

- b. His picture of reform was to remove misunderstandings and errors that had made their way into Ptolemaic astronomy, returning to the original but with the sort of superior observational basis Ptolemy had originally called for
 - c. In early 1460s finished *Epitome of the Almagest*, an abridged Latin translation with comments, begun by his senior colleague Peurbach [1423-1461]); published in print, 1496
 - d. This became the basic source for Copernicus and subsequent generations
3. Regiomantanus's approach typical of the era: classic learning had become corrupted by the Scholastics; the solution was to return to the original works
 - a. Regiomantanus initiated a huge publishing program, including the *Almagest*, *Geography*, and two other works of Ptolemy; Euclid's *Elements*; the surviving works of Archimedes; and the *Conics* of Appolonius (all of which he knew)
 - b. His death at age 40 curtailed this project, though they were all published during the next century, in some cases continuing his effort
 - c. Before he died he published two works of his own that contributed significantly to astronomy during the next decades: a 7-place trigonometric table to the minute of arc and a nearly 900 page Ephemerides for 1475-1506, giving calculated daily positions of the sun, moon, and planets
 4. (One must not underestimate the importance of the invention of the printing press (ca. 1440s) to the emergence of active research in astronomy in Europe at this time
 - a. Just as Luther's German translation of the Bible (1536) made it accessible to a large range of people, so too the printed versions of classic and current works in astronomy and mathematics made them widely available
 - b. It also opened the way to intellectual careers for the first time to people who lacked voluminous memories, for memory ceased being a prerequisite)
 5. Regiomantanus was the most talented of the astronomers of the era, but there were many others too
 - a. His associate, Bernhard Walther (1430-1506) continued his program of observations over the period from 1475 to 1504, providing a good deal of useful data, especially of the sun
 - b. These observations, together with those of Peurbach and Regiomantanus, were published (by Schöner) in 1544, and republished in 1618 by Snel
- E. Nicolaus Copernicus: A Brief Biography
1. Born in 1473 in Torun, son of a well-to-do merchant who died when he was 10, after which he grew up under his uncle, the Bishop of Ermland
 - a. Associated with Church all his life: canon, though never a priest
 - b. Apparently lived in Ermland, which borders on Prussia, from roughly 1503 on, after completing his education -- i.e. from age 30 on
 - c. Performed duties as canon, acted as a medical doctor, and carried on his research in astronomy
 2. As good an education as could be had at the time

- a. University of Cracow from 1491 to 1495, where studied astronomy, among other things
 - b. Canon law and astronomy in Bologna from 1496 to 1501, then medicine at Padua from 1501 to 1503, with degree in law from Ferrara in 1503
 - c. Astronomy a hot topic in both Bologna and Padua
3. We have comparatively little biographical information on Copernicus's efforts in astronomy -- indeed, not even on when and how he became so proficient
 - a. Noted enough that Pope invited him to Rome in 1514 to comment on calendar reform that eventuated in the Gregorian calendar in 1582
 - b. He refused, saying that motions of sun and moon had to be worked out correctly before appropriate to turn to calendar
 4. Sometime around 1610 Copernicus formed the idea of the heliocentric system
 - a. *Commentariolus* summarizes system -- a manuscript that he circulated (date of composition unknown, but almost certainly no later than 1514)
 - b. First section, included in the Appendix, lays out his motivation and axioms
 - c. Spent much of the next 20 to 30 years developing complete heliocentric system, at a level of detail comparable to Ptolemy's *Almagest*
 - d. Delay in publication not because of fears of Church, but because of fear of ridicule (see his prefatory remarks); probably also hoping to find some compelling evidence for his system
 5. Rheticus came to work with him in 1539, published a summary in 1540, and arranged for full publication (in Lutheran Germany) of *De Revolutionibus* as Copernicus apparently preferred to call it
 - a. Publication carried through by Osiander, who anonymously added preface saying just a hypothesis (undoubtedly out of fear of Lutheran Church, for Luther himself had dismissed Copernicus's heliocentrism when he heard of it)
 - b. Legend has it that Copernicus saw printed book, or at least pages from it, on his death bed and was upset by the preface
 - c. Whether this is true or not, Copernicus was definitely opposed to the idea that astronomical models should be regarded just as hypotheses used for calculations -- indeed, he was opposed to Scholastic nominalism quite generally, not just this one manifestation of it
- F. Copernicus and Ibn al-Shāṭir (d. 1375)
1. A chance discovery in 1957 of an Arabic manuscript by Ibn al-Shāṭir (*The Ultimate Quest regarding the Rectification of [Astronomical] Principles*) in an Oxford University library has transformed Copernican scholarship -- and increasingly the historiography of Islamic science as well, though this transformation is still in process
 - a. Before: Copernicus effected a mathematical transformation of Ptolemaic astronomy into a heliocentric system, in the process eliminating all violations of uniform circular motion as well as the error on the variation of the distance of the moon in that astronomy