

PREFACE

ASTRONOMY IN THE MIDDLE AGES

Recent highly regarded books that view the history of astronomy as one long narrative tend to treat the Middle Ages in two parts.¹ Around the middle of the fifth century, the story goes, the collapse of the Roman Empire began a dark period in the history of astronomy. Knowledge of astronomy in the Latin West after this time is characterized as being essentially limited by the contemporary sources. Because a knowledge of Greek was not present, only Latin sources were available. Four sources were particularly popular for astronomy: Calcidius's commentary on Plato's *Timaeus*, Macrobius's *Commentary on the Dream of Scipio*, Martianus Capella's *Marriage of Philology and Mercury*, and Pliny's *Natural History*.² These sources contained only qualitative information and did not offer explanation of the methods by which such information had been originally assembled, and thus limited the potential for Latin scholars to advance the science of astronomy. The main use of astronomy of a more technical nature in this period was on behalf of *compotus*, or the science of determining the correct dates for Christian festivals, especially Easter; Bede's

¹Examples include *The Cambridge Illustrated History of Astronomy*, edited by Michael Hoskin, Cambridge: Cambridge University Press, 1997; John North, *The Norton History of Astronomy and Cosmology*, New York: W. W. Norton & Co., 1994; and *Astronomy Before the Telescope*, edited by Christopher Walker, New York: St. Martin's Press, 1996, especially Olaf Pedersen, "European Astronomy in the Middle Ages," 175–186.

²See, for example, Bruce Eastwood, "Astronomy in Christian Latin Europe c. 500–c. 1150," *Journal for the History of Astronomy* 28 (1997): 235–258.

The Reckoning of Time stands out as the great achievement in Latin computus and astronomy in the early Middle Ages.

The view that astronomy had such a limited role relies mainly on a historiographical program that insists that astronomy should be characterized by quantitative analysis of the motions of the heavenly bodies. Neugebauer, for example, expresses a very low opinion of the astronomy of the early Middle Ages.³ Some historians of astronomy who investigate this period, however, have identified other research agendas. Bruce Eastwood, for example, has noted that Carolingian scholars attempted to work with the limited Latin sources to investigate the problems of the orbits of Venus and Mercury.⁴ Steven McCluskey has noted a variety of uses of astronomy in the early Middle Ages, including the replacement of pagan solar festivals with Christian festivals and monastic timekeeping.⁵ And Valerie Flint has argued that the early Middle Ages was characterized by the attempt of the Church to “rescue” astrology for its own purpose.⁶ So the history of astronomy in the middle ages need not be a history merely of technical achievement.

The second part of the medieval period in the history of astronomy is generally said to begin in the eleventh or twelfth centuries. In the eleventh century, the first astrolabes, as

³See his *A History of Ancient Mathematical Astronomy*, part 2, New York: Springer-Verlag, 1975, especially Book 5, Part C, pp. 942ff.

⁴See, for example, his “Astronomical Images and Planetary Theory in Carolingian Studies of Martianus Capella,” *Journal for the History of Astronomy* 31 (2000): 1–28; and “Plinian Astronomical Diagrams in the Early Middle Ages,” in *Mathematics and Its Applications to Science and Natural Philosophy in the Middle Ages*, edited by Edward Grant and John E. Murdoch, 141–172, Cambridge: Cambridge University Press, 1987.

⁵See his *Astronomies and Cultures in Early Medieval Europe*, Cambridge: Cambridge University Press, 1998.

⁶See her *The Rise of Magic in Early Medieval Europe*, Princeton: Princeton University Press, 1991.

well as astronomical tables, came to Western Europe.⁷ With the importation of these devices, astronomy could again become quantitative. To understand fully the basis for the astrolabe and tables, however, required the translation of Arabic and Greek works and the development of theoretical astronomy. For two centuries, Latin scholars, often in collaboration with Arabic or Jewish assistants, translated such works into Latin. In addition, they wrote original works to assist in the teaching of astronomy, such as Sacrobosco's *Sphere*. The combination of new instruments, revised astronomical tables, and translated and original works of a theoretical nature, brought a new maturity to the science. This more mature science would be developed and propagated through the institution of the university, where astronomy was a part of the curriculum of the arts. Thus every student who progressed to one of the higher faculties, as well as many who never went past the undergraduate level, would be introduced to the advancing science.

Recently, some modern scholars have suggested that, in the twelfth and thirteenth centuries, a desire for astrological knowledge led to a renewed interest in astronomy. That is, understanding the motions of the heavenly bodies may not have been enough motivation to pursue the difficult tasks of translating works from Greek and Arabic and gaining a higher degree of quantitative knowledge. Instead, medieval scholars who pursued astronomical sophistication did so in order to develop their abilities in astrology.⁸ Even if this motivation

⁷See Hoskin and Gingerich, "Medieval Latin Astronomy," in *The Cambridge Illustrated History of Astronomy*, pp. 72ff; or Olaf Pedersen, in *Early Physics and Astronomy, A Historical Introduction*, revised edition, Cambridge: Cambridge University Press, 1993, pp. 219ff.

⁸For example, Roger French argues that English medical practitioners wanted to gain the practical benefit of foretelling the future, as well as increasing their reputation by having knowledge of the heavenly influences on the physical body; see his "Astrology in Medical Practice," in *Practical Medicine from Salerno to the Black Death*, edited by Luis García, et.al., 30-59, Cambridge: Cambridge University Press, 1994, and "Foretelling the Future: Arabic astrology and English Medicine in the Late Twelfth Century," *Isis* 87 (1996): 453-480. Hoskin and Gingerich acknowledge the "incentive" of astrology; see their "Medieval Latin Astronomy," p. 73. Pedersen, in his "European Astronomy in the Middle Ages," p. 183, suggests that medieval scholars interested in astronomy had little recourse to pursue their interest in

was not universal, it was recognized contemporaneously as a benefit by Roger Bacon, who argued that education and research in the West must include astrology so as to benefit the Church.⁹

How, then, does this current research project on the astronomical and computational works of Robert Grosseteste fit into the history of astronomy? In one sense, it clearly fits into the traditional story as one instantiation of the incorporation, after the translation movement, of sophisticated astronomical knowledge into the educational program of the university. In this light, the project can be seen as a case study in the ways in which the new scientific texts gained from the translation movement made an impact on the educational content of astronomy as one of the liberal arts and as a portion of natural philosophy. In addition, investigation of the level of astrological material presented to undergraduates furthers the agenda of explaining the place of astrology in the medieval understanding of astronomy.

In other ways, however, my project intends to accomplish a different kind of goal from the traditional historiography. Rather than seeing the medieval period in the context of “recovery” of Greek astronomy and the increasing “sophistication” of Latin astronomy, this project will concentrate on understanding the creation of new Latin texts for the medieval context itself. I will be interested not in determining whether medieval astronomers got the science “right,” but will instead focus on the content of the science and the purposes for which it was taught to students. In order to accomplish this, I will make use of a methodological approach of “assimilation.”

academic circles, and instead needed to seek employment as court astrologers or ‘mathematicians.’

⁹See especially his chapter on “Mathematics” in his *Opus maius*, translated by Robert Belle Burke in *The Opus Majus of Roger Bacon*, 2 vols, Russel and Russel, Inc.: New York, 1962. Bacon defends the reality of astrological influences, argues that doctors of the Church have delineated precisely the limits of acceptable astrological prognostication, explains the medical benefits of astrology, and notes various benefits of knowing the future for economic and military activities on behalf of the Church.

A. I. Sabra has argued that a great deal of the modern scholarship on translation movements has been of a ‘kinematic’ sort.¹⁰ He describes such publications as those that give an account

of the transmission of scientific knowledge from one culture to another ... [and] a description of movements of scientific products (texts, concepts, theories, techniques, etc.), in abstraction from the forces underlying these movements. The principal aim of such a description would be to state when and where the transport of these products took place, and thus to determine the path of their movement.¹¹

While this type of work is a necessary part of the process of describing a historical situation, it cannot give a full picture of that situation. Sabra suggests instead of such a kinematic approach, which he labels ‘transmission,’ that historians of cultural exchange adopt the analytical category of ‘appropriation.’ This word highlights the notion that what is under investigation is not merely the text, but also the manner in which the text was used within the cultural milieu. Adoption of the category of appropriation forces one to confront complex issues of use, motivation, and diffusion and modification of ideas and theories.

Roger French has raised similar concerns regarding the recovery of Aristotle’s works. While recognizing the value of knowing what texts of Aristotle were grouped together at different times, French argues that further questions must be asked: who used them, what they did with them, and so forth.¹² “So the central story of the introduction of Aristotle’s texts into the teaching of the new universities is about why they were there and

¹⁰A. I. Sabra, “The Appropriation and Subsequent Naturalization of Greek Science in Medieval Islam: A Preliminary Statement,” *History of Science* 25 (1987): 223–243.

¹¹Sabra, “The Appropriation and Subsequent Naturalization of Greek Science in Medieval Islam,” p. 223.

¹²Roger French, “Teaching Aristotle in the Medieval English Universities: *De plantis* and the Physical *Glossa ordinaria*,” *Physis* 34 (1997): 225–296.

how they were understood.”¹³ As with Sabra’s methodology, the central question becomes how the text was incorporated into the milieu in which it was used.¹⁴

This dissertation will use a methodology that combines these two approaches. I will be examining texts as they were used in the context of thirteenth-century teaching at an advanced level, either in a university or some other institution. The need for examining the context of educational institutions, and indeed arguing that the texts were intended for that purpose, is thus clear. Using the category of assimilation, this investigation will consider the content of texts, as well as for what purpose they were intended. It is here that the project will depart from the typical historiography of the “advance” of astronomy. Rather than attempting to demonstrate the increasing sophistication of astronomical theory, or greater precision in tables, for example, I will instead focus on the content of the science as it was presented, not as a part of a narrative of getting the science “right.”

Issues such as these are particularly relevant to the history of medieval science for two reasons, first, because of the significance of being ‘medieval,’ and second, because of the problematic term ‘science.’ To recognize the context as medieval is to emphasize the radical differences from today’s society. Medieval Europe was Christian in a way that no society is today. Not only did the Roman Church play a greater role in society and culture, Christian concerns impacted heavily on nearly all aspects of life. In the educational system, for example, decisions on curriculum were influenced by how course material would contribute to an education relevant to a Christian society. Natural philosophy, knowledge of the world, then, was useful so far as it contributed to Christian aims. Astronomy, one branch

¹³French, “Teaching Aristotle in the Medieval English Universities,” p. 226.

¹⁴French also elaborates on his methodology in “Foretelling the Future,” and in the book he co-authored with Andrew Cunningham, *Before Science: The Invention of the Friars’ Natural Philosophy*, Brookfield, VT: Ashgate Publishing Company, 1996.

of natural philosophy, contributed, for example, by maintaining the calendar (and especially finding the proper date for Easter) or revealing the workings of God in creation. To promote astronomy for its own sake, to value increasing sophistication of quantitative analysis of celestial motions as a contribution to science, would be a foreign ideal.

This brings us to the second problematic term: science. The word ‘science,’ if taken to mean a unified body of knowledge about the natural world and incorporating a methodology of experimentation and verification within a profession dedicated to that task, did not exist in English until the middle of the nineteenth century.¹⁵ In the Middle Ages, the Latin word *scientia* referred to a body of knowledge with a sure foundation, and included many fields that do not fit under the modern term. To lump knowledge of the natural world into a category by itself, and suggest that the task of a scholar dedicated to such fields of endeavor was simply to increase our understanding of natural phenomena, would be foreign to the medieval mind.¹⁶ This does not mean that individuals in the Middle Ages could not be interested in better understanding the world around them, but never in terms of contributing to some body of knowledge, restricted to the natural world, labelled ‘science.’ Typically, such investigations were meant to bring about practical benefits: improved medical care, appreciation of the Creator, and so on. Dangers of such investigations were typically seen in theological terms: warping God’s intention for the world, or underappreciating the role of the Creator by focussing solely on the creation.

What, then, was the situation of astronomy in the context of a medieval university? It was one of the liberal arts, and a part of natural philosophy, and thus formed at least of

¹⁵Regarding the term ‘science,’ see Sydney Ross, “Scientist: The Story of a Word,” *Annals of Science* 18 (1962): 65-85.

¹⁶It can be argued that such an attitude developed during the Scientific Revolution, or at least in the nineteenth century when the profession of ‘scientist’ was being created.

portion of nearly every undergraduate's education. It had certain benefits: understanding the motions of the heavens, ordering the calendar, aiding biblical exegesis, and, in some circumstances, predicting astrological influences on the world. Other claims about astronomy, such as its increasing sophistication on the theoretical level or the role of observation,¹⁷ can be foreign to this context.

Trying to understand, wholesale, the place of astronomy within the medieval university would be too large a task for a research project of this magnitude. Instead, I have chosen to focus on one particular scholar of the era: Robert Grosseteste of England. Grosseteste makes a fascinating subject, for his interests were manifold, and among them were astronomy, astrology, and computus. He has also been the subject of a number of modern studies, some concentrating on his contributions to natural philosophy, and many on his philosophy and theology more broadly, but few on the astronomically-related aspects of his thought. Another reason to choose him as a figure of study is that he was closely associated with and very influential in the development of natural philosophy at one of the earliest universities: Oxford. Thus understanding his approach to astronomy and computus will aid us in understanding the place of those sciences within the fledgling university. The first two chapters of this dissertation will set the context for his work, covering, respectively, the intellectual and institutional developments of the twelfth and early thirteenth centuries, and the biography of Grosseteste.

The astronomical and computistical works of Grosseteste have received some attention in the secondary literature, but much remains to be done. In the third and fourth chapters, I will examine Grosseteste's works. They have never been translated into English,

¹⁷For a balanced treatment of the issue of observation, see Bernard R. Goldstein, "The Status of Models in Ancient and Medieval Astronomy," *Centaurus* 24 (1980): 132–147, and "Theory and Observation in Medieval Astronomy," *Isis* 63 (1972): 39–47, reprinted in Goldstein's *Theory and Observation in Ancient and Medieval Astronomy*, London: Variorum Reprints, 1985.

though they are available in Latin in printed versions. In this dissertation, I will provide what I have labelled an “exposition” of the texts. This is not a straightforward translation; it is my opinion that many of the technical details of the works require explanation for modern audiences (and, indeed, probably for medieval ones, as well). Thus my expositions will provide explanation for the content of the works, while at the same time preserving certain aspects of the text, such as the order of the material as it was presented by Grosseteste. In some cases, this may be confusing, as he sometimes uses terms or concepts that he has not explained in the text; it is for such reasons that I wish to provide commentary on the text, and so incorporate it through the use of exposition. In many places, I will also present a close translation of the wording of the Latin to preserve the flavor of what the text is like in the original language; in some cases, this will result in somewhat awkward English, but I have chosen not to eliminate certain cases of this because of the desire to present something akin to a translation. Where the meaning of the text is obscure or uncertain, I will provide the Latin for the benefit of the reader. I will also provide technical Latin terms in order to bring out the vocabulary of the science. It is my hope that this practice of exposition will thus serve the purposes of both translation and commentary without strictly speaking being identical to either one of them.

In addition to the exposition of the texts, I will provide analysis of them. It is in these sections that I hope to accomplish further the task of understanding the assimilation of the texts into their cultural context. By the conclusion of the dissertation, I will have more general comments to make regarding the place of astronomy and computus in the early thirteenth century, comments that would be out of place here, before the texts have been explicated and analyzed. I will also suggest that certain biographical details of Grosseteste’s life will need to be modified because of my analysis of these texts. In particular, I believe that he began the work of assimilating Arabic and Greek science during the 1190s while he was in the Hereford and Oxford region. Finally, I will also discuss the place of astronomy

and compotus at the University of Oxford, based upon Grosseteste's influence.

This dissertation will thus contribute to a number of research areas. Foremost among these is the presentation of texts, not merely in a strict translation, but in a more valuable exposition, combining aspects of translation and commentary. I will also analyze these texts under the methodological approach of assimilation, concentrating on the means by which and the purposes for which the texts were produced. I will thereby also contribute to the understanding of the life and works of one of the most fascinating figures of medieval science, Robert Grosseteste.