

NOTES

INTRODUCTION

1. Many such questions were also integrated into commentaries on John of Sacrobosco's *Sphere* (see, for example, Thorndike 1949, 30–31). See further Edward Grant's valuable "Catalog of [400] Questions on Medieval Cosmology, 1200–1687," in Grant 1994, 681–741.

2. "In addition, they invent another earth, lying opposite to our own, which they call by the name of 'counter-earth' " (Aristotle 1939, bk. 2, chap. 13, 217; cf. bk. 2, chap. 14, 241–45). There are some differences in how sixteenth-century translators rendered the Greek, e.g., "Pythagorici autem habitantes Italiam contradicunt illis, et dicunt quod ignis est positus in medio, et quod terra est stellarum una, et revolvitur circulariter, et ex motu eius circulari fit nox, et dies, et faciunt aliam terram, quam vocant antugamonani" (Aristotle 1962a, V, fol. 146K–L); "Pythagorei, dicunt in medio enim ignem esse inquit: terram autem astrorum unum existentem circulariter latam circa medium, noctem, & diem facere. Amplius autem oppositam aliam huic conficiunt terram, quam antichthona nomine vocant" (Aristotle 1997, T. 72, 643–44).

3. See Robin Bruce Barnes's excellent treatment of this problem (1988, 1–59, 73–75).

4. See Smoller 1994, 3–4; Smoller 1998.

5. Columbus to a member of the royal court (1500) on his return in chains from his third voyage to the "New World Indies," quoted by Watts 1985, 73.

6. See Osiander 1527, well discussed in Scribner 1981, 142–47.

7. See Kuhn 1957, 93–94: Kuhn's exclusion of astrology was entirely typical of other "big-picture" narratives of his historiographical moment: Koyré 1992; Blumenberg 1987, 1965; Zinner 1988. See Westman 1997.

8. North 1975; LeMay 1978. North credits Giacon

(1943) as the earliest modern historian to maintain that "Copernicus was an astrologer." Charles Webster was not able to connect Copernicus himself to the wider themes of astrology and Christian eschatology, but he was looking for the right kinds of connections (Webster 1982, 15–47). See also my brief preliminary study anticipating the present work (Westman 1993).

9. Whewell 1857, 271–331.

10. Quoted from Kuhn's classic *Copernican Revolution* (Kuhn 1957, 230). By now it is well established that Copernicus's book was widely consulted (see Gingerich 2002). For recent appreciations, see Westman 1994; Swerdlow 2004a.

11. In reading Kuhn's *Structure of Scientific Revolutions*, Ernan McMullin offers an illuminating distinction between "deep" and "shallow" revolutions, suggesting that the Copernican episode exemplified "a revolution of a much more fundamental sort because it involved a change in what counted as a good theory, in the procedures of justification themselves. . . . And what made it revolutionary was . . . the very idea of what constitutes valid evidence for a claim about the natural world, as well as in people's beliefs about how that world is ordered at the most fundamental level" (McMullin 1998, 123).

12. The classic statement of this view is Geertz 1983, 55–70.

13. On the perils of extreme localism, see Dear 1995, 4, 245–46; Schuster and Watchirs 1990, 38–39.

14. Regiomontanus 1496, in Regiomontanus 1972, fifth conclusion, 68.

15. Here it must be emphasized that practitioners were neither making their own observations nor in some sense "testing" earlier theories against new evidence but utilizing what Bernard Goldstein has aptly characterized as "a literary tradition of scientific treatises" (Goldstein 1994, 189).

16. How Apollonius and Hipparchus interpreted the *choice* between these different hypotheses is a separate matter. Duhem (1996) held that the Greeks, in general, saw the choice as entirely one between theories used as calculational instruments with no claim to truth; but Lloyd (1978) has raised serious questions about Duhem's readings of the Greek sources.
17. Ptolemy 1998, bk. 3, chap. 4, 153.
18. See Swerdlow 1973, 472: "It is even possible that, had Regiomontanus not written his detailed description of the eccentric model, Copernicus would never have developed the heliocentric theory."
19. Copernicus 1543, bk. 2, introduction, fol. 27v; see also bk. 3, chaps. 15, 20, 25. For less literal translations than mine, cf. Copernicus 1978, 51; Copernicus 1976, 79.
20. Copernicus 1543, bk. 1, chap. 8/Copernicus 1978, 16; Virgil, *Aeneid*, bk. 3, 72.
21. Kuhn 1957, 23–24, develops the analogy of a merry-go-round ticket collector to assist understanding of the Sun's daily and annual motions.
22. Copernicus 1543, bk. 1, chap. 9, 71–v; book 5, 133v–134/Copernicus 1978, 227–29: "Primum non iniuria motum commutationis dicere placuit. . . . Nam motus commutationis nihil aliud esse dicimus." See also Walters 1997.
23. Aiton 1987, 23. Albert of Brudzewo lectured on Peurbach at Krakow; in 1494, it became the earliest printed commentary on that work. Aiton suggests that Peurbach's comment may have played an important role in suggesting to Copernicus the primacy of the Sun (9).
24. Copernicus 1978, bk. 4, 173: "The moon, taken by itself, gives no indication that the earth moves, except perhaps in its daily rotation."
25. On the phases of Venus, see Thomason 2000. On the gaps between the spheres, see Van Helden 1985, 46–47. On the ontology of the spheres, see Aiton 1981; Jardine 1982; Grant 1994, 346; Lerner 1996–97, 1:121–38, 2: 67–73; Goddu 2004.
26. Rheticus 1971, 137; Rheticus 1982, 107.
27. See Van Helden 1985, 50–52.
28. Ptolemy 1998, bk. 1, chap. 7, 45. Ptolemy also considers and rejects the possibility that the air surrounding the earth carries objects around, for either they would be left behind by the more rapidly moving air or, if "fused" to it, would never appear to change position.
29. See Lloyd 1979, 25–28, 71, 73–74, 76–78, 205–6.
30. Copernicus 1978, bk. 1, chap. 8, 16–17; for intelligibility, see Dear 2006, 8–14.
31. Copernicus 1978, bk. 1, chap. 9, 18; for an exhaustive study of the possible sources of this theory, see Knox 2005, esp. 203–11.
32. See Wallis in Copernicus 1952, 528–29; Toulmin 1975, 384–91; McMullin 1998, 134–35. For entailments of the heliocentric theory that Copernicus might have—perhaps should have—foregrounded in *De Revolutionibus*, see Swerdlow 2004a.
33. Of course, even if false, potential explanations may be very appealing (see P. Lipton 1991, 56–74).
34. Copernicus 1978, preface, 5; bk. 5, 227.
35. For what Duhem did and did not hold, see Ariew 1984.
36. Duhem 1894, 85.
37. See esp. Laudan 1990, 320–53.
38. See the clear and helpful discussion of Klee 1997, 65–67.
39. Duhem 1894, 87.
40. Philip Kitcher maintains that the question of underdetermination is now a philosophical commonplace (1993, 247–56); for its widespread influence in science studies, see Kuhn 1957, 36–41, 75; Kuhn 1970, 4; Dietrich 1993; Zammito 2004.
41. Duhem believed that eventually physical theories do reach ultimate truth, but he was wary of making untimely metaphysical claims. See Roger Ariew and Peter Barker in Duhem 1996, xi.
42. For the seventeenth-century theme of the use of divine powers, see Funkenstein 1986.
43. Duhem 1908, 150–51. Duhem's attribution to Bellarmine of the omnipotence argument is hasty and unwarranted.
44. Duhem 1996, 150–83; Finocchiaro 2005, 266–69. Little is known of Urban's beliefs about the natural world, although it is clear that, apart from his traditionalism in natural philosophy, he subscribed to a belief in astral forces (D. Walker 1958, 205–12).
45. Lloyd 1978.
46. Barker and Goldstein 1998.
47. Clavelin 2006, 16–17.
48. John Marino grounds the periodization of the Italian states ca. 1450–1650 in economic history (Marino 1994); for M. S. Anderson, it is armed struggle among the European states from the French invasion of Italy to the beginning of the Thirty Years' War (1998); in contrast, Eric Hobsbawm has argued for a "short twentieth century" (1994).
49. See Westman 1975b.
50. Schilling 1981, 1986; Headley 2004, xvii–xxv; Brady 2004.
51. In some of my earlier writings, I worked in the historiographical framework that organized the period 1543–96 around the Copernican proposals. See, for example, Westman 1975b.
52. Voelkel 2001, 130–210.
53. For Victorian representations, see Barton 2003. Rudwick argues that the undifferentiated term *savant* or *learned* was the predominant designator (2005, 22–23).
54. For an introduction to different ideas of progress, see Ginsberg 1973.
55. See Oreskes 1999.
56. Kuhn 1970, 1–9; Duhem 1996, 79.

