological and herbal. Both traditions represent and result from the approach of natural history, the study of matters that were not quantifiable but were, especially in the instance of herbals, nevertheless replicable, classifiable, and homologous. Both balneological and herbal sources provided information for medical practice that could have been derived from observation.

Most important, an ancient text that provided an authoritative source for the very *doctrina* on which that practice was based could have created a crucial connection between these interests. The book on plants (*Peri phytōn*, *De plantis*) associated with Aristotle in earlier times, though now usually attributed to the first-century-C.E. Greek philosopher Nicholas Damascenus, furnishes a link between the study of herbs and that of baths.⁶ In a passage in 2.3, this Aristotelian treatise accounts for the composite constitution of wild herbs by reference to the origin of saltwater. The account entails an observation about the precipitation of salt and the condensation of vapors in baths.⁷ Thus beyond the general empirical thrust that Aristotelian writings imparted to subsequent tradition, both balneological and herbal, this passage seems to establish a theoretical justification for combining an interest in baths and herbs. By calling attention to baths in the context of a discussion of plants, *De plantis* effectively creates a place for considerations of balneology within herbal doctrine that is founded in part on, as it were, Aristotelian as well as other ancient discussions of plants.

Although now regarded as pseudo-Aristotelian, *De plantis* belonged to the stock of traditional treatises of natural philosophy through the sixteenth century.⁸ A translation from Arabic into Latin by Alfred of Sareshel was made probably before 1200, and it gained wide diffusion: at least 159 manuscripts containing *De plantis* have been identified.⁹ Roger Bacon, Albertus Magnus, and Vincent of Beauvais all wrote commentaries on it. It was definitely used at the University of Paris in the thirteenth century, and we can assume that it would have been known at the northern Italian universities—especially at Padua, where instruction was given on the text of Dioscorides and where Aristotelian traditions were strong.¹⁰

In any event, associating an interest in plants with one in baths not only helps link the topic discussed by Park with that of simples, Findlen's topic, but has immediate pertinence for Renaissance science—and art. These realms are directly conjoined by Leonardo da Vinci, who also speaks of the importance of the use of pictorial images in the study of nature. Given what might be called the neo-Duhemian echoes of Park's arguments for the late medieval or early Renaissance origins of scientific empiricism, the absence of any mention of Leonardo in her paper, as in that of Findlen—as indeed anywhere else

in this collection—is striking. Can it be that the alternative tradition Leonardo represents would mount too great a challenge to a unified view of the scientific tradition? All the more, then, do Leonardo's comments about the empirical utility of painting to those investigating nature, including water and plants, call for quotation and discussion here:

Whoever disparages painting loves neither philosophy or nature. If you disparage painting which alone is the imitator of all the works to be seen in nature, you most surely will disparage an invention which with philosophic or subtle speculations, examines all qualities of forms: the sea, lands, animals, plants, flowers, which are surrounded by shadow and light. This is truly science and the legitimate daughter of nature, because painting is born of nature herself or, to put it more correctly, let us say granddaughter of nature because all things we sense are born of nature and painting is born of all those things.¹¹

Among other allusions, these lines play on a passage in Dante's *Inferno* (11.97–105) where Dante places a discussion of *arte* in the mouth of Vergil.¹² It is known that Leonardo read Dante closely and responded to him in his own writings.¹³ Here he takes the larger sense of *arte*, or art as understood more generally in Renaissance contexts,¹⁴ and relates it more specifically to the art of painting. In Dante human *arte* is a *nepote* of God (as nature): painting is a *nipota* of nature in Leonardo. Leonardo's use of this trope has a specific purpose in his defense of painting.¹⁵ It is deployed as part of an effort to redefine the meaning of art.¹⁶

Because of the context from which the reference to art is drawn, however, Leonardo's text also seems to imply a specific understanding of science, or *scientia*. Leonardo speaks of *scientia* where Dante refers to *Fisica*. Hence Leonardo seems to be speaking not just of science with the significance of knowledge in general but, like Dante, of the science of nature, as in Aristotle's *Physics*. And in Aristotle's *Physics* (199a) there is a passage that closely conjoins art (*technē*) and nature (*physis*): *technē* either completes (*epitelei*) things that nature has not accomplished, or it imitates (*mimetai*) nature. Consequently Leonardo seems to be deliberately tying painting to *scientia* in the sense not just of knowledge but of something akin to contemporary notions of science.

Moreover, the conjunction of terms in Dante allows for a reading of Leonardo's play on his text as applying not simply to science in general but to natural philosophy in particular. Dante begins the passage in question with the word *Filosofia* and explicates philosophy as referring to nature: that is, it is natural philosophy that he is discussing. Leonardo's first line also couples philos-

ophy and nature. He goes on to describe just those sorts of subjects (including the sea, plants, animals) that might be associated with natural philosophy.

