24 • Maps as Educational Tools in the Renaissance

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Introduction

Maps were part of both formal and informal education in early modern Europe, although they performed different functions and had a different status in each setting. While the more institutional curricula of grammar schools and universities treated geography as more important, with maps seen as useful only for their illustrative properties, informal market-driven and patronage-supported education privileged map knowledge as necessary for the gentleman or merchant. Increasingly during this period, those in positions of power saw maps as important imperial, mercantile, and aesthetic objects, and this encouraged an informal educational system, which relied on their patronage, to introduce maps into education. Humanists, the educational theorists of the period, bridged the informal and formal educational categories and, depending on their primary allegiances and sources of support, stressed or ignored maps as pedagogical tools. The success of the map as an important educational text in the early modern period owes most to the new court patronage structures and to the entrepreneurial mathematical practitioners rather than to the more traditional and institutional educational structures.

Geography, Cosmography, and Maps

From the grammar schools on, both formal and informal educational systems had some interest in the study of the earth and cosmos. While the formal institutional curricula stressed geography, especially the work of Strabo, those students following the more informal programs of study were more inclined to examine maps. Thus, the study of the earth was divided into different disciplines: cosmography, geography, and maps more generally. In the sixteenth century, geography was developing into a discipline distinct from the older study of cosmography. Although both terms continued to be used, sometimes interchangeably, a distinction was increasingly made.[1] Cosmography, as John Dee proclaimed, "matcheth Heauen, and the Earth, in one frame," requiring "*Astronomie, Geographie, Hydrographie* and *Musike*" to be complete.[2] Geography, on the other hand, "teacheth wayes, by which, in s[un]dry formes, (as *Sphærike, Plaine* or other), the Situation of Cities, Townes, Villages, Fortes, Castells, Mountaines, Woods, Hauens, Riuers, Crekes, & such other things, [upon] the outface of the earthly Globe . . . may be described and designed."[3] In other words, while the subject of cosmography was the globe and its relationship with the heavens as a whole, picturing the earth as an integral part of the cosmos, geography had a narrower focus, concentrating specifically on the earth itself.[4]

Geography could be divided into the three subdisciplines of mathematical geography, descriptive geography, and chorography, as I have argued elsewhere.[5] Related to mathematical geography was the practical art of mapmaking, although mapmakers depended far more on for-

Abbreviations used in this chapter include: *Henrician Age* for Alistair Fox and John Guy, *Reassessing the Henrician Age: Humanism, Politics, and Reform, 1500–1550* (Oxford: Basil Blackwell, 1986); *Jesuits* for John W. O'Malley et al., eds., *The Jesuits: Cultures, Sciences and the Arts, 1540–1773* (Toronto: University of Toronto Press, 1999); and *Universities in Early Modern Europe* for Hilde de Ridder-Symoens, ed., *A History of the University in Europe,* vol. 2, *Universities in Early Modern Europe (1500–1800)* (Cambridge: Cambridge University Press, 1996).

1. Frank Lestringant, *Mapping the Renaissance World: The Geographical Imagination in the Age of Discovery,* trans. David Fausett (Cambridge: Polity, 1994). Lestringant argues that André Thevet worked in this older tradition of cosmography, attempting to describe the entire world and using all available sources to do so. At the end of Thevet's life in the 1580s, Lestringant argues, he was operating in an outmoded genre, as more focused geographies were beginning to take over the field.

2. John Dee, *The Mathematicall Praeface to the Elements of Geometrie of Euclid of Megara (1570),* intro. Allen G. Debus (New York: Science History Publications, 1975), esp. b.iij recto. This distinction is repeated by Thomas Blundeville in *M. Blvndevile His Exercises, Containing Sixe Treatises* (London: John Windet, 1594), pt. 2, and later by Nathanael Carpenter in *Geography Delineated Forth in Two Bookes* (Oxford: Iohn Lichfield and William Tvrner, Printers to the famous Vniversity, for Henry Cripps, 1625), A1r.

3. Dee, *Mathematicall Praeface,* a.iiij recto.

4. For a discussion of this shift into the eighteenth century, see Roy Porter, "The Terraqueous Globe," in *The Ferment of Knowledge,* ed. G. S. Rousseau and Roy Porter (Cambridge: Cambridge University Press, 1980), 285–324.

5. Lesley B. Cormack, "'Good Fences Make Good Neighbors': Geography as Self-Definition in Early Modern England," *Isis* 82 (1991): 639–61.

mal and informal apprenticeships for transfer of knowledge and less on any systematic development of theories or models.[6] Maps could be and were used in educational settings without much interest in or regard to the mapping tradition or skills needed to produce them.

Early Modern Education

Education was a rapidly changing institution in early modern Europe. Prior to this period, education had been largely an ecclesiastical concern. Most schools were sponsored by the church, and many schoolmasters were clerics. From the mid-fifteenth century on, secular interest in education began to increase, first in Italy and later throughout Europe. The goal of education ceased to be only a career in the church; government offices, secretarial positions, and eventually gentry culture and patronage possibilities all provided new incentives for achieving a certain level of education. At the same time, the Protestant Reformation produced a new impetus for education and literacy, both because Protestants argued for the importance of personal and vernacular Bible reading and because the Catholic Church responded, in part, through educational strategies.[7] Thus, education became a *desideratum* for a wider sector of the population.[8]

England provides a very good example of these developments.[9] During the sixteenth century, entrée into governing and public careers was more and more frequently provided by formal education rather than household apprenticeship. Literacy and knowledge of a number of disciplines were viewed as increasingly important attributes for the ambitious man on his way to the top. Therefore, more and more gentle and mercantile families sent their sons first to school and then to Oxford or Cambridge, where they would meet the right people and through their studies gain access to the common understanding of the world they would need for governance. Because of this change of demographics at early modern universities, formal curricular offerings were often supplemented or subsumed by alternate programs of study.[10] Recent scholarship on European universities has confirmed that this English example is typical, although there are distinct regional variations.[11] At northern universities and many southern ones, the trend toward a new group of students from gentry and mercantile roots, with different motives for university attendance, allowed for a wider range of subjects, more often connected with the political and social world that these more elite students were destined to enter.

Formal education was carried out at a number of distinct venues and proceeded through a series of levels, based on ability and to a certain extent age. Early literacy training was often carried out at home. In households that could afford to lose the labor of their young children, both boys and girls could be educated at this point. Sir

6. Cartography did not develop into an academic discipline until the eighteenth century. See Matthew H. Edney, "Mapping Eighteenth-Century Intersections of Scientific and Cartographic Practices" (paper presented at the History of Science Society Annual Meeting, Vancouver, 2001); Thomas R. Smith, "Manuscript and Printed Sea Charts in Seventeenth-Century London: The Case of the Thames School," in *The Compleat Plattmaker: Essays on Chart, Map, and Globe Making in England in the Seventeenth and Eighteenth Centuries,* ed. Norman J. W. Thrower (Berkeley: University of California Press, 1978), 45–100; and Tony Campbell, "The Drapers' Company and Its School of Seventeenth Century Chart-Makers," in *My Head Is a Map: Essays & Memoirs in Honour of R. V. Tooley,* ed. Helen Wallis and Sarah Tyacke (London: Francis Edwards and Carta Press, 1973), 81–106.

7. There is major disagreement concerning the role of Protestantism in educational change. See Arthur Francis Leach, *English Schools at the Reformation, 1546–8* (1896; reprinted New York: Russell and Russell, 1968), for a claim to Protestantism's importance in England. Nicholas Orme, *Education and Society in Medieval and Renaissance England* (London: Hambledon Press, 1989), disagrees with Leach and with Jo Ann Hoeppner Moran, *The Growth of English Schooling, 1340–1548: Learning, Literacy, and Laicization in Pre-Reformation York Diocese* (Princeton: Princeton University Press, 1985), showing the complications on both sides. Willem Frijhoff, "Patterns," in *Universities in Early Modern Europe,* 43–110, shows that both Catholic and Protestant universities flourished in sixteenth-century Europe, although northern universities fared better than their southern counterparts.

8. There are many histories of education in the Middle Ages and Renaissance, including Philippe Ariès, *Centuries of Childhood: A Social History of Family Life,* trans. Robert Baldick (New York: Knopf, 1962); Joan Simon, *Education and Society in Tudor England* (Cambridge: Cambridge University Press, 1966); William Harrison Woodward, *Studies in Education during the Age of the Renaissance, 1400–1600* (Cambridge: Cambridge University Press, 1906); Paul F. Grendler, *Schooling in Renaissance Italy: Literacy and Learning, 1300–1600* (Baltimore: Johns Hopkins University Press, 1989); and Anthony Grafton and Lisa Jardine, *From Humanism to the Humanities: Education and the Liberal Arts in Fifteenth- and Sixteenth-Century Europe* (Cambridge: Harvard University Press, 1986). For increasing literacy in this period, see R. A. Houston, *Literacy in Early Modern Europe: Culture and Education, 1500–1800* (London: Longman, 1988).

9. This is most dramatically portrayed in Lawrence Stone, "The Educational Revolution in England, 1560–1640," *Past and Present* 28 (1964): 41–80. For a more nuanced approach, see James McConica, "The Rise of the Undergraduate College," in *The History of the University of Oxford,* vol. 3, *The Collegiate University,* ed. James McConica (Oxford: Clarendon, 1986), 1–68. Rosemary O'Day, in *Education and Society, 1500–1800: The Social Foundations of Education in Early Modern Britain* (London: Longman, 1982), rehearses the arguments concerning who was attending schools and in what numbers, concluding that although Stone exaggerates the case, there was a major increase in both attendance in general and attendance by gentry and merchants in particular.

10. Mark H. Curtis, in *Oxford and Cambridge in Transition, 1558–1642* (Oxford: Clarendon, 1959), argues that we should look to the tutorial system and to an informal curriculum tailored to students less interested in achieving a bachelor's degree. Robert Gregg Frank, in "Science, Medicine and the Universities of Early Modern England," *History of Science* 11 (1973): 194–216 and 239–69, suggests that we will find science and other new disciplines in preparations for the senior degrees, such as for the master's degree. See also Hugh F. Kearney, *Scholars and Gentlemen: Universities and Society in Pre-Industrial Britain, 1500–1700* (London: Faber, 1970).

11. Roger Chartier and Jacques Revel, "Université et société dans l'Europe moderne: Position des problèmes," *Revue d'Histoire Moderne*

Thomas Elyot argued, for example, that children should be educated at home by women until the age of seven, so that they would have no contact with vice in those early years.[12] This was followed by primary school training, at schools called infant or ABC schools.[13] These schools taught the alphabet and reading in the vernacular. Writing was seldom included, because reading and writing were seen as very different and unrelated skills, with reading prior and prime. The primers used at this level were typically biblically based; few other topics were pursued. As Paul Grendler points out, "No educational revolution occurred at the primary level."[14] There is thus no evidence that any geographical information or exposure to maps and map construction was included in this early educational training.

For scholars who were successful at this level, and for those whose families were financially able to support seven- to eleven-year-olds not gainfully employed, grammar school was the next logical step. These schools were explicitly gendered (in ways that the primary schools, occasionally taught by women, were not)[15] and were so called because they taught Latin grammar. Latin was taught through a rigorous regime of rote learning, parsing, note taking at sermons, and written and oral exercises.[16] Eugene Kintgen argues that reading was taught as a nonlinear skill, so reading for understanding of concepts was less important than reading for individual snippets of information.[17] Grammar school scholars were learning to promote and maintain their position in the social hierarchy rather than to think independently or critically, so the topics covered were less important than the skills gained, although the subjects of the reading tended to be religious or humanistic letters.[18]

Finally, for a very small percentage of students, the university was the final and logical step. Universities had developed in the Middle Ages as a training ground for clerics. During the fifteenth century, professional training for lawyers and physicians was added. In the sixteenth century, especially in northern and Protestant Europe, the university curriculum became much more eclectic. Students began to attend university without the intention of taking up any of the three professions, and the curriculum expanded to reflect the more general, secular, and worldly interests of an increasingly paying student body.[19]

This elaborate educational system could work well when boys could continue through it from beginning to end. Unfortunately, this was seldom the case. The majority of men and women in early modern Europe never attended school, and those who did, did so erratically.[20] Although attempts to discover literacy rates in this period are notoriously inaccurate, it appears that no more than 10 to 15 percent of the population was literate.[21] Of course, this hides a wide variation; several European towns had male literacy rates of over 90 percent, and the urban, the wealthy, and younger adult men were much more likely to read than women, the rural, the poor, or the elderly.[22] In such a situation, one might argue that maps would be a perfect educational resource for the nonliterate, but only when the maps could be viewed. This was difficult, because public maps were scarce and printed maps were unusual, especially for the disadvantaged groups, until the late sixteenth century at the earliest, and were very expensive.

Still, a significant (though tiny) minority were very well educated, and increasingly during the early modern period, these well-educated men were in positions of social, political, and economic power. In addition, some men and women were self-taught, or continued their education on an informal basis throughout their lives. Because of this increasing market for educational currency, institutions such as the universities developed less formal curricula designed for those not interested in a credentialed profession.[23] Other kinds of academies sprang up all over Europe to cater to those who desired specialized learn-

et Contemporaine 25 (1978): 353–74, and Maria Rosa di Simone, "Admission," in *Universities in Early Modern Europe,* 285–325, esp. 299.

12. Thomas Elyot, *The Boke Named the Gouernour* (London: Tho. Bertheleti, 1531), 18r–20v. For early education, see Ralph A. Houlbrooke, *The English Family, 1450–1700* (London: Longman, 1984), 146–49.

13. David Cressy, *Literacy and the Social Order: Reading and Writing in Tudor and Stuart England* (Cambridge: Cambridge University Press, 1980), 35–37, and Houston, *Literacy in Early Modern Europe,* 12–22. Many historians have debated the status of childhood in this period, including the growing importance of schooling. The debate begins with Philippe Aries; a recent and reasonable statement of the state of the argument is given by L. J. Jordanova in "Children in History: Concepts of Nature and Society," in *Children, Parents, and Politics,* ed. Geoffrey Scarre (Cambridge: Cambridge Univerity Press, 1989), 3–24.

14. Grendler, *Schooling,* 142; Houston, *Literacy in Early Modern Europe,* 23–25; and Houlbrooke, *English Family,* 149–51.

15. Sara Heller Mendelson and Patricia Crawford, *Women in Early Modern England, 1550–1720* (Oxford: Clarendon, 1998), 321–27. See also Houston, *Literacy in Early Modern Europe,* 73–75.

16. See Houston, *Literacy in Early Modern Europe,* 56–61, for the European story; O'Day, *Education and Society,* 43–60, and Orme, *Education and Society,* 16–21, confirm this in an English context.

17. Eugene R. Kintgen, *Reading in Tudor England* (Pittsburgh: University of Pittsburgh Press, 1996), 58–139.

18. Grafton and Jardine, *Humanism to the Humanities,* 1–28.

19. Walter Rüegg, "Themes," and L. W. B. Brockliss, "Curricula," both in *Universities in Early Modern Europe,* 3–42, esp. 3–14, and 563–620, and O'Day, *Education and Society,* 70–100.

20. Cressy, *Literacy and the Social Order,* 28–29.

21. Houston, in *Literacy in Early Modern Europe,* 116–54, argues that literacy varied enormously with geography, age, sex, and other demographic factors. Grendler demonstrates that Venice had a literacy rate of 23 percent in 1587 (Grendler, *Schooling,* 46). For a critique of the very idea of literacy and why we insist on measuring it, see Jonathan Barry, "Literacy and Literature in Popular Culture: Reading and Writing in Historical Perspective," in *Popular Culture in England, c. 1500–1850,* ed. Tim Harris (London: Macmillan, 1995), 69–94.

22. Houston, *Literacy in Early Modern Europe,* 130–54.

23. Stone, in "Educational Revolution," and Curtis, in *Oxford and Cambridge,* argue for this informal curricula. In "Undergraduate College," McConica claims that these studies were just as rigorous as those

ing.[24] Self-help books became more and more popular, and educational entrepreneurs, both humanists and others such as mathematical practitioners, began to sell their educational wares through individual lessons and books.[25] Thus, this early modern period witnessed a change in the status of education among the governing classes across Europe, especially in the north and west, and thus in the demand for both educated advisors and information itself. In this climate, the putative utility of the subjects studied became important, and maps and geography fit nicely into this schema.

Theories of Education

Beginning in the fifteenth century, a new group of educators began to practice and articulate new theories of education, emphasizing the classics and a secular path to the good life. From Guarino Guarini of Verona to Meric Casaubon in England, men inspired by humanist ideas set out to develop a new training ground for governors and gentry. All of them were motivated by political and religious imperatives, and all were forced to negotiate patronage connections in order to survive as educators, first outside the traditional university structure and later within that system as well. As they developed their programs of study, hoping to attract patrons and scholars, many stressed the importance of geographical or map knowledge.

For at least three centuries, historians have claimed that humanism was the intellectual movement of the Renaissance.[26] These historians have argued that humanism stressed the importance of the pagan past for its beautiful Latin and Greek and for its profound insights into the human condition. Those following this intellectual path rejected the hidebound strictures of scholasticism, favored the trivium over the quadrivium, and plied their trade in schoolrooms and princely courts rather than in universities or for the Catholic Church.

This interpretation has been greatly modified in the last fifty years. While grammar and rhetoric, particularly in Latin, were definitely stressed by humanists, their struggle with scholasticism can now be seen to have been more institutional than intellectual.[27] Nor were humanists the radical defenders of free expression they were once held to be. As Grafton and Jardine have shown, humanist pedagogy aimed to teach Latin texts of antiquity through rote, with schoolmasters more interested in the ability of students to parse a sentence than in their exploration of any new ideas revealed by such study.[28] Guarini, for example, was training good citizens by stressing docility rather than innovation. Bushnell has recently argued against this Foucauldian model of discipline and punishment, claiming that schoolteachers, in a subsidiary position to parents and often the social inferiors of their pupils, had less opportunity for punishment and intimidation than might be thought.[29] Most humanists stressed the need to teach with a light hand and to use games and playfulness rather than the rod as an enticement to learning. Thus, the topics introduced by these pedagogues were designed to be attractive to potential pupils and their parents rather than to be used as a disciplinary tool. As well, Rüegg argues that humanism became stultifying for university curricula only in the late seventeenth century. Before that time, humanists were exploring interactions between ancient ideas and modern applications.[30]

Many humanists who wrote about method and curriculum made some mention of the need to teach geographical material, especially in the context of understanding passages from Roman literature or the Bible.[31] Casaubon, for example, saw biblical geography as an important component of exegetical analysis and showed that geographical knowledge had been a necessary component in discovering that the Donation of Constantine had been

that were degree-related, a conclusion backed up by my findings on geography in Lesley B. Cormack, *Charting an Empire: Geography at the English Universities, 1580–1620* (Chicago: University of Chicago Press, 1997).

24. Frijhoff, "Patterns," and Olaf Pedersen, "Tradition and Innovation," both in *Universities in Early Modern Europe,* 43–110 and 451–88, esp. 465–66.

25. For an example of the growing popularity of self-help books, see Miriam Usher Chrisman, *Lay Culture, Learned Culture: Books and Social Change in Strasbourg, 1480–1599* (New Haven: Yale University Press, 1982). Concerning mathematical practitioners, see Lesley B. Cormack, ed., *Mathematical Practitioners and the Transformation of Natural Knowledge in Early Modern Europe* (in preparation), particularly the chapter by Lesley B. Cormack, "Mathematical Practitioners and the Scientific Revolution: The Zilsel Thesis Revisited." See also E. G. R. Taylor, *The Mathematical Practitioners of Tudor & Stuart England* (Cambridge: Cambridge University Press, 1954), and Edgar Zilsel, "The Sociological Roots of Science," *American Journal of Sociology* 47 (1942): 544–62, esp. 552–55.

26. Anthony Goodman and Angus MacKay, eds., *The Impact of Humanism on Western Europe* (London: Longman, 1990).

27. Rüegg, "Themes," 34; Charles B. Schmitt, *John Case and Aristotelianism in Renaissance England* (Kingston: McGill-Queen's University Press, 1983); Alistair Fox, "Facts and Fallacies: Interpreting English Humanism," in *Henrician Age,* 9–33; and Jerry Brotton, *The Renaissance Bazaar: From the Silk Road to Michelangelo* (Oxford: Oxford University Press, 2002), 62–91.

28. Grafton and Jardine, *Humanism to the Humanities.*

29. Rebecca W. Bushnell, *A Culture of Teaching: Early Modern Humanism in Theory and Practice* (Ithaca: Cornell University Press, 1996), esp. 73–116.

30. Rüegg, "Themes," 34–41.

31. See, for example, Richard Pace, *De fructu qui ex doctrina percipitur (The Benefit of a Liberal Education),* ed. and trans. Frank Manley and Richard S. Sylvester (New York: For the Renaissance Society of America by Frederick Ungar Publishing, 1967), or, later, Henry Peacham, *The Compleat Gentleman: Fashioning Him Absolute in the Most Necessary & Commendable Qualities Concerning Minde or Bodie That May Be Required in a Noble Gentleman* (London: Francis Constable, 1622); Peacham expected his "compleat gentleman" to learn geography and chorography. See Grafton and Jardine, *Humanism to the Humanities,* and Curtis, *Oxford and Cambridge,* 269.

a forgery.[32] This was a fairly tangential use of geography, however, and often made no mention of maps at all.

During the first half of the sixteenth century, educational reformers began to move in two different directions with regard to geographical study or the use of maps in education. While the more humanistically inclined pedagogical writers mentioned only the need to understand geography, those more reliant on court, elite, or mercantile patronage began to emphasize both the importance of a liberal arts education and the need for young gentlemen to learn geography, navigation, and the military arts, including the use of maps. In *The Scholemaster* (1570), Roger Ascham emphasized the importance of education, both for success in government and for personal satisfaction, when he supplied advice to Sir Richard Sackville on the education of his son.[33] Likewise, Elyot stressed the need for potential governors of the state to receive a substantial education. In a book designed to win favor with Henry VIII, Elyot suggested that "the education or fourme of bringing vp of the childe of a gentilman / which is to haue authoritie in a publike weale" should include an understanding of "the olde tables of Ptolomee / where in all the worlde is paynted" as well as "the demonstration of cosmographie," not through travel but through reading: "I can not tell what more pleasure shuld happen to a gentil witte than to beholde in his owne house every thynge that with in all the worlde is contained."[34]

Elyot was "perhaps the most outstanding humanist of his generation."[35] His advice on the education of those destined to govern was an interesting blend of Neoplatonic idealism and political expediency. While his life was a series of unsuccessful patronage bids, his advice in *The Gouernour* was that the classics and moral philosophy must be learned and used in the service of the state.[36] Given this overt message regarding the engagement with the world necessary for the scholar, Elyot's interest in cosmography and maps is intended for application. Elyot argued for the introduction of the maps of Ptolemy (after an understanding of the sphere had been achieved) "to prepare the childe to vnderstandynge of histories."[37] Such histories, and such maps, were necessary knowledge for someone aspiring to status and power.

Maps were seen by educators most interested in ancient letters as a tool for the understanding of history and geography, just as Elyot had claimed. Indeed, it is often not possible to distinguish among these enterprises in their proposals. Richard Pace, for example, writing *The Benefit of a Liberal Education* in 1517, stated that Ptolemy and Strabo, through their geographical studies, provided important contributions to this liberal education. He claimed that it was "through the art of these men the Portuguese discovered Ceylon in our own time."[38] He then proceeded to discuss the relative merits of text, map, and travel: "But whoever takes the science of geography to heart either has to travel all over the world (which is extremely unpleasant, difficult, and expensive) or he has to read through Strabo, which is about as long and as broad as the earth and is a world in itself—and in Greek too, since the translation is extremely corrupt. But that's what you have to do, unless this seems shorter: to study the sketches of the globe called colloquially maps of the world [*mappaemundi*]."[39] However, this was the only mention of maps or the study of the earth in Pace's long discussion of educating the gentleman. Likewise George Buchanan, who taught both Michel de Montaigne and James VI of Scotland, stressed geography and history rather than maps or charts.[40]

Juan Luis Vives, a Spanish humanist employed by Catherine of Aragon, developed an important method of education, much influenced by that of Desiderius Erasmus.[41] Both advocated the teaching of Latin grammar, usually through Christian sources, as a means to teach boys (and occasionally girls) to take their place as active Christian citizens and governors. Vives was more interested in nature than was Erasmus, who feared the distractions caused by the outside world. Therefore Vives deviated from Erasmus by suggesting the reading of authors who specialized in interpreting the book of nature as a complement to biblical and religious writings.[42] In *De tradendis disciplinis* (1531), Vives advocated a selection of texts appropriate for each stage in the school curriculum. At a level where pupils were conversant with both Latin and Greek, Vives indicated that it was time to study Strabo and geography: "Let [the student] also con-

32. Meric Casaubon, *Generall Learning: A Seventeenth-Century Treatise on the Formation of the General Scholar* [1668], ed. Richard Serjeantson (Cambridge: RTM Publications, 1999), 104.

33. Roger Ascham, *The Scholemaster or Plaine and Perfite Way of Teachyng Children, to Understand, Write, and Speake, the Latin Tong* (London: Iohn Daye, 1570), Bj recto, ff.

34. Elyot, *Boke Named the Gouernour,* 15v and 37r–37v.

35. Alistair Fox, "Sir Thomas Elyot and the Humanist Dilemma," in *Henrician Age,* 52–73, esp. 52.

36. Fox demonstrated Elyot's failure at gauging the political climate, claiming that Elyot was "too moral to be a Machiavel, but too weak to be a martyr" (Fox, "Sir Thomas Elyot," 62). For a similar story, concerning a different text by Elyot, see Constance Jordan, "Feminism and the Humanists: The Case of Sir Thomas Elyot's *Defence of Good Women,*" in *Rewriting the Renaissance: The Discourses of Sexual Difference in Early Modern Europe,* ed. Margaret W. Ferguson, Maureen Quilligan, and Nancy J. Vickers (Chicago: University of Chicago Press, 1986), 242–58.

37. Elyot, *Boke Named the Gouernour,* 37r.

38. Pace, *De fructu,* 109.

39. Pace, *De fructu,* 109.

40. For Buchanan's life, see George Buchanan, *The History of Scotland,* 4 vols., trans. James Aikman (Glasgow: Blackie, Fullarton, 1827), 1:ix–lxxix.

41. G. H. Bantock, *Studies in the History of Educational Theory,* 2 vols. (London: George Allen and Unwin, 1980–84), 1:106–14.

42. Erasmus, in *On Copia of Words and Ideas* (1512), suggested the importance of a description of place to rhetoric, but this does not refer to maps, or even necessarily to the description of real places. Juan Luis Vives, *On Education,* cited in Simon, *Education and Society,* 110–11.

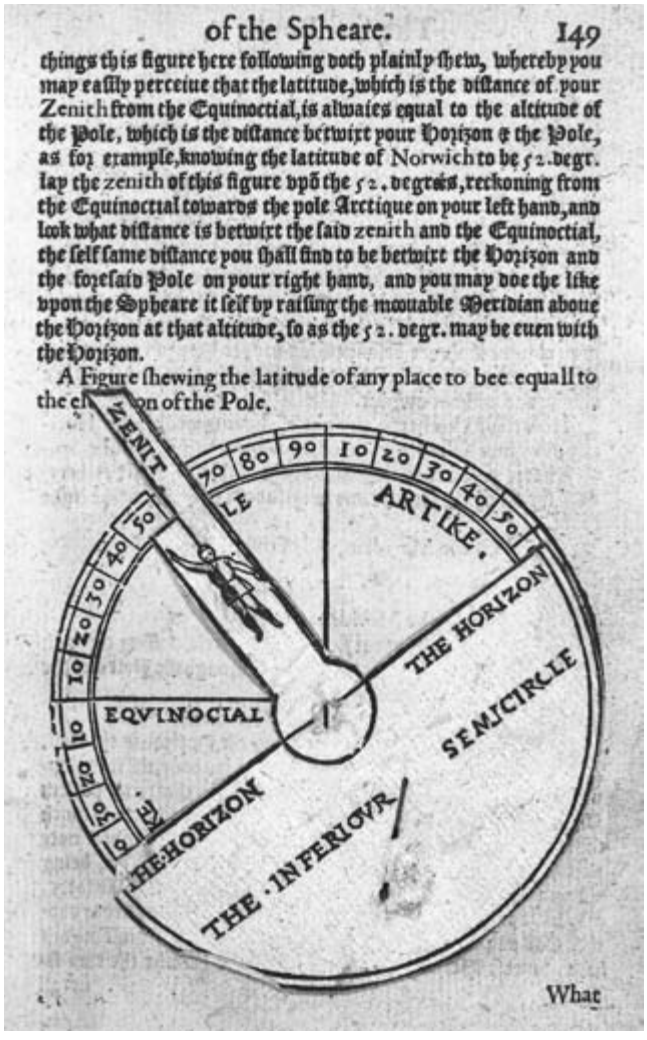

FIG. 24.1. VOLVELLE FROM BLUNDEVILLE'S *EXERCISES*. Volvelles were contained in the section of Blundeville's work on the art of navigation. This one is titled "The Shape or Figure of the Rectifier of the North Starre."
Thomas Blundeville, *M. Blvndevile His Exercises, Containing Sixe Treatises* (London: John Windet, 1594), 149. By permission of Houghton Library, Harvard University.

sider the maps of Ptolemy, if he can get a corrected edition. Let him add the discoveries of our [i.e., Spanish] countrymen on the borders of the East and the West."[43] Vives advocated the importance of involving the pupil and using sources that would interest him; he saw maps as a significant educational aid, because they would capture the curiosity of the student.

Sir Humphrey Gilbert echoed these earlier sentiments in a proposal to educate Elizabeth's wards. Gilbert had been educated himself at Eton and Oxford, and had then devoted his life to navigation and a search for the Northwest Passage.[44] Before perishing at sea in an unsuccessful attempt to colonize Newfoundland, he became convinced of the need for a more practical education for those actively involved with the state and its enterprises. In his proposal, designed to obtain court patronage, he stressed the need for mathematics and navigational education. Among the instructors to be hired, Gilbert included two mathematicians: one to read cosmography, astronomy, and navigation and the other to teach the art of maps and sea charts.[45] Both Elyot and Gilbert stressed imperial aims and commonwealth values, in which the study of maps and navigation played an important part.[46]

Thomas Blundeville, a Norfolk gentleman and popular author of educational treatises for gentry, was even more convinced that cosmography, navigation, and maps were a necessary part of any young gentleman's education. Blundeville was one of a growing number of mathematical practitioners making his living writing popular books and using these books as advertisements for his private mathematics lessons.[47] In *His Exercises, Containing Sixe Treatises, . . .* [*for*] *Yoong Gentlemen* (1594), Blundeville carefully explained the mathematical arts necessary to anyone interested in the globe, for profit or pleasure. He began with two treatises on arithmetic, written, he claimed, for Elizabeth Bacon, daughter of Sir Nicholas Bacon, for whom, he said, "I had made this Arithmeticke so plaine and easie as was possible."[48] He then added a third treatise on the principles of cosmography, first of the heavens and then of the earth. The fourth treatise examined the uses of the globes, both terrestrial and celestial. This included a long section on the universal map of Petrus Plancius. Fifth, Blundeville explained the use of the astrolabe, and finally, included a long treatise on navigation (fig. 24.1), including the finding of longitude and latitude.

43. Juan Luis Vives, *De tradendis disciplinis;* see *Vives: On Education,* trans. and intro. Foster Watson (Cambridge: Cambridge University Press, 1913), 169.

44. E. G. R. Taylor, *Tudor Geography, 1485–1583* (London: Methuen, 1930), 122–23.

45. Humphrey Gilbert, *Queene Elizabethes Achademy,* ed. Frederick James Furnivall (London: Early English Text Society, 1869), 4–5.

46. While historians such as Markku Peltonen, in *Classical Humanism and Republicanism in English Political Thought, 1570–1640* (Cambridge: Cambridge University Press, 1995), have argued that later sixteenth-century humanists had radical republican interests, all those with explicit pedagogical proposals, including the inclusion of maps and navigation in the curriculum, preferred tried and true hierarchical power structures. See Fox, "Facts and Fallacies"; idem, "English Humanism and the Body Politic," in *Henrician Age,* 34–51; and Fritz Caspari, *Humanism and the Social Order in Tudor England* (Chicago: University of Chicago Press, 1954), for the essential conservatism of humanists. Brotton argues that humanists were essentially pragmatic and practiced *realpolitique* (*Renaissance Bazaar,* 90–91).

47. David Watkin Waters, *The Art of Navigation in England in Elizabethan and Early Stuart Times* (London: Hollis and Carter, 1958), 212–15. "Blundeville, Thomas," in *The Dictionary of National Biography,* 22 vols. (1921; reprinted London: Oxford University Press, 1964–65), 2: 733–34, and Tessa Beverley, "Blundeville, Thomas (1522?–1606?)," in *Oxford Dictionary of National Biography,* 60 vols. (Oxford: Oxford University Press, 2004), 6:345–46. Blundeville was most famous for *The Fower Chiefyst Offices Belonging to Horsemanshippe* (London, n.d. ca. 1560s). See note 83 concerning mathematical practitioners.

48. Blundeville, *Exercises,* A5r.

Taken together, this course of study, fairly typical for those interested in the mathematical arts, represents a significant exposition of the various means of understanding the globe, in which maps and the making of maps play an important part. Interestingly, no map was illustrated, and in fact the section on Plancius's map makes little sense without this illustration. One must suppose that this treatise was written as a supplement to the map, published separately, a genre much used by geographers by the eighteenth century.[49] Blundeville's book was very popular, appearing in several further editions in the seventeenth century.

Henry Peacham, writing in 1622, recommended Blundeville's explanations to gentlemen seeking the geographical knowledge or map understanding necessary to become a "compleat gentleman."[50] Peacham advised his readers to become well acquainted with cosmography, geography, and maps, "that like a stranger in a forraine land, ye may not wander without a guide, ignorant of those places by which you are to passe, and sticke amused; amazed in the Labyrinth of *History: Cosmography* a second *Ariadne,* bringing lines enough, is come to your delivery."[51]

According to Peacham's editor, G. S. Gordon, at Trinity College Cambridge in the 1590s Peacham "spent much of his time, like Hobbes at Oxford, hanging over maps."[52] In other words, Peacham practiced what he preached; he called for the use of maps and geographic descriptions because he himself had learned of them at university.

Many humanists and pedagogues thus had a real interest in using maps in the classroom or for individual tutoring. Those educators more properly labeled mathematical practitioners placed these maps in a curriculum that included arithmetic, geometry, astronomy, and navigation. Those who were more humanistically inclined saw maps and geography as an aid to the study of history and the military arts. All agreed that some ability to understand and interpret maps was necessary for the public life of the gentleman or aristocrat.

Correspondence to Practice

schools

When we turn from theory to practice, educational history becomes a more speculative subject. There is relatively little direct evidence of what happened on a daily basis in schools, so historians have often taken educational theorists at their word.[53] This approach has been challenged in recent years by historians arguing for the less noble nature of day-to-day instruction, the chaotic structure of early modern schools, and the social inferiority of schoolmasters.[54] In other words, grammar school teaching was a rather pragmatic attempt to teach boys of widely varying abilities the rudiments of Latin. The curriculum was designed not to create original thought, but to encourage the development of structured Christian lives. Still, because the schoolteachers were often dependent on the patronage of the higher-status parents, they looked for ways to interest their charges, ruling more often with encouragement than with stern discipline.

Within this Latin-based curriculum, there seems to have been little room for maps or geographical knowledge, except in the explanation of literary passages.[55] Rather than taking a place within grammar schools, this knowledge of the world was studied in two alternate venues: in the universities (including higher-level Jesuit schools), where geographical knowledge was valued over maps, and in the entrepreneurial and extrainstitutional structures, where maps were given a good deal of emphasis.

jesuit schools

The most significant new educational system in Europe during the sixteenth and seventeenth centuries was that developed by the Jesuits. The Society of Jesus, founded in 1540, rapidly built and staffed hundreds of schools all over the world (fig. 24.2). These schools were designed to teach catechism and piety, but soon expanded to offer a full curriculum. Given the importance of travel and geography to the Jesuit order, we might expect to find that Jesuit-run schools, colleges, and academies taught about the earth and its inhabitants, and that they might employ maps in this task.

While Ignatius Loyola had not initially conceived of his as a teaching order, education very rapidly became an extremely important mandate for the Society. Using the private endowments of rich and powerful patrons, Jesuits founded schools and offered free tuition as part of their mission in the Counter-Reformation.[56] Their first school

49. Anne Godlewska, *Geography Unbound: French Geographic Science from Cassini to Humboldt* (Chicago: University of Chicago Press, 1999), 37. Blundeville describes the map in *Exercises,* 246r–78v.

50. Henry Peacham, *Peacham's Compleat Gentleman, 1634,* intro. G. S. Gordon (Oxford: Clarendon, 1906), 71.

51. Peacham, *Compleat Gentleman*, 55.

52. G. S. Gordon, "Introduction," in Peacham, *Compleat Gentleman,* v–xxiii, esp. vii.

53. For instance, Caspari, *Humanism and Social Order;* Simon, *Education and Society;* and Arthur B. Ferguson, *The Articulate Citizen and the English Renaissance* (Durham: Duke University Press, 1965).

54. Grafton and Jardine, *Humanism to the Humanities;* Ariès, *Centuries of Childhood;* Grendler, *Schooling;* and Bushnell, *Culture of Teaching,* for example.

55. Grafton and Jardine, *Humanism to the Humanities,* 14.

56. See foundational work by François de Dainville: *La naissance de l'humanisme moderne* (Paris: Beauchesne et Ses Fils, 1940); *La géographie des humanistes* (Paris: Beauchesne et Ses Fils, 1940); and *L'éducation des Jésuites (XVI^e–XVIII^e siècles)* (Paris: Les Éditions de Minuit, 1978). See also Peter Robert Dear, *Discipline and Experience: The Mathematical Way in the Scientific Revolution* (Chicago: University of Chicago Press, 1995), 32, and Grendler, *Schooling,* 364–70.