bk. 1, sig. A2. For further discussion, see also Trinkaus 1985, 450–51.

174. Rheticus 1971, 109–10, my italics.

175. Copernicus 1972, fol. 13, my italics: “Assumptus extra quibusdam revolutionibus mobilem esse tellurem quibus tamque primario lapidi totam astrorum scientiam instruere initium”; Copernicus 1978, 26; again, in the *Letter against Werner* (1524), he says that “the science of the stars is one of those subjects which we learn in the order opposite to the natural order” (Copernicus 1971c, 98; Copernicus 1985, 146).

176. For Copernicus’s reconfiguring of gravity and the elements, see Knox 2002, 2005.

177. The manuscript of *De Revolutionibus* contains a suppressed passage from Lysis’s letter to Hipparchus, available to Copernicus both in Bessarion’s *In Calumniatorem Platonis*, fols. 2v–3r, and in *Epistolae Diversorum Philosophorum* (Venice, 1499). Introducing the text of the letter, Copernicus mentions that “Philolaus believed in the earth’s motion” and that “Aristarchus of Samos too held the same view according to some people”; Copernicus also explains that these views are not widely known because of the Pythagoreans’ practice of not committing “the secrets of philosophy to writing” (see Rosen’s discussion in Copernicus 1978, 25–26, 361–63; Prowe 1883–84, 2:128–31; Africa 1961).

4. BETWEEN WITTENBERG AND ROME

1. See Barnes 1988.

2. See Hammerstein 1986; Köhler 1986; Reeves 1969, v–vi.

3. Quoted in Rupp 1983, 257, and Bonney 1991, 21. Luther completed his translation of the Bible in 1534.

4. See Dobrzycki and Szczucki 1989.

5. The *Commentariolus* was not published until the nineteenth century (Copernicus 1884, 2:184–202); it lacked an explicit public strategy of persuasion and, therefore played a somewhat different role in promoting Copernicus’s work.

6. He was known to his classmates as Hosen Enderle (see Swerdlow and Neugebauer 1984, 1:13.).

7. On Schöner, see Wrightsman 1970, 120. Copernicus is not known to have had a mistress, but he did have a female housekeeper, whose presence in his house made him the subject of fairly strong censures by the Varmia bishop (see Rosen 1984b, 149–57).

8. Giese attributed Copernicus’s failure to mention Rheticus to a kind of absentmindedness about anything that was not “philosophical”: “incommodi, quo in praefatione operis praeceptor tuus tui mentionem omisit. quod ego non tui neglectu, sed lentitudine et incuria quaedam (ut erat ad monia quae philosophica non essent, minus attentus), praesertim iam languescenti evenisse interpretor, non ignarus, quanti facere solitus fuerit tuam in se adiuvando operam et facilitatem” (Giese to Rheticus in Leipzig, 26

July 1543; Prowe 1883–84, 2:420). However, Hooykaas endorsed the view of Bruce Wrightsman that “Copernicus shrewdly declined to name his Lutheran disciple, Rheticus, in his letter of dedication to the Pope, as one of those whose assistance and encouragement persuaded him to have the work published. What other possible reason could there be for such a significant omission?” (Hooykaas 1984, 38; Wrightsman 1975, 234). By the same token, Rheticus nowhere mentions the pope in the *Narratio Prima*.

9. Edward Grant concludes: “Astrologers and natural philosophers may have shared the Aristotelian conviction that celestial bodies were the ultimate causes of terrestrial effects, but natural philosophers largely excluded the prognosticative aspects of astrology from their deliberations. Except for the attribution of certain qualities to certain planets, astrological details and concepts are virtually ignored in questions on Aristotle’s natural books, especially on *De caelo*. The properties, positions, and relationships of the planets used for astrological prognostication were of little significance for the scholastic tradition in natural philosophy” (Grant 1994, 36 n. 66). Of course, the general exclusion of astrology from natural philosophy did not mean that specific churchmen were averse to engaging in practical astrology.

10. Luther 1969; Ludolph 1986; Barnes 1988, 46–53.

11. Caroti 1986, 120; Kusukawa 1991, 1995.

12. Barnes 1988, 97; Bretschneider et al. 1834–, 20:677–85.

13. See, for example, Hammer 1951, 313: “At the sight of these beautiful luminaries, they may meditate upon the entire arrangement of the year and upon the reason why God, the Author of all, created differences in seasons and annual cycles. And finally, that at such contemplation they may acknowledge God as the Creator and praise His wisdom and goodness shining forth from the infinite variety of blessings by which He shows His care for mankind. May they also realize that the wise and just Creator has shed the rays of His light upon us, namely, in order to distinguish between the concepts of good and evil.”

14. Barnes 1988, 96–99; Caroti 1986, 109–21.

15. See Bretschneider et al. 1834–, 8:63, no. 5362; Caroti 1986, 120. Of course, although Stöffler’s 1499 *Almanach* had been a major resource in the flood predictions, he himself had thrown cold water on the rising expectations as the time grew close (see Stöffler 1523).

16. Quoted and trans. in Warburg 1999, 656–57.

17. Ludolph 1986, 106.

18. For an excellent analysis of the meaning of *superstition* in this period, see Clark 1991, 233–35.

19. See Caroti 1986, 118. On D’Ailly’s astrology, see Smoller 1994.

20. Cited by Barnes 1988, 97; the example comes

from Melanchthon's preface to Johannes Funck, the son-in-law of Andreas Osiander (Funck 1559).

21. Ibid.

22. Peucer 1591.

23. Ibid., 389–91v.

24. "Johannes Schonerus dicebat se vidisse antiquissimum librum apud episcopum Bambergensem manu scriptum ex quo Joannes iste Pico omnia descripsit, impudenter sibi ea vindicatus, quibus contra astrologos arbitratur. Liber autem ille ignoti auctoris erat." Discovered by Aleksander Charles Gorfunkel in a copy of Pico's *Disputationes* (Pico della Mirandola 1504). Eugenio Garin cites this reference without further identification of location (Garin 1983, 85). It is not clear who wrote this note.

25. According to Garin 1983, 86: "The diffusion of the knowledge of this annotation was attributed to 'George Joachim Rheticus the famous mathematician and doctor,' who said that he had heard it in person." Because Rheticus could only have heard this remark from Schöner on the occasion of his visit in 1539, he would have been able to pass it on to Copernicus in the same year and thereupon to Melanchthon on his return to Wittenberg. "Est in manibus hominum farrago criminationum a Pico non scripta, sed excerpta ex vetustioribus commentariis, qui ad huius divinatricis reprehensionem multo ante collecti fuerunt" (preface to Schöner 1545, fol. β2r; also in Bretschneider et al. 1834–, 5:819).

26. Bretschneider et al. 1834–, 3:119, no. 1455; Caroti 1986, 114 n.

27. See also Garin 1983, chap. 4.

28. Bretschneider et al. 1834–, 5:818. Cf. Cicero 1959, bk. I, i, 1, 223: "There is an ancient belief, handed down to us even from mythical times and firmly established by the general agreement of the Roman people and of all nations, that divination of some kind exists among men; this the Greeks call *mantike*—that is, the foresight and knowledge of future events."

29. "Hos refutarunt docti viri, Bellantius et alii quidam; et multae leves et ieiunae cavillationes obiciuntur, quarum repetitio longa, et refutatio non necessaria est" (Bretschneider et al. 1834–, 5:819).

30. Preface to Schöner's *De Iudiciis*, Bretschneider et al. 1834–, 5:823: "At saepe fallimur, saepius etiam quam in ceteris artibus. Fateor hoc quoque. Nec tamen ars nulla est. Quid enim familiarius homini, quam hallucinari ac errare? Sed manent tamen aliquae verae notitiae, quas alii magis, alii minus dextre ad ea, de quibus iudicant, accommodant; et de futuris rebus etiam pauca prospicere et utile et magnum est." Pico had already noticed Ptolemy's admission that the art of astrology is uncertain (Pico della Mirandola 1496, bk. 2, chap. 6) and that "only those inspired by the divine predict particulars" (bk. 2, chap. 1). See Bellucci 1988, 619.

31. Bretschneider et al. 1834–, 13:537: "Ars est ordo certarum propositionum, exercitatione cognitarum

ad finem utilem in vita." Cited in Bellucci 1988, 615–616.

32. Bretschneider et al. 1834–, 13:185.

33. Pico della Mirandola 1496, bk. 11, chap. 1; see Bellucci 1988, 616–17.

34. "Cum natura uno et eodem modo agat, postquam multa exempla congruere compertum est, recete inde extruitur universalis. Hoc modo et Medicus suas universales constituit. Non colligi omnes singulares experientias de Cichorio, cuius magnus usus est in febribus, possunt, et saepe effectio eius impeditur, sed tamen consensus multorum exemplorum, quia natura uno modo agit, vim speciei ostendit. ita de astris, recte dicimus universales experientias esse, quas recitavimus de Solis et Lunae effectioibus: item de insignibus coniunctionibus, quia compertum est, similes esse effectiones plerumque" (Bretschneider et al. 1834–, 13:333).

35. Bretschneider et al. 1834–, 13:223–91, 335–36; see 261 for the equant.

36. Hooykaas 1984.

37. Thorndike 1923–58, 5:354–69.

38. The press was located first at Bamberg and later at Kirchehrenbach (see Zinner 1941, 57, e.g., nos. 1151 and 1266); for Apianus's press, see Günther 1882, 11.

39. Zinner 1990, 115.

40. See Rosen 1971b, 393.

41. Zinner 1941, nos. 1038, 1080, 1099, 1100, 1151, 1186, 1217, 1266, 1303, 1304, 1394–96, 1459, 1463–64, 1503–4, 1573, 1575–77, 1677, 1702, 1728, 1790–91, 1837, 1857, 1884, 1892, 1920–21.

42. Burmeister 1967–68, 3:50.

43. Buonincontro 1540. It is noteworthy that the Basel publisher of this work, Robert Winter, issued Rheticus's *Narratio Prima* in the following year.

44. On April 8, 1535, Johannes Apelt, the former chancellor to Duke Albrecht of Brandenburg, sent Albrecht from Nuremberg a nativity prepared by Joachim Camerarius with the suggestion that if he could not find someone to explain it to him, he should consult "an old canon from Frauenburg" (Prowe 1883–84, 1:401 n.; Biskup 1973, 155).

45. Hooykaas 1984, 14; Prowe 1883–84, 1:516; Burmeister 1967–68, 1:19; Rheticus 1982, 209–22; Swerdlow 1992.

46. Gaurico 1552.

47. Trans. Swerdlow 1992, 274; however, I render *pars* as "part" rather than "branch."

48. Alubater 1540, preface: "Quare ne illius difficultate deterreatur, pedissequam illius Astrologiam, ceu fructum ac mercedem quendam illi adiungendam esse putamus, quae & ipsa multas affert utilitates. In qua cum hoc tempore aliquid typis excudere uellemus, commodum ad manus nostras prouenit, Alubateris Liber genethliacus, siue De natiuitatibus inscriptus: quem non solum propter rerum copiam & authoris diligentiam, caeteris praeferendum putamus, uerum etiam propter iucundam ordinis nouita-

tem. Ita enim rerum per stellas significatarum ordinem secutus est, ut tamen ordinem Domorum non inuerterit."

49. Swerdlow 1992, 272.

50. Ludwik Birkenmajer pointed out that the horoscope must have been made while Copernicus was alive, as it made no sense to prepare a forecast for someone who was not living. Furthermore, he believed that Rheticus was the source of the information and that the Wittenbergers were interested to judge the worth of Copernicus's doctrine based upon the horoscope of its creator (see Birkenmajer 1975, 726-27, 728-33). Swerdlow and Neugebauer have analyzed Cod. lat. Monac. 27003, fol. 33 (see figure 32; also reproduced in Biskup 1973, plate 22), and conclude that the horoscope is in somewhat closer agreement with the Alfonsine-based *Tabulae Resolutae* than the numbers predicted by Copernicus's theory (Swerdlow and Neugebauer 1984, 454-57).

51. See Thorndike 1923-58, 5:367. From my inspection of the copy held by the Bibliothèque Nationale, I can find no evidence for Thorndike's comment that "Schöner maintained that the Copernican system was not unfavorable to astrology" (Schöner 1545). In the description of a copy of this work for sale by Jonathan Hill in 1995 (catalogue no. 88, item no. 89, 37), Thorndike's comment is endorsed. However, when I checked with the dealer, he too was unable to find any references to Copernicus.

52. For the hypothesis that Copernicus functioned as a powerful father figure to Rheticus, see Westman 1975b.

53. See Burmeister 1970, 1:46-105.

54. For a listing of these works, see *ibid.*, 2:29-37.

55. *Ibid.*, no. 21, 2:43.

56. *Ibid.*, 1:69-70; 2:39-40. The Latin works are all called *Prognosticum Astrologicum*; the German works are called *Gemeine Anzeigung* (for 1545) and *Practica* (for 1547). The prognostication for 1546 appeared also in English (London: Richard Grafton, 1545).

57. Copernicus 1543, Vatican copy, title page; for illustration and description, see Gingerich 2002, Vatican 2, 108-10.

58. Achilles Gasser in Feldkirch to Georg Vögeli in Konstanz, 1540, in Burmeister 1967-68, 3:15-19. Burmeister published the original text with German translation; there is also an excellent French translation in Rheticus 1982, 197-99.

59. Burmeister 1967-68, 3:15: "Videtur tamen novae et verissimae astronomiae restitutionem, immo τῆς παλιγγευσθησῶν haud dubie prae se ferre, praesertim cum de eiusmodi propositionibus evidentissima decreta iactitet, super quibus a doctissimis non modo mathematicis, sed philosophis maximis etiam non citra sudorem."

60. Rheticus 1971, 109-10.

61. *Ibid.*, 110.

62. Later, however, Rheticus does return to the

question of the *primus motus*, making it appear that he has indeed been working his way through the manuscript. This passage creates the impression that either Rheticus was studying and writing in great haste (without revising) or that the order of treatment was meant to make it appear as if Rheticus was faithfully reporting his own study of the manuscript.

63. J. L. E. Dreyer believed this to be the case: "Nothing of this theory of monarchies is mentioned by Copernicus himself but we cannot doubt that Rheticus would not have inserted it in his account if he had not had it from his 'D. Doctor Praeceptor,' as he always calls him" (Dreyer 1953, 333). Alexandre Koyré was more cautious: "It is difficult to say if Copernicus shared the views of his young friend, or was merely indifferent to them" (Koyré 1992, 32-33). See also North 1994, 289-90.

64. Rheticus 1982, 11. The title of the Basel edition is somewhat different: instead of putting Schöner's name first, the title now begins "Concerning the Books of Revolutions." It then continues unchanged with Copernicus's full title: "of that most erudite man and most excellent Mathematician Nicolaus Copernicus, Canon of Varmia." However, where the Gdańsk edition then identifies only "a certain young man studious of Mathematics," the Basel edition names Georg Joachim Rheticus.

65. This is the view of the translators of the French edition: "Ce passage astrologique de Rheticus interrompt l'exposé sur la variation de l'excentricité et sur le mouvement de l'apogée du soleil, commencé au chapitre IV. Aussitôt après cette digression, d'ailleurs, Rheticus poursuit la description de la théorie copernicienne du soleil. On voit bien sur cet exemple que les indications portées en manchettes par H. Zell dans l'édition de Gdansk visent à attirer l'attention du lecteur sans toujours remplir la fonction de titres de chapitres" (Rheticus 1982, 155).

66. Here I differ with the brilliant French team of editors and translators, who interpret this section as a digression from the astronomical material (Rheticus 1982, 155, n. 47).

67. "Addam et vaticinium aliquod" (Rheticus 1982, 47; Rheticus 1550b).

68. "De dignitate astrologiae" (Burmeister 1967-68, 3:25 n., 88, 90, 1:27).

69. Rheticus 1971, 121-22; Rheticus 1982, 47-48. Figure 33 is a reconstruction not found in the original work (Rheticus 1982, 153-54).

70. Derived not from the Bible but from the Babylonian Talmud. *Elias* is the Greek form and *Helias* the Latin of "Elijah." See further Warburg 1999, 693-95; Rheticus 1971, 122 n.; Rheticus 1982, 155 n. Barnes 1988, 78, 104-5, 107-8, 113, 279 n.; Granada 2000a, 109.

71. Reeves 1969, 309. For the Elijah prophecy, besides Rheticus 1982, 155 n. 46; Barnes 1988; Granada 1997b.

72. Carion 1550, *Biv; Melanchthon and Peucer 1624, preface, 120: "Sex millia annorum mundus, & deinde conflagratio. Duo millia Inane. Duo millia Lex. Duo millia dies Messiae. Et propter peccata nostra, quae multa & magna sunt, deerunt anni, qui deerunt."
73. See Burmeister 1970, 1:85–91.
74. Barnes 1988, 107.
75. Melanchthon 1532 in Bretschneider et al. 1834–, 12:708; Melanchthon and Peucer 1624, 27: "Nomen Chronici Carionis retinui, quod mutare illud autor primu sanctae beataeque memoriae Philipp. Melanthon socer meus noluit. Occasio nominis huius inde extitit, quod cum Ioannes Carion Mathematicus ante annos XL. coepisset contexere Chronicon, & recognoscendum illud atque emendandum, priusquam prelo subiiceretur, misisset ad Philippum Melanthonem, hic, quod parum probaretur, totum aboleuit [aboluit?] una litura, alio conscripto, cui tamen Carionis nomen praefixit. Sed et hoc cum retexisset, amici nomen et memoriam, à cuius primoridijs [Gr.: aformi] prima Chronici contexendi nata atque profecta esset, titulo posteritati commendare voluit." Peucer prepared the tabular index to the book ("Tabella ostendens quo origine legenda et cognoscenda sit series historiarum mundi; 49); cf. Barnes 1988, 106–8.
76. The passage ends exactly like Carion's: "Et si qui deerunt, deerunt propter nostra peccata quae multa sunt." Bretschneider et al. 1834–, 12:46 f. Melanchthon says in a letter to Carion on the comet of 1531 that Paul of Santa Maria is the source of the Elijah prophecy cited by Carion himself in his *Chronica*. On the Elijah prophecy in the Renaissance, see Secret 1964, 11; for these references, see Rheticus 1982, 155 n. 46.
77. Barnes 1988, 50–52; Headley 1963, 108–10.
78. Pico della Mirandola 1969, exp. vii, chap. 4, 53–55; Pico della Mirandola 1965, 159–62.
79. See Hooykaas 1984, 56, 87.
80. Pico della Mirandola 1965, 160.
81. *Ibid.*, 161.
82. *Ibid.*, 159.
83. *Ibid.*, 159.
84. Cf. Rosen (1943, 468), who recognized the possible astrological associations of the first part of the work's title but avoided any further discussion of it.
85. Rheticus 1971, 122. I have modified Rosen's translation.
86. "Letter to Emperor Ferdinand," preface to Johannes Werner, *De Triangulis Sphaericis* and *De Meteoroscopiis* (Krakow, 1557), in Rheticus 1982, 233; see also Rheticus 1971, 123 n.
87. "Preface to Werner" in Rheticus 1982, 233.
88. Rheticus 1971, 126–27.
89. "As for the fact that the planets are each year observed as direct, stationary, retrograde, near to and remote from the earth, etc., my teacher shows that this can be due to a regular motion of the terrestrial globe. . . . This [terrestrial] movement is such that the Sun occupies the middle of the universe while the earth, in place of the Sun, revolves on an eccentric that my teacher has decided to call the Great Orb" (Rheticus 1982, 54, 106; cf. Rheticus 1971, 135–36).
90. *Ibid.*
91. Granada (1996a, 794–97) also regards Copernicus as playing a silently supportive role for Rheticus's views about scripture and the Earth's motion.
92. Rheticus 1971, 136; Rheticus 1982, 106. Cf. Copernicus 1543, bk. 3, chaps. 1, 3.
93. Ravetz 1965, 1966; Curtis Wilson 1975. Working at a different historiographical moment, neither Ravetz nor Wilson was concerned with the rhetoric of Rheticus's arguments.
94. Rheticus 1971, 137; Rheticus 1982, 107.
95. See Copernicus 1543, bk. 1, chap. 4. The immediately preceding sentence reads: "Terrae igitur, ad Martis et aliorum planetarum motus restituendos, alium locum deputandum esse patet" (Rheticus 1982, 55).
96. In a highly suggestive and influential interpretation of this *petitio*, Noel Swerdlow argued that Copernicus meant the spheres to be taken as material, impenetrably solid entities whose motions would be incompatible with the nondiametral axes of the equant (Swerdlow 1973, 424–25, 432, 438–40). Later, in outlining the arrangement of the universe, Rheticus wrote in such a way as to suggest that the planets are situated in eccentric orbs (*orbis*): "Intra concavam superficiem orbis Martis et convexam Veneris, cum satis amplum relictum sit spatium, globum telluris cum adiacentibus elementis orbe Lunari circumdatum circumferri." In my opinion, although talk of "concave and convex surfaces" warrants talk of "thickness," it does not logically imply impenetrability.
97. Swerdlow (1973) has suggested that Copernicus's starting point was not the Earth's motion but his dissatisfaction with the equant, already evident in the first *petitio* of the *Commentariolus*.
98. Rheticus 1982, 186–187; Kepler 1937–, 1:119–120; the letter was dated September 13, 1588 (Brahe 1913–29, 7:129); when the letter came into Maestlin's possession is not known.
99. Rheticus 1971, no. 5, 137–38; Rheticus 1982, 107: "Since we see that this one motion of the earth satisfies an almost infinite number of appearances, should we not attribute to God, the creator of nature, that skill which we observe in the common makers of clocks? For they carefully avoid inserting in the mechanism any superfluous wheel or any whose function could be served better by another with a slight change of position."
100. *Ibid.*
101. For an excellent discussion of dialectical topics, see esp. Goddu 2010, 275–300; Moss 1993, 7–9.

102. For further analysis of Copernicus's logical resources, see Goddu 1996; Goddu 2010, 300–24.
103. Rheticus 1971, 165.
104. *Ibid.*, 145.
105. *Ibid.*, 138.
106. Rheticus 1971, 139; Rheticus 1982, 108.
107. Rheticus 1971, 139.
108. Rheticus 1971, 140; Rheticus 1982, 57, 109.
109. *Ibid.*
110. Rheticus 1971, 140–41; Rheticus 1982, 110; Aristotle 1960, bk. 2, chap. 5, 287b34–288a1.
111. “Ego quidem statuo Aristotelem, auditis novarum hypothesium rationibus, ut disputationes de gravi, levi, circulari latione, motu et quiete terrae diligentissime excussit, ita dubio procul candide confessorum, quid a se in his demonstratum sit, et quid tanquam principium sine demonstratione assumptum” (Rheticus 1982, 58, 110; Rheticus 1971, 142).
112. Rheticus 1971, 141; Rheticus 1982, 110.
113. Aristotle 1961–62, bk. 2, chap. 1, 993b 26–27; Rheticus 1971, 142–43; Rheticus 1982, 111. See Goddu's important discussion (2010, 321–23). According to Rosen, Rheticus generally quoted from Greek authors, but in this instance, the passage that Rheticus produced came from Cardinal Bessarion's Latin translation of Aristotle's *Metaphysics*—which means that that work could have been in the Varmia library.
114. Rheticus 1971, 146; I agree with the translation in Rheticus 1982, 113, which takes “orb” for *orbis*, rather than Rosen's “sphere.”
115. See Achillini 1498; chap. 1 above.
116. Rheticus 1971, 146; Rheticus 1982, 60, 113; *principium motus et lucis*. The editors of Rheticus (1982, 169) comment here that “for Copernicus, the sun is simply a light that illuminates the world . . . the thesis of the sun as a principle of motion does not appear in Copernicus.” Kepler later found inspiration in this particular passage, which he developed in ways anticipated by neither Copernicus nor Rheticus (see chap. 11, this volume; Kepler 1937–, 1:70, l. 34).
117. Rheticus 1971, 147; Rheticus 1982, 113.
118. As Rosen observes, Rheticus sometimes does not follow carefully the lettering of the diagram that he is reporting from Copernicus's manuscript (see Rheticus 1971, 155 n.).
119. For an example of a diagram added by Maestlin, see Kepler 1937–, 1:111; Rheticus 1982, 175–76; Maestlin 1596b, 134 ff. See also Grafton 1973.
120. Rheticus 1971, 186; Rheticus 1982, 138.
121. For a representation of the equant, compared with Kepler's ellipse, see Dennis Duke's animation (<http://people.scs.fsu.edu/~dduke/Kepler.html>; accessed July 19, 2008).
122. As Edward Grant maintains: “Nothing that Copernicus said or implied in *De Revolutionibus* enables us to decide with any confidence whether he assumed hard or fluid spheres. Copernicus fits the pattern of the Middle Ages, when explicit opinions about the rigidity or fluidity of the orbs were rarely presented” (Grant 1994, 346; cf. Lerner 1996–97, 1:131–38; Westman 1980a, 107–16; Goddu 1996, 28–32).
123. See especially chap. 12: “On Librations” (Rheticus 1971, 153–62; Rheticus 1982, 118–22, 172–75. This is the so-called Tūsi couple. See Hartner 1973, 420–22; Ragep 2007. It is noteworthy that Rheticus makes no ascription to Arabic authority.
124. Rheticus 1971, 148; Rheticus 1982, 114.
125. Rheticus 1971, 194; Rheticus 1982, 144.
126. *Ibid.*
127. Rheticus 1982, 189, 141. Melanchthon used the story of traces on the Rhodian shore in his preface to a 1537 edition of Euclid's *Elements* (see Moore 1959, 147).
128. “Judicabat Alfonsinos potius quam Ptolemaeum imitandum et tabulas cum diligentibus canonicibus sine demonstrationibus proponendas; sic futurum, ut nullam inter philosophos moveret turbanm: vulgares mathematici correctum haberent motuum calculum, veros autem artifices, quos aequioribus oculis respexisset Iupiter, ex numeris propositis facile perventuros ad principia et fontes, unde deducta essent omnia . . . atque illud Pythagoreorum observaretur, ita philosophandum, ut doctis et mathematicae initiatis philosophiae penetralia reserantur, etc.” (Rheticus 1982, 85, 143; Rheticus 1971, 192).
129. The word *artifex* means, literally, “author.” Rosen translates it as “scholar”; the French team uses “savant.” Had Rheticus used *homo doctus*, *eruditus*, or perhaps even *scholasticus*, the translation would have been straightforward. Clearly, Rheticus wants to contrast more than just *learned* and *unlearned*, as “ordinary mathematicians” are not *unlearned*. I suggest that the distinction that Rheticus is urging is between *theorica* and *practica*: only a few are capable of grasping the theoretical assumptions from which the tables are derived. A few paragraphs later, Rheticus offers clarification when he cites Aulus Gellius's *Noctes Atticae* (bk. 1, chap. 9, no. 8): “As for the unlearned, whom the Greeks call ‘people incapable of speculation, people who are strangers to the muses, to philosophy, and to geometry,’ their shouts ought to be ignored” (see Rheticus 1982, 86, 144; Rheticus 1971, 195).
130. Rheticus 1971, 193; Rheticus 1982, 143.
131. *De caelo*, bk. 2, chap. 14. Rheticus quotes the full passage in Greek. This confirms what already seems obvious: Rheticus availed himself of books in the library of Copernicus and Giese.
132. For Osiander's life in relation to his views on natural knowledge, see Wrightsman 1975, esp. 215–21; Wrightsman 1970.
133. Osiander 1532; Wrightsman 1970, 46.
134. Quoted and trans. in Seebass 1972, 36.
135. Bretschneider et al. 1834–, 3:115.
136. Rosen 1971b, 403.

137. See Shipman 1967.
138. Kepler 1858–71, 1:246; Prowe 1883–84, 1: pt. 2, 523 n.; Burmeister 1967–68, 3:25–26; Rheticus 1982, 208–9.
139. Prowe 1883–84 1: pt. 2, 522.
140. "Peripathetici et theologi facile placabuntur, si audierint, eiusdem apparentis motus varias esse posse hypotheses, nec eas afferi, quod certo ita sint, sed quod calculum apparentis et compositi motus quam commodissime gubernent, et fieri posse, et alius quis alias hypotheses exogitet, et imagines hic aptas, ille aptiores, eandem tamen motus apparentiam causantes, ac esse unicuique liberum, immo gratificaturum, si commodiores excogitet. Ita a vindicandi severitate ad exquirendi illecebras avocati ac provocati primum aequiores, tum frustra quaerentes pedibus in auctoris sententiam ibunt" (Prowe 1883–84, 1: pt. 2, 523; Burmeister 1967–68, 3:25; Rheticus 1982, 208; Hooykaas 1984, 36–37).
141. See Wrightsman 1975; Williams 1992, 249–54, 483–88, 998–1001.
142. My italics. For English translations of the text of the "Ad Lectorem," see Rosen 1971a, 24–25; Copernicus 1978, xvi.
143. Ibid.: "Is there anyone who is not aware that from this assumption it necessarily follows that the diameter of the planet in the perigee should appear more than four times, and the body of the planet more than sixteen times as great as in the apogee, a result contradicted by the experience of every age?"
144. Rheticus 1971, 146; Rheticus 1982, 113.
145. Rheticus crossed out the offending Osiander letter with a red crayon before he sent it off to Wittenberg (see Gingerich 1992a, 72–73).
146. See Barnes 1988, p. 129.
147. This point is correctly stressed by Wrightsman 1975, 222.
148. Osiander 1548 (trans. George Joye).
149. Wrightsman cites a letter from Osiander to Luther's chaplain, Justus Jonas, following the comet of 1538 (Wrightsmen 1970, 229): "I do not wish to tell Germany's future on the basis of the stars; but on the basis of theology, I announce to Germany the wrath of God."
150. This interpretation appears to be supported by a fragment of an Osiander letter written from Nuremberg, 13 March 1540 (List 1978, 455–56).
151. Wrightsman 1970, 161 ff.
152. "Quia optem etiam praemitti vitam auctoris quem a te eleganter scriptam olim legi. . . . Vellem adnecti quoque opusculum tuum, quo a sacrarum scripturarum dissidentia aptissime vindicasti telluris motum" (Giese from Lubawa to Rheticus in Leipzig, July 16, 1543; Prowe 1883–84, 1: (2), 537–39; 2:419–421; Burmeister 1967–68, 3:54–55).
153. Hooykaas 1984, 144.
154. Hooykaas offers no speculations or evidence on this matter, although in October 1541, Melancthon wrote to Mithobius criticizing "that Sarmatian astronomer" (ibid., 145).
155. Hooykaas 1984, 82 n. (referring to original pp. 1, 11, 16, 32, 33, 59, 63).
156. On the principle of accommodation, see Funkenstein 1986, 11–12, 222–70; Scholder 1966, 56–78; Westman 1986, 89–93.
157. Hooykaas 1984, 8 (45, 68): "Quemadmodum Scriptura genus sermonis, consuetudinem loquendi, et rationem docendi a populo et vulgo sumit." Subsequent references to this text in Hooykaas 1984 provide page numbers for the original Latin followed in parentheses by those for the modern Latin text and English translation.
158. Ibid., 10 (46, 70).
159. Ibid., 35 (54, 84).
160. Ibid., 39 (56, 87): "Manifestum est propter eandem causam, excepto Sole et Luna nihil de reliquis Planetis ibidem dici, utcunque Picus in suo Heptaplo eos conetur inde eruere, ut et alia taceam, quae ibidem praetermittuntur."
161. Pico della Mirandola 1965, 69.
162. Ibid., 69–70.
163. Ibid., 95–96.
164. Ibid., 97–98.
165. Ibid., 100–101.
166. Ibid.
167. Ibid.
168. Ibid., 101. Hooykaas (1984, 33), who partly paraphrases and partly quotes these passages, ends with his own irritable judgment: "Evidently some allegorical exegetes did not shrink back from the most tortuous reasonings and the most gratuitous assumptions in order to reach their goal."
169. Hamilton 2004, 108, 115.
170. On this episode, see Prowe 1883–84, 1: pt. 2, 274; Müller 1908, 25; Rose 1975a, 131; also Striedl 1953, 96–120; Rosen 1971b, 387–88.
171. For Edward Rosen, however, only the pope's personal knowledge and approval of *De Revolutionibus* could have indicated positive sentiment in Rome: "Had Copernicus actually received Paul III's permission to print the *De Revolutionibus*, what earthly reason would have deterred him from making a public proclamation to that effect at some prominent point in his Preface?" (Copernicus 1978, 337; see also Rosen 1975b). However, Rosen ignores the serious possibility that there was a negative shift among the Roman authorities only after the arrival, in July 1542, of a new master of the sacred palace, Bartolomeo Spina (see Kempfi 1980, 252).
172. Copernicus 1978, xvii. I have emended Rosen's translation. On Schönberg's life, see Walz 1930; Rose 1975a, 131.
173. See Burmeister 1967–68; Gingerich 1993c.
174. See Faculty of Law, University of Cambridge,

"Primary Sources on Copyright, 1450–1900," www.copyrighthistory.org/htdocs/index.html, accessed September 9, 2010. For an important account of the transitional moment in the conception of literary property, see Rose 1994.

175. See Frugoni 1950; Thorndike 1923–58, 5:252–74.

176. D'Amico 1983, 47.

177. Gauricus 1541. I have not been able to consult this early edition (1504).

178. Granada and Tessicini (2005) point out important rhetorical and linguistic parallels between Copernicus's and Fracastoro's prefaces while suggesting that "at least part of [Copernicus's dedicatory letter] was intended to neutralize and oppose the Fracastorian reform in order to win support for his own system" (472).

179. See Thorndike 1923–58, 5:256–59; Pèrcopo 1894, 123–69.

180. See, for example, the *Liber de revolutionibus et nativitatibus* of the Jewish astrologer and Talmudic scholar Abraham ben Meir ibn Ezra (1092–1167), also known as Abraham Judaeus and Abraham Abenare. Pico cited him frequently as "Avenazram" (e.g., Pico della Mirandola 1496, bk. 1, chap. 1, 106–7). The first published edition appeared in 1485 (Venice: Erhard Ratdolt) with the title *De Nativitatibus* and advertising itself as "utilissimus in ea parte astrologie qui de nativitatibus tractat: cum figuris exemplaribus singulis domibus antepositis." See also Petrus Pitatus, *Tractatus de Revolutionibus Mundi atque Natiuitatum*: "Reuolutionem annorum mundi, uidelicet Introitum Solis in primum Arietis, uel etiam in quodcunque aliud Zodiaci punctum, utputa natiuitatum, uel aedificiorum inuenire." As usual, Edward Rosen tried to dissociate Copernicus from any taint of astrology (Rosen 1943, esp. 468).

181. Cf. the interesting remark written by a sixteenth-century commentator—probably from the Wittenberg orbit—on the title page of a copy of *De Revolutionibus*. The commentator guessed that "Copernicus derived the title of his volume from that passage in the *Astronomical Hypotheses* of Proclus [*Hypotyposis*, IV, 98] where he mentions 'Sosigenes the peripatetic and his work *περὶ τῶν ἀνελιττουσῶν*, that is, *de revolutionibus*; it was not Copernicus who added *orbium caelestium*, but someone else. In these six books Copernicus embraced the whole of astronomy, stating and proving individual propositions mathematically and by the geometrical method in imitation of Ptolemy" (Prowe 1883–84, 1: pt. 2, 541–42; Rosen 1943, 468–70; Gingerich 2002, Wolfenbüttel 1, 96–98). The last statement comes almost verbatim from Rheticus's *Narratio Prima*. Rosen argues that Copernicus was probably unfamiliar with Proclus's text, contrary to what the commentator believed; but Copernicus certainly was aware, from Pico's *Disputationes*, of the more familiar association between revolutions and nativities.

182. All quotes from suppressed introduction to bk. 1, Copernicus 1978, 7–8.

183. *Chrys.*: I think I've never read anything in pagan writers more proper to a true Christian than what Socrates spoke to Crito shortly before drinking the hemlock: "Whether God will approve of my works," he said, "I know not; certainly I have tried hard to please him. Yet I have good hope that he will accept my efforts."

Neph.: An admirable spirit, surely, in one who had not known Christ and the Sacred Scriptures. And so, when I read such things of such men, I can hardly help exclaiming, "Saint Socrates, pray for us!" (Erasmus 1965, 67–8).

184. "Qui apud me pressus non in nonum annum solum, sed iam in quartum nouennium, latitasset" (Copernicus 1543, fol. iii, ll. 13–14).

185. "Pleraque tamen interim admiserunt, quae primis principis, de motus aequalitate, uidentur contrauenire" (ibid., fol. iii b, ll. 12–13). This refers to the equant's violation of the principle of uniform, circular motion. Cf. "Prima petitio" in the *Commentariolus*: "Omnium orbium caelestium sive sphaerarum unum centrum non esse": "There is no one center of all the celestial orbs or spheres" (Copernicus 1884, 2:186).

186. "Mundi formam, ac partium eius certam symmetriam non potuerunt inuenire, vel ex illis colligere" (Copernicus 1543, fol. iii b, ll. 14–15). I translate *forma* as "arrangement" in order to convey *symmetria* (the due proportion of each part to another with respect to the whole). The sixteenth-century editor of Vitruvius, Guillaume Philandrier (1505–65), pointed out that there is no specific Latin word for the Greek *symmetria* and that Vitruvius appears to favor the noun *commensum*, from the verb *commetior*. Philandrier's notes are cited in Laet 1649, 38.

187. "Sed accidit eis perinde, ac si quis a diuersis locis, manus, pedes, caput, aliaque membra optime quidem, sed non unius corporis comparatione, depicta sumeret, nullatenus inuicem sibi respondentibus, ut monstrum potius quam homo ex illis componeretur" (Copernicus 1543, fol. iii b, ll. 15–19). Cf. Pierre Gassendi's paraphrase of the same passage, where, as in my translation, the analogy to painting is stressed: "Sed iis perinde evenire, ac si quis Pictor manus, caput, pedes, membra caetera, optime illa quidem, sed non unius corporis comparatione depicta adunaret, sicque ex illis monstrum potius, quam hominem compingeret" (Gassendi 1655, 296).

188. Horace 1926, 451, ll. 1–13.

189. See Weinberg 1961, 1:74.

190. Landino 1482, clvii v.

191. Fracastoro's difficulty was at the level of the assumed premises (eccentric vs. concentric spheres), whereas Copernicus's objection was at the level of the consequence, the *mundi formam*: neither the one nor

the other kind of spheres produced the right entailment. (For further discussion of Fracastoro and Copernicus, see Granada and Tessicini 2005, 462–63.)

192. “Sed & syderum atque orbium omnium ordines, magnitudines, & coelum ipsum ita connectat, ut in nulla sui parte possit transponi aliquid, sine reliquarum partium, ac totius uniuersitatis confusione” (Copernicus 1543, fol. iii j, ll. 22–25). Cf. the translations in Kuhn 1957, 142; Copernicus 1978, 5; 1976, 26. For discussion of the terms *ordo* and *symmetria* in *De Revolutionibus*, see Rose 1975b, 153–58.

193. For Copernicus’s knowledge of the *Posterior Analytics*, see Birkenmajer 1972a, 615. On demonstration, see Bennett 1943; see also Wallace’s illuminating discussion of the later career of this ideal of knowledge in Galileo’s period (Wallace 1984b, 99–148).

194. For discussion of the dialectical intrinsic topos from an integral whole, see Goddu 2010, 64–65, 67, 69, 83–84, 182, 283–84; Goddu 1996, 41, 50; Moss 1993, 44.

195. According to Lucio Bellanti, Paul of Middelburg excelled “in both parts of astrology,” that is, astronomy and “true astrology” (Bellanti 1554, 218).

196. Cf. Hallyn 1990, 73–103.

197. Nardi 1971, 99–120, and, following Nardi, Bettini 1975. A description of Copernicus’s alleged self-portrait is known only through Biliński 1983, 276: “[One sees] a scar on Copernicus’s face, at first not visible, and furthermore, what is more surprising, in his pupil one sees a reflection of the bell tower of a Gothic church.” In response to my queries, Jerzy Dobrzycki reported that this painting is undoubtedly the one hanging today in the municipal high school of Toruń. However, although it is very like an original portrait, it seems to have been painted not by Copernicus but by a professional artist of northern European origin. Bettini and Nardi also suggest that Giorgione’s *The Three Philosophers* portrays young Copernicus, al-Battani, and Ptolemy as the figures, but this hypothesis is just as conjectural as the interpretations of other art historians who have suggested three Aristotelians or three magi: cf. Wind 1969, 4–7, 25–26. For a more sober treatment of this painting, see Meller 1981, 227–47.

198. Klein 1961, 215–16.

199. Gauricus 1969, 92–93: “Mensuram igitur, hoc enim nomine Symmetriam Intelligamus, cum in caeteris omnibus quas natura progenuit rebus, tum uero in homine ipso admirabilissimam et contemplari et amare debemus, Ita enim undique exactissime dimetatis partibus compositum est nostrum hoc corpus, ut nihil plane aliud quam Harmonicum quoddam omnibus absolutissimum numeris instrumentum esse uideatur.” Cf. Vitruvius: “Symmetria est ex ipsius operis membris conueniens consensus”: Vitruvius 1496, bk. 1, chap. 2; bk. 3, chap. 1; bk. 6, chap. 2. Vitruvius, in turn, had drawn the notion of *symmetria* from ancient rhetoric.

200. Copernicus 1543, fols. iii b, iv b. Copernicus’s emphasis on God’s ordained power, or *potentia ordinata* (“ab optimo et regularissimo omnium opifice”), rather than his absolute power (*potentia absoluta*), fits well with the association of papal authority with natural order.

201. Maffei 1518, fol. 141: “Imprimis urbs tua [papa] curanda interpolandaque quin frustra (ut inquit apostolus) aliis praesideat, qui domum propriam neglexerit. Ante omnia tuis contraria moribus auaritia purganda ac pristinae libertati protinus restituenda, quum natura id expetat ut membra capiti congrua, ciues principi ac greges pastori similes in hac parte reddantur” (quoted in D’Amico 1980, 182; my translation). Maffei’s measures included reform of the collection of revenues, curbing of lawyers’ fees, policing of crime near the Curia, preservation of a regular and steady food supply, personal papal involvement in acts of charity, and the establishment of seminaries where the *artes liberales* might be taught (D’Amico 1980, 183).

202. D’Amico 1983, 223.

203. For a superb treatment of this theme, see Scribner 1981, 100–104, 165, 232–34; for illustrations, see Westman 1990, 190–91.

204. Luther 1883–, 10:2, 458; quoted and trans. in Scribner 1981, 245.

205. By contrast: “If the hypotheses assumed by [traditional astronomers] were not false, everything which follows from their hypotheses would be confirmed beyond any doubt” (Copernicus 1543, fol. iii b). Cf. Gauricus: “As for what is said about poets and painters, that they may do what they please, this is valid to the extent that they do not depart from nature” (Gauricus 1541, fol. Aiii). Here again, Copernicus’s humanism is profoundly evident. As Paul Oskar Kristeller reminds us, “Moral teaching is often contained in literary genres cultivated by the humanists where a modern reader might not expect to find it. . . . The humanists also followed ancient and medieval theory and practice in their belief that the orator and prose writer is a moral teacher and ought to adorn his compositions with pithy sentences quoted from the poets or coined by himself” (Kristeller 1961b, 1:295).

206. See Kempfi 1972.

207. Rheticus 1982, 84–85, 142–43; see Drennowski 1978.

208. See Copernicus 1978, 342.

209. In 1525, Tiedemann Giese wrote one of the earliest anti-Lutheran polemics (*Anthelogikon*), in which he advocated tolerant persuasion and mutual compromise. See Borawska 1984, 303–43; Kempfi 1972, 397–406, esp. 400; Hooykaas 1984, 20–27; Hipler 1868.

210. Alexandre Birkenmajer (1965, 15), has observed that on the four occasions when Copernicus refers to a deity, he nowhere uses the word *God* but rather employs such terms as *Opifex omnium*, *Opifex universorum*, and *Opifex Maximus*.

211. From Piccolomini 1551, 964, verse 32. See also Drewnowski 1973; Prowe 1883–84, 2:278–80; Hipler 1875, 21.

212. As J. G. A. Pocock has observed about the languages of political thought, “We wish to study the languages in which utterances were performed, rather than the utterances which were performed in them. . . . When we speak of ‘languages,’ therefore, we mean for the most part sub-languages: idioms, rhetorics, ways of talking about politics, distinguishable language games of which each may have its own vocabulary, rules, preconditions and implications, tone and style” (Pocock 1987, 21).

213. Laudan 1990, 323.

214. Dear 1995, 12.

5. THE WITTENBERG INTERPRETATION OF COPERNICUS'S THEORY

1. It was hardly “the book that nobody read”: see Gingerich 2002, 2004.

2. Clavius 1594, 68.

3. Rothmann to Brahe, April 18, 1590, Brahe 1913–29, 6:217, ll. 6–7, 20–22.

4. “Nam ipsos Copernici libros Reuolutionum legere non omnibus vacat” (Kepler 1984, 31; Kepler 1937–, 1: chap. 1, p. 15).

5. “Considerations on the Copernican Opinion” (1615), in Finocchiaro 1989, 71.

6. Hortensius made these remarks in the dedication to a work by Wilhelm Blaeu (1571–1638), once an assistant of Tycho Brahe, which provided just such illustrations of Copernican and Ptolemaic globes as were called for: “Candido ac Beneuolito Lectori M. Hortensius,” in Blaeu 1690, unpag. The passage is referred to also by Thorndike 1923–58, 6:7, and F. Johnson 1953, 286.

7. In 1551 Mercator made an elegant but still traditional celestial sphere and an astrological disc (see Vanden Broecke 2001).

8. In recent historiography, Copernicus's beliefs regarding the ontology of the celestial spheres and the logic of his main claim are good examples of areas of philological difficulty. See, for example, Swerdlow 1973, 432, 437–39, 477–78; Rosen 1971a, 13–21; Aiton 1981, 96–98; Jardine 1982; Westman 1980a, 112–16.

9. The classic work on the *Prutenics* and their subsequent use is Gingerich 1973c.

10. See Hartfelder 1889, 419–36, 491–500; see also Woodward 1924.

11. Hartfelder 1889, 210–22.

12. For the application of Melanchthonian principles at the Nuremberg *Gymnasium*, see Strauss 1966, 236 ff.

13. Hartfelder 1889, 489–538; Kusukawa 1995, 185–88; cf. Eulenburg 1904.

14. Quoted and translated by Thorndike 1923–58, 5:378; also quoted in Kusukawa 1995, 186–87.

15. Euclid 1537; Moore 1959, 150.

16. Bretschneider et al., 1834–, 9:261–66.

17. Melanchthon 1536, 1537.

18. Zinner 1941, nos. 1602, 1647 (also Bretschneider et al., 1834–, 3:115), 1701, 1802, 1833, 1881, 2025. See also Pantin 1987, 85–101.

19. Zinner 1941, no. 1969.

20. Ibid., nos. 2027, 2047 (Augsburg 1551).

21. As I did in Westman 1975b, 165–93. Although breaking with internalism in its heyday, the article failed to give any place to astrology. See now Kusukawa 1995; Brosseder 2005.

22. My emphasis. See Hammer 1951.

23. Bretschneider et al., 1834–, 11:265–66.

24. Peucer 1553, preface.

25. G. Kepler 1931, 2:137–38; Jarrell 1971, 36.

26. Höss 1972; Burmeister 1967–68, 3:8.

27. See Schilling 1981, 1986.

28. Williams 1992, 610; Swerdlow and Neugebauer 1984, 1:10, 2: figs. 1, 2, pp. 564–65.

29. Williams 1992, 613.

30. Rheticus 1971, 190.

31. Dantiscus, in his *Jonas propheta or Prophecy of the Destruction of the Free City of Danzig* (1538), warned the Danzigers of, among other things, Lutheran “impiety” (see Williams 1992, 615–16).

32. See Hartmann to Duke Albrecht, April 27, 1543, in Voigt 1841, 283.

33. See Voigt 1841, 111–12.

34. Burmeister 1967–68, 1:47.

35. Ptolemy 1991, 25.

36. See Barton 1994, 179–81, 206, 209, 212.

37. Burmeister 1967–68, 3:28–29.

38. Ibid., 28–38. Presumably, Rheticus had in mind that part of a particular prediction that concerns the region of the Earth affected by eclipses (see Ptolemy 1940, bk. 2, chaps. 4–5).

39. Burmeister 1967–68, 1:65–69.

40. See especially Moran 1978, 190–96; Moran 1977, 1991b; Feingold 1984; Zinner 1956, 604–5; Clulee 1988, 32–33, 192–93; Hill 1998; Hayton 2004. Consider also the great market for ivory sundials (Gouk 1988).

41. As I argued in Westman 1980a, 117–18.

42. Burmeister 1967–68, 1:67.

43. Ibid., 1:69.

44. Ibid., 1:72.

45. For descriptions of these copies and their owners, all from 1543, see Gingerich 2002: Peucer (Paris 12, p. 40); Heller (Rostock, p. 90); Schreiber, later owned by Kepler (Leipzig, pp. 76–80); Stoius (Copenhagen 1, p. 32); Homelius, later owned by Praetorius (New Haven 1, CT, Yale, 306–13); Reinhold (Edinburgh, Crawford Library, 268–78).

46. See Gingerich 2002, Vatican 2, 108–10.

47. Blumenberg 1965, 109.

48. Bretschneider et al., 1834–, 4:847.

49. New evidence, based on the records of Iserin's trial, undermines an earlier claim that the main charge