Citing the passage from Leonardo, in his own translation, James S. Ackerman thus seems justified in observing that Leonardo was able to refer to painting as a path to science or natural philosophy because of the dependence on visual evidence and observation implicit in nature studies. Ackerman claims that artists like Leonardo virtually preempted the fields of scientific investigation in many areas, including botany.¹⁷ Although Leonardo is himself too late a figure to fall within Park's purview, both his comments reflecting Dante and his surviving drawings demonstrate that he continued earlier traditions. His interests in studies of plants and in studies of moving water, for example, are both abundantly represented in his drawings.¹⁸ In them as in his anatomical studies, artistic techniques, such as the treatment of light and shadow that Leonardo specifically evokes in the passage quoted above, are developed to serve the investigation of nature, as a number of scholars have noted.¹⁹ In turn, Leonardo's outspoken defense of the importance of painting for the study of natural phenomena establishes the visual arts as another manifestation of scientific learning.²⁰

Leonardo thereby not only reminds us of the need to study visual sources as well as texts in the history of science, especially in its nonquantitative aspects, but he also leads us to reconsider another aspect of the implications of Park's paper for the study of herbals.²¹ Herbals obviously involved an empirical concern with the growths found in nature and a focus on individual objects, as Leonardo's studies of individual plants and their particularities also suggest. Although herbal books did not necessarily impart their information in words, the collections of simples gathered together in the tradition of *materia medica* depended on illustration to disseminate their information. Hence the role of images depicting plants was central to the immediate—and empirical—concern of the herbal. The communication of the information they imparted depended on accuracy of representation: naturalistic verisimilitude came to be essential to establishing the identification of plants.

Herbals might seem to be about kinds, and their pharmacological properties were largely regarded as universal. But crucially, just as physicians studied individual springs, examining them as if they were individual patients, herbals also began to generalize from particular observations. While earlier, medieval artistic representations and illustrations of plants may have been copies of earlier pictures or composite idealizations, printed herbals of the sixteenth century, at least from the work of Brunfels on, in fact often depicted individual specimens, using them as the basis for illustrations.²²

The development seen in printed herbaria had precedents, however, not only in the work of Leonardo, and of Albrecht Dürer,²³ but also in the work of illustrators of the period discussed by Park. While the dimensions and details of the change still require further investigation, art-historical researches have nevertheless long indicated that in the late fourteenth and early fifteenth century, artistic practices changed from the use of the model book, in which previously existing types were recorded, to books with sketches, in which freely observed and executed drawings begin to be made.²⁴ And among these drawings there do exist studies of plants and animals made from observation of individual specimens.²⁵ These provided the basis for a transformation of the herbal, as they did for other sorts of natural historical compendia.

Already half a century ago Otto Pächt illuminated this development when he considered the importance of the relation of art to science in the herbal. Pächt thus pointed to another way in which the history of the visual arts is to be related to the concerns of the history of science. In an essay on early Italian nature studies and the origins of calendar landscapes in manuscript illumination, he demonstrated that some of the first new empirical studies of plants since antiquity presented in herbals, in the traditions of *materia medica* and of the *Tacuinum Sanitatis* in the late fourteenth and early fifteenth century, led to the creation of the new genre of landscape in painting. He argued specifically that the development of nature studies runs parallel to the growth of empirical science.²⁶

Pächt's argument about these new creations has in turn implications for Park's thesis. The coincidences are striking. Pächt associated the new experiment, as he called it, in herbal illustrations with Padua, where there was present an important medical faculty at the university, where many other medical developments were made. But the exact context for the manufacture of the manuscripts discussed, and the origin of nature studies in model books, needs to be examined further. As in the instance of the work of Giovannino de' Grassi, workshops of illuminators of nature studies often seem in fact to have been associated with northern Italian courts.²⁷ The splendid illustrations turn the herbal books in question into luxury products that far surpass the practical needs (or means?) of a university physician; it is thus possible that these books, which Pächt first described as evincing an empirical turn, were related to, if not indeed created for, precisely the same milieus, and the same sorts of physicians, as those discussed by Park.

The herbal tradition also demands attention here, because herbals are central to Findlen's concerns as well. Like Park, Findlen has extended arguments from her earlier work, especially those in her book on scientific col-

lections.²⁸ Making more particular the characterization of early modern science, she urges closer attention to the context in which science was carried out. Emphasizing the notion of culture, she argues for the importance in scientific activities of the formation of a scientific culture that depended on sensory engagement. Findlen has thereby broadened the category of activities that are to be studied under the rubric of science, taking scholarship into new arenas by asking what contexts made it possible for science to thrive in early modern Italy. She argues that late Renaissance natural history was defined by its audience as well as by the books that outlined its shifting parameters; the knowledge that it sought and imparted was therefore a matter of self-knowledge as well as of social knowledge.

In her paper Findlen proposes that natural history was a locus where theory and practice could be conjoined, because the practice of medicine could be linked with the study of natural history. She argues that in sixteenth-century Italy a scientific community for natural history was formed. This is a process that involved what she describes as the emergent book culture of the time. The dissemination of knowledge through and by books becomes part of what makes the new science. This argument raises a number of issues of broader importance that are worth further examination in relation to issues of science and art: in particular, the definition of what makes a community and its location.

Let us first question the definition of what Findlen describes as “Italy.” For location cannot be simply equated with matters of late-twentieth-century language or geography. Although employing the vernacular may to a degree have defined speakers and writers in the sixteenth century, the issue is much more complicated than that. The definition (or self-definition) of “Italian” as applied to Mattioli in this regard cannot be taken to correspond strictly to the nation of Italy, because the use of the Italian language did not serve as a marker of Italian nationality at the time: other “nationals” outside of present-day Italy also spoke Italian.²⁹ The nation-state of Italy as a country of Italian-speakers did not yet exist; and because Italy as such did not yet appear on the map, the actual location of the place where Mattioli worked before going north also needs to be considered more carefully.

Mattioli worked in the city of Gorizia, now situated within Italy on its border with Slovenia. But in the later sixteenth century, Gorizia was within the bounds of the Holy Roman Empire; more specifically, it belonged to Carniola, a part of what then constituted *Innerösterreich* (Inner Austria), one of the Habsburg hereditary lands.³⁰ Trent, another place where Mattioli was active before he journeyed north, was a disputed territory. As a prince-bishopric, it was *Reichsunmittelbar*: it recognized as its suzerain only the Holy

Roman emperor in his person as ruler thereof. A counterclaim was made, however, that it was a Habsburg land, and rather than being ruled ultimately by the emperor (then a Habsburg), it thus belonged to the Habsburg dynasty as such. From 1564 onward, Mattioli's quondam student and patient Archduke Ferdinand II, regent of the Tyrol, tried to annex Trent to the territories over which he ruled, and in 1568 it was occupied. The year 1571 was a key moment in the struggle with the Habsburgs for control over the city.³¹

Can the dispute over Trent, and the difficulties for inhabitants that it created, have provided an impetus for Mattioli's departure from the city? Does not the Tridentine-Habsburg debate provide a more specific historical context for an understanding of Mattioli's remarks about Italians and others, especially his pro-Italian and related anti-German comments? And in general, do such remarks not reflect the continuing, long-lasting dispute and antagonism on the borderlands between the *welsch* and the *deutsch*, the conflict between Italian and German speakers?³² It may be remembered that this conflict would have disastrous consequences, eventually leading to much loss of life on the battlefields of the First World War.

In any event, in the sixteenth century the extremely close relationships that existed between Trent and the imperial court belie an exclusively national or nationalistic interpretation. It is no accident that a whole sequence of scholars passed on from Trent to Vienna and Prague to serve at the imperial court. Not only Mattioli but also Giulio Alessandrino and Ippolito Guarinoni, to mention but the most famous, served the imperial court as botanists and physicians.³³

In Vienna and in Prague these men would have become members of cosmopolitan courts, where they could have joined an intellectual community that consisted not only of Italian-speaking scholars but of natives of many lands; it was a polyglot group.³⁴ Among those with interests similar to their own, people like Mattioli could have encountered in Vienna or later in Prague scholars such as the Lusatian Paulus Fabricius, university professor of medicine and court mathematician; the Viennese Johann Aicholz, professor of medicine at the university there; the Silesian Crato von Craffheim; the Flemish botanist Rembert Dodoens; and later his fellow Netherlander Carolus Clusius (Charles de l'Écluse).³⁵ Several of these men are indeed known to have been friendly with Mattioli.³⁶

Interaction between figures at court and in the city also suggests that the cosmopolitanism of the court affected the cities in which it was located. The Latinate, humanist culture of the Renaissance (as of the antecedent period) was an international culture. In one instance, Clusius lived on Aicholz's lands in Vienna, in the *Alsergrund* (now the ninth *Bezirk*), where his garden

was located. The dual activity of Aicholz, who both owned a private garden and taught at the university, is typical of many in the Viennese group, such as Fabricius, who in addition to his court employment was, as remarked, also a university professor; they illustrate the multiple connections of this circle. Furthermore, the loci provided by the court for botanical activities in both Prague and Vienna would have attracted Mattioli as well as other figures in town. The imperial gardens that would have served botanists were located on Hradčany in Prague, in the castle precinct, as well as elsewhere in the city environs. At least as important were the gardens on the Prater in Vienna, about which Georg Tanner wrote in a poem; these also may have been helpful to Mattioli.³⁷

Not only Clusius and Crato but many other figures in this group were writers on scientific matters, which pertained both to court and university concerns. Their publications, like those of writers who remained in the Italian peninsula, would also have disseminated their views. To follow Findlen, publications by authors at the imperial court would have helped make a community. Fabricius, for example, compiled a book, published in 1557, on plants found in the region of Vienna.³⁸ This was a work that would no doubt have been of interest to Mattioli when he came to Vienna, even if there is not yet evidence that he ever met Fabricius personally.

A further note about books and botanists in this community: the Netherlander Ogier Ghiselin De Busbecq, who brought the tulip to Europe, also brought back with him from Istanbul (Constantinople) a manuscript containing the text of Dioscorides—the famed Anicia Juliana Codex (also known as the Vienna Dioscorides), an ancient illustrated herbal that includes theriac illuminations.³⁹ Busbecq is probably that imperial ambassador to whom Findlen refers as having supplied material to Mattioli.⁴⁰ The Anicia Juliana Codex, perhaps one of those manuscripts, and in any event one that Mattioli knew, is of course a work of great interest to art history, the history of science, and history more generally. The time of contact between Busbecq and Mattioli, which fell between 1568 and 1569, suggests connections to other figures in a larger intellectual community. Because of the attention such a manuscript attracted, this community must also have included the imperial librarian Hugo Blotius (since not Prague but Vienna was then the seat of the imperial library).⁴¹

The Vienna Dioscorides was in fact but one of several manuscripts included in a trade in such materials. Manuscripts circulated back and forth from various centers. Italians such as Jacopo Ligozzi supplied nature studies for Rudolf II Habsburg as well as for the Medici and for private scholars such as Ulisse Aldrovandi.⁴² Georg (Joris) Hoefnagel provided works for various

courts, and his materials were also used by Aldrovandi.⁴³ Giorgio Liberale illustrated Mattioli's commentary to the *Materia Medica* of Dioscorides and supplied illuminated nature studies for Archduke Ferdinand of the Tyrol.⁴⁴ It can now be demonstrated that the imperial court artist Giuseppe Arcimboldo was regarded as something of an expert on natural history as well. Arcimboldo supplied specimens for the imperial collections, and he also executed nature studies for Aldrovandi. These were in turn used both for elements in his paintings of composite heads (thus for works of art) and for compendia of illustrations of creatures from the world of nature (thus for natural history, or science).⁴⁵

Another point of practice would have helped form a community of informants. For many of the figures that have been mentioned—Alessandrino (Alexandrinus), Fabricius, Crato—held the position of personal physician to the emperor (*kaiserlicher Leibarzt*). This concern with medical matters gave them reason to have had commerce with Mattioli as well.⁴⁶

Contrary to some of the evidence adduced by Findlen for the Italian situation, it is doubtful that this intellectual community was predominantly Catholic. At the imperial court Mattioli would have encountered a situation that was much more complicated; there in the 1550s the man who helped bring the Jesuits to Central Europe, St. Peter Canisius, could examine the Lutheran Fabricius for a position as court mathematician.⁴⁷ While by no means intentionally ecumenical, and also deeply involved in issues of church and throne, the rulers held beliefs of uncertain tenor; their courts remained open to men with various shades of opinion. Ferdinand I (emperor 1558–1564), though at times wavering in his religious attachments and in any case relatively tolerant, strongly supported the Roman church, but his successor Maximilian II, the patron of the Vienna group of humanists and scientists (1564–1576), was suspected of crypto-Lutheranism; Maximilian II was certainly open to scholars of all persuasions, including many Lutherans and some Calvinists.⁴⁸ The personal beliefs of Rudolf II (1576–1612), the great patron of art and science, are unclear; a wide variety of confessions were represented at his court, and ultimately he signed a Letter of Majesty granting freedom of religious practice in Bohemia.⁴⁹

Regardless of the ruler's beliefs, many of the scholars in the Vienna and Prague circles of humanists were Protestants of various stripes. To mention just those with botanical interests, Dodoneus (Dodoens), Crato, and later Clusius were certainly Calvinists. Aicholz and Tanner were Lutherans.⁵⁰ Fabricius seems to have been a moderate Lutheran of Melancthonian persuasion, and he wrote a tract against the Gneseo-Lutheran Flaccists.⁵¹

While Rudolf II was also interested in a host of occult and scientific pursuits, including natural history, Mattioli's patron Emperor Maximilian II was highly interested in botany.⁵² Maximilian's interest was part of his broader

concerns with astronomy and other sciences.⁵³ We might therefore posit another definition of Mattioli's immediate scientific community. As noted, during Maximilian II's reign as well as during that of Rudolf II many connections existed between the imperial court and Italy; figures such as Aldrovandi employed court artists such as Hoefnagel and Arcimboldo along with Ligozzi, who in turn supplied materials to the imperial court. Moreover, Mattioli's son Ferdinando was one of the few individuals who were not dignitaries or members of the Habsburg family who were portrayed by Joseph Heintz, the court painter of Rudolf II.⁵⁴

So, while Findlen suggests that Mattioli belonged to an Italian community from afar, we might focus instead on his connections with the community that he would have encountered more directly and immediately in Central Europe. This shift in attention applies even to the publication of books, for note must be taken of his work published in Prague by G. Melantrich. The republic of botanists was larger than the citizenry of any one nation. The community of scholars and scientists was much bigger, embracing all of Europe, as indeed the redaction and publication of editions of Mattioli's herbal book show. Several editions were published in Frankfurt am Main, and the Nuremberger Joachim Camerarius added illustrations and more text.⁵⁵

Finally, a focus on court culture provides not only another link between Findlen's and Park's papers but also a further challenge to traditional historiography, and even to its revision as suggested in this collection. For the idea of the court servitor who is also a scientific innovator does not correspond to the current model of the scientific virtuoso found in England, or of his counterpart in Italy.⁵⁶ If however we examine the sites where scientific innovation actually occurred in the Renaissance, we may discover that they were located not only in the late trecento and early quattrocento duchies of northern Italy but also in Sforza Milan, and later in the northern and Central European courts—including most notably but by no means exclusively Rudolfine Prague. In both the period around 1400 and that around 1600, courts seem to have furnished important foyers for the sciences as well as the arts, and at both times an international court style may have existed in science as it did in art.

NOTES

1. See H. Floris Cohen, *The Scientific Revolution: A Historiographical Inquiry* (Chicago: University of Chicago Press, 1994). A broader statement about the importance of quantification has more recently been made by Alfred W. Crosby, *The Measure of Reality: Quantification and Western Society* (Cambridge: Cambridge University Press, 1997).

2. As in the work of Nancy G. Siraisi, e.g., *Medieval and Early Renaissance Medicine: An Introduction to Knowledge and Practice* (Chicago: University of Chicago Press, 1990).
 3. See Harold J. Cook, "The New Philosophy and Medicine in Seventeenth-Century England," in *Reappraisals of the Scientific Revolution*, ed. David C. Lindberg and Robert S. Westman (Cambridge: Cambridge University Press, 1990), pp. 397–436.
 4. Most notably R. K. Merton, *Science, Technology, and Society in Seventeenth-century England* (Bruges, 1938; reprint, New York: H. Fertig, 1970); see also the discussion in Cohen, *Scientific Revolution*, pp. 328 ff.
 5. Katharine Park, *Doctors and Medicine in Early Renaissance Florence* (Princeton: Princeton University Press, 1985).
 6. See Bernard G. Dod, "Aristoteles Latinus," in *The Cambridge History of Later Medieval Philosophy*, ed. Norman Kretzmann, Anthony Kenny, and Jan Pinborg (1982; reprint, Cambridge: Cambridge University Press, 1988), p. 47, for the current attribution. The issues of authorship and diffusion of this text are discussed in S. D. Wingate, *The Mediaeval Latin Versions of the Aristotelian Scientific Corpus, with Special Reference to the Biological Works* (London: Courier, 1931), pp. 55–56. Wingate makes the point that even if "pseudo-Aristotelian," *De plantis* contains genuine Aristotelian doctrine. Wingate also gives a different span, fl. 37–4 B.C.E. for the lifetime of Nicholas Damascenus (p. 55).
 7. *De plantis* is most conveniently available in Aristotle, *Minor Works*, ed. W. S. Hett, Loeb Classical Library (Cambridge, Mass.: Harvard University Press, 1936), pp. 198 ff.
 8. See William A. Wallace, "Traditional Natural Philosophy," in *The Cambridge History of Renaissance Philosophy*, ed. Charles B. Schmitt et al. (Cambridge: Cambridge University Press, 1988), pp. 211–212. It also belonged to the stock of works to be associated with psychology; see Katharine A. Park and Eckhard Kessler, "The Concept of Psychology," in *ibid.*, p. 455.
 9. See Dod, "Aristoteles Latinus," p. 79. For the possibility of the availability of other versions of the *De plantis* in the Latin West, see Wingate, *Mediaeval Latin Versions of the Aristotelian Scientific Corpus*, and further Charles Lohr, "Medieval Latin Aristotle Commentaries," *Traditio* 23 (1967): 313–413.
 10. For the commentaries, see Wingate, *Mediaeval Latin Versions of the Aristotelian Scientific Corpus*, pp. 67 ff. Karen Meier Reeds, *Botany in Medieval and Renaissance Universities* (New York: Garland, 1991), pp. 7 ff., discusses the use of *De plantis* in medieval universities and mentions instruction in Dioscorides at Padua (p. 16). For Padua, known for its "Averroistic" tradition, it is also important to note that a commentary by Averroës might have existed on *De plantis*; see Wingate, pp. 71–72.
 11. Leonardo da Vinci's *Treatise on Painting*, introduction, as translated by James S. Ackerman, "Early Renaissance 'Naturalism' and Scientific Illustration," reprinted in his *Distance Points: Essays in Theory and Renaissance Art and Architecture* (Cambridge, Mass.: MIT Press, 1991). 185.
- The original text (Leonardo da Vinci, *Treatise on Painting* [Codex Urbinas Latinus 1270], facsimile [Princeton: Princeton University Press, 1956], pp. 4 ff.) reads: "Se tu

sprezzarai la pittura la quale, e sola inuentrice de tutte le opere, euidenti de natura per certo tu sprezzarai una sottile invention la quale con filosoficha, è sottile speculatione considera tutte le qualità delle forme, mare siti piante, animalie, herbe, fiori, le quali sono cinte d'ombra, e lumi et ueramente questa e scientia e legitima figlia de natura perche la pittura, è patorita da essa natura ma per dir più corretto diremo nipota de natura per che tutte le cose euidenti sonno state partorita dalla natura delle quali cose, e' nata la natura, an-donque nettamente la chiamaremo nipota d'essa natura, et prente d'Iddio."

12. Filosofia, mi disse, a chi la intende,
 Nota non pure in una sola parte
 Come natura lo suo corso prende
 Dal divino intelletto e da sua arte;
 E se tu ben là tua Fisica note,
 Tu troverai non dopo molte carte
 Che l'arte vostra quell, quanto puote
 Segue, come il maestro fa il discente,
 Sia che vostr'arte a Dio quasi è nepote.

Le Opere di Dante Alighieri, ed. Dr. E. Moore, rev. Paget Toynbee (Oxford: Oxford University Press, 1963), p.v.

13. See, e.g., Martin Kemp, *Leonardo da Vinci: The Marvellous Works of Nature and Man* (London: Dent, 1981), passim; on the *Divina Commedia*, see pp. 104, 162, 33.

14. See the paper by William Newman in this collection.

15. See most recently Claire J. Farago, *Leonardo da Vinci's "Paragone": A Critical Interpretation with a New Edition of the Text in the "Codex Urbinas"* (Leiden: Brill, 1991). Farago (p. 314), recognized that Leonardo's text in the *Trattato* might be a paraphrase of Dante's *Inferno*, canto 11, but made no further comment on the relation between the texts.

16. See the classic essay by Paul Oskar Kristeller, "The Modern System of the Arts," reprinted in his *Renaissance Thought II: Papers on Humanism and the Arts* (New York: Harper and Row, 1965), esp. pp. 176, 184, for Dante and Leonardo, and Anthony Blunt, *Artistic Theory in Italy, 1450–1600* (London: Oxford University Press, 1962), pp. 23 ff., for Leonardo.

17. Ackerman, "Early Renaissance 'Naturalism'."

18. These drawings have been frequently exhibited, and there is, as in all matters Leonardesque, an ever-increasing literature on them. A good starting point is the catalogue of an exhibition organized in London in 1989, *Leonardo da Vinci* (New Haven: Yale University Press in association with the South Bank Centre, 1989), with contributions by E. H. Gombrich, Martin Kemp, and Jane Roberts.

For Leonardo's water studies, see the essay by E. H. Gombrich, "The Form of Movement in Water and Air," in *The Heritage of Apelles*, Studies in the Art of the Renaissance 3 (Ithaca, N.Y.: Cornell University Press; Oxford: Phaedon, 1976), pp. 39–56.

19. See Martin Kemp, "Il concetto dell'anima in Leonardo's Early Skull Studies," *Journal of the Warburg and Courtauld Institutes* 34 (1971): 115–134; Ackerman, "Early Renaissance 'Naturalism.'"

20. These relationships between the visual arts and science are well discussed by Kemp, *Leonardo da Vinci*. An earlier essay in a similar direction by a historian of science is V. P. Zubov, *Leonardo da Vinci*, trans. David H. Kraus (Cambridge, Mass.: Harvard University Press, 1968).
21. For the subject of herbal illustration, see in general A. R. Arber, *Herbals, Their Origin and Evolution: A Chapter in the History of Botany*, 3rd ed. (Cambridge: Cambridge University Press, 1986 [1st ed., 1912]); Wilfried Blunt and Sandra Raphael, *The Illustrated Herbal* (New York: Thames and Hudson, Metropolitan Museum of Art, 1979).
22. I am grateful to an anonymous reader of this article for suggesting I may have missed Park's point, thus leading me to elaborate these arguments and ensure that Ackerman's point, summarized here, not be missed.
23. See, e.g., Fritz Koreny, *Albrecht Dürer and the Animal and Plant Studies of the Renaissance*, trans. Pamela Marwood and Yehuda Shapiro (Boston: Little, Brown, 1988); and for the link with herbaria, see the review of this book by Karen Reeds in *Isis* 81 (1990): 768.
24. See for this issue most recently and fully Robert W. Scheller, *Exemplum: Model-Book Drawings and the Practice of Artistic Transmission in the Middle Ages (ca. 900–1450)*, trans. Michael Hoyle (Amsterdam: Amsterdam University Press, 1995), and Albert J. Elen, *Italian Late-Medieval and Renaissance Drawing-Books from Giovannino de' Grassi to Palma Giovane: A Codicological Approach* (Leiden: Elen, 1995), both with extensive bibliographies.
25. The relatively few examples on which judgments are based, as cited from the secondary art-historical literature by an author like Reeds, *Botany in Medieval and Renaissance Universities*, p. 185 n. 83, do not take into account the problem of survival of manuscripts and drawings from the period, and thus do not give an adequate picture of the problem. Already Otto Pächt (see note 26) considered the objects he was studying not as singular but as exemplary of a wider trend. This issue may be reconsidered in relation to information gathered in more recent studies and exhibitions, e.g., Marco Rossi, *Giovannino de Grassi: La corte e la cattedrale* (Milan: Silvana, 1995), and Paola Marini, ed., *Pisanello* (Milan: Electa, 1996); however, these works do not really tackle the question again.
26. Otto Pächt, "Early Italian Nature Studies and the Early Calendar Landscape," *Journal of the Warburg and Courtauld Institutes* 13 (1950): 13–47, especially pp. 25–31.
27. See *ibid.* and Rossi, *Giovannino de Grassi*.
28. Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Berkeley: University of California Press, 1994).
29. The general issue of how language and nation relate to the definition of the Renaissance is reviewed in Peter Burke, "The Uses of Italy," in *The Renaissance in National Context*, ed. Roy Porter and Mikuláš Teich (Cambridge: Cambridge University Press, 1992), pp. 6–20, esp. pp. 13–14; see further now Burke, *The European Renaissance: Centres and Peripheries* (Oxford: Blackwell, 1998). For the question of the relation of the imperial court to Italy and Italians in the time of Mattioli, see Heinz Noflatscher, "Sprache und Politik: Die Italienexperten Kaiser Maximilians II.," *Kaiser Maximilian II: Kultur und Politik im 16. Jahrhundert*, ed. Friedrich Edelmayr and Alfred Kohler, Wiener Beiträge zur Geschichte

der Neuzeit 19 (Vienna: Verlag für Geschichte und Politik; Munich: Oldenbourg, 1992), pp. 143–168. For the continuing importance of Italian as a spoken language (and cultural determinant) at the imperial court through the seventeenth century, see Thomas DaCosta Kaufmann, *Court, Cloister, and City: The Art and Culture of Central Europe, 1450–1800* (Chicago: University of Chicago Press, 1995), p. 270.

30. For a variety of essays on the social and cultural history of this region, see *Innerösterreich 1564–1619*, ed. Alexander Novotny and Berthold Sutter, Joannea 3 (Graz: Universitätsbuchdruckerei Styria, [1968]); *Graz als Residenz: Innerösterreich 1564–1619*, ex. cat. (Graz: Steirermarkischen Landesbibliothek am Joanneum, 1964).

31. The essays by Bruno Passamani, “Ragioni e struttura della mostra: Un principato per l’impero,” and Marco Bellabarba, “Il Principato vescovile di Trento e i Madruzzo: L’Impero, la Chiesa, gli stati italiani e tedeschi,” in *I Madruzzo e l’Europa, 1539–1638: I principi vescovi di Trento tra Papato e Impero*, ed. Laura Dal Prà, ex. cat. (Milan: Charta, 1993), pp. 11–28, 29–42, provide an introduction to the political vicissitudes of Trent in this era.

32. This conflict provides an introduction to some of the discussion of period eye in Michael Baxandall, *The Limewood Sculptors of Renaissance Germany* (New Haven: Yale University Press, 1980); a somewhat different interpretation of these issues is offered in Kaufmann, *Court, Cloister, and City*.

33. For Mattioli in this context of Trent physicians, see Franco Ottaviani, “Quattro generazioni di medici trentini (1539–1653),” in Dal Prà, *I Madruzzo e l’Europa*, pp. 673–679.

34. For the presence of these Italians in the midst of a host of other physicians, and the description of the courts as cosmopolitan, see R. J. W. Evans, *Rudolf II and His World: A Study in Intellectual History 1576–1612* (Oxford: Clarendon, 1973), pp. 203–204; idem, *The Making of the Habsburg Monarchy, 1550–1700* (Oxford: Clarendon; New York: Oxford University Press, 1979), p. 22. For Mattioli at the imperial court, see now Maria Ludovica Lenzi, “Dal ‘Regno di Iatria’ alla corte di Praga,” in *Pietro Andrea Mattioli (Siena 1501–Trento 1578): La vita, le opere*, ed. Sara Ferri (Siena: Quattroemme, 1997), pp. 83–104.

35. For a recent treatment of Fabricius, see Thomas DaCosta Kaufmann, “Astronomy, Technology, Humanism, and Art at the Entry of Rudolf II into Vienna, 1577: The Role of Paulus Fabricius,” in his *The Mastery of Nature: Aspects of Art, Science, and Humanism in the Renaissance* (Princeton: Princeton University Press, 1993), pp. 136–150; for Crato, see Howard Louthan, *Johannis [sic] Crato and the Austrian Habsburgs: Reforming a Counter-reform Court*, *Studies in Reformed Theology and History* 2, no. 3 (Princeton: Princeton Theological Seminary, 1994); for Dodoens, see *Luister en remspoed van Mechelen ten tijde van Rembert Doedoens*, ex. cat. (Brussels, 1985); for Clusius, *Carolus Clusius und seine Zeit*, *Wissenschaftliche Arbeiten aus dem Burgenland* 54 (Eisenstadt: Amt der Burgenlandische Landesregierung, 1974); for Aicholz and for the whole group, see Joseph Ritter von Aschbach, *Die Wiener Universität und ihre Gelehrten 1520 bis 1565*, *Geschichte der Wiener Universität* 13 (Vienna: Verlag der K. K. Universität, 1888).

36. For Fabricius’ friendship with Mattioli, see Kaufmann, *The Mastery of Nature*, pp. 144, 275 n. 20. For Busbecq and Mattioli, see note 40 below.

37. See Kurt Mühlberger, “Bildung und Wissenschaft: Kaiser Maximilian II. und die Universität Wien,” in Edelmayer and Kohler, *Kaiser Maximilian II*, pp. 203–230, and in general Evans, *Rudolf II and His World*, pp. 119 ff. Also see still Aschbach, *Die Wiener Universität*, with further references.

38. Paulus Fabricius, *Catalogus Stirpium circa Viennam nascentium* (Vienna, 1557); see for further references Kaufmann, *Mastery of Nature*, pp. 146, 278 n. 40.

39. Vienna, Österreichische Nationalbibliothek, cod. med. gr. 1; for the literature on this manuscript, see *Der Wiener Dioscurides (Codex Vindobonensis Med. gr. 1)*, intro. H. Gerstinger (Graz: Akademische Drucke und Verlagsanstalt, 1965); Kurt Weitzmann, *Ancient Book Illumination* (Cambridge, Mass: Harvard University Press for Oberlin College and the Department of Art and Archaeology of Princeton University, 1959), pp. 12 ff., 15 ff. and *passim*.

40. For Busbecq and the court, see most recently Zweder von Martels, “On His Majesty’s Service: Augurius Busbequius, Courtier and Diplomat of Maximilian II,” in Edelmayer and Kohler, *Kaiser Maximilian II*, pp. 169–181. Busbecq’s friendship with Mattioli is mentioned on p. 177. Findlen connects him with Mattioli on p. 384 above (with n. 53).

41. For Blotius and the imperial library, see Alphons Lhotsky *Die Geschichte der Sammlungen (Festschrift des Kunsthistorischen Museums 1891–1941)* (Vienna: F. Berger, 1941–1945), 1.1:164.

42. For Ligozzi and Rudolf II, see Thomas DaCosta Kaufmann, *The School of Prague: Painting at the Court of Rudolf II* (Chicago: University of Chicago Press, 1988), pp. 76, 95, 129 n. 28, and *Prag um 1600: Kunst und Kultur am Hofe Rudolfs II*, ex. cat., Kunsthistorisches Museum Wien (Freren: Luca, 1988) 2:138–143; for Ligozzi and the Medici, see *Palazzo Vecchio: Committenza e collezionismo medicei*, ex. cat. Firenze e la Toscana dei Medici nell’Europa del Cinquecento ([Milan]: Electa, [Florence]: Centro Di Alinari Scala, 1980), pp. 295 ff; for Ligozzi and Aldrovandi, see Giuseppe Olmi, “Osservazione della natura e raffigurazione in Ulisse Aldrovandi (1522–1605),” in his *L’inventario del mondo: Catalogazione della natura e luoghi del sapere nella prima età moderna* (Bologna: Il Mulino, 1992), pp. 61 ff.

43. An introduction to works done by Hoefnagel for the Habsburgs is found in Theadora Alida Gerarda Wilberg Vignau-Schuurman, *Die emblematischen Elemente im Werke Joris Hoefnagels*, 2 vols. (Leiden: Universitaire Pers, 1969), and Lee Hendrix and Thea Vignau-Wilberg, *Mira Calligraphiae Monumenta: A Sixteenth-Century Calligraphic Manuscript Inscribed by Georg Bocskay and Illuminated by Joris Hoefnagel* (Malibu, Calif.: J. Paul Getty Museum, 1992); for Hoefnagel and Aldrovandi, see Olmi, *L’inventario del mondo*, p. 131 and note 25.

44. See most recently Alfred Auer and Eva Irblich, *Natur und Kunst: Handschriften und Alben aus der Ambrasers Sammlung Erzherzog Ferdinands II. (1529–1595)*, ex. cat., Schloss Ambras, Innsbruck (Vienna: Kunsthistorisches Museum Wien, 1995), pp. 64–78, and Eva Irblich, “Naturstudien Erzherzog Ferdinands II (1529–1598): zur Kunstkammer auf Schloss Ambras bei Innsbruck,” in *Thesaurus Austriacus: Europas Glanz im Spiegel der Buchkunst Handschriften und Kunсталben von 900 bis 1600*, ed. Irblich, ex. cat. (Vienna: Nationalbibliothek, 1996), pp. 209–225, both with further references.

45. On Arcimboldo, see further Irblich, *Thesaurus Austriacus*, pp. 233–260, and Thomas DaCosta Kaufmann, “Caprices of Art and Nature: Arcimboldo and the Monstrous,” in *Kunstform Capriccio: Von der Groteske zur Spieltheorie der Moderne*, ed. Ekkehard Mai and Joachim Rees, *Kunstwissenschaftliche Bibliothek 6* (Cologne: König, 1998), pp. 33–51.
46. On court physicians and their various origins, see Noflatscher, “Sprache und Politik,” pp. 155–156.
47. For this incident involving Canisius and Fabricius, see Kaufmann, *Mastery of Nature*, p. 144.
48. See most recently Mühlberger, “Bildung und Wissenschaft,” pp. 209 ff., 217 ff.; and now Howard Louthan, *The Quest for Compromise: Peacemakers in Counter-Reformation Vienna* (Cambridge: Cambridge University Press, 1997). Also see Otto Helmut Hopfen, *Kaiser Maximilian II. und der Kompromißkatholizismus* (diss., Munich, 1895).
49. The best treatment of the problem of the emperor’s beliefs and of the question of religion at Rudolf’s court remains Evans, *Rudolf II and His World*, pp. 84–115.
50. In addition to Mühlberger, “Bildung und Wissenschaft,” see Grete Mecenseffy, *Evangelische Lehrer an der Universität Wien* (Vienna: n.p., 1967).
51. See Kaufmann, *Mastery of Nature*, pp. 144–145, with nn.
52. For Rudolf and the occult, see Evans, *Rudolf II and His World*, pp. 196–242; for Rudolf and flowers, a starting point is Kaufmann, *The School of Prague*, pp. 75, 76, 229, 244, 245; for Arcimboldo, Rudolf II, and natural history, see “Caprices of Art and Nature.”
53. See Mühlberger, “Bildung und Wissenschaft”; Kaufmann, *Mastery of Nature*, pp. 140 ff.
54. See Jürgen Zimmer, *Joseph Heintz der Ältere als Maler* (Weißenhorn: Konrad, 1971), pp. 38–39, 143–144; Kaufmann, *The School of Prague*, p. 196, cat. no. 7.42.
55. The Melantrich edition is *New Kreuterbuch*, trans. G. Handsch (Prague, 1563). Editions by Camerarius include *De plantis epitome* (Frankfurt a. M., 1586) and *Kreutterbuch* (Frankfurt a. M., 1600). Mattioli’s *Opera omnia*, ed. C. Bauhinus, was also published in Frankfurt in 1598.
56. See, however, the alternative picture created by the essays—including one by Paula Findlen (“The Economy of Scientific Exchange in Early Modern Italy,” pp. 5–24) and one by Pamela H. Smith (“Curing the Body Politic: Chemistry and Commerce at Court, 1664–70,” pp. 195–209)—collected in *Patronage and Institutions: Science, Technology, and Medicine at the European Court, 1500–1750*, ed. Bruce T. Moran (Rochester, N.Y.: Boydell, 1991). Other Italian examples are provided by the exhibition catalogues *La corte, il mare, i mercanti: La rinascita della scienza. Editoria e società; Astrologia, magia e alchimia; Firenze e la Toscana dei Medici nell’Europa del Cinquecento* (Florence: Electa, 1980), and Dario A. Franchini [et al.], *La Scienza a Corte: Collezionismo eclettico natura e immagine a Mantova fra Rinascimento e Manierismo* (Rome: Bulzoni, 1979), to mention just a few of a growing number of works on this theme. See, e.g., Kaufmann, *Mastery of Nature*, esp. pp. 188 ff.

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