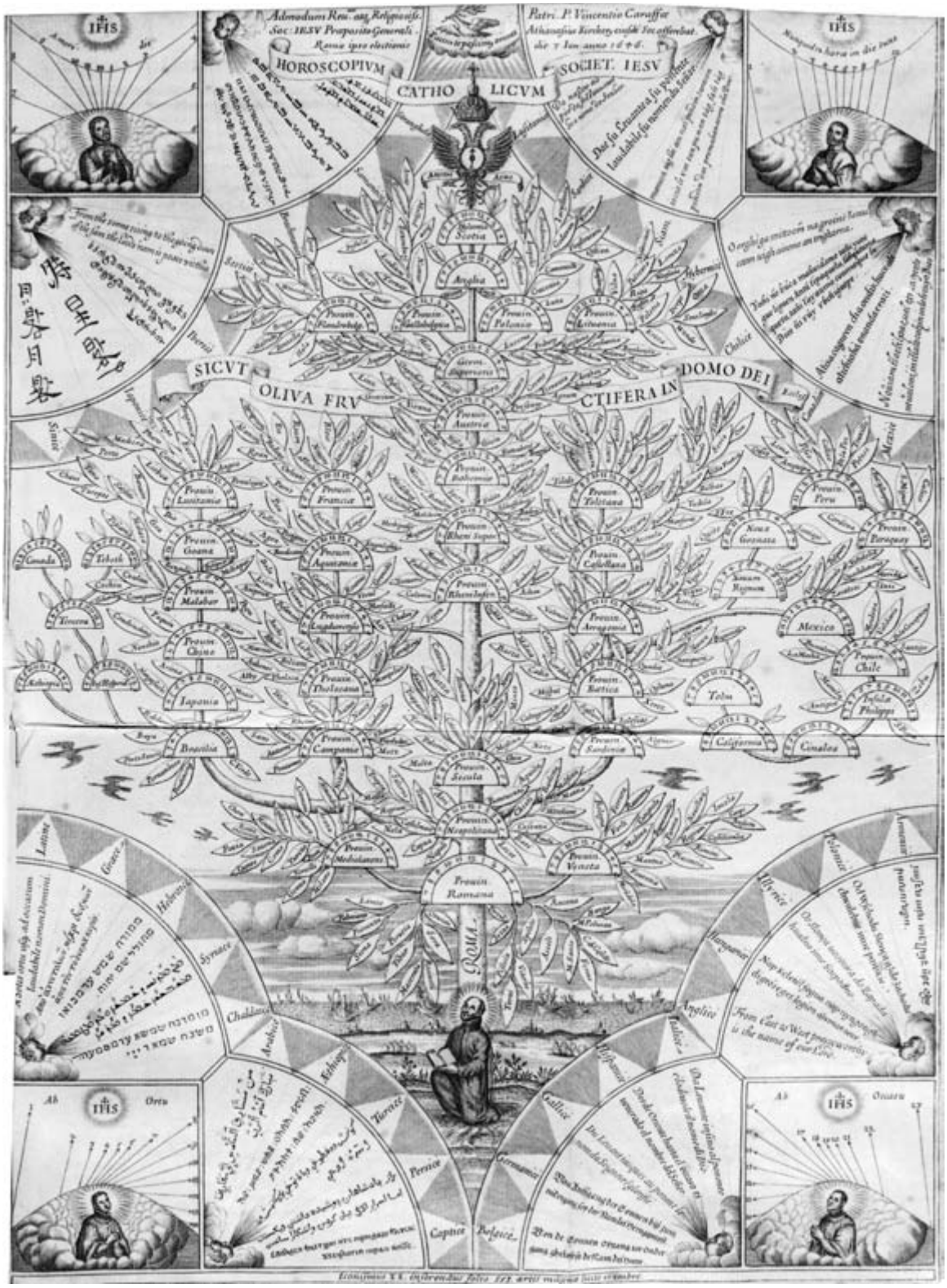

FIG. 24.2. THE IGNATIAN TREE, 1646. Titled "Horoscopivm catholicvm Societ. Iesv," this engraving is found in Kircher's treatise on light. The tree represents the chronological branching out of the assistencies and provinces, and the names of Jesuit college towns are on the leaves of the tree. Athanasius Kircher, *Ars magna lucis et vmbrae* (Rome: Sumptibus Hermanni Scheus, 1646). Photograph courtesy of Special Collections and Rare Books, Wilson Library, University of Minnesota, Minneapolis.

was arguably that run by Francis Xavier in Goa from 1543, while the first European school opened in Valencia in 1546, with the private sponsorship of Francis Borgia, duke of Gandia. This was followed by a constant demand from Catholic centers to open Jesuit colleges, a demand that the society could not match with trained personnel. By the mid-seventeenth century, there were at least 650 Jesuit colleges worldwide.[57]

These schools followed very similar institutional and curricular models. The lower levels, resembling grammar schools, taught grammar, humanities, and rhetoric, while the upper levels (in the same manner as the undergraduate "halls," now being subsumed into universities) had classes in dialectic, philosophy, scholastic theology, Greek, Hebrew, and, after 1590, mathematics.[58] Just as was the case elsewhere, the lower schools were more concerned with Latin grammar than with geography or maps. The higher courses offered much more scope for map construction and use, as well as geographic knowledge, especially after the mathematical innovations of Christoph Clavius. Clavius fought successfully to have mathematics considered part of the curriculum (and part of philosophy); it was enshrined in the official Jesuit curriculum, the *Ratio studiorum* of 1599. Clavius and his followers included under this rubric mixed mathematics, a pseudo-Aristotelian category that included spherical astronomy, geography, surveying, and mathematical instruments.[59] Although no historian has demonstrated that maps were included in this portion of the Jesuit educational program, it seems possible that they were used and discussed.

The peripatetic nature of the Jesuits meant that members witnessed and described large and virtually unknown parts of the world. Jesuits sent home letters and descriptions by the thousands; nearly every major natural philosopher in Europe during this time corresponded with overseas Jesuits. Members of the society published almost eight hundred titles in geography and natural history between 1540 and 1782.[60] This information must have been shared with the students of the Jesuit colleges. Geography was named as a subject of study in the *Ratio studiorum* and was more often taught under the auspices of the instructor of rhetoric, or combined with history, than as a separate subject.[61] Again, we have no indication that maps were part of this flood of information from east and west. Jesuits made maps, and it is possible that they illustrated their lectures with maps. However, there is little evidence to support this as yet.

Thus, geography was definitely part of the Jesuit upper school curriculum by the seventeenth century, just as it was in European universities more generally. However, despite the close relationship between travel and the Jesuits, there is no strong evidence that maps were an important part of that curriculum. Jesuit colleges were proud to teach the social and political elite of Europe, and these men were increasingly interested in mapped representations of the world. Jesuits also taught important mathematical practitioners, such as René Descartes. More research is needed, however, before we can say that maps were more than incidental to the larger teaching goals and methods of this important teaching order.

UNIVERSITIES

In contrast, we know that geography was an important part of the formal and informal curricula of early modern universities. At the best-studied examples, Oxford and Cambridge, geography had a place in the formal statutes of the arts curricula in many colleges and in the universities more generally.[62] There are no comparable studies of geographical interest at Continental universities, although preliminary work suggests that, at least at universities in France, Spain, and the Netherlands, geography was of in-

57. Grendler, *Schooling,* 373, and Steven J. Harris, "Mapping Jesuit Science: The Role of Travel in the Geography of Knowledge," in *Jesuits,* 212–40, esp. 224.

58. Grendler, *Schooling,* 365. Grendler argues that these schools took over the earlier fifteenth-century humanist model of education essentially unchanged. The result, however, was far-reaching, because the free tuition of the Jesuits virtually wiped out the independent Italian schools and set up the ancien régime model of education by the church (pp. 364–77). This is confirmed by Marc Fumaroli in "The Fertility and the Shortcomings of Renaissance Rhetoric: The Jesuit Case," in *Jesuits,* 90–106. For the demise of the halls, see McConica, "Rise of the Undergraduate College."

59. Dear, *Discipline and Experience,* 32–36. See also Rivka Feldhay, "The Cultural Field of Jesuit Science," in *Jesuits,* 107–30, esp. 109–19. For a more complete discussion of Clavius, see James M. Lattis, *Between Copernicus and Galileo: Christoph Clavius and the Collapse of Ptolemaic Cosmology* (Chicago: University of Chicago Press, 1994).

60. Harris, "Mapping Jesuit Science," 213–15.

61. Dainville, *L'éducation,* 439. For a discussion of the *Ratio* itself, see Allan P. Farrell, *The Jesuit Code of Liberal Education: Development and Scope of the Ratio Studiorum* (Milwaukee: Bruce, 1938). Godlewska argues that geography was still being taught in Jesuit colleges in the eighteenth century (Godlewska, *Geography Unbound,* 26).

62. Cormack, *Charting an Empire.* For the Continental situation, Fletcher and Deahl provide an important bibliography of university research that shows that investigations of what was actually taught lag behind institutional histories; see John M. Fletcher and Julian Deahl, "European Universities, 1300–1700: The Development of Research, 1969–1979," in *Rebirth, Reform and Resilience: Universities in Transition, 1300–1700,* ed. James M. Kittelson and Pamela J. Transue (Columbus: Ohio State University Press, 1984), 324–57. L. W. B. Brockliss, *French Higher Education in the Seventeenth and Eighteenth Centuries: A Cultural History* (Oxford: Clarendon, 1987), is a notable exception, examining real lectures and courses of study. In his article "Curricula," an overview of recent scholarship on the European universities, however, Brockliss groups history and geography together as one topic and does not actually mention geography (pp. 575–78). There is a great need for such research, for only with comparative work can we understand the whole European situation and determine the relationships between the study of geography and cartography, on the one hand, and imperialism, religion, and the state, on the other, in the context of a rapidly changing educational system.

terest to students and teachers. Students at these universities also read geography texts more informally, collectively owning substantial numbers of books of geography and cartography. Maps were less formally part of the university offerings, although they were also owned both by university students and by the institutions. Maps did not primarily fulfill curricular requirements but were employed in the study of mathematical geography generally and in illustrations of biblical, classical, and contemporary history. On the other hand, while map reading and mapmaking were not fundamental to the geography curriculum, men who went on to certain kinds of careers in mapping, such as Thomas Harriot and Edward Wright in England, Pedro Nunes in Spain, and Gerardus Mercator in the Low Countries, learned from and about maps while at university.[63]

As the curriculum changed in the sixteenth and seventeenth centuries to meet the needs of new students and new professional expectations, geography entered the curriculum at early modern universities, particularly in England.[64] The subject developed from a general interest in the world as part of the cosmos, a study more properly called cosmography, into the discipline of geography, which was centered on political society and driven by concerns that were both intellectual and pragmatic. The topic of geography was the earth and its inhabitants, an area of increasing interest to those students soon to be engaged in that world. The presence of geography in the formal curricula of Oxford and Cambridge is confirmed by its presence in some of the university and college statutes.[65] For example, the Edwardian statutes at Cambridge specified that arithmetic, geometry, and cosmography were to be studied in the first year of the bachelor of arts program. Later, in 1619, when Sir Henry Savile founded the Savilian chairs of geometry and astronomy at Oxford, he specified that land measurement was to be taught as part of the duties of the professor of geometry and that the professor of astronomy was to teach geography and navigation.[66] Most of the students who studied geography did so in the process of following the statutory requirements for the arts degrees.

The academic career patterns of geographically inclined students demonstrate two important conclusions about the early modern universities. First, geography was part of the formal education received by the majority of young men at Oxford and Cambridge. Geographical study was thus encouraged and pursued by serious students following the curriculum, whether they planned a career in the church, academe, or elsewhere. Second, men who were destined for a more active political life, the "new men" who flooded the colleges as commoners and fellow commoners, still tended to pursue the formal arts curriculum, even if they did not intend to sit for the degrees. Thus, the introduction of these young men helped to modify the existing curriculum, adding topics of more immediate relevance to their lives but continuing to insist on the more rigorous four- to seven-year arts program. The picture may have been similar in northern European universities, because they also experienced this demographic change, with similar social and cultural implications.[67] In France, for example, geography was taught at a number of universities, and professors dealt with political, physical, economic, and cultural aspects of other parts of the world.[68]

Historians have begun to examine book ownership in an effort to understand the content of study rather than just its title. Most historians have looked at complete library listings, while Catherine Delano-Smith and I have looked more explicitly at geography book and map ownership.[69] Students at Oxford and Cambridge, as well as college libraries, owned a significant number of mathematical geography and cartography texts in the period from 1550 to 1650. For example, multiple copies of Ptolemy's *Geography* and Pomponius Mela's *De situ orbis* were owned in each decade. Sebastian Münster's *Cosmography,* more a descriptive geography book but with a significant mathematical geography section (including maps), also appeared in multiple copies throughout the period. The steady ownership of classical geography sources, as well as Peter Apian's *Cosmographicus liber* in most years, and the appropriate sections of Münster, indicates that a foundation for mathematical geography had been laid in the pre-Copernican framework of the early sixteenth century. Apian's work combined cosmographical theory, basic instruction in mapping techniques, and maps of European and later New World countries and regions. The continued presence of Ptolemy's *Geog-*

63. Pedersen, "Tradition and Innovation," 466, and Nicholas Crane, *Mercator: The Man Who Mapped the Planet* (London: Weidenfeld and Nicholson, 2002), 36–45.

64. Pedersen argues that the absence of navigation and cartography from the curricula of European universities shows the failure of the universities to adapt to the innovations around them (Pedersen, "Tradition and Innovation," 465). The distinction between geography, taught at the universities, and navigation and mapmaking, learned in less formal settings, is instructive.

65. Mordechai Feingold, *The Mathematicians' Apprenticeship: Science, Universities and Society in England, 1560–1640* (Cambridge: Cambridge University Press, 1984), 23–44, and Cormack, *Charting an Empire,* 27–31.

66. James Heywood, comp., *Collection of Statutes for the University and the Colleges of Cambridge* (London: William Clowes and Sons, 1840). For the Latin text, see John Lamb, ed., *A Collection of Letters, Statutes, and Other Documents from the Manuscript Library of Corpus Christi College* (London: J. W. Parker, 1838), 125. See also Curtis, *Oxford and Cambridge,* 116–17.

67. Rüegg, "Themes," 5–8.

68. Brockliss, *Higher Education,* 154–55.

69. Catherine Delano-Smith, "Map Ownership in Sixteenth-Century Cambridge: The Evidence of Probate Inventories," *Imago Mundi* 47 (1995): 67–93, and Cormack, *Charting an Empire,* esp. 24–46 and 106–16.

raphy, though acting as a firm classical foundation for the subdiscipline of mathematical geography, does not imply a slavish devotion to ancient or outmoded ideas. Unlike Apian's or Münster's books, which remained essentially the same through numerous editions, Ptolemy's work was revised with each new editor, usually with up-to-date maps of newly discovered and surveyed parts of the globe. It is probable that the continuing interest in Ptolemy throughout this period demonstrates both the establishment of a firm foundation in the work of that most excellent creator of the science of geodesy and the satisfaction of curiosity concerning newly revealed information about all parts of the world.[70]

Maps and atlases were consistently popular throughout the period. As well as the old standards of Ptolemy and Münster, new information could even more effectively be sought in such innovative atlases as those of Abraham Ortelius and Mercator. The continuing and significant presence of Ortelius, combined with an increase in ownership of Mercator's *Atlas,* indicates a slight shift in focus from Ptolemy's maps, probably with modern interpolations, to genuinely new and innovative atlases. This is particularly so because both Ortelius's and Mercator's atlases changed significantly in later editions. Although it is usually impossible to know which editions were referred to on these lists of maps, it is at least possible that later ownership of these map collections was of current rather than older editions. An interest in maps is clear from the five copies of Ortelius's *Theatrum orbis terrarum* owned in 1600 and 1610, four copies of Mercator's *Atlas* appearing on the list for 1610, and multiple copies of atlases and globes by Mercator, Ortelius, and Hondius owned in 1620.[71]

How were these maps used in the curriculum? Geography became more specialized through time, as seen by the growth of the three subdisciplines of mathematical geography, descriptive geography, and chorography. Mathematical geography was the most common type of geography in the early period, but by 1620 descriptive geography had become most popular at the universities and beyond. Maps were used in all three areas of geography, albeit in different ways. Academic mathematical geography dealt most fundamentally with the construction of maps, because its students were interested in spherical trigonometry and therefore in the projection of three-dimensionality onto two dimensions. While students at the universities did not themselves construct maps, this study aided in the popularization of mapmaking for social and administrative purposes that was already underway by familiarizing the men of the universities with the concept of maps and map projections.[72]

The development of mapping techniques in this period focused on translating coordinates and measurements of actual coastlines and country estates onto charts suitable for use by navigators and government officials, while mathematical geography at the universities imagined the globe as a theoretical construct consisting of an exact grid of coordinates and properties, which necessitated the use of exact mathematical formulas. The two are interrelated, but relatively few men who read or wrote mathematical geography treatises also drew maps and charts for a living. Descriptive geography provided students with a vision of their own nations and of the rest of the world that advanced their career aspirations and influenced their attitude toward the wider world. Descriptive geographies sometimes used maps as illustrations, although it is striking that many important descriptive geography writers, such as Hakluyt, have almost no maps in their published accounts.[73] In fact, maps were more often used illustratively in historical or biblical circumstances, as Casaubon claimed. Finally, chorography, the study of local places, came to employ large numbers of maps. However, the chorography texts most often owned and read by Oxford and Cambridge students consist almost entirely of written descriptions, such as at least the early editions of William Camden's *Britannia,* rather than of Christopher Saxton's maps.[74]

An investigation of student commonplace books shows us that occasionally students found mapping or navigational topics of interest, both within and outside the formal curricular structure. Sir Julius Caesar, for example, a student at Oxford and later judge of the admiralty under Elizabeth I, began compiling a commonplace book at Oxford in the 1570s and continued to add to it throughout his life. He used a printed commonplace book, *Pandecte locorum communium* (1572). This book contains a title page with edifying verse, running heads throughout the book, and an index at the end, while the majority of the book is left blank for the use of the owner.[75] Within a preponderance of religious and moral topics, it is interesting to note a number of navigational, mapping, and

70. Cormack, *Charting an Empire,* 112–14. Delano-Smith finds Ptolemy and Münster the most popular map authors in her Cambridge survey ("Map Ownership," 76–77).

71. Cormack, *Charting an Empire*, 112–14.

72. Peter Barber, "England II: Monarchs, Ministers, and Maps, 1550–1625," in *Monarchs, Ministers, and Maps: The Emergence of Cartography as a Tool of Government in Early Modern Europe,* ed. David Buisseret (Chicago: University of Chicago Press, 1992), 57–98, esp. 58. See also P. D. A. Harvey, *Maps in Tudor England* (Chicago: University of Chicago Press, 1993).

73. Richard Hakluyt, *The Principal Navigations, Voiages, Traffiques and Discoueries of the English Nation,* 3 vols. (London: G. Bishop, R. Newberie and R. Barker, 1598–1600). See also Giovanni Battista Ramusio, *Delle navigationi et viaggi,* 3 vols. (Venice: Giunti, 1550–59); Pietro Martire d'Anghiera [Peter Martyr], *De orbe nouo* (Compluti: Michaele[m] d[e] Eguia, 1530); and José de Acosta, *De natvra novi orbis libri duo* (Salamanca: Guillelmum Foquel, 1589).

74. William Camden, *Britannia* (London: R. Newbery, 1586), and Christopher Saxton, [Atlas of England and Wales] (London, 1579). See also Cormack, *Charting an Empire,* 191–92.

75. "Sir Julius Caesar's Commonplace Book," BL, Add. MS 6038. This is described in some political and religious detail by L. M. Hill in *Bench and Bureaucracy: The Public Career of Sir Julius Caesar, 1580–1636* (Stanford: Stanford University Press, 1988). Although Moss

geographical headings that Caesar appears to have kept in this commonplace book throughout his life; his first entry was made while at Magdalen Hall, Oxford, in 1577 at the age of nineteen, and the last entry is dated 1636, shortly before his death.[76] In this notebook he recorded a lifetime of citations, quotations, and ideas. He seems to have had relatively little to say on the pages devoted to theology and mathematics, but the sections of the notebook devoted to geography and navigation are closely filled. Indeed, Caesar added several manuscript pages with the running heads "Cosmographia, Geographia."[77] He cited all the important geographical authors, including Ptolemy, Mercator, Strabo, and Pliny. He discussed navigation in terms of the care and design of ships and included chorography in such entries as one headed "The Singularities of England."[78] While Caesar was not primarily interested in mapping, his commonplace book shows us that geography and cartography entered the university curriculum and encouraged some students to pursue these topics throughout their lives.

Probably the most significant contribution of the universities to the development of cartography and mapping in this early modern period came not from the teaching of these subjects within the curriculum, but through the training of those destined to careers in cartography and cosmography and through the connections forged between mathematically inclined individuals. Men like Pedro Nunes attended the University of Salamanca before being made, in Nunes's case, royal cosmographer to the Spanish king in 1529. Mercator studied theology at Louvain, before turning to the less formal mathematical training of Gemma Frisius.[79] In addition, the study of mathematical geography and maps encouraged the emergence of a number of coteries of like-minded individuals, both at the universities and outside. Meeting first at university, geographically inclined men established connections and communities that would last well beyond the years of their arts education. These connections helped link academics and practical men and helped transform the discipline of geography into an interactive science requiring the integration of theory and practice in order to explain the world. Men like Wright and Harriot, trained at the universities and interested in maps and geography from their student days, moved into the more politicized patronage circles and began to develop new ideas about maps and mathematics within that more practical community.

Mathematical Practitioners and Maps

While maps and the study of geography were definitely used in the university and school setting, both within and outside Jesuit circles, they were arguably more important for those who acquired their knowledge personally or through practical venues. This was particularly the case for men selling their educational services as mathematical practitioners and for their patrons, both mercantile companies such as the East India Company or the Dutch East India Company and wealthy (or aspiring) gentlemen and aristocrats. Independent educators, reliant on payment and patronage, stressed the usefulness of the information they could impart, and maps were seen as increasingly useful for trade, navigation, and high politics.[80] As men in governance and investment positions became more comfortable reading and interpreting maps, maps were increasingly seen as a source of information and beauty.[81] Mathematical practitioners thus sold their services as educators who could explain the mysteries of mapping and understanding the earth.

Blundeville provides an important example of this new category of educator. He advocated an educational program for young gentlemen through his book, also using this book as an advertisement for his further personal instruction and instrumentmaking. He made his sales pitch as an independent mathematical practitioner. Blundeville claimed the utility of mapmaking and navigational skills for those who would "trauell by sea [who therefore] requireth skil in the Art of Nauigation, in which it is unpossible for any man to be perfect unles he first haue his Arithmetick" and the rest of the information in Blundeville's publications. He added, "I do earnestly request all yoong Gentlemen to take these my simple pamphlets no lesse thankfullie than they haue done my horse booke, and in so doing I shall haue iust cause to thinke my labour well bestowed."[82]

Mathematical practitioners were a relatively new category of scientifically inclined men who first made their appearance in early modern Europe.[83] Mathematics was a separate area of investigation from natural philosophy,

addresses the issue of commonplace books printed in their entirety (with no blank space for personal additions), she does not mention this form, with printed running heads and most of the book left blank. See Ann Moss, "Printed Commonplace Books in the Renaissance," in *Acta Conventus Neo-Latini Torontonensis,* ed. Alexander Dalzell, Charles Fantazzi, and Richard J. Schoeck (Binghamton, N.Y.: Medieval and Renaissance Texts and Studies, 1991), 509–18.

76. Hill, *Bench and Bureaucracy,* 6.

77. "Sir Julius Caesar's Commonplace Book," 348r.

78. "Sir Julius Caesar's Commonplace Book," 409v and 250r.

79. Pedersen, "Tradition and Innovation," 466.

80. See Katherine Neal, "The Rhetoric of Utility: Avoiding Occult Associations for Mathematics through Profitability and Pleasure," *History of Science* 37 (1999): 151–78; Barber, "England II"; and Jerry Brotton, *Trading Territories: Mapping in the Early Modern World* (Ithaca: Cornell University Press, 1998), for some of the political uses of mapping.

81. For an important discussion of the role of maps in the personal and economic lives of rich Dutch merchants, see Svetlana Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago: University of Chicago Press, 1983).

82. Blundeville, *Exercises,* A4v. Blundeville's earlier topic, based on classical models of horsemanship, showed that his intended audience consisted of gentlemen and that he could turn his hand to a variety of self-help projects, depending on perceived demand.

83. With some modification, I take here Taylor's important classification of the more practical men in *Mathematical Practitioners.* For modern

and those interested in mathematical issues had usually tied such studies to practical applications, such as artillery, fortification, navigation, and surveying.[84] These mathematical practitioners became more important in the early modern period and provided a necessary ingredient in the transformation of nature studies to include measurement, experiment, and utility.[85] Their growing importance was a result of changing economic structures, developing technologies, and new politicized intellectual spaces such as courts, and thus demonstrates the relationship between changes in "science" and the development of mercantilism and the nation-state. Mathematical practitioners claimed the utility of their knowledge, a rhetorical move that encouraged those seeking such information to regard it as useful.[86] When they used and explained maps and motivated their students to do likewise, they were claiming the utility of such devices. In the process, maps came to be seen as practical and important sources of new information.

Mathematical practitioners professed expertise in a variety of areas. For example, Galileo's early work on physics and the telescope was a successful attempt to gain patronage in the mathematical realm.[87] Descartes advertised his abilities to teach mathematics and physics. Simon Stevin claimed the status of a mathematical practitioner, with expertise in navigation and surveying.[88] William Gilbert argued that his larger philosophical arguments about the magnetic composition of the earth had practical applications for navigation. Many practitioners, such as Thomas Hood and Edward Wright, explicitly demonstrated an interest in mapping and navigation.

In the 1580s, Hood, a university-trained mathematics lecturer, was in London teaching mathematical geography and navigation at the home of Sir Thomas Smith on Gracechurch Street. He had earlier attended Trinity College, Cambridge, where he had received his bachelor of arts degree in 1578 and his master of arts degree in 1581.[89] Hood's lectureship in London had been established by Sir Thomas, merchant and later governor of the East India Company, and was intended to educate those involved with overseas ventures, possibly employees of the Virginia Company, whose expeditions Hood underwrote. The makeup of the audience is now unknown, although from the tone of his introductory remarks, Hood seemed to be talking to his mathematics colleagues and mercantile patrons rather than to the mariners he insisted needed training.[90] The contents of Hood's lectures are also unknown, but the treatises bound with the copy now in the BL indicate that he stressed navigational techniques, instruments, astronomy, and geometry—all of which he might have learned while at Cambridge.[91]

Wright, the most famous English geographer of the period, was also educated at Cambridge in the 1580s and remained there until the end of the century, with a brief sojourn to the Azores with the earl of Cumberland in 1589.[92] In 1599, Wright translated Simon Stevin's *De*

treatment of these crucial figures, see J. A. Bennett, "The Mechanics' Philosophy and the Mechanical Philosophy," *History of Science* 24 (1986): 1–28, and Stephen Andrew Johnston, "Making Mathematical Practice: Gentlemen, Practitioners and Artisans in Elizabethan England" (Ph.D. diss., University of Cambridge, 1994).

84. Mario Biagioli, "The Social Status of Italian Mathematicians, 1450–1600," *History of Science* 27 (1989): 41–95.

85. J. A. Bennett, "The Challenge of Practical Mathematics," in *Science, Culture, and Popular Belief in Renaissance Europe,* ed. Stephen Pumfrey, Paolo L. Rossi, and Maurice Slawinski (Manchester: Manchester University Press, 1991), 176–90. Thomas S. Kuhn, in "Mathematical versus Experimental Traditions in the Development of Physical Science," *Journal of Interdisciplinary History* 7 (1976): 1–31, reprinted in Thomas S. Kuhn, *The Essential Tension: Selected Studies in Scientific Tradition and Change* (Chicago: University of Chicago Press, 1977), 31–65, provides an early attempt to claim a different history for mathematics and natural philosophy. See Cormack, "Mathematical Practitioners," for a full discussion of the role of mathematical practitioners in the transformation of science in this period.

86. Neal discusses some attempts to make mathematics appear useful in "Rhetoric of Utility."

87. Of course, once Galileo successfully gained a patronage position, particularly with the Florentine Medici court, he left his mathematical practitioner roots behind and became a much higher-status natural philosopher; see Mario Biagioli, *Galileo, Courtier: The Practice of Science in the Culture of Absolutism* (Chicago: University of Chicago Press, 1993).

88. Ivo Schneider, "The Relationship between Descartes and Faulhaber in the Light of Zilsel's Craft/Scholar Thesis" (paper presented at the Zilsel Conference, Berlin, 1998); in *Reappraisals of the Zilsel Thesis,* ed. Deiderick Raven and Wolfgang Krahn (Philadelphia, forthcoming). Descartes was, of course, Jesuit-trained (Dear, *Discipline and Experience,* 33–34).

89. Biographical material on Thomas Hood can be found in Taylor, *Mathematical Practitioners,* 40–41; Waters, *Art of Navigation,* 186–89; "Hood, Thomas," in *The Dictionary of National Biography,* 22 vols. (1921; reprinted London: Oxford University Press, 1964–65), 9: 1164; and H. K. Higton, "Hood, Thomas (*bap.* 1556, *d.* 1620)," in *Oxford Dictionary of National Biography,* 60 vols. (Oxford: Oxford University Press, 2004), 27:938–39.

90. Thomas Hood, *A Copie of the Speache: Made by the Mathematicall Lecturer . . . at the House of M. Thomas Smith* (London, 1588; reprinted Amsterdam: Theatrum Orbis Terrarum, 1974), A2r, ff.

91. Thomas Hood, *The Vse of the Two Mathematicall Instruments, the Crosse Staffe . . . and the Iacobs Staffe* (London, 1596; reprinted Amsterdam: Theatrum Orbis Terrarum, 1972), and idem, *The Making and Use of the Geometrical Instrument, Called a Sector* (London, 1598). Hood wrote to Lord Burghley requesting that funds be forthcoming for this lectureship and indicating that the intention was the training of forty captains in mathematical arts. However, it is not clear that the money was procured (BL, Lansdowne MS. 101, fols. 56–58).

92. As a result of this voyage, Edward Wright wrote *The Voiage of the Right Honorable George Erle of Cumberland to the Azores* (1589), which was later printed by Richard Hakluyt, who subtitled it as "written by the excellent Mathematician and Enginier master Edward Wright," in *Principal Navigations,* vol. 2, pt. 2, 155 [misnumbered as 143]–166. Marie Boas Hall, *The Scientific Renaissance, 1450–1630* (New York: Harper and Brothers, 1962), 204; Waters, *Art of Navigation,* 220; and John William Shirley, "Science and Navigation in Renaissance England," in *Science and the Arts in the Renaissance,* ed. John William Shirley and F. David Hoeniger (Washington: Folger Shakespeare Library, 1985), 74–93, esp. 81, all cite this trip to the Azores as the turning point in Wright's career, his "road to Damascus" experience, because it convinced him in graphic terms of the need to revise completely the whole navigational theory and procedure.

havenvinding from the Dutch.[93] In this work, Stevin claimed that magnetic variation could be used as an aid to navigation in lieu of the determination of longitude.[94] He set down tables of variation, means of finding harbors with known variations, and methods of determining variations. In his translation, Wright called for systematic observations of compass variation to be conducted on a worldwide scale, "that at length we may come to that certaintie, that they which take charge of ships may know in their nauigations to what latitude and to what variation (which shall serue in stead of the longitude not yet found) they ought to bring themselues."[95]

This call for greater accuracy in measurement would, of course, lead to better charting and mapping. Unfortunately, Wright's scheme was not entirely successful. By 1610, in his second edition of *Certaine Errors of Navigation,* Wright had constructed a detailed chart of compass variation—but he had also become more hesitant in his claims concerning the use of variation to determine longitude.[96]

Wright's greatest achievement was *Certaine Errors in Navigation* (1599), his appraisal of the problems of modern navigation and the need for a mathematical solution. In this book, Wright explained Mercator's map projection mathematically for the first time, providing an elegant Euclidean proof of the geometry involved. He also published a table of meridian parts for each degree, which enabled mapmakers to construct accurate projections of the meridian network, and offered straightforward instructions on map construction.[97] And he constructed his own map using this method. Wright's work was the first truly mathematical rendering of Mercator's projection and placed English mathematicians, for a time, in the vanguard of European mathematical geography. It was equally significant for the close communication it claimed for and required of theoretical mathematicians and practical navigators.

At about the turn of the century, Wright moved from Cambridge to London, where he established himself as a teacher of mathematics and geography. In the early seventeenth century, he is said to have become a tutor to Henry, Prince of Wales (the elder son of James I), a claim strengthened by Wright's dedication of his second edition of *Certaine Errors* to Henry in 1610.[98] Upon becoming Henry's tutor, Wright "caused a large sphere to be made for his Highness, by the help of some German workmen; which sphere by means of spring-work not only represented the motion of the whole celestial sphere, but shewed likewise the particular systems of the Sun and Moon, and their circular motions, together with their places, and possibilities of eclipsing each other. In it was a work by wheel and pinion, for a motion of 17100 years, if the sphere could be kept so long in motion."[99]

In or around 1612, Wright was appointed librarian to Prince Henry, but Henry died before Wright could take up the post.[100] In 1614, Wright was appointed by Sir Thomas Smith, governor of the East India Company, to lecture to the company on mathematics and navigation for a salary of £50 per annum.[101] There is some speculation as to whether Wright actually gave these lectures, since he died the following year. Wright had spent his life teaching, writing, and conducting research about the problems of map construction and navigation. His life and work mark an important connection between maps and the informal route to education.

Hood, Wright, and Stevin, as well as a host of other mathematical practitioners interested in the interconnection between theoretical and practical issues, earned their living as educators, for armies, princes, aristocrats, and mercantile companies. In the process, they encouraged both the mapping of the world and the necessary use of existing maps. Because they fit into a new and informal educational system, they were able to introduce innovative material that caught the interest of newly powerful and educated social groups. They could respond much more rapidly to demand, so it is not surprising that we find the greatest use of maps as pedagogical tools in this informal educational setting.

Ideological Implications of Maps in Education

The use of maps in education, both formal and informal, influenced the way Europeans thought about the world around them. They began to develop a sense of space and place that shaped their self-definitions, as well as their political, legal, and military operations. Furthermore, map use and information changed the way scholars thought

93. Simon Stevin, *The Haven-Finding Art,* trans. Edward Wright (London, 1599; reprinted Amsterdam: Theatrum Orbis Terrarum, 1968); see Taylor, *Mathematical Practitioners,* 336.

94. Stevin, *Haven-Finding Art,* C2. Bennett marks the relationship between magnetism and longitude as one of the important sites of the scientific revolution in "Practical Mathematics," 186.

95. Edward Wright's preface in Stevin, *Haven-Finding Art,* B3r, and Waters, *Art of Navigation,* 237.

96. Edward Wright, *Certaine Errors in Navigation, Detected and Corrected* (London: Felix Kingst[on], 1610), 2P1r–8r, and Waters, *Art of Navigation,* 316.

97. Edward Wright, *Certaine Errors in Navigation* . . . (London: Valentine Sims, 1599), D3r–E4r, and Taylor, *Mathematical Practitioners,* 336.

98. Wright, *Certaine Errors in Navigation* (1610), *3r–10v, X1–4; see "Wright, Edward," in *The Dictionary of National Biography,* 22 vols. (1921; reprinted London: Oxford University Press, 1964), 21: 1015–17, esp. 1016, and A. J. Apt, "Wright, Edward (*bap.* 1561, *d.* 1615)," in *Oxford Dictionary of National Biography,* 60 vols. (Oxford: Oxford University Press, 2004), 60:437–38. See also Thomas Birch, *The Life of Henry Prince of Wales, Eldest Son of King James I* (London: Printed for A. Millar, 1760), 388–89.

99. "Mr. Sherburne's Appendix to His Translation of Manilius, p. 86," cited in Birch, *Life of Henry,* 388–89, esp. 389 n. g.

100. Roy C. Strong, *Henry, Prince of Wales and England's Lost Renaissance* (London: Thames and Hudson, 1986), 212.

101. Waters, *Art of Navigation,* 320–21.

about the natural world. While many of the seeds sown in the sixteenth and seventeenth centuries through the pedagogical use of maps would bear fruit only in the eighteenth, increasing familiarity with maps and their contents began to change many aspects of early modern intellectual, political, and ideological life.

Familiarity with maps on a local, national, or world scale helped Europeans develop a sense of identity. As Wintle has argued, Renaissance maps aided in the construction of the idea of Europe, as opposed to the earlier concept of Christendom.[102] World maps started the process of imperialism, identifying worlds to be conquered and the exotic "other" to be experienced and controlled. National maps gave their observers a sense of their own national identity, while those who owned or understood local maps began to define themselves by their own localities.[103]

Governing and landowning elites began to develop an understanding of maps, or, as Barber has labeled it, "map-consciousness"—an ability to think cartographically and to prepare sketch maps as a means of illuminating problems.[104] This understanding began to infiltrate and alter many legal, political, and military procedures, especially after 1580. In disputes regarding landownership and title, courts came increasingly to admit maps as a legitimate source of legal proof.[105] Administrators in the Italian states, in England, in France, and in the Habsburg territories all began to make use of maps for day-to-day administrative purposes. Likewise, those leading military campaigns began to experiment with the use of map knowledge and understanding.[106] International diplomatic negotiations, for example the dispute over the Moluccas by the Spanish and Portuguese in the early sixteenth century, increasingly included the expert knowledge of mapmakers and geographers.[107]

An increasing awareness of maps by scholars, both inside and outside the universities, influenced the development of new explanatory systems as well. The discovery of new worlds forced a reassessment of the knowledge of the ancients, and practical interest in mapping and understanding the earth encouraged natural philosophers to include studies of the earth in their new scientific endeavors.[108] The investigation of the shape of the earth in the eighteenth century, designed to prove Newton's predictions, was possible only because natural philosophers and mathematicians in the seventeenth century had begun to examine the globe in a new way. The use of maps and globes in the early modern educational system was a necessary first step to these important investigations.

Conclusion

Our knowledge of the place of maps and the study of the earth more generally within early modern education is still very rudimentary. Much work needs to be done, particularly on European universities, mathematical practitioners, and the important role of the Jesuits. It is clear that maps and geographical knowledge were part of the Renaissance educational system. Maps were used most at the more senior levels of formal education, although many humanist pedagogues suggested their use at an earlier level. Map use and interest were most pervasive, however, in informal educational settings. For the entrepreneurial mathematical practitioner and his pupils, maps provided an attractive, practical, and innovative pedagogical tool. As more men, and occasionally women, became aware of maps, concepts of the globe and their place in it changed. This was a prolonged development, and, just as the vast majority of Europeans had never been to school, the vast majority of Europeans never saw a map. But gradually, through a growing emphasis on education and literacy and through the geographical interest of the Jesuits and the rise of imperial nations, maps became more familiar. By the end of the eighteenth century, maps and mapping had become essential tools of governance and integral parts of nearly all scientific endeavors and therefore were firmly entrenched in the educational system.

102. Michael Wintle, "Renaissance Maps and the Construction of the Idea of Europe," *Journal of Historical Geography* 25 (1999): 137–65. J. R. Hale, in *The Civilization of Europe in the Renaissance* (London: HarperCollins, 1993), also claims that the study of geography and maps helped create Europe.

103. Anthony Pagden, *Lords of All the World: Ideologies of Empire in Spain, Britain and France, c. 1500–c. 1800* (New Haven: Yale University Press, 1995); John Gillies, *Shakespeare and the Geography of Difference* (Cambridge: Cambridge University Press, 1994); Lesley B. Cormack, "Britannia Rules the Waves? Images of Empire in Elizabethan England," in *Literature, Mapping, and the Politics of Space in Early Modern Britain,* ed. Andrew Gordon and Bernhard Klein (Cambridge: Cambridge University Press, 2001), 45–68; Richard Helgerson, "The Land Speaks: Cartography, Chorography, and Subversion in Renaissance England," *Representations* 16 (1986): 50–85; and idem, *Forms of Nationhood: The Elizabethan Writing of England* (Chicago: University of Chicago Press, 1992). For an overview of the sixteenth-century use of maps, see David Buisseret, *The Mapmaker's Quest: Depicting New Worlds in Renaissance Europe* (New York: Oxford University Press, 2003).

104. Barber, "England II," 58.

105. Barber, "England II," and Harvey, *Maps in Tudor England*. William Brandon, in *New Worlds for Old: Reports from the New World and Their Effect on the Development of Social Thought in Europe, 1500–1800* (Athens, Ohio: Ohio University Press, 1986), argues that ideas about private property and socialism came from Europeans' encounters with New World peoples.

106. David Buisseret, ed., *Monarchs, Ministers, and Maps: The Emergence of Cartography as a Tool of Government in Early Modern Europe* (Chicago: University of Chicago Press, 1992).

107. Brotton, *Trading Territories,* esp. 119–50.

108. Anthony Grafton, *New Worlds, Ancient Texts: The Power of Tradition and the Shock of Discovery* (Cambridge: Belknap Press of Harvard University Press, 1992); David Livingstone, *The Geographical Tradition: Episodes in the History of a Contested Enterprise* (Oxford: Blackwell, 1992), 32–62; and Cormack, "Mathematical Practitioners."