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Ordering the Heavens

Roman Astronomy and Cosmology in the Carolingian Renaissance

BRUCE S. EASTWOOD

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Roman Astronomy and Cosmology in the Carolingian Renaissance

By

Bruce S. Eastwood

TUTA SUB AEGIDE PALLAS · 1683 ·

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On the cover: Leiden Universiteitsbibliotheek, Special Collections, ms. Voss. lat. Q.79, f. 93v

This image (see Figure 3.12) from the famous Carolingian manuscript of the Aratea combines astronomical diagrams and texts based on Pliny the Elder and Martianus Capella, and it places the discs for the planets under zodiacal signs in a pattern to indicate a date in either March or April of 816.

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dedicated
to the memory of my wife,
Sanae Asahara
(1948–2006)

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PREFACE

Many incarnations lie behind this book. I began studying early medieval astronomical and cosmological diagrams over twenty five years ago. More recently I became convinced that the development of astronomy and especially of astronomical diagrams from ca. 800 to ca. 1100 provided an essential basis for the European investigation and study of Greco-Arabic astronomy in the eleventh and twelfth centuries and beyond. Western familiarity with the technical concepts of the eccentric and the epicycle grew out of the Carolingian development of Roman astronomy. Roman texts were the essential sources of astronomy in Charlemagne's Europe. This intellectual foundation paralleled the increase in mathematical precision and the instrumental developments that grew in eleventh and twelfth century Western astronomy on bases that were both Latin and Greco-Arabic. The more I explored the three centuries from Charlemagne to Louis le Gros (or the emperor Henry IV), the more I understood the need for a book treating the Carolingian origins of the conceptual development tied to the astronomical diagrams—primarily planetary diagrams—used in the ninth-century. The past six years have been devoted primarily to writing the chapters for such a book. I have tried to describe a wide variety of Carolingian interests related to astronomy and cosmology as a context for the emergence of the study of more technical concepts. I have also tried to explain in some detail the conceptual, diagrammatic steps in the Carolingian studies of the four Roman works that were foundations of the ninth-century knowledge of astronomy.

Over the years I have had encouragements from so many friends and colleagues that I can not name them all. I mention here two who inspired me at critical moments. Marshall Clagett encouraged me early to pursue in more depth what was at first a limited investigation of circumsolar planetary diagrams in manuscripts of the early Middle Ages. John North more than once recharged my professional batteries to spark my continuing research into early medieval astronomical diagrams.

Available time to write is, of course, an ever-present need. A lengthy interval for full-time research and writing of this book, unencumbered by committee and teaching duties, was provided by a fellowship from

the National Endowment for the Humanities (2001–2002) and a generous grant from the National Science Foundation (SES 0004224) for 2001–2003. I am deeply grateful for both these supports. I regret that it has taken longer than expected to complete the work and can only hope the result has been worth the wait.

Ranging widely over the holdings of so many libraries, I have found it not only useful but necessary to depend on microfilms for much of my manuscript study in this work. However, my research on the versions of the Anonymous commentary on Martianus Capella required extended study of the texts in the flesh at three libraries. I thank Marie-Françoise Damongeot, Conservateur-en-chef at the Bibliothèque nationale de France, for clearing the way for me to make direct and extended use of ms. lat. 13955. At the Bibliothèque d'Étude et de Conservation in Besançon, Marie-Claire Waille ensured that I had ready access to ms. 594 during my visits there. By far the longest of my on-site visits took place at Leiden's University Library, where the staff of the Dousa, now reorganized under Special Collections, housing the Western manuscripts, provided friendly and efficient assistance over many weeks as I went back and forth from one manuscript to another in my studies of mss. Voss. lat. F.48, BPL 36, BPL 87, and BPL 88. Investigation of the Carolingian commentaries on Martianus Capella must be founded on this group of four Leiden manuscripts, and it was a pleasure to find and return again and again to such accommodating working conditions as the Dousa provided.

It has been my good fortune to find scholars willing to take time to offer information and thoughtful advice—and also forbearance when faced with my undiplomatic disagreements. I have benefited from information and helpful suggestions given by Wesley Stevens and Faith Wallis. Stephen McCluskey's admirable *Astronomies and Cultures in Early Medieval Europe* (1998) has provided me with much food for thought, and I look at my book in part as a response to questions raised by his. More especially I owe a large debt to colleagues who have read and commented on chapters in this book. John Contreni graciously found time to read and offer suggestions regarding the chapters on Macrobius, the Capellan commentaries, and diagrams. Both Paul Dutton and Richard Kremer with their distinctly different lines of expertise added important, helpful comments on the wide-ranging chapter on Pliny. Finally, an anonymous reader for the press made very many helpful suggestions and corrections. I thank these busy scholars for sharing their time and giving their insights and suggestions. Readers of the final form of the book can rest assured that many improvements came from these critiques. For the errors remaining in this book I am solely responsible.

In the process of imagining, re-conceiving, researching, writing, and rewriting such a book, there have been many times when my determination faltered and was revived by support from my wife, Sanae Asahara. She brought a sense of order into my erratic work habits and a sense of balance into my attentions to many competing interests. She listened to me talk too much about the book and never flagged in her support. Somehow she knew it would be published without needing major revisions, and she hoped very much to see the final result. I was prepared to dedicate it with gratitude and the deepest affection to my wife, but I can now only dedicate it to her memory. For me her image remains inextricably woven into the book's fabric. Without her support I could not have written this book.

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I have attempted to use manuscript illustrations, primarily diagrams, as a fundamental body of source material in working out a history of Carolingian astronomy and cosmology. I am extremely indebted to the following libraries for permissions to reproduce images from their manuscript holdings: the Special Collections Library of the University of Michigan in Ann Arbor (nr. 2.1), the Staatsbibliothek Bamberg (nr. 5.10), the Universitätsbibliothek Basel (nr. 3.15), the Staatsbibliothek zu Berlin (nrs. 2.5, 2.7, 5.12), the Burgerbibliothek Bern (nrs. 2.2, 3.5, 3.8, 3.9, 3.10, 3.13), the Bibliothèque d'Étude et de Conservation of Besançon (nrs. 5.6, 6.18), the Bibliothèque municipale of Boulogne (nr. 6.19), the Bibliothèque royale in Brussels (nrs. 5.1, 5.9, 6.3), Trinity College Library in Cambridge (nr. 2.3), the Biblioteca Medicea Laurenziana in Florence (nr. 5.4), the Bibliothèque municipale de Laon (nrs. 3.14, 6.16), Leiden's Universiteitsbibliotheek (nrs. 3.12, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 4.12, 4.13, 4.14, 4.15, 4.16, 5.5, 6.11, 6.12, 6.13, 6.14, 6.15), London's British Library (nr. 2.8), the Bibliothèque municipale of Lyon (nr. 6.8), the Biblioteca nacional de España in Madrid (nrs. 3.1, 3.2, 3.3, 3.6, 5.13, 5.14), the Bayerische Staatsbibliothek in Munich (nrs. 2.10, 3.11, 6.10, 6.17), the Bibliothèque nationale de France in Paris (nrs. 2.6, 3.4, 5.8, 5.11, 6.1, 6.2, 6.4, 6.6, 6.9), the Bibliothèque municipale of Valenciennes (nrs. 5.7, 6.7), the Biblioteca Apostolica Vaticana (nr. 2.9), and Vienna's Ősterreichische Nationalbibliothek (nrs. 3.7, 6.5). The numbers following each library's name are the figure numbers in this book; detailed credits are included in the captions with the individual illustrations.

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LIST OF ABBREVIATIONS

AVL	Astronomus, *Vita Hludowici*.
CCCM	*Corpus Christianorum Continuatio Mediaevalis*.
CCSL	*Corpus Christianorum Series Latina*.
CCT	*Timaeus a Calcidio translatus commentarioque instructus*.
CISAM	Centro Italiano di Studi sull' Alto Medioevo.
CNRS	Centre Nationale de Recherche Scientifique.
CSS	*Commentarii in Somnium Scipionis*. Ed. Willis (1970).
DNR	*De natura rerum*.
DTR	*De temporum ratione*.
HAMA	Neugebauer. *A History of Ancient Mathematical Astronomy*.
JHA	*Journal for the History of Astronomy*.
MGH	*Monumenta Germaniae Historica*.
NH	*Naturalis Historia*; *Natural History*.
NPM	*Martianus Capella.* [*De nuptiis Philologiae et Mercurii*.] Ed. Willis.
PG	*Patrologiae Cursus Completus. Series Graeca*. Ed. J. P. Migne.
PL	*Patrologiae Cursus Completus. Series Latina*. Ed. J. P. Migne.
REA	*Realencyclopädie der classischen Altertumswissenschaft*.
Settimane	Settimane di Studio del CISAM.

CHAPTER ONE

INTRODUCTION

In the lands of the Franks, roughly equivalent to France, Belgium, southern Germany, and the north of Italy today, the transition from the Merovingian to the Carolingian dynasty in the mid-eighth century has commonly been seen as a shift that ushered in a revitalization of government, religion, and culture during the next century and beyond. In modern studies of the cultural renewal, most often referred to as the Carolingian renaissance, there has been very limited attention to the natural sciences, and even this limited attention has focused almost completely on the study of computus, a discipline devoted to practical problems in the study of time, especially the calculation and projection of calendars for the feasts of the Christian year far into the future. Throughout the first half of the eighth century no one in the Merovingian world showed interest in the classical astronomy lying dormant in ancient Roman texts. Words such as 'epicycle' and 'eccentric' did not appear in the scientific works consulted by scholars of the day, nor were there astronomical diagrams to explain any of the irregularities in the motions of the Sun or the other planets. By the middle of the ninth century Carolingian scholars were exploring and expounding upon four Roman texts that provided the knowledge needed to understand the various motions in the heavens as parts of a reasoned and transparent order. This reason and transparency was enhanced by many astronomical diagrams that gradually awakened a new perception and deeper understanding of celestial phenomena. I propose to describe and explain this fundamental transformation of astronomy by studying the reception of these four Roman works and the ways they were used by Carolingian scholars to teach the order of the heavens.

1. *The Carolingian Renaissance*

Christened as a renaissance by nineteenth-century historians and discussed as such well into the latter half of the twentieth century, Carolingian cultural developments have been interpreted more recently in the context of continuities from Merovingian times and of Visigothic Spanish as well as Anglo-Saxon influences. Cultural activities emerged from a long early medieval genesis and drew contributions from a wide European field.

Stronger emphasis has now been placed on the background of reforms in liturgy and the defense of churches and monasteries from expropriations. From Pippin (king 752–768) onward these were among the foremost royal concerns with the intent of correcting morals, establishing uniformity in religious observance (following Roman practices), and restoring order in monasteries and dioceses. Pippin's successors Charlemagne (768–814) and Louis the Pious (814–840) vigorously pursued similar goals. The revitalization of the monarchy with the election of Pippin, the first king in the Carolingian dynasty, provided the energy and determination to give reality to what were unrealized ideals under the last Merovingians.

The Carolingian program of reform was seen primarily as religious renewal, to be carried forward by bishops and abbots under the guidance of the king. It was only after some decades of effort that the expansion of knowledge for purposes of clerical literacy and competence led to a significant expansion in the study of secular works from the Roman imperial past. In brief, what has been called the Carolingian renaissance, if we wish to focus on the revival of classical Roman texts, was very much the creature of a religious renewal and was not readily apparent before the last years of the eighth century. The reigns of Pippin and Charlemagne strengthened ecclesiastical institutions greatly, and, as the push developed for continued clerical education and broader religious and moral reform, the king and reform-minded bishops and abbots enlarged the scope of renewal and revival to include more of the Roman past.[1]

Models of clerical education, not necessarily in agreement with each other, stemmed from various predecessors. A well-known figure was Cassiodorus (ca. 480–ca. 575), important in the government of

[1] For earlier conceptions of the Carolingian renaissance consult Patzelt, *Karolingische Renaissance*. An excellent introduction with further references to the renaissance, its origins and development, appears in Brown, "Carolingian Renaissance," in *Carolingian Culture*, pp. 1–51. The various cultural achievements are surveyed in *Karl der Grosse*, vol. 2: *Das Geistige Leben*. See also Contreni, "The Carolingian renaissance: education and literary culture."

the Ostrogothic kingdom of Italy, who retired from public life and set up a monastery on his estate at Scyllacium in southeastern Italy (ca. 560?). Here at the monastery of Vivarium the monks were given a guide to the study of both religious and secular books. Cassiodorus's *Institutiones* divided into two parts, the first recommending approaches to and interpreters of the books of the Bible as well as Christian historians and the Church Fathers. Cassiodorus opened the second book with a brief homily on the number 'seven,' citing Exodus, Psalms, and Proverbs to support the number of seven secular studies, or liberal arts, as foundation stones for true literacy. He named the seven arts—grammar, rhetoric, dialectic, arithmetic, music, geometry, astronomy—and proceeded to definitions, or at least lists, of their main elements and important authorities in each area.[2] He praised arithmetic as the basis of the three other parts of the quadrivium (four mathematical disciplines) and proceeded to describe astronomy by listing and defining a number of its simple terms in observational and practical language. Ptolemy's name, attached to three book titles, gave the outstanding sources for astronomy, although there is no evidence that Cassiodorus had consulted these. He also mentioned that the work of Martianus Capella, which contained a synopsis of astronomy along with the other liberal arts, had become unavailable.[3] In conclusion Cassiodorus wrote that this sequence of studies, ending with astronomy, should

> ...lead from earthly affairs minds which have been devoted to secular wisdom and have been purified by training in the sciences and place these minds in laudable fashion in the celestial realms created by God.[4]

Carolingians consulted not only Cassiodorus on the seven liberal arts but other authorities as well. Isidore of Seville (ca. 570–636) dedicated the first three of the twenty books in his encyclopedic *Etymologies* to the same seven liberal arts as Cassiodorus but listed the quadrivium in the order arithmetic—geometry—music—astronomy, which suggested

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[2] See *Cassiodori Senatoris Institutiones*, pp. 89–93 (preface to Book 2). For a useful translation see Cassiodorus, *Introduction*, trans. Jones, pp. 142–5.

[3] *Institutiones*, p. 132.18–21 on arithmetic as the fundamental mathematical discipline; pp. 153–7 on the contents of astronomy and its authorities; p. 130.11–14 on the unavailability of Capella's handbooks.

[4] Cassiodorus, *Introduction*, p. 204. Cf. *Ptolemy's Almagest*, pp. 36–7: "With regard to virtuous conduct in practical actions and character, this science, above all things, could make men see clearly; from the constancy, order, symmetry and calm which are associated with the divine, it makes its followers lovers of this divine beauty, accustoming them and reforming their nature, as it were, to a similar spiritual state." (I.1; H7)

different relationships among them. Astronomy consumed by far the largest part of the space devoted to the four disciplines, and Isidore's sources were non-mathematical Roman texts, especially Hyginus's *Astronomicon* as well as parts of Macrobius's *Commentary on Scipio's Dream* and Calcidius's *Commentary on Plato's Timaeus*.[5] If Isidore retained, at least in his *Etymologies*, a largely traditional Roman sensibility in surveying the proper studies for a literate administrator of the early seventh century, his insular successors followed a different strain that could be found in his writings and elsewhere.

The seventh-century anonymous Irish text *De ratione conputandi* referred to the authority of Saint Augustine in prescribing the four necessary studies for clerics: the Holy Scripture, both as the account (*canon divinus*) of future events and, with other Christian writings, as the record (*historia*) of things past, computation (*numerus*) in the enlarged sense of establishing the numerical order in God's creation and its chronology, and grammar (*grammatica*) as the knowledge of words and their varied uses.[6] *De ratione conputandi* was one of the sources used by scholars at the Carolingian computistical conference of 809.[7] And while there were clearly wide interests in the natural world among Irish writers of the later seventh century, the focus of clerical education was on grammar, Holy Writ, and computus.[8] The Englishman Bede (673–735) followed Irish leads, both educational and computistical.[9]

We can observe during the eighth century the spread of a different notion of "seven liberal arts" deriving from both continental and insular traditions. An ancient tripartition of philosophy had been adapted in Isidore of Seville's *Differentiae*, in Aldhelm of Malmesbury's *De virginitate*, and in an anonymous seventh-century Irish letter *Ad Cuimnanum*

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[5] Fontaine, *Isidore de Seville*, II, 453–589. For Isidore's text, see *Etymologiae*, [unpaginated] III.xxiv–lxxi (on astronomy), which ends with a familiar Cassiodoran ring: "Ordo autem iste septem saecularium disciplinarum ideo a Philosophis usque ad astra perductus est, scilicet ut animos saeculari sapientia implicatos a terrenis rebus abducerent, et in superna contemplatione conlocarent." (III.lxxi.41)

[6] See *De ratione conputandi* 2, in *Cummian's Letter*, p. 117. Also the reference here to *De Genesi ad litteram* I, 1, where Augustine listed the four senses of Scripture, which the Irish writer converted into four bodies of knowledge.

[7] See Ó Cróinín's introduction to the edition of *De ratione conputandi*, pp. 102–3.

[8] Examples of Irish attention to the natural world are collected in Smyth, *Understanding the Universe*.

[9] Bede, *Historia ecclesiastica* IV, 2. Ó Cróinín, "The Irish Provenance of Bede's Computus." Bede showed students how computus and historical chronology were intimately related.

to identify three bodies of knowledge—physics, ethics, and logic—as necessary tools for the understanding of Scripture, with physics being further subdivided into seven parts. Bernhard Bischoff has identified many manuscripts with versions of this tradition and described details in the *Ad Cuimnanum* from an early eighth-century Anglo-Saxon codex. The text says that the arts existed already in germ, that is, innately, but undivided at the time of Adam and then unfolded thereafter. Physics is subdivided into arithmetic, geometry, music, astronomy, astrology, mechanics, and medicine; we can find these seven labeled as the seven liberal arts in manuscripts through the eighth, ninth, and tenth centuries.[10]

The variety of curricula does not tell us what clerics actually studied. These lists of disciplines were to some extent no more than lists. At the same time they offered bases for potential development. Development, however, required the commitment of ecclesiastical leaders to a program, or possibly many programs, of study. And it also required texts—dependable texts in multiple copies. It was the royal directives of 789 in the *Admonitio generalis* (*General Directives*, or *Sermon to All*) that finally laid down a foundation for clerical literacy across the Carolingian realm, but this was preceded by a great amount of pertinent activity. Charlemagne's annexation of the Lombard kingdom of northern Italy in 774 added greatly to the image of the king as the Frankish successor to the rulers of Rome. From this point forward evidence grows of foreign poets and scholars at the royal court. We find Peter of Pisa from the Lombard court, who taught the king grammar and wrote an introduction to the subject, remaining until ca. 790. Paulinus, another grammarian, spent less than a decade at Charles' court and returned to northern Italy as the royal appointee to the patriarchate of Aquileia. Two Italian scholars at the court were awarded the bishoprics of Verdun and Pavia shortly after 780. Fardulf came to the Frankish court originally as a hostage after a failed Lombard rebellion in 776, and his subsequent loyalty to Charlemagne brought him the abbacy of Saint Denis in 793. Among the early Gospel books produced for the king was Godescalc's (ca. 781), written primarily in Roman uncial,

[10] Bischoff, "Eine verschollene Einteilung der Wissenschaften." Isidore, *Differentiae* II.xxxix.149. Pseudo-Isidore, *Liber numerorum* VIII, 44. A Carolingian example of this seven-part division of *physica* appears in Paris 7530, ff. 62v–65v, "De VII artibus liberalibus. quid sit philosophia et cur sic dicamus;" the manuscript was composed at Monte Cassino ca. 800 and transmitted to northern France (Reims).

replete with purple and gold decoration, clearly fitting the heightened status and suggesting a Roman tradition, including a Roman text of the lectionary, for the royal patron.[11] In the first decade after 774 we see a combination of royal patronage, Italian scholars, and increasingly self-conscious Roman orientation.

At the same time, in the 770s and 780s, an Insular surge, both Irish and Anglo-Saxon, appeared at court. Notker of Saint Gall's *Gesta Karoli* (ca. 884) opens with an encomium of Charles and the story of two learned Irishmen, followed by the English Alcuin, who came to the royal court to reestablish both sacred and secular wisdom in the kingdom.[12] We have the letter (ca. 775) of the Anglo-Saxon Cathwulf to Charlemagne on kingship and the primacy of the king over bishops as well as the arrival of Joseph the Deacon, Candidus, Dungal, and others as witnesses to Insular influence. Yet other names from other places, like Theodulf of Orleans and Angilbert, stood equally high, and it was this mixture of sources that made Charlemagne's court famous for learning, poetry, and competitive wit. The royal patron utilized the opportunity to have some of these learned courtiers teach youths who had been selected to fill administrative posts, ensuring that these students knew proper Latin grammar, writing, and other relevant skills. The modern notion that a regular school of some sort existed at the royal court, however, lacks adequate foundation.[13]

Just before 792, when the court settled in Aachen as its permanent location, Charles issued the *Admonitio generalis* (789), a set of eighty-two orders together with elaborate preface and closing exhortations. The general intention of this package of major reforms was to ensure adequacy, correctness, and uniformity in clerical preaching, reading, writing, teaching, and all aspects of the liturgy in parish and monastic worship. In pursuit of these goals the king commanded (*iussimus*) among other things that "schools"—formal teaching but not necessarily permanent

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[11] Many sources describe this first generation of scholars at the court. See Brown, "Carolingian Renaissance," pp. 28–30, and Bullough, *Carolingian renewal*, pp. 130–1. On the Godescalc Evangelistary see Bullough, *Renewal*, pp. 11–14, and Mütherich, "Die Buchmalerei am Hofe Karls des Grossen," pp. 30–4 with four plates.

[12] On the context for this opening legend by Notker, see McKitterick, "Carolingian Renaissance," pp. 152–4. Notker's work is translated by Thorpe, *Two Lives of Charlemagne*; see pp. 93–4.

[13] Brown, "Carolingian Renaissance," pp. 31–2; John Contreni, "Carolingian renaissance: education and literary culture," p. 713; McKitterick, "Carolingian Renaissance," bears witness to teaching at the court but not to an institutionalized school.

spaces—be established for boys both in monasteries and in dioceses and that certain subjects be taught. The psalms, shorthand (tironian) notes,[14] chant, computus, and grammar were to be studied and learned as were corrected copies of canonical religious works ("libros catholicos bene emendate"). All too often, this order (section 72 of the *Admonitio*) continued, Christians wish to pray to God but they follow incorrect texts of the regular prayers. With this in mind, only trained adult scribes were to be allowed to copy the gospels, the Psalter, and the missal.[15] The subjects for teaching at ecclesiastical schools focused on all that was needed for a good basic religious education, and the context of this training made it clear that uniformity was essential. The emendation of inaccurate texts, the correction of incorrect pronunciation, singing, and writing, and the conformity to recommended models of literary composition and calendrical computation were expected results of the reforms. Although the *Admonitio* went no further in prescribing subjects of clerical study, another royal document urged more extensive scholarly preparation by those clerics who were able. Charlemagne's *Epistola de litteris colendis* (*Letter on the Study of Literature*) circulated sometime in the 780s or 790s among abbots and bishops. It expressed concern about misunderstandings of the Scriptures in these words.

> We all know well that, although errors of speech are dangerous, far more dangerous are errors in understanding.... Since, moreover, images, tropes and similar figures are found in the sacred pages, no one doubts that each man in reading these will understand the spiritual sense more quickly if previously he shall have been fully instructed in the mastery of letters. Let men be chosen for this work who have the will and ability to learn and also the desire to instruct others. And may this be done with a zeal as great as the earnestness with which we command it.[16]

Here we see the outspoken determination of the king to produce effective action. He specified the broad field of "letters" and left the details of choosing texts and techniques to the abbots, bishops, and

[14] Among this list of five specified items each is unambiguous except for the *notas*. This word has been interpreted to mean musical notes, letters of the alphabet, and tironian notes. A reasoned argument exists for each. To my mind the term does not refer to musical notes; it may mean letters of the alphabet, but is more likely to refer to the shorthand (tironian) notes found in many Carolingian manuscripts. On these notes see Hellmann, *Tironische Noten*, with extensive bibliography.

[15] "Admonitio Generalis," in MGH *Leges*, II, 1, pp. 52–62, c. 72 at pp. 59–60.

[16] "Karoli epistola de litteris colendis," MGH *Leges*, II, 1, pp. 78–9; translated in *Carolingian Civilization*, ed. Dutton, p. 80; I modify this translation a bit.

their scholars. While the purpose of this letter was crystal clear, the king did not circumscribe the sorts of material to be used in advancing this educational goal. Across the land various activities contributed to its fulfillment.

2. *Elaborating the Reforms*

Among the participants in Charlemagne's educational reforms Alcuin (737–804), who had been deacon, teacher, and librarian at York and came to stay with the peripatetic Frankish court by 786, is by far the best known to us.[17] While we should not try to connect him with a non-existent school at the royal court, his impact on what we might call the second generation of court scholars can hardly be overemphasized.[18] He was teacher to the king for rhetoric, dialectic, and astronomy and wrote basic texts for grammar, rhetoric, dialectic, and computus. Among his works the text on grammar has special interest because of its preface, known as *De vera philosophia*, in which Alcuin presented the path to wisdom as a gradual approach, requiring careful attention to each step. Citing *Proverbs* IX, 1—"Wisdom has built her house; she has set up her seven pillars"—he equated the seven columns of the house of Wisdom with the seven liberal arts, each one a step upwards from grammar through rhetoric and dialectic to arithmetic, geometry, music, and astronomy. With such knowledge, he wrote, defenders of Christian orthodoxy are much better prepared to engage in public debate successfully with heresiarchs. And through these seven arts students can achieve a spiritual maturity enabling them to understand more fully the Holy Scripture.[19]

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[17] See Bullough, *Alcuin*, pp. 331–470 for a detailed discussion of Alcuin's time at the court of Charlemagne with elaboration on the controversies over the chronology and activities of Alcuin at the Frankish court. He was absent from the court from 790 to 793.

[18] Alcuin's influence and unique status at court depended not on any official position but on the affection and familiarity that the king and royal family showed towards him. See Garrison, "The Social World of Alcuin." Further information on Alcuin and his associates at the Frankish court appears in ead., "The English and the Irish at the Court."

[19] Alcuin's *De vera philosophia* constitutes the opening of his *Grammatica*; see PL 101, coll.849–854, esp. 853B–854A. See also Holtz, "Alcuin et la renaissance des arts libéraux."

In pursuit of these arts Alcuin drew on a wide variety of sources—patristic, classical, and post-classical. Grammars, for example, from those of Donatus (ca. 350) and his commentators along with the Insular elementary grammars that built upon and expanded Donatus were readily available in the late eighth century. To these Alcuin was instrumental in adding Priscian's newly recovered *Institutiones grammaticae*, whose influence one can find in Alcuin's grammar. Cassiodorus's *Institutiones* and Isidore's *Etymologies* provided matter for the other disciplines along with works of Vergil (and the commentaries of Servius), Cicero, Horace, Lucan, Pliny the Elder, Censorinus, and others. For the quadrivium specifically, the works of Pliny the Elder and Macrobius were supplemented by Roman translations of Aratus's *Phaenomena* as well as by Isidore of Seville's *De natura rerum* and *Etymologies* and Bede's *De natura rerum* and *De temporum ratione*. Needless to say, the long tradition of texts on computus, including the Irish tradition, was extensively consulted. From 796 until his death in 804 Alcuin was abbot of Saint Martin's of Tours where he taught students at different levels; it was for the more advanced students, following the directions of Charlemagne's *Epistola de litteris colendis*, that Alcuin held an ongoing seminar in the higher disciplines such as astronomy and theology.

The copying of texts, sometimes involving recovery as well, was clearly of primary importance for the advancement of such monastic schooling as Alcuin and others practiced. The king appointed as heads of monasteries court scholars like Alcuin, Angilbert at Saint Riquier, Arno at Saint Amand, Einhard at Saint Wandrille, Fardulf at Saint Denis, and Theodulf at Fleury. All of these saw to the development of regular teaching and the improvement of manuscript copying in their scriptoria. Certainly religious texts, whether liturgical or biblical or patristic, came first in order of priority, but we find the inclusion of more and more secular texts by the close of the eighth century and during the course of the ninth. Some monks found books elsewhere for their own libraries and schools. Vadilleoz traveled from Reichenau on Lake Constance to Alcuin's Tours and collected books which he brought back to Saint Mary's of Reichenau. Abbot Erlebald at Reichenau commissioned copies of books from the scriptorium at Saint Denis. In the Reichenau library catalogue of 821/822 appear names of various medical and veterinary books, a numerological text for fortune-telling (*Prognostica Democriti*), Boethius's arithmetic and geometry, and an Aratea. By the 840s the library there included Vitruvius's *Architectura*, a copy of Hyginus's *Astronomia*, and Boethius's *Musica*, not to mention illustrated copies of Pliny's astronomical excerpts, discussed in detail in our Chapter Three, and copies of the works *de natura rerum* of both Isidore and Bede containing many *rotae* (circular cosmological and computistical images).[20] Our knowledge of Carolingian scriptoria, libraries, and schools is fragmentary, but studies of individual sites continue to be published, including important centers like Auxerre, Corbie, and Fleury.[21]

When we look for texts and teaching of astronomy the most obvious evidence is the increase in copies and compilations of computus works. These require further consideration, but at present we are looking for works that reflect a growing awareness of classical astronomy. Although Greek theological and other religious texts came in small numbers to Carolingian Europe, no evidence at all survives for the transmission of any Greek astronomical work (in Greek). No knowledge of works by Hipparchus, Ptolemy, or Theon of Alexandria, for example, appears in ninth-century Western Europe. No Greek commentaries on Plato came to the West; the only Platonic commentary was the Latin commentary with translation of Plato's *Timaeus* by Calcidius. While we know of a partial translation, named *Praeceptum Canonis Ptolemei*, of Theon's commentary on the Ptolemaic *Handy Tables*, the earliest manuscrit comes from ca. 1000, and there is no evidence of Western circulation of this text before the late tenth century.[22] Astronomy, aside from computus, as it was known in the Carolingian world was Roman astronomy, which included Latin translations and commentaries of a very few Greek works, such as Aratus's *Phaenomena* and Plato's *Timaeus*. Our studies in the chapters of this book reveal the extended and progressive body of knowledge offered by the four Roman texts of Macrobius, Pliny the Elder, Martianus Capella, and Calcidius along with other, associated works.

In our search for astronomy in Carolingian libraries and schools we shall not accept the claim, "In order to find *Astronomy*, as it was taught and learned in Carolingian schools, one must search for it in the

[20] On these activities and books at Reichenau, see *Mittelalterliche Bibliothekskataloge Deutschlands und der Schweiz*, vol. 1, pp. 222–66.

[21] For Auxerre see *L'École carolingienne d'Auxerre* and *Saint-Germain d'Auxerre—Intellectuels et artistes*. On Corbie see Ganz, *Corbie*. On Saint-Benoît-sur-Loire (Fleury) see Mostert, *The library of Fleury*. Others are described by McKitterick, "Script and book production," in *Carolingian Culture*, pp. 221–47.

[22] Pingree, "The Preceptum," and *Preceptum Canonis Ptolemei*, ed. Pingree, esp. pp. 7–9.

computistical texts and tables extant in medieval Latin manuscripts."[23] The best way to proceed beyond such confusion is to preserve the two terms 'computus' and 'astronomy' and pay attention to the texts involved and what they say. That there is overlap between the two studies, as in the use of observations of the zodiacal constellations and in determination of the solstices and equinoxes, is clear, but the separate concerns of astronomy and computus are far more numerous than the overlaps. We should remember that in the *Admonitio generalis* Charlemagne required the teaching of computus and not astronomy. Computus was a distinctly ecclesiastical study that used a very limited body of astronomical information about the cycles of the sun and the moon and generated elaborate tables and rules for establishing the intersections of these cycles over time in order to predict the annual date of Easter. Astronomy, on the other hand, was a very large discipline by the middle of the ninth century, including the locations of all the constellations, not just the zodiac, and both the description and the explanation of the paths of all the planets. Computus was neither interested in explaining nor capable of explaining the variations in planetary motions, including the variations in solar motion. Astronomy was implied in Charlemagne's direction (the *Epistola de litteris colendis*) to Abbot Baugulf and others to encourage those who were capable to go beyond the basics of clerical adequacy, e.g., grammar and computus, and learn the liberal arts. Cassiodorus provided a model. Alcuin and others would follow that model and its variants.

[23] Stevens, "Astronomy in Carolingian Schools," p. 421. Stevens' essay deals with some astronomical and computistical work in the eighth and ninth centuries. It does not attend to the astronomy of Macrobius, Pliny, Martianus Capella, or Calcidius as discussed in this book and found in manuscripts that were associated with the teaching of astronomy in Carolingian schools. Stevens briefly presents Capellan circumsolar planets and Plinian astronomical diagrams. The relationship between computus and astronomy might usefully be seen to be analogous to the relationship between our modern first year of high school algebra and the mathematics for thermodynamics; one is computational literacy while the other is used by students preparing to do much more advanced study. The two may overlap, but they are not the same. There are concepts in the second that are not even imagined in the first. Obviously, fewer students will study the latter; both levels involve students, teachers, and texts. (This is not to say that certain computistical writers of the eighth century and later, e.g., Abbo of Fleury (d. 1004), were not highly accomplished manipulators of numbers, tables, and arithmetical formulae.) A basic, orderly introduction to computus appears in McCluskey, *Astronomies and Cultures*, ch. 5; for a useful encyclopedic view see Blackburn and Holford-Strevens, *The Year*, pp. 791–815.

Alcuin, it is clear, taught not only computus but also astronomy. He taught it at some level to Charlemagne. He referred to the seven, not three or four, liberal arts in his analogy between the arts and the pillars of the House of Wisdom in the Book of Proverbs. He did not write on astronomy but only on computus. Still we find that his most famous student (after Charlemagne), Rabanus Maurus (780–856), identified the seven liberal arts as the central intellectual tool in the larger monastic educational program.[24] When writing from Fulda around 830, Lupus of Ferrières (ca. 805–862), referred to the quadrivium as part of the routine of studies for himself and other students there under Rabanus.[25] And as Mayke de Jong has remarked, by the 840s Rabanus was grumbling about the younger generation among whom there were know-it-alls (*scioli*) that wanted novel ideas and not just the well worn authorities.[26]

In Alcuin's letters to the king there are computistical questions as well as conversations about potentially ominous events in the heavens, such as an unusually long invisibility of the planet Mars.[27] Alcuin made use of Book Two of Pliny's *Natural History* for discussion of celestial phenomena. Not long after his death in 804, another learned monk, Dungal, referred not only to Pliny but also to Macrobius for astronomical information regarding the planets and astronomical predictions. Astronomical excerpts were drawn from Pliny to a larger extent and from both Macrobius and Martianus Capella very briefly for important compilations of computistical, cosmological, and astronomical material during the second decade of the ninth century. By ca. 840—perhaps some years earlier—the astronomy (Book VIII) of Martianus Capella's *Marriage of Philology and Mercury* was not only being studied but also submitted to an enormous effort of commentary, resulting in what we now call the Anonymous Commentary, which traveled in many versions and had tremendous influence on scholars such as John Scottus Eriugena and Remigius of Auxerre in the ninth century. And the more demanding astronomy of Calcidius's *Commentary on Plato's Timaeus* was

[24] Rabanus Maurus, *De institutione clericorum*, cc. 18, 26.

[25] Admittedly, the mathematical studies were covered more superficially by Rabanus at that time. See Loup de Ferrières, *Correspondance*, vol. 1, p. 6.

[26] De Jong, "From Scolastici to Scioli," in *Alcuin of York*, pp. 55–6, citing MGH *Epistolae*, vol. 5, p. 476.

[27] For this see ch. 3; for the following specific references to each of the four Roman authors, see the relevant chapters, 2–5, below. Here I simply make summary references to matters discussed in detail in chs. 2–5.

being studied and excerpted by mid-century, and was being copied and corrected later in the century. This brief litany of the major uses of the four Roman texts to be studied in the subsequent chapters of our book bears witness to the outlines of an evolution. If computus was the bright star in the heavens of late eighth-century studies of the heavens, the astronomy of our Roman texts came gradually to the fore and outshone computus for all inquiries other than practical calendrical questions.

We should recognize here one Roman text, the *Phaenomena* of Aratus, translated from the Greek by different Romans, that does not receive discussion in this book. The various Latin versions, sometimes with commentary, were treated primarily as literary sources in the Carolingian world. Lupus of Ferrières wrote to Ansbaldus in 847 to obtain a copy of Cicero's translation of Aratus. Aratea were commonly illustrated, indicating their luxury quality, and an outstanding example is the Leiden manuscript Vossianus lat. Q.79, probably produced in the royal scriptorium, possibly in 816.[28] The images of the celestial mythological figures that accompanied Aratea manuscripts did not usually attempt to reproduce the individual stars in the proper points of each constellation and very often failed even to reproduce the correct number of stars in each constellation according to the text. Produced primarily for non-technical general interest, the various versions of Aratea might best be called catalogues of constellation names and stories;[29] the descriptions of star positions in each constellation could only be discerned by looking directly at the night sky with the assistance of an instructor who had already learned when and where to find the constellations.

The works of Macrobius and Pliny were much in evidence early in the century, especially, let us say, over the first quarter of the ninth century. Capella seems to have rocketed onto the scene with the huge anonymous commentary we have mentioned and was clearly the most prestigious source for astronomy by the 840s and thereafter, although Pliny continued to hold ground as an important ancillary through the ninth century and beyond. Calcidius became an astronomical source for

[28] For Lupus's letter see his *Correspondance*, vol. 2, p. 4. For the Leiden Aratea see Bischoff, *Aratea Kommentar*, which shows that the production of the manuscript was much more an exercise in classical mythology and art than in science. On various Aratea see also McGurk, "Carolingian Astrological Manuscripts," in *Charles the Bald*, pp. 317–32.

[29] Obrist, *Cosmologie médiévale*, vol. 1, pp. 218–26.

Carolingians by the 840s as well, but his text apparently posed certain difficulties for full comprehension so that it was appropriated into the astronomical curriculum slowly and at a limited number of centers before the eleventh century.

The sorts of issues presented to Carolingian scholars by these Roman sources make clear how far beyond the limits of computus they pushed the boundaries of cosmological and astronomical understanding. From Macrobius came natural reasoning for accepting the earth as the center of the universe and arguments from symmetry for the human habitation of all four quadrants of the globe. Pliny offered such a variety of perceptions that the choices are legion; two of special interest were the physical cause of the bounded elongation of the inner planets from the Sun and the physical cause of the retrograde motions of five planets. The Capellan astronomy was a representative survey of major topics, and among the more important were these three: (a) the precise forms of the epicycles of Mercury and Venus around the Sun, (b) the precise nature of the changes in the lengths of daylight through the year, and (c) the cause, not simply the description, of the different lengths of the four seasons. As for Calcidius, if more difficult at times, his qualitative geometry of celestial phenomena promised to Carolingian students fully rational explanations of the four seasons (by eccentric circles), retrograde motions (by epicycles), and the bounded elongation of Mercury and Venus from the Sun (by epicycles). It need hardly be said that these questions were beyond the scope of computus and that some monastic teachers and students came to engage in these novel explorations with delight as the four Roman sources came to be better known and more available.

By the end of the ninth century two of the most fundamental techniques of classical Greek astronomy, the eccentric and the epicycle, were being investigated not only in theory but in application. Their full comprehension depended on a perspective that returned to astronomy—it had been lost—only with the recognition that observation of a body's (a planet's) motion against a separate background is a relative change in position that can vary in more than one way, depending on the relationship of the point of observation with the centers of motion and background framework. Such recognition depended on the ability to represent this sort of situation adequately in diagrams. Students of Calcidian astronomy in the late ninth and tenth centuries were wrestling with and solving the problems in producing such diagrams. Students of computus showed no such capability and may well have considered it a useless exercise. Astronomical diagrams and computistical images had different goals and developed quite differently over the ninth century. They reflect the growing differences between those clerical scholars who pursued the continuing elaboration of knowledge in all of the seven liberal arts and those who held to the more restrictive interpretation of the goal of religious renewal as stated explicitly in Charlemagne's commands in Section 72 of the *Admonitio generalis*.

3. *Materials for the Carolingian Renaissance in Astronomy*

The collection, correction, copying, and dissemination of manuscripts was the foundation both for Charlemagne's conception of a literate, correctly trained, and conforming clergy and for the more intellectually ambitious and narrowly focused project of learning the quadrivium, especially astronomy. At a general level we can say that the royal court and royal monasteries, that is, monasteries founded or at least funded by the king, were the primary locations for manuscript books. The king had an interest in supporting these institutions. The abbots and scholars at such monasteries reciprocated with a strong desire to obtain books. Gospels, psalters, and liturgical manuscript books were the major part of this literary traffic, but we shall now turn our focus to books that facilitated the study of astronomy and related areas like astrology.[30]

Astronomy and astrology occurred, we should remember, as a pair of recognized disciplines in the alternate division of the seven liberal arts, defined in the eighth-century *Ad Cuimnanum* as arithmetic, geometry, music, astronomy, astrology, mechanics, and medicine, and this division was used and taught in Carolingian schools.[31] Saint Augustine had

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[30] See the extremely helpful introduction by McKitterick, "Script and book production," with selected bibliography on many scriptoria in the French and German parts of the Empire (pp. 246–7). Further details appear in McKitterick, *Carolingians and the Written Word*, esp. ch. 5.

[31] At the cathedral school of Laon a teaching manual of Martin of Laon (Laon BM 468, f. 9r, s. IX¾) recorded its version, which differed modestly from the version we noted above (n. 10); the Laon text: "Phisica autem in quattuor divisiones partitur, id est arithmeticam, geometricam, musicam, astronomiam quibus adhaerent astrologia, et medicina, et etiam minores artes [mechanicas] quas aratores, et fullones, et cimentarii exercent." Further, f. 9v: "Astronomia id est astrorum lex. Astrologia, astrorum verbum. Inter astronomiam et astrologiam hoc differt quod astronomia ad certam rem pertinet, astrologia ad certam et incertam. Ad incertam enim pertinet dum in stellis auguriatur." On this ms. and its use see Contreni, *Carolingian Learning*, ch. 6, pp. 13–22.

already warned Christians firmly against astrology and its practicioners, the *mathematici*.[32] Isidore had attempted to make a clear distinction between astronomy and astrology in his *Etymologies*, where he defined each as follows.

> Now astronomy considers the turning, rising, setting, and motion of the heavenly bodies ("siderum"), or why they are named as they are. Astrology in turn is partly natural and partly superstitious. 'Natural,' insofar as it investigates the courses of the Sun and the Moon or the defined stations of planetary orbits; 'superstitious' fits the part followed by the *mathematici*, who augur by the stars and who assign the twelve signs of the zodiac individually to parts of the soul or body and who attempt to foretell the nativities and characters of men by the course of the stars ("siderum").[33]

While astrology was a suspect science according to some, it was more than tolerated. It was sought after, although not in the sense of individual horoscopes, by Charlemagne and Louis the Pious to name only the most famous examples. These rulers wanted at different times to know the significance of observed phenomena like eclipses or comets or other notable celestial events, always potentially ominous, that seemed to correspond with momentous earthly events.[34] Over the course of the ninth century not only rulers but many others came to consult the order of the heavens, as witnessed by the elaborate development of lunaria, or calendars with the days of the lunar cycle marked as good, bad, or appropriate only for certain activities.[35] David Juste has studied a number of Carolingian manuscripts of a short text that begins, "In quo signo versetur Mars" (IQSVM hereafter), which describes a way to compute the longitude for any planet—Mars, Jupiter, Saturn, Venus, Mercury—at any time. The procedure simply requires the arithmetical manipulation of the zodiacal periods of the planets, the time interval

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[32] An outspoken Augustinian condemnation of astrology, distinguished from astronomy, appears in the *De Doctrina Christiana*, II.xxix.46, pp. 64–5. A useful translation is that of Green in Augustine, *On Christian Teaching*, pp. 56–7; Augustine warned against the distortions of astronomy that occurred in astrology, "the deadly error of those who prophecy fatuously about fate.... [and] we should not try to extract something of relevance to our own actions and experiences [from the study of the heavens], like the maniacs who cast horoscopes" (trans. Green, p. 57).

[33] Isidore, *Etymologiae*, III.xxvii.1–2.

[34] I address the topic of celestial omens and royal concern about them below in Ch. 3, Sects. 8–9, 11.

[35] Blackburn and Holford-Strevens, *The Year*, pp. 590–5, present the so-called Egyptian and other unlucky days of the months through the year.

since Creation, and the reported positions of the planets at Creation. IQSVM was included in three of the major astronomical-computistical collections of the ninth century. Its most obvious use was astrological, and in, for example, Heiric of Auxerre's copy of this text (Melk 412, p. 29) from ca. 840 we discover both the method for finding planetary longitude and the means to find the rising sign, or astrological ascendant.[36] Astrology in the Carolingian world was an expanding concern with techniques to interpret and prognosticate from all sorts of phenomena in the heavens, including the sublunar heavens. Although we have no personal Carolingian horoscopes surviving, we have just seen that the text IQSVM provided the critical element in the construction of a horoscope, the ascendant at the time of birth. As we shall see in subsequent chapters, the desire to predict the future from the heavens was neither absent nor severely restrained at the literate level. Only the practices of the unlettered, common people were seen as dangerous and to be prohibited. Given the books available to them, Carolingians resorted to many learned paths to know what is to come.[37]

For both astronomy and astrology the manuscript sources are often anonymous. The surviving Carolingian manuscripts of our four Roman authors are frequently untraceable; that is, we do not know precisely when or where they were copied. The positions of those we can locate, that is, the cathedral or monastic libraries, appear on the map (Figure 1.1). Our earliest extant copy of the complete text of Macrobius's *Commentary on the Dream of Scipio* appears in Paris 6370, copied ca. 820 at Tours and subsequently used and corrected by Lupus at the monastery of Ferrières.[38] We know that an earlier copy existed at Saint Denis in Paris in 810–811 because of Dungal's extensive quotations in his letter of 811 to Charlemagne, yet no direct record survives of a copy at that monastery. Later in the century copies were made at Corbie and Fleury as well as the region of Ferrières. Other copies appeared in France and we find a German copy by the end of the century.[39] The currency of

[36] Full description of IQSVM and its ms. locations appear in Juste, "Neither Observation."

[37] Flint, *The Rise of Magic*, chs. 5–6, describes many of the relevant practices, both forbidden and tolerated or supported.

[38] Loup de Ferrières, *Correspondance*, vol. 1, p. 110 (a. 840–841). Lupus wrote to Adalgaudus in thanks for help in correcting a copy of Macrobius by sending one folio from a very good copy that Adalgaudus possessed; he had refrained from sending the whole book.

[39] Paris 6370 is described and discussed by Barker-Benfield, "Macrobius," 225–7;

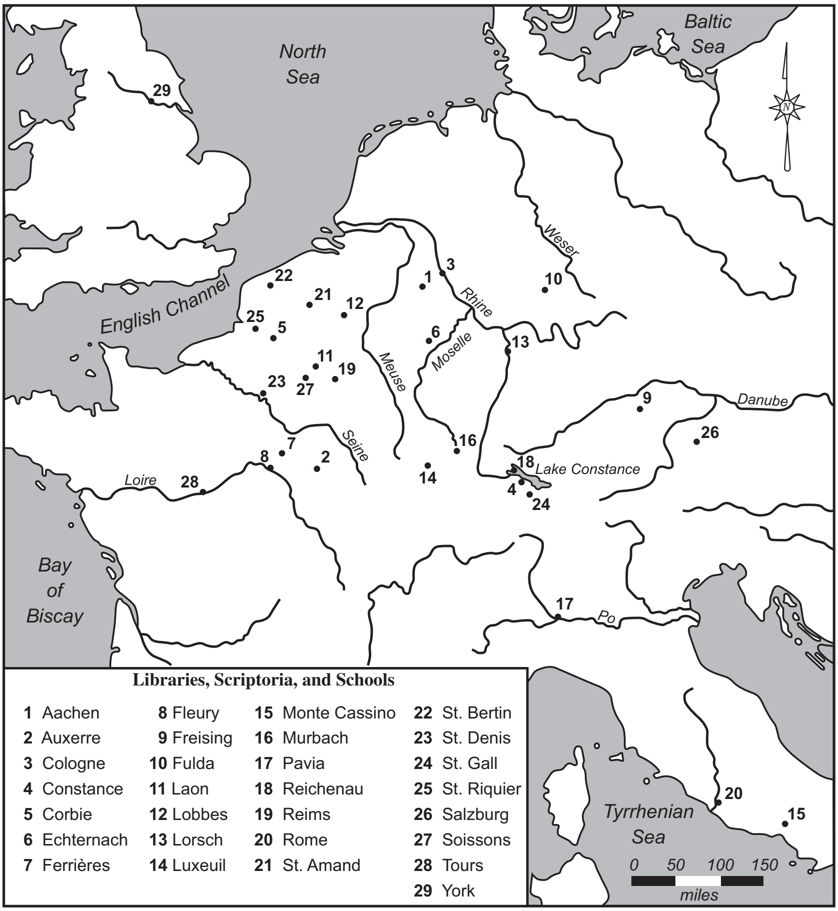

Fig. 1.1. Map of Libraries and Scriptoria

Macrobius in the ninth century would seem to have been limited to major French centers from the Loire north with the exception of copies of Dungal's letter, which traveled to Verona and elsewhere.

Both Macrobius and Pliny were seen as sources for astronomical excerpts that could be used in schools, and we do not find their texts heavily glossed. The earlier books of Pliny's *Natural History* were known and excerpted for specific astronomical doctrines by both Isidore and Bede in their respective works with the title *De natura rerum*. In Carolingian times copies were held at the royal court, as letters of 798 and 799 by Alcuin to Charlemagne indicate. The king's librarian, Gerward, built the royal library for Charlemagne and rebuilt it for Louis the Pious, both times including Pliny's encyclopedia.[40] Books 2 and 18 of Pliny, the sources for excerpts in the Seven Book Computus ca. 812, may have come from the Corbie library, where Paris 6796, a now mutilated and incomplete manuscript, had been copied. The earliest surviving copy of the Seven Book Computus, Madrid 3307, was made at the monastery of Murbach, along the headwaters of the Moselle River, ca. 820,[41] and a very similar copy ca. 869 at Lobbes in southern Belgium.[42] A copy of Books 1–17 (now incomplete) of Pliny was produced at the royal monastery of Lorsch on the Rhine River.[43] An inventory of the books owned by Saint Riquier in 831 indicates a copy that can no longer be traced.[44] Pliny was excerpted along with Macrobius and Calcidius for the Corbie compendium of astronomical and other sciences in the mid-century Paris 13955, which we discuss below in Chapter Five under the title "Paris Compend."[45] And at Reichenau at mid-century a copy

Pellegrin, "Manuscrits de Loup," 11; Gariepy, "Lupus of Ferrières," pp. 103–4. For the St. Denis connection and the copies of Dungal's letter see Ch. 2, Sect. 4, below. Paris nal 454 was written at Corbie and used by Hadoard for his excerpts in Vat. Regin. 1762. Paris 16677 is a Fleury copy. The lengthy excerpts in Bern 347 were made near Ferrières; see Bischoff, *Katalog*, vol. 1, p. 123. For more on the Loire valley scriptoria see McKitterick, "Carolingian Book Production," pp. 8–11. The copy in Cologne 186 was copied in Germany; see Bischoff, *Katalog*, vol. 1, pp. 403–4.

[40] Bischoff, "Bibliothek im Dienste der Schule," p. 392. The full text of Pliny in two bindings is listed in the Lorsch library catalogue; see Becker, *Catalogi*, p. 109 (nrs. 399–400).

[41] See Williams, *The Illustrated Beatus*, vol. 1, p. 94; Borst, *Das Buch der Naturgeschichte*, p. 163.

[42] Regarding Monza F.9.176, see King, "Investigation," p. 48; McGurk, *Catalogue of Astrological Manuscripts in Italian Libraries*, pp. 52–61; Belloni and Ferrari, *Biblioteca capitolare di Monza*, pp. 106–7.

[43] This ms. is now New York, Pierpont Morgan Library M.871 (s. IX^{1}).

[44] McKitterick, *Carolingians and the Written Word*, p. 177.

[45] David Ganz, *Corbie*, pp. 140, 152–3.

was made of a long set of excerpts from the first six books of Pliny that had first been produced ca. 800 at the Sankt Gallen monastery. A complete copy of the *Natural History* (Leiden Lipsius 7) was made in the first half of the century by two scribes whose handwriting shows one to have been trained at Murbach, the other at Luxeuil. At the same time, two centers with important teaching masters in the second half of the ninth century, Auxerre and Laon, seem not to have possessed copies of either Macrobius or Pliny.[46] This fact does not indicate a lack of interest in natural science or astronomy but rather the unpredictable distribution of books in the Carolingian world—unpredictable not in the sense of a thoroughly random distribution but rather because of the varying conditions at individual scriptoria. The presence of a copy of a work at a particular monastery depended not simply on having a library but also on contacts with other centers, the knowledge of the holdings of other libraries, the presence of a competent scribe trained either locally or elsewhere, and many other factors.[47]

The fifth-century work of Martianus Capella was recovered and spread rapidly during and after the second quarter of the ninth century as a set of ready-made handbooks on the liberal arts, although the trivium, especially grammar, continued to be taught by using many other texts. Capella's work had been mentioned by Cassiodorus, whose lists of books were one of many guides used by Carolingians to select the contents of their own libraries. Gregory of Tours (d. 594) spoke of studying Martianus, but this was rather surely a reference to the books of the trivium, and Gregory's brief text on stellar time-keeping does not depend on Capella. The Capellan books on the quadrivium, especially astronomy, were seized upon as rare gifts for teaching these arts.[48] Of our four Roman sources for astronomy only Capella—indeed all nine books of his *Marriage of Philology and Mercury*—received extensive interlinear

[46] Contreni, *Cathedral School of Laon*, p. 67, notes that Martin of Laon had excerpts from Macrobius but insufficiently to argue for presence of the text. *L'École carolingienne d'Auxerre*, pp. 59–146, shows a variety of texts but not these two. The presence of Heiric of Auxerre's hand as a glossator in Paris 6370 (Macrobius) only testifies to Heiric's work while studying with Lupus at Ferrières from 859 to 862; the marginal indices by Heiric in the manuscript show primary concern with the soul, astronomy, and cosmic harmony.

[47] These points and more are discussed by McKitterick, "Carolingian Book Production," pp. 7–14. Fuller development appears in her *Carolingians and the Written Word*, pp. 165–210.

[48] A useful overview is provided by Préaux, "Les manuscrits principaux du *De nuptiis*." On Capellan mss. see also Shanzer, "Review Article. Felix Capella."

and marginal glossing and commentary in the ninth century, intended both for school use and individual study. Twenty copies of Capella survive from the ninth century, and two of these are separate copies of Book 8 (the astronomy), indicating the early interest in having copies of this part of Capella's *De nuptiis* (*Marriage of Philology of Mercury*) alone. We can locate eleven of the twenty during the century, giving us some sense of the distribution of the work. In Germany (and Switzerland) copies existed at Cologne, Constance, Freising, and Lorsch;[49] in France (and Belgium) there were copies at Auxerre (2), Corbie (2), Reims, Saint Oyan, and Soissons.[50] Four more of the twenty manuscripts can be designated as French in origin.[51] With one-fifth of the manuscripts at major centers in southern and southwestern Germany and over half at French, primarily north French, cathedrals or monasteries, the preponderance of French scriptoria, libraries, and schools is obvious in the case of Capella's work. And as Chapter Four below emphasizes, the major commentaries on Capella's astronomy in its first decades of Carolingian school use are French, those of the Anonymous and John the Scot. These facts suggest the special importance of Martianus Capella's work for teaching astronomy and the greatest attention being given to this work from the Loire valley northwards.

Calcidius's *Commentary on Plato's Timaeus* was known already by the end of the eighth century, apparently at the royal court, as is witnessed by its use among Alcuin's students, especially by Candidus. For astronomy the work of Calcidius seems to have emerged suddenly in the 840s in a Corbie manuscript, Paris 13955, containing a group of upper level school texts. Certain references of John Scottus Eriugena to Platonist views in his *Annotationes* to Martianus Capella (composed in the 850s) suggest a second-hand, erroneous grasp of what may have been astronomical doctrines inspired originally by Calcidius's *Commentary*, and we do not know where John discovered the supposedly Platonist notions reported for him in Paris 12960. Cicero's incomplete translation of

[49] These copies, in the order listed for their ninth-century locations, are London Harl. 2685, Bruxelles 9565–9566, Kremsmünster Fragm. 1.20 (Bk 8 only), and Leiden BPL 36; they are described in Leonardi, "I Codici," nrs. 101, 26, 81, 82.

[50] These copies, in the order listed for their ninth-century locations, are Leiden Voss. lat. F.48, Vat. Regin. 1535, Paris 8670, Paris 13955 (Bk VIII only), Leiden BPL 88, Besançon 594, and Paris 8669; they are described in Leonardi, "I Codici," nrs. 89, 208, 161, 171, 84, 20, 160.

[51] In Leonardi's catalogue these are nrs. 8 (Bamberg Class. 39), 73 (Karlsruhe Aug. LXXIII), 144 (Oxford Laud 118), and 210 (Vat. Regin. 1987).

the *Timaeus* circulated in conjunction with his *De natura deorum*, *De divinatione*, and *De fato*, but Cicero's version did not provide the views that John the Scot invoked in his commentary on Capella.[52] While there are other references to Platonist astronomical views, specifically in the Anonymous commentary on Capella's *astronomia*, the only extant ninth-century manuscripts of Calcidius are two, Lyon Bibliothèque municipale 324 and Valenciennes Bibliothèque municipale 293.[53] The Valenciennes copy was rather surely made at Reims in the late ninth century, and it was taken by Hucbald of Saint Amand (d. 930) when he left Reims for Saint Amand where the manuscript remained until the French Revolution.[54] This copy in turn testifies to a copy at Reims that served as exemplar, although we have no further information about that exemplar.[55] As the chapters below on Martianus Capella and Calcidius show, there were many Carolingian references to astronomical doctrines of Plato (or Platonists). Some of these derived from Macrobius's *Commentary*, but Cicero's translation of the *Timaeus* as well as Calcidius's translation and commentary must have been far more widely known than surviving manuscripts indicate. For astronomy, which depends much more on the commentary of Calcidius than on the text of Plato, our evidence is strong for direct knowledge, with the extended quotations in the Paris Compend (in Paris 13955) of the 840s, but weak for widespread use, with only two surviving copies of the commentary earlier than the tenth century.[56]

[52] Ninth-century mss. of these works together include Vienna cod. 189 (s. IX^1, Ferrières, corrected by Lupus), Leiden Voss. lat. F.84 + F.86 (s. IX m., French), and Florence Bibl. Laur. San Marco 257 (s. IX$^{2/3}$, copied at Corbie). On these mss. see Munk-Olsen, *Étude*, I, 311, 199–201, 180–1; Reynolds, *Texts and Transmssion*, pp. 124–6; McKitterick, "Knowledge of Plato's *Timaeus*," pp. 86–9. It is possible that scholarly discussion attempting to interpret Cicero's text of Plato regarding planetary order was partly responsible for the related doctrines attributed to Plato in John the Scot's *Annotationes*.

[53] Lyon 324 would seem to have been the textual twin of Paris 2164, but the latter ms., formerly dated ca. 800 and placed at Charlemagne's court, has been relocated to Fleury in the time of Abbo (s. X ex.). Paris 2164 may well have had as exemplar a ms. at the royal court ca. 800. See Huglo, "Réception de Calcidius," 11–13. We have no secure location for Lyon 324. For Valenciennes 293 see McKitterick, "Knowledge of Plato's *Timaeus*," pp. 90–4.

[54] For Saint Amand's library collection see Boutemy, "Le scriptorium et la bibliothèque de Saint-Amand."

[55] On the Reims scriptorium see Carey, "The Scriptorium of Reims during the Archbishopric of Hincmar."

[56] This small number of manuscripts might, like those of the other Roman texts for astronomy, be reasonably multiplied by at least 5 and perhaps 10 to 15, if we try to hypothesize the number actually available for use in Carolingian libraries.

In general there were five ways in which Roman scientific works entered Carolingian culture and had their effects. First there was, of course, the simple recovery of classical books. After that we find imitation and the multiplication of copies. Further, some users preferred to select parts of Roman works, and we find many longer excerpts as well as florilegia, or collections of little snippets. Next, with the appearance of extensive glossing and commentaries we encounter creative teaching, such as the Carolingian Anonymous commentary on Capella used in expanding the number of geographical latitudes when reporting the amount of daylight through the year and thereby making the nature of the change more evident. Finally, beyond creative teaching we can find innovative theorizing as with the comparison in the Anonymous commentary of models of circumsolar planetary motion derived from three different ancient sources. By the middle of the ninth century we can find all of these forms of Roman scientific impact and stages of Carolingian interaction in the study of astronomy.

4. *Roman Astronomy in the Carolingian Renaissance*

In 1927 Charles Homer Haskins declared the scientific vista of the early Middle Ages to be largely a wasteland. He was most emphatic in his view of the mathematical sciences and focused especially on astronomy, claiming that nothing of significant value was done. As for computus, he noted, its achievements were trivial. Thus astronomy had to wait for the twelfth-century importation of Greco-Arabic sciences to begin its medieval European development. In 1975 Olaf Pedersen argued against Haskins' blanket dismissal of early medieval astronomy, proposing that computus was precisely the area where astronomical achievements were made, calling it "a purely scientific effort to elucidate the only astronomical problem of immediate importance for early medieval society." Finally, in 1994 Brigitte Englisch elaborated carefully and extensively upon Pedersen's points and further claimed that computus was the sole area where real scientific thinking and work emerged in early medieval astronomy. It was Bede who did this most clearly, and Englisch blamed Rabanus Maurus and others in the ninth century for abandoning this model of how to do good science.[57]

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[57] These three historiographical signposts do not exhaust the noteworthy writing on early medieval astronomy and computus, but they identify fundamental positions.

Some scholars have pointed out to me that observation was the most important element of early medieval astronomy and that this came often in connection with computistical work. Wesley Stevens has described the elaborate efforts of Bede to determine with some precision the date of equinox, and Stevens' detailed account provides us with much food for thought regarding Bede's observational apparatus.[58] First we learn that Bede accepted the so-called Alexandrian date of 21 March for spring equinox in preference to the Roman date of 25 March; both of these dates were established by authorities in the past, and Bede followed his own schoolmaster, abbot Ceolfrith, in preferring the decision of the Egyptians. Stevens then presents us with Bede's large gnomon and zodiacal circle laid out on the ground; it was designed to show "anyone who did not learn in school as a child" how to understand and observe the movement of the sun through the year. We might properly say that this large pedagogical demonstration was Bede's way of moving the dustboard of the abacus out of doors, enlarging it sufficiently to produce the acknowledged facts of annual solar motion and to allow easy presentation of the different divisions of the signs of the zodiac. Following Bede through his operations with this large *horologium*, Stevens argues that it is extremely difficult to observe precisely the equinox and that Bede's difficulties and failure are quite understandable—even forgivable. However, it seems much more likely that Bede did not fail in his intent. Bede's intention was to show the date of equinox "horologia inspectione." In fact, his intent was to show "horologia inspectione" ("by observing with the gnomon") that the date of equinox was 21 March rather than 25 March. In the *Ecclesiastical History* Bede wrote that the Alexandrian date of 21 March could be approved by such a device ("horologica inspectione probamus").[59] The issue here was approval of a preferred authority, not independent experimentation. Taking Bede's observational work in this sense, a sense that had a long tradition through Antiquity, we see it as a nice example of disproof

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See Haskins, *Renaissance of the Twelfth Century*; idem, *Studies in the History of Mediaeval Science*; Pedersen, "The Corpus Astronomicum and the Traditions of Mediaeval Latin Astronomy," p. 63; Englisch, *Artes liberales im frühen Mittelalter*.

[58] Stevens, "Astronomy in Carolingian Schools," pp. 423–32.

[59] Stevens, pp. 426–7, quotes and translates the passage from Bede's *H.E.* V.21. His subsequent effort to explain Bede's supposed failure seems to me to miss the point of Bede's account. It was pedagogical. It was in support of a designated authoritative view. It used observation to approve one view over another, not to discover a new and different date for the equinox. In pursuit of this goal Bede was fully successful.

of the opposition, not as an example of experimental investigation.[60] It is all too evident that Bede did not say that he would have liked a better dating than 21 March but could not achieve it. That is the view of the modern historian.

Among the Carolingians Bede's work *On Time Reckoning* (*De temporum ratione*) appears to have been the preferred guide for computistical study, even though it did not gain the status of sole authority. On the contrary, Bede's work simply competed successfully with a variety of others, including extracts from Isidore, Irish compositions, and Carolingian works.[61] In the ninth century computus was in an expansive mode, encyclopedizing, as it were, rather than solving new problems. Large compilations characterize this era in the history of computus, including the two collections discussed below in Chapter Three, the Seven Book Computus and the Three Book Computus. Keeping in mind the traditional computistical concern to establish a regular cycle of Christian feasts, not to establish a cycle of astronomical periods, we may see Carolingian computists as following both the lead of Cassiodorus and Alcuin in enlarging their understanding of the motions of the luminaries used to define the calendar and also the lead of Bede in his careful precision in defining all the elements of the calendrical cycle. Thus the apsidal and latitudinal motions of the sun and moon in the contexts of planetary apsides and latitudes according to Pliny enlarged Carolingian computus beyond its very specific needs. At the same time Carolingians continued to debate the correct length of calendrical time since the beginning of the world.[62] In the Carolingian world computus was a precise science but not an experimental science.[63] It thus remained a science of numerical calculation and cycles.

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[60] For an overview of the topic see Lloyd, *Magic, Reason and Experience*, ch. 3. It was convenient that the actual date of equinox about Bede's time was 17 or 18 March, since this assisted in making the Roman dating obviously incorrect while the Alexandrian dating was a bit too close to discriminate. Borst, *Kalenderreform*, pp. 683–7, has also recognized Stevens' misdirected thrust; Borst puts Bede's preference for 21 March in the larger framework of appropriate computistical goals.

[61] Among these we may note those studied by Cordoliani, "Une encyclopédie carolingienne de comput: les *Sententiae in laude compoti*;" idem, "Le comput de Dicuil;" and the massive overview by Borst, *Kalenderreform*.

[62] The introduction of Plinian excerpts on planetary apsides and latitudes into computus compilations in the ninth century is well known and is described below in Chapter Three. For the increasing Carolingian concern with determining the length of time since Creation see Landes, "Lest the Millenium Be Fulfilled: Apocalyptic Expectations."

[63] McCluskey, "Changing Contexts and Criteria," pp. 205–11.

In the exploration of Roman astronomy and cosmology in the Carolingian world I have tried to set out the ways that four Roman texts were used to bring order into the picture of the heavens in the late eighth and ninth centuries. The books themselves derived from the first to the fifth centuries. Limited use of one or more of them can be discovered in the works of Isidore of Seville and Bede, but the fuller use of all four of these books, aimed at a comprehensive view of the world above us in the skies, emerged in the age of Charlemagne and his successors. It was this revival, or renaissance, of Roman knowledge that enabled those scholars who were competent to reach the fullest understanding of the art of astronomy. This was the study of God's "laws," as Isidore said, made visible in the heavens. What was seen in the heavens could, in turn, be made visible in a different and more elaborated way by the use of astronomical diagrams.

This renaissance of Roman astronomy made possible later in the ninth century a line of study that opened up to Carolingian scholars a coherent view of two fundamental techniques of Greek geometrical astronomy, the epicycle and the eccentric. The epicycle was seen at first, through the astronomy of Martianus Capella, as a peculiarity of the motions of Mercury and Venus, useful in explaining their limited elongations from the Sun. This peculiarity was opened up by excerpts from Calcidius's commentary on the *Timaeus* to reveal the applicability of epicycles to all the planets. Similarly, the abbreviated explanation by Capella of the different lengths of the four seasons became in Calcidius's account a clear, qualitative geometrical explanation, using eccentrics, of the variation in seasonal lengths. These specific astronomical understandings were completely enmeshed in the larger Carolingian search for knowledge of the heavens and could only emerge as individual realizations after many decades. In fact, only in the early eleventh century do we find evidence of scholars showing clearly a full understanding of the epicycle and the eccentric as astronomical techniques. But it was this long development, from the Carolingian deployment of Roman astronomy to the eleventh-century engagement fully with all the questions and techniques of Capella and Calcidius, that laid a conceptual basis for the twelfth-century inquiry into Greco-Arabic astronomy.

My focus in this book is the Carolingian framework—the rebirth of the quadrivial art of astronomy—with all its associated learning. With Macrobius's *Commentary on the Dream of Scipio* we find an orderly overview of the cosmos. It is sufficiently general to serve as a cosmology for computists and not to stimulate questions about the astronomical limits of computus. The cosmos as a sphere with the spherical earth at the center is the basis. The parallels between the terrestrial and celestial zones are highlighted. We are shown the symmetry of the earth, its parts, and its inhabitants. If Macrobius can be used to suggest order and interrelatedness, Pliny is used to display the diversity of the world. From Pliny Carolingians learned details of the planets, comets, eclipses, winds and storms, as well as portents associated with all of these. Pliny also provided rationales for planetary phenomena, eclipses, and winds of different kinds. Explanations, not simply descriptions, emerged as important contributions of Plinian astronomy at those points where it used the configurations of eccentric apsides to account for changing speeds and brightness of planets. Extensive detail and remarkable diversity were found in Pliny's accounts of what happens in the skies.

Explanations increased with the use of Martianus Capella, whose handbook offered the appearance of a comprehensive overview. Carolingians seized on his astronomy text as an ordered guide to the subject. In it they found improved understanding of the change in the amount of daylight through the year. Students were also given an explanation of the different lengths of the four seasons. If it was not as good a geometrical guide as Geminus had been for ancient students and Sacrobosco would be for thirteenth-century students, Capella's astronomy managed to present topics in a coherent sequence and preserved at least some portions of the mathematical picture of solar, lunar, and planetary motions in Greek astronomy. A number of these points became subjects for elaboration and investigation in Carolingian commentaries on Capellan astronomy.

Calcidius offered Carolingians for the first time a coherent philosophical and qualitative geometrical account of the cosmos. This account was, at least geometrically, a challenge that clearly was beyond the aptitude of most early readers, and only a modest number of students were likely to have benefited from a work such as the Paris Compend, which extracted Calcidius's explanations of solar motion using both an eccentric and an epicycle and showed their equivalence. Yet this set of excerpts was meant as a textbook, or study guide, and its inclusion in the same codex with a roughly contemporary commentary on the *astronomia* of Capella is further evidence of the fact.

To repeat in quick chronological summary, approximately 800–820 saw the introduction of Macrobius with his big picture of the cosmos aided by Pliny's expansive coverage of many more topics in detail. Adding to this foundation in the 830s and beyond were the copies of

Martianus Capella's astronomical textbook, often with elaborate commentaries. And as the Capellan superstructure solidified by extended copying of both the text and the commentaries, from the 840s onwards Calcidius's *Commentary* offered a larger philosophical framework and the opportunity to focus on new and unfamiliar geometrical techniques.

Throughout these four Roman works diagrams were used by Carolingian scholars to illuminate the meanings of the texts; they gave not only descriptions but also, in many cases, explanations. Macrobius had provided a set of diagrams, and ninth-century readers not only used but also modified them. Pliny made no mention of diagrams for his text, but a set of four, subsequently modified (or improved), was invented to accompany four lengthy astronomical excerpts from Pliny. Martianus Capella likewise made no mention of diagrams, but more than one commentator at or before mid-century devoted much time to the invention of diagrams for Capella's text and for parts of the commentary. These diagrams were usually illustrative, at times exploratory and theoretical, and occasionally revealing of unexpected barriers to understanding. Finally, for Calcidius's text there were geometrical diagrams to which the text referred and fully depended on. Because many of these diagrams did not survive uncorrupted into the Carolingian world, ninth-century scholars had a double difficulty, first the challenge of incorrect diagrams, second the challenge of a geometrical perspective sufficiently unfamiliar so as to make it hard to determine which diagrams were incorrect and in what ways they were incorrect.

In the diagrams produced by Carolingians for each of the four Roman sources we learn much about the abilities and limitations of the scholars involved. It is especially from the Carolingian diagrams, copied or invented for one or another of these works, that we discover much more deeply what and how the ninth-century teachers and students were able to understand. It has been said that a picture is worth a thousand words, and, for investigating Carolingian astronomy, a coherent diagram and an incoherent diagram are each worth a thousand words. Unraveling an incoherence can be at least as instructive as following an orderly, coherent diagram. Expanding our survey of each of the four Roman works to incorporate relevant material from literary, religious, and other scientific sources gives us a far more complete awareness of Carolingian astronomy and cosmology and its integration within the literate culture. At the same time, a highly detailed analysis of diagrams, such as the (coherent) three versions of circumsolar planetary motion in the Anonymous commentary on Capella or the (incoherent) diagram assembling the elements of Capella's explanation of the different lengths of the seasons, can reveal buried assumptions and understandings that we are unlikely to discover in any other way. Both expansion of our vista across the culture and penetration into the hidden geometry of Carolingian mindsets are goals of the following chapters.

CHAPTER TWO

MACROBIUS'S *COMMENTARY ON SCIPIO'S DREAM*: ITS CAROLINGIAN USES FOR ASTRONOMY AND COSMOLOGY

A picture of the physical cosmos—the earth, the stellar sphere, and the intermediate ordered planets—appeared most clearly for the scholars of Charlemagne's day in Macrobius's lengthy commentary on Cicero's *Somnium Scipionis*.[1] Theodulf of Orleans, Alcuin, and others who knew this text must have appreciated its firm images of the circles of the celestial and terrestrial globes, the climatic zones of the earth, and the zodiacal and planetary orders. Diagrams of these topics were included in the *Commentary* and appear in most of the ninth-century manuscripts; Dungal seems to have used at least one such diagram when adapting the work of Macrobius to answer Charlemagne's letter of astronomical inquiry in the year 811. While Macrobius did not provide the sort of detailed and technical information that Carolingians could or would find in the works of Pliny, Martianus Capella, and Calcidius, his global picture, both literal and figurative, held great appeal and was excerpted many times.[2] Just as a spherical earth implied the regular sequences of

[1] The evidence of Freeman, "Additions and Corrections to the *Libri Carolini*," p. 162, reveals the desire to include a direct reference to Macrobius's classification of dreams in the *Libri Carolini* ca. 793. One fragment of an eighth century manuscript and ten ninth-century manuscripts, often fragmentary or excerpted, of Macrobius's *Commentarii* still survive. The earliest complete copy we now have, Paris 6370, copied at Tours probably ca. 820, shows connections with various important centers and persons during the century; see the description in Pellegrin, "Manuscrits de Loup de Ferrières," p. 11. In 811 the Irish monk Dungal made extensive use of the *Commentarii* in his letter to Charlemagne about astronomy. See Eastwood, "The astronomy of Macrobius."

[2] A brief and useful summary of the content of the commentary appears in the introduction to Macrobius, *Commentary on the Dream of Scipio*, trans. Stahl, pp. 9–23. Although each of the disciplines of the quadrivium (arithmetic, geometry/geography, astronomy, music) received extensive treatment by Macrobius, these were not the limits of his focus, for he stated clearly that he considered his *Commentary* to be an introduction to the whole of philosophy, its three branches being "moralis, naturalis et rationalis" (ethics, physics, and logic; at II.xvii.15). For an introduction to Macrobius and his Platonism, see Gersh, *Middle Platonism and Neoplatonism*, vol. 2, pp. 493–595, esp. 493–6 nn. 1–2, for bibliography. The Macrobian philosophical tradition in the Middle Ages is surveyed by Hüttig, *Macrobius im Mittelalter*, pp. 39–52 on the early Middle Ages (see

day and night, of the seasons of the year, and of climatic variation, so the surrounding concentric spheres and sidereal circles led a reader to understand as well the association of certain constellations with certain times of the year and the separate paths of planets in orderly cycles of movement.

1. *Concentric Spheres as a Home for Matter and Spirit*

Macrobius described a cosmos of concentric spheres, from the central and spherical earth up through the seven planets to the outermost, stellar sphere. This world was composed of the four elements: earth, water, air, and fire. 'Fire' and 'aether' he used indiscriminately, importing some attributes of the Aristotelian aether for this fourth and outermost matter among the cosmic spheres. Aether alone made up the cosmos from the lunar sphere outward, the other elements being confined to the lower world. While he reviewed other teachings on the elemental makeup of the planetary spheres, his own view followed a Pythagorean-Platonic tradition which saw all planets and stars, from the moon upward, as divine and unchanging in nature, yet active in their effects upon our sublunar realm. In fact, the seven planetary spheres govern all things below ("inferiora omnia gubernarent").[3] The sublunar region is unable to produce a living body, and the celestial ethereal fire alone can endow earthly beings with life, spirit, and vital heat. The matter of the celestial realm, ether, called eternal fire as well, is clearly the matter of the moon as well as all above it, but the lunar sphere holds a transitional status. It is the only planet, according to Macrobius, that has no light of its own and needs the sun's reflected light to become a luminary. With the regions of air, water, and earth directly below it,

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the review of this work in *Isis*, 84 (1993), 366–7). The scientific content of Macrobius's *Commentarii* is discussed by Stahl, *Roman Science*, pp. 151–69, esp. 156–64 on astronomy; also by Flamant, *Macrobe*, with speculative interpretations, chs. 7 (arithmetic), 8 (music), 9 (astronomy). The most recent introduction to the *Commentarii* is the extensive, detailed, and dependable work of Caiazzo, *Lectures*, a study of the background tradition and an edition of the twelfth-century glosses in Cologne 199; see pp. 13–57.

[3] Macrobius, *Commentarii in Somnium Scipionis*, ed. Willis (1970; reprinted 1994), pp. 46 (I.xi.5–6), 27 (I.vi.47). Hereafter I refer to this work as CSS. I retain as well the traditional numbering system of the edition of Jan, *Commentarii in Ciceronis Somnium Scipionis* (1848), and other editions. A French edition, translation, and commentary has been made by Armisen-Marchetti, *Commentaire*, 2 vols.

the moon affords an intermediate, albeit divine and etherial, between the two extremes of celestial and terrestrial worlds.[4]

Among the more intriguing aspects of the world order described by Macrobius was its link with the Platonic myth of the soul's descent from the heavens to an earthly existence and subsequent return. Signs of the zodiac, the Milky Way, and the tropics of Cancer and Capricorn were all given special significance as signals or steps in the soul's initial descent, followed by attributes of the planets that molded the characteristics of the soul as it proceeded downward through their spheres.[5] Macrobius emphasized the difference between the corporeal, etherial parts and the incorporeal souls of the stars and planets. Their spherical shape made them fit to receive souls, which by their nature were active.[6] Revolving eternally, each possessed a breath (*spiritus*) that carried it along at its own speed.[7] And just as the World (cosmic) Soul was responsible for the reasoning power of celestial spheres, so each individual soul brought reason to a terrestrial, human body, lodging in the uppermost and sphere-like part, the head. The stars and planets had solid spherical bodies, and they moved through the heavens attached to great hollow spheres, whose reality Macrobius assumed without discussion.[8] Their continuous circular motions attested to their orderliness and their immortality. By contrast, the centrality of the earth and the minuteness of the earth marked it with minimal importance.[9]

2. *The Sun and the Other Planets in Macrobius's World*

The description of the precise relationships of the spheres occupies many chapters of the commentary, laying out the positions of the Milky Way, the zodiac and ecliptic, the five parallels, and two colures as a framework (Figure 2.1) against which the Sun, the Moon, and the five

[4] CSS 55 (I.xiv.4), 58 (I.xiv.18), 61–2 (I.xv.7), and 91 (I.xxi.35) for the etherial, fiery, and potentially hot matter of the heavens. See p. 91 (I.xxi.35) for the celestial ether as the source of sublunar life. For the lunar sphere as boundary between ether-fire and the other three elements, p. 92 (I.xxii.5). The moon as only celestial body not self-illuminating appears at pp. 74–5 (I.xix.8–10). That other planets along with the sun have their own light appears at pp. 74–5 (I.xix.10), 78 (I.xx.3), and 90 (I.xxi.30).

[5] CSS 47–51 (I.xii).

[6] CSS 58 (I.xiv.18), 56 (I.xiv.8), 68 (I.xvii.8).

[7] CSS 107 (II.iv.4).

[8] CSS 55–60 (I.xiv).

[9] CSS 64–6 (I.xvi).

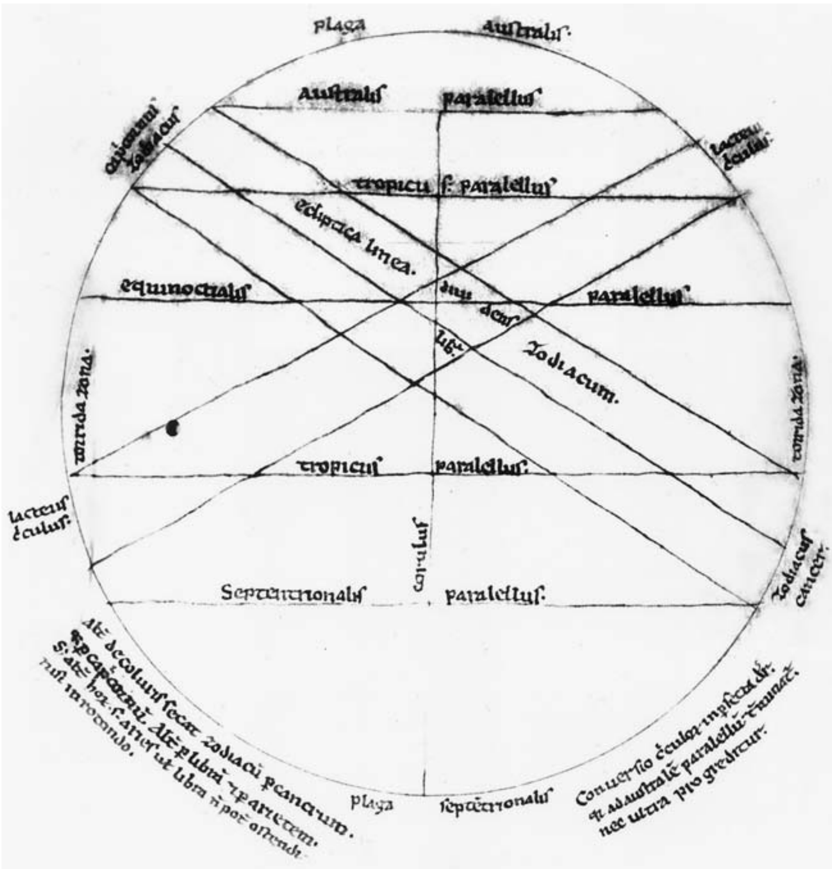

Fig. 2.1. The Circles on the Cosmic Sphere. This example shows confusion on the colures. Ann Arbor, University of Michigan, Special Collections Library, Mich. ms. 195, f. 38r

other planets can be seen. The diurnal revolution of the fixed stars with the celestial sphere from east to west is clearly set in opposition to the revolutions of the separate planetary spheres, all of which move from west to east, and each of which has its own speed. At the same time, the total movement of each of these planetary spheres is also carried around with the outer, stellar sphere (east to west) while moving with its own distinctive planetary motion in the opposite direction (west to east), thus making its total planetary motion a composite of the two opposed motions. The signs of the zodiac, each having 30° of arc, are designated as the proper background for determining planetary motions and so make it evident that each planet progresses, let us say, from Aries to Taurus to Gemini and so on, thus proving the movement from west to east independent of the stellar sphere.[10] Among the planets, the Sun, as Cicero said and Macrobius repeated, is "leader, chief, and regulator of the other lights, mind and moderator of the universe" ("dux et princeps et moderator luminum reliquorum, mens mundi et temperatio").[11] He went on to explain.

> Each planet has a definite limit which it reaches in its course away from the sun and then, as if forbidden to transgress, it is seen to turn back, and again, when it reaches a certain point, it is recalled to its former direction. In this way the sun's power and influence direct the movements of the other planets over their appointed paths.[12]

Here Macrobius seems to have combined two distinct parts of planetary motion: first, the simple circulation of a planet around the earth, which, when observed with respect to the Sun's position, has extreme points, whether at limited angles or a full 180° (opposition) from the Sun; second, except for the Moon (and Sun), the appearance of each planet pausing in its direct motion from west to east, then reversing and moving in retrograde (east to west) for a limited interval, after which it pauses and returns to its direct motion. At this point, Macrobius

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[10] CSS 70–3 (I.xviii), 108 (II.iv.8). Figure 2.1, from a Macrobius ms. of s. XII, is the earliest surviving attempt to draw the circles of the cosmic sphere in a copy of Macrobius's *Commentary*.

[11] CSS 67 (I.xvii.3).

[12] *Commmentary*, trans. Stahl, p. 169. CSS 79 (I.xx.5): "Nam certa spatii definitio est, ad quam cum unaquaeque erratica stella recedens a sole pervenerit, tamquam ultra prohibeatur accedere, agi retro videtur, et rursus, cum certam partem recedendo contigerit, ad directi cursus consueta revocatur. Ita solis vis et potestas motus reliquorum luminum constituta dimensione moderatur."

neither names nor distinguishes in any way these two aspects of planetary motion. A reader could only recognize their dual presence by knowing about them from another source, such as Pliny's *Natural History*. But such a sharp distinction is foreign to Macrobius's purpose here, which is to emphasize comprehensive solar power with regard to the other planets, not to describe details of planetary motion.[13]

3. *Macrobius's Preference for a Platonic Order of the Planets*

He explains the order of the seven planets by the periods of planetary revolution. These orbital periods would seem to be quite traditional and uncontroversial: Moon—one month, Sun—one year, Venus and Mercury—approximately one year, Mars—two years, Jupiter—twelve years, and Saturn—thirty years.[14] If we assume a direct relationship between planetary distance from the earth and planetary orbital period, we will conclude that the Sun, Mercury, and Venus are very close to each other in radial distance, and this seems to be Macrobius's view. It depends upon the belief that the planets all travel at the same linear speed and differ in time of revolution only because of their various radial distances.[15] And because of the observed similarity in the periods of the Sun, Mercury, and Venus, ancient authorities disagreed on the order of these three planets. Macrobius reports and discusses three different orders for them, producing the following ascending orders and attributions.

[13] That Macrobius may not have understood the distinction is suggested by his reference to Plotinus's *Do the Stars Have Effects?* (*Enneads* II.iii.3) and to the appearances of the *seven* (my emphasis) planets in motion, station, and retrograde ("per eorum septem transitum stationem recessumve"): CSS 78.18–19 (I.xix.27). He clearly misinterpreted Plotinus, who referred only to the rising, standing high, and setting of the seven.

[14] CSS 128 (II.xi.5–7).

[15] CSS 85–6 (I.xxi.5–7). Macrobius ignores this interpretation of planetary periods at p. 108 (II.iv.9), where he makes Mercury and Venus move at the same radial distance from the earth while the Sun has a different distance. The Sun is said to produce a distinctly different tone in the celestial harmony. Taylor, *Commentary on Plato's Timaeus*, p. 173, n. 1, points out Macrobius's contradiction here. On Greek planetary orders see Neugebauer, HAMA, pp. 647, 650, 690–3.

Archimedes (Chaldean system): Moon—Mercury—Venus—Sun.[16] (Figure 2.2)
Plato (Egyptian system): Moon—Sun—Mercury—Venus.[17] (Figure 2.3)
Later Platonists: Moon—Sun—Venus—Mercury.[18]

The order he favors is definitely the Egyptian system, although there has been debate over this fact at least since the time of Charlemagne. To understand this controversy we begin with the text of Macrobius and then proceed to its readings by later scholars.

Following Macrobius step by step, we find him not only describing but also analyzing and evaluating the two patterns that gained most of his attention, the Chaldean and the Egyptian.[19] The Chaldean system was the choice not only of Archimedes but also of Cicero, as the text points out and then elaborates.

> Next a few things must be said concerning the order of the spheres ("sphaerarum"), about which Cicero can be found to disagree with Plato by saying the sphere of the Sun is fourth of seven, that is, located in the middle; Plato places the Sun next above the Moon, that is, holding among the seven the sixth position down from the top. And the doctrine of the Chaldeans unites Archimedes to Cicero, while Plato has followed the Egyptians, progenitors of all the branches of philosophy, who considered the Sun to be positioned between the Moon and Mercury.[20] They moreover grasped and made known the reason why the Sun was believed by so many to be above both Mercury and Venus. Nor have those who so opine ("aestimant"/"existimant") strayed far from a semblance of what is true ("a specie veri procul aberrant"). Indeed, the following sort of thinking led to the belief in such a variant ("permutationis"). From Saturn's sphere,

[16] CSS 73 (I.xix.1–2), 106 (II.iii.13).

[17] CSS 73 (I.xix.2). This order, as we know, reversed the positions of Mercury and Venus in the sequence which Plato actually preferred.

[18] CSS 106–7 (II.iii.14–15). The later Platonist order involved vastly different radial distances from the earth for the three planets concerned; Sun at 2 Earth-Moon radii, Venus at 6 Earth-Moon radii, Mercury at 24 Earth-Moon radii. This is what Porphyry reported, and Macrobius does not lend it explicit support, contrary to the assumption of Stahl in his trans., *Commentary*, p. 196, n. 20. But Stahl is correct in pointing here to a contradiction between I.xxi.6 (p. 86) and II.iv.4 (p. 107) concerning the linear speeds of the planets.

[19] This discussion occurs at CSS 73–5 (I.xix.1–10). The introduction of the later Platonist alternative happens only very much later in the commentary (II.iii.14–15), and is not accompanied by anything like the analysis or evaluative comments found in the earlier comparison.

[20] For a review of scholars who have remarked upon this inversion by Macrobius of Plato's real order of Mercury and Venus above the Sun, see *Commentarii*, ed. Jan, p. 102, n.; and *Commentary*, trans. Stahl, p. 162, n. 1.

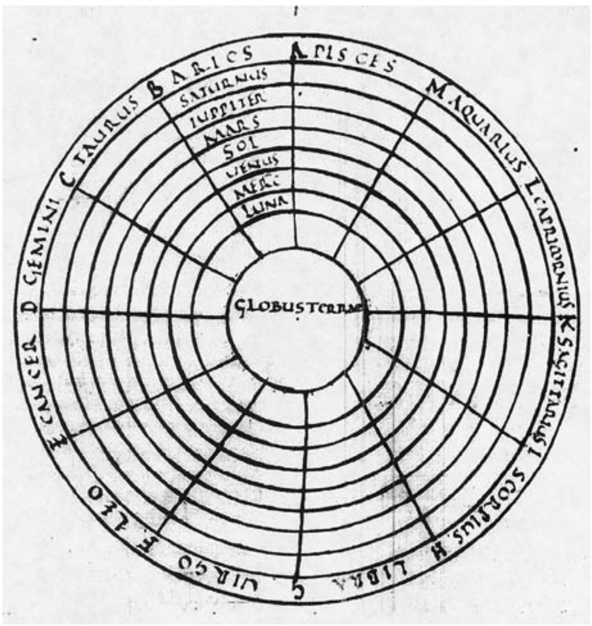

Fig. 2.2. The Chaldean Order of the Planets. Bern, Burgerbibliothek cod. 347, f. 9r

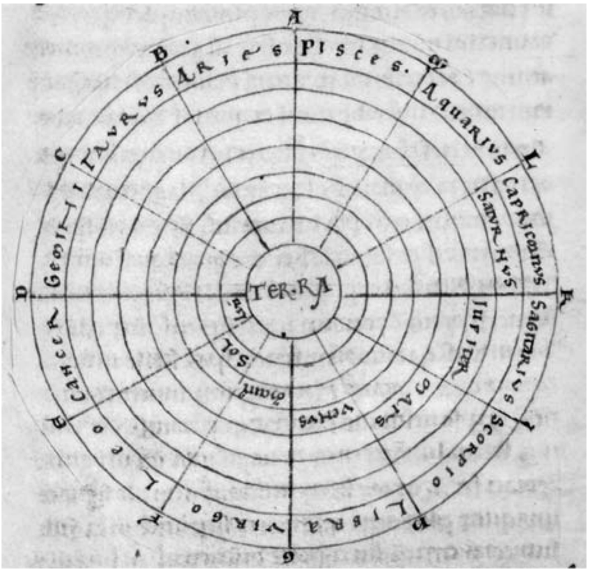

Fig. 2.3. The Egyptian Order of the Planets. Cambridge, Trinity College ms. R.9.23 (James 824), f. 43v

which is first of the seven, all the way to the sphere of Jupiter, second from the highest, there is so great a distance of intervening space that the higher planet completes a course of the zodiac in thirty years while the lower does so in twelve. Furthermore, the sphere of Mars stands so far from Jupiter as to run the same course in two years. Likewise Venus is so far below the realm of Mars that a year suffices it for coursing the zodiac. Now in fact, the planet Mercury is so near Venus, and the Sun so near Mercury, that these three circle through their heavenly realm ("caelum") in the same interval of time, that is, in a year more or less. And so Cicero called these two coursers the companions of the Sun, because in the same interval they never withdraw far from each other. The Moon fell so far below these that it covered in twenty eight days what they did in a year. Therefore among the ancients there has been no disagreement over the order of the three higher planets, which shows forth obviously and clearly by virtue of immense distance, nor disagreements over the realm of the Moon. The nearness of those three companions, Venus, Mercury, and the Sun, has confounded their ordering, but only for some authorities. For the explanation has not escaped the shrewdness of the Egyptians and is thus. The orbit ("circulus") along which the Sun travels is surrounded as an inferior by the orbit (*circulus*) of Mercury; this latter orbit in turn the superior orbit of Venus contains, and it happens thus that these two planets, when traveling through the superior *vertices* of their orbits are thought ("intellegantur") to be located above the Sun, and when they pass easily ("commeant") through the inferiors of their orbits, the Sun is believed ("aestimetur"/"existimetur") to be superior to them. Therefore, those who have said that these planetary spheres ("sphaeras") [of Mercury and Venus] are below the Sun have seen this during that course ("cursu") of the planets which sometimes, as we said, seems ("videtur") to be inferior; and this appearance is really more noticeable, for it can be seen more clearly ("liberius apparet") then. When they occupy the superiors they are hidden more [quickly] by the Sun's rays ("Nam cum superiora tenent, magis radiis occuluntur"). And so this latter conviction ("persuasio") has gained strength, and the corresponding order of the planets has been accepted almost universally. Nevertheless, more perspicacious observation discerns a truer order, which, apart from the examination of the appearances, the following reasoning also recommends: that the Moon, which lacks a light of its own and borrows from the Sun, is necessarily subordinated ("subjectam") to the source of its light. That the Moon has no light of its own, that all the other planets are seen by their own light, the following explanation accounts for. Those planets above the Sun are located in the purest ether, in which everything whatever is naturally and intrinsically light ("lux"), which, complete with its fire, inclines toward the sphere of the Sun, so that the zones of heaven distant from the Sun are perpetually burdened by cold, as will be shown later on. Indeed, the Moon, since it alone is beneath the Sun and next to the non-luminous realm of transitory things, could have no light if not for the Sun above it, to which it shines back. And so because the lowest part of the whole

> universe is the earth and the Moon is the lowest part of the ether, they call the Moon also an earth but an ethereal one.[21]

Not only Macrobius's short statements about the orbits of the Sun and its "companions" but also his vocabulary and tone throughout the passage demand attention, if we want to understand it fully. He sets a tone by his appellations and prejudicial words in his comparisons of the two points of view. While Plato's predecessors include those (Egyptians) who were the "progenitors of all the branches of philosophy," Cicero's authorities have no such auspicious label. One side of the argument is clever enough to have "grasped and made known the reason why" the other side arrived at its position; only Plato's Egyptians were shrewd enough to do this. On the other hand, Cicero and others following the same view can be forgiven, says Macrobius, for supposing (*existimant*) as they did, for they have not "strayed [too] far from semblance" of the truth. So he explains patiently how the belief in such a *permutatio* ever came about. The way it happened, he says, is by way of the appearances. The appearances result in what we call estimations, judgments, or opinions, to wit, *persuasiones*. But a more intelligent observer will discover a "truer order" than that of the Chaldeans, a "truer order" also reinforced by a proper understanding of the Moon's light. In the face of anything less than direct contradiction, the distinctly biased vocabulary of Macrobius's account should be sufficient to make it clear (1) that Plato's system is to be taken as correct, and (2) that the alternative to Plato's system has "strayed" and is explicable as an opinion based on appearances.

The meaning of the word 'circulus' in this account of the order of the lower planets requires some precision. Macrobius uses 'circulus' to indicate orbit, never epicycle. An epicyclical interpretation would involve a number of unacceptable suppositions. Since he is describing Plato's order, Macrobius would have to have read Calcidius's *Commentary on Plato's Timaeus* and considered Plato's system to use the epicyclical explanations found in that *Commentary*, even though Calcidius does not attribute them to Plato. Also, Calcidius clearly describes Plato's order of the inner planets as Moon—Sun—Venus—Mercury, which is not

[21] CSS 73–5 (I.xix.1–10); cf. ed. Jan, pp. 102–5. I follow Jan's reading here rather than that of ed. Willis. I have disagreed with Stahl's translation, pp. 162–4, at various points.

what Macrobius assigns to Plato.[22] Finally, the reading of Macrobius's 'circulus' as 'epicycle' requires us to assume that his audience, ostensibly his young son, Eustachius, along with a wider, fairly unsophisticated audience (astronomically), would immediately have understood the shift from 'circulus' (orbit) of the Sun to 'circulus' (epicycle) of the planet, even though Macrobius never mentions or explains epicycles as such anywhere in his *Commentary*! Macrobius has no need for epicycles in this account of planetary order, for he is describing what appears to happen, not what the theoretical explanation is. Epicycles do not appear; they are devised.

It is evident that Macrobius says in this text that there are two fixed orders of the planets, the Egyptian and the Chaldean, and nowhere does he introduce any variable order for the planets Mercury and Venus. At the end of his analysis and explanation of the appearances, he introduces a "reasoning" to advance his position on the "truer order" of the planets. This reasoning is that there is no luminary with its own light below the Sun, only the Moon is below the Sun, and among the bodies of the heavens only the Moon has no light of its own. Finally, we have Macrobius's simple and unambiguous description some paragraphs later of what he calls the "order which Plato assigned to the spheres," naming in sequence the planets: Moon—Sun—Mercury—Venus—Mars—Jupiter—Saturn.[23] Unequivocally the order of Plato has Mercury and Venus as planets constantly above the Sun according to Macrobius at any point in his commentary.

The reading of this passage on the Egyptian and Chaldean systems by moderns has not generally followed what we describe here as Macrobius's view. In 1600–01 Johann Kepler set forth in his *Apologia Tychonis contra Ursum* a sequence of pre-Copernican sources for heliocentrism going back to the ancients. Among these sources Kepler listed the *Commentary on Scipio's Dream*, which he considered the key witness in tracing a path from Copernicus back to Plato. Convinced that such connections existed, revealing the hidden truth of Platonic inspiration behind the heliocentrical doctrine, Kepler insisted that Macrobius found a heliocentric pattern for Mercury and Venus in Plato's *Timaeus*.[24] In

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[22] *Timaeus a Calcidio translatus commentarioque instructus*, ed. Waszink (CCT hereafter), p. 148 (c. 96).

[23] CSS 89 (I.xxi.27).

[24] A full discussion of Kepler's arguments for all the authors involved in the

the seventeenth century various astronomers delved into the historical background of heliocentrism, among whom two of the better known were Andreas Argolus and Giambattista Riccioli. Argolus, a professor of mathematics at Padua (1632–57), published a lengthy work in which he adopted as his own the system of Martianus Capella, in which Mercury and Venus revolve concentrically around the Sun, which in turn revolves around the earth.[25] Riccioli, an important Jesuit astronomer and prefect of studies at the Jesuit college in Bologna in the 1640s, produced a monumental work in 1651 in which, among other things, he traced the history of various astronomical doctrines. At one point he included as adherents of the "system of the Egyptians" Vitruvius, Martianus Capella, Macrobius, Bede, and Argolus. Riccioli's diagram of the Egyptian system showed Mercury and Venus on concentric circles around the Sun, and his discussion of the opposing systems of Chaldeans and Egyptians suggests that he had the account of Macrobius in mind.[26] The most familiar scholarly names of the last century to read Macrobius's text as an account of epicyclical Mercury and Venus around the Sun are T. L. Heath and Pierre Duhem, both of whom were following a long line of nineteenth-century investigators of the system of the ancient Heraclides of Pontus.[27] William Harris Stahl, who investigated these assertions carefully, insisted that Heath and Duhem were mistaken in their views of Macrobius's text, although Stahl also supposed that Macrobius was "undoubtedly alluding to the Heraclidean theory" in the text we have been considering.[28] Finally, with regard to any possible reference to a specifically Heraclidean theory of heliocentric Venus and Mercury in late ancient Latin writers like

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pre-Copernican heliocentrical tradition appears in Eastwood, "Kepler as Historian of Science;" see pp. 383–91 for Macrobius.

[25] Argolus, *Pandosion sphaericum* (1644), pp. 10, 14.

[26] Riccioli, *Almagestum novum* (1651), vol. 2, pp. 282–3.

[27] Heath, *Aristarchus of Samos*, pp. 258–9. Duhem, *Le Système du monde*, vol. 3, pp. 51–2. A useful survey of the Heraclidean question, using all the important literature to his time, is by Gottschalk, *Heraclides of Pontus*, pp. 58–87. A detailed revision of the traditional interpretation appears in Eastwood, "Heraclides and Heliocentrism."

[28] Stahl, "Astronomy and Geography in Macrobius," pp. 236–42. See trans. Stahl, *Commentary*, p. 250, for the statement that Macrobius alluded to Heraclides. Armisen-Marchetti, in her edition of *Commentaire au Songe, Livre I*, pp. lxiii, 189, follows Flamant, *Macrobe*, pp. 423–35, in finding heliocentrism in Macrobius and does not review more recent studies.

Macrobius, there no longer appears to be adequate evidence to suppose such knowledge or reference.[29]

4. *Dungal and the Carolingian Revision of Macrobius's Planetary Order*

The Carolingian reading of Macrobius's passage on the Chaldean and Egyptian orders of the lower planets did not follow anything like the post-Copernican interpretation, but there were from the beginning of the ninth century signs that a debate existed over the proper fixed order of these planets. Perhaps the most striking evidence is the canonical diagram for the distribution of the seven planets under the signs of the zodiac, designed to accompany the text of *Commentary* I.xxi.1–7, where Macrobius described how it is that each of the planets, set below the zodiacal band, can be said to travel through that band (Figure 2.4). Almost immediately after this description he pointed out that the order of the planets in this diagram is the same as Plato's, which, he said, he had supported previously (at I.xix.1–10, discussed above).[30] The prescribed diagram appears in seven of the surviving ninth-century manuscripts of Macrobius's *Commentary*, both excerpts and complete texts, and in every example the planetary order is the Chaldean rather than the Egyptian order (Figure 2.5). Furthermore, instead of distributing the planets individually under the circle of signs of the zodiac, every one of these ninth-century diagrams locates them all under the sign of Aries, which emphasizes the order of the planets and defeats one of the original purposes of showing the placement of each planet under a separate sign. The reader simply sees a set of concentric circles, from the central earth out to the stellar sphere, with the seven planets in a fixed, Chaldean order. One of the earliest of these extant manuscript diagrams was inserted after the year 820 into the space left

[29] I believe I have argued this position successfully both with regard specifically to the views of Macrobius and generally with regard to the existence of any reference to such a Heraclidean hypothesis in any ancient writer; see my articles cited above in nn. 24, 27.

[30] In short, Macrobius thoroughly and consistently argues for the Platonic order, placing Mercury and Venus above the Sun. See CSS 84–6 (I.xxi.1–7), 89–90 (I.xxi.27: "…in genitura mundi…ordinem…quem Plato adsignavit sphaeris…, ut esset luna prima, sol secundus, super hunc Mercurius, Venus quarta….sed sine huius tamen rationis patrocinio abunde Platonicum ordinem prior ratio commendat.").

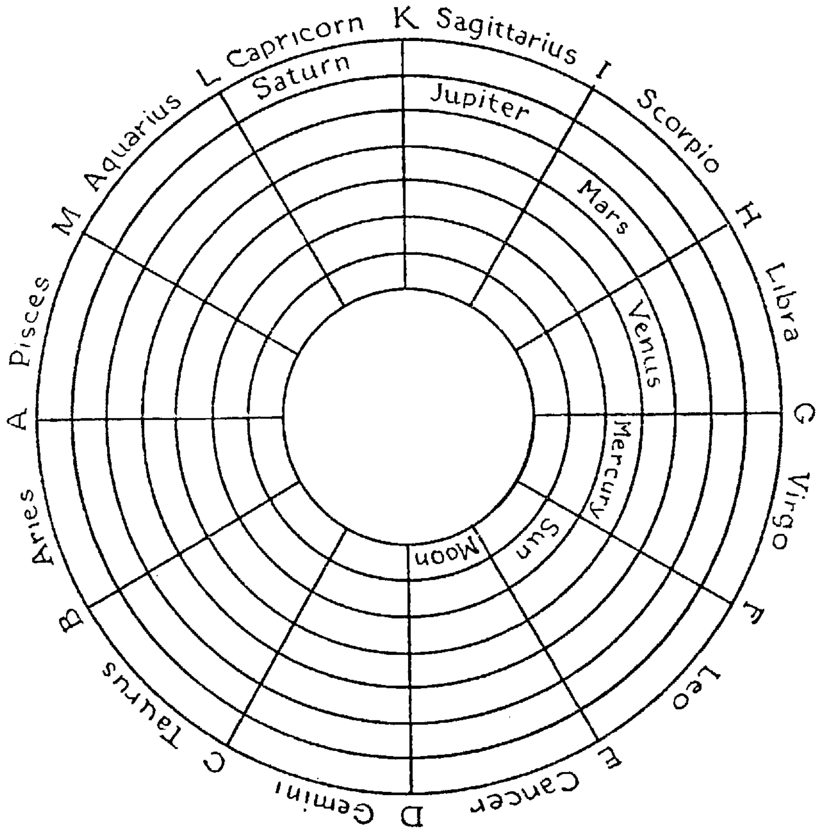

Fig. 2.4. The Macrobian Framework. Macrobius, *Commentary*, trans. Stahl, p. 175

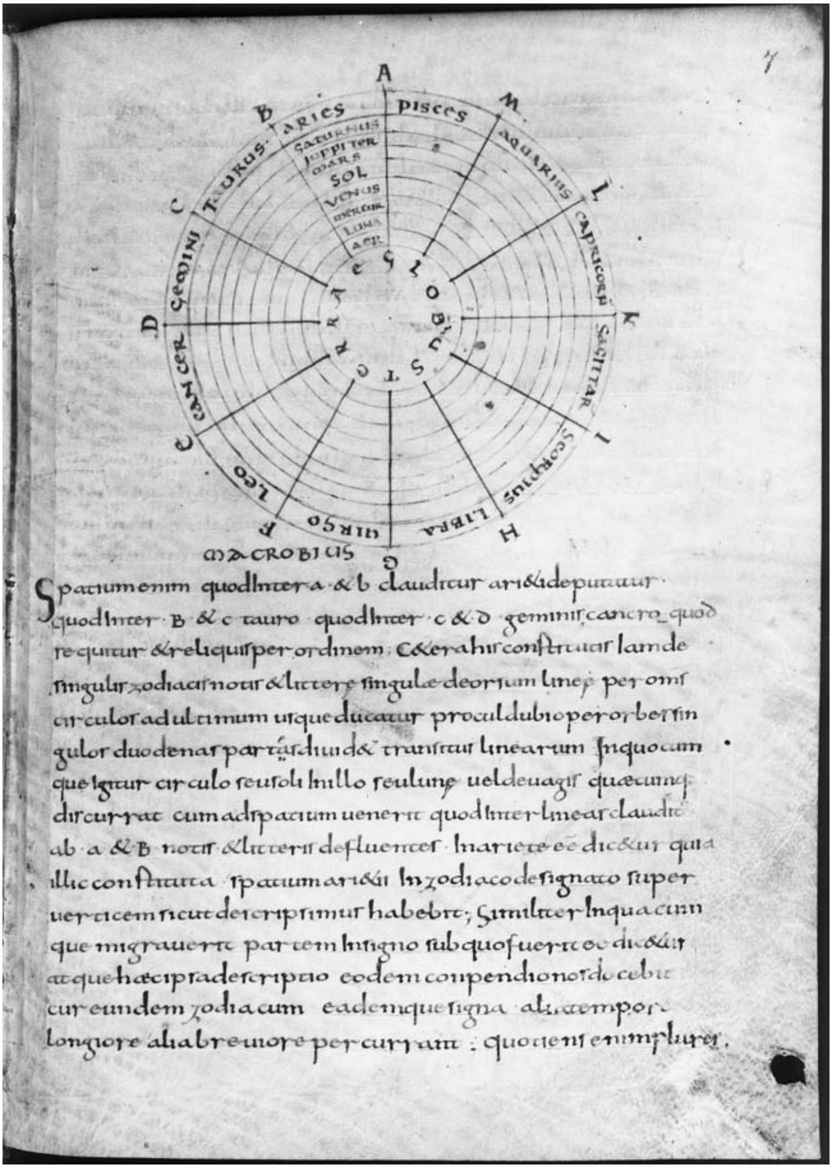

Fig. 2.5. Plinian Planetary Order (supported by Dungal). Berlin, Staatsbibliothek zu Berlin—Preußischer Kulturbesitz, Handschriftenabteilung ms. Phillipps 1784, f. 7r

by the scribe.[31] The manuscript itself probably came from Tours, and its primary corrector and supervisor for the addition of the diagrams was Servatus Lupus at Ferrières (ca. 805–862).[32] Lupus' work with this manuscript of Macrobius seems to have occurred after 840, and later corrections to it were made by Lupus's student, Heiric of Auxerre (841–ca. 880).[33] We today are left to ask how this clear contradiction between text and diagram occurred.

A solution to the mystery of this planetary diagram—we should remember that it is the only version that Carolingians provided for this text—comes from the earliest known user of the text, the Irish monk Dungal.[34] Dungal, who had been *famulus et orator* at the royal court, was at the abbey of Saint Denis in 811 when the abbot, Waldo, received a letter from Charlemagne asking that Dungal explain to him how two eclipses of the sun might have occurred in the previous year. There is no evidence that the king or any of his subjects claimed to have observed both events. Only the second of the two, on 30 November, was widely observed and recorded in Western Europe. The news, or at least the claim, arrived by way of a bishop from Constantinople, and we have no further knowledge of the situation.[35] In replying to Charlemagne's

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[31] Paris 6370, f. 61v, copied ca. 820, shows this early example. The other, similar examples from s. IX are: Berlin Phillipps 1784 (Rose 177), f. 7r; Bern 347, f. 9r; Cologne 186, f. 98v; Paris 16677, f. 37v; Paris nal 454, f. 52r; Vat. Regin. 1762, f. 184r. We should add that 13 mss. of *Commentarii* with the diagram of planetary order survive from s. X–XI (1/2), and all but one of these diagrams present the same unambiguous Chaldean order. The sole dissenter, with Egyptian order, may have been labeled by a later hand; see Los Angeles, Getty Museum, Ludwig XII.4, f.12v.

[32] Barker-Benfield, "Macrobius," pp. 225–7. See Caiazzo, *Lectures*, pp. 18–19, for further details and reference to the excellent but unpublished 1975 dissertation of Barker-Benfield.

[33] Bischoff, *Manuscripts and Libraries*, pp. 125, 133. On Heiric, who studied under Lupus from 859 to 862, see Quadri, *Collectanea di Eirico*, pp. 3–28.

[34] Bibliography on Dungal can be found in Lapidge and Sharpe, *Bibliography of Celtic-Latin Literature*, p. 173. A full account of Dungal's relevant, astronomical letter appears in Eastwood, "The astronomy of Macrobius."

[35] MGH *Epistolae*. Vol. 4, pp. 570–8, esp. 570; also, from a now lost manuscript of St. Remigius of Reims, printed in PL 105, coll. 447–58, esp. 448–9. There has been a certain amount of discussion of this report and the eclipses of 810. Newton, *Medieval Chronicles*, pp. 595–6, discusses reports in annals of Lorsch (written ca. 829) and of Gottweig (written ca. 1054), which he took to be for the penumbral eclipse of 5 July 810 (invisible in Europe, visible no closer than Iceland) though reported as 7 June 810, along with that of 30 November, which he lists at pp. 257–8, 382, 387. For the report of these eclipses see *MGH Scriptores*, vol. 1, ed. Pertz, p. 198, where the editor points out that 8 mss. give 7. id. Iun., 6 mss. give 8. id. Iun, and only 2 mss. give either 7. id. Iul. or 8. id. Iul. for the first of the solar eclipses. Cf. McCluskey, *Astronomies and Cultures*, pp. 133–4, who takes pains to remind us, "Dungal and his

inquiry, Dungal used Macrobius's work to compose an introduction to planetary astronomy so that he could explain the motions of the Sun and Moon in some detail and added important relevant Plinian doctrines. As part of this introduction Dungal invoked the Chaldean order of the planets and excerpted the text of the *Commentary* in such a way as to make the Egyptian order seem weaker than its opponent.

Dungal did not refer to a diagram, but it seems that, if he had a copy of the text with a diagram, it would have been like the ones appearing in all ninth- and tenth-century manuscripts surviving today.[36] But can we safely say this? Here we find a pair of tantalizing questions. Did Dungal—his letter was copied, expanded with excerpts and diagrams, and very soon circulated as a text to be studied—adopt the Chaldean order because he saw it in a diagram attached to Macrobius's text, thus following a distortion of unknown origin? Or did he believe Macrobius to be wrong and in need of correction by the superior knowledge of Pliny the Elder, who supported the Chaldean order, and so create an interpretation of Macrobius that held sway and informed the diagrams for Macrobius's *Commentary* for the next two centuries and beyond?

Was Dungal a revisionist with regard to Macrobius's text? One way or another, the answer is 'yes.' Either he revised the text and its meaning on the basis of a prior diagram which represented the Chaldean (and Plinian) order of the planets, or he simply chose to revise the clear sense of Macrobius's text in favor of the preferred view of Pliny and thereby persuaded contemporary Carolingian readers, scholars, and teachers to insert a Plinian (Chaldean) order into the diagram prescribed by Macrobius, thus disregarding the Platonic order preferred in the text. We know from Dungal's letter how he chose to interpret Macrobius

contemporaries did not know the kind of [spherical] geometry that could have been applied to these problems [of predicting eclipses]" (p. 134). In PL 105, coll. 447–8, the edition of Luc d'Achery (based on a transcription by Mabillon) appends a critique of Dungal's calculation by the seventeenth-century savant Ismael Bouillau, who points out that Dungal's calculated eclipse of 7 June (actually 5 June) could only be seen in the southern hemisphere. None of these sources notices that Dungal's information about the earlier eclipse came from a bishop from Constantinople and was probably the result of computation. The nature of the information preserved by Dungal would allow that the Constantinopolitan bishop told the king no more than that two solar eclipses had occurred according to mathematical calculation, which Byzantine scholars of the time could easily have provided. Regarding the Byzantine embassy of 811(?), see below, p. 125, n. 47. There is no claim in Dungal's letter that the earlier (calculated) eclipse was observable in Europe. For more on this calculation of an earlier solar eclipse, before 30 November in 810, by Dungal, see below, pp. 175–7.

[36] See above, n. 31, for details on these mss.

on this matter. He excerpted parts of the text of *Commentary* I.xix.1–10 at two different points in his letter of response. He began by stating as fact the order placing Mercury and Venus between the Moon and the Sun. Next, using an excerpt, he immediately linked Cicero with Archimedes and the Chaldeans, likewise Plato with the Egyptians, and repeated in support of Plato only the reasoning that all sub-solar bodies differed from the Sun and the bodies above it.

> In the first sphere of seven is the planet Saturn, in the second Jupiter, in the third Mars, in the fourth and middle the Sun, in the fifth the planet Venus, in the sixth Mercury; the seventh, which is last and lowest, has the Moon. Thus says Cicero, with whom the viewpoint of Archimedes and the Chaldeans agrees. Plato states that the Sun holds the second position from the Moon upward, that is, the sixth place among the seven from the top down, following the Egyptians, founders of all branches of philosophy, who considered the Sun to be positioned between the Moon and Mercury. However, although the opinion supported by certain statements and credible reasons of Cicero and its authors has gained strength and has been accepted almost universally, nevertheless the shrewder perception of Plato seems to have discovered a truer order, which, apart from the examination of the appearances, the following reason also recommends: that the Moon, which lacks a light of its own and borrows from the Sun, is necessarily subordinated to the source of its light. This reason requires the Moon to have no light of its own and all the other planets to shine by their own light, for those located above the Sun are in the purest ether, in which everything whatever (as I might say in the words of the philosopher), is naturally and intrinsically light, which, complete with its fire, inclines towards the sphere of the Sun, so that the zones of heaven distant from the Sun are perpetually burdened by cold. Indeed, the Moon, since it alone is below the Sun and next to the non-luminous realm of transitory things, could not shine.[37]

What Dungal omitted in this excerpt were both the explicit support of Macrobius for the Egyptian order and Macrobius's reasonings, pro and con, about certain appearances of Mercury and Venus that seemed to favor the Chaldean order but did not adequately do so. Dungal thereby allowed only a weaker support for the Platonic order to remain in his excerpt. At the second point where he referred to this controversy of planetary order, Dungal was following Macrobius's explanation of orbital times based on orbital size, at which point the recitation of the

[37] Dungal, MGH *Epistolae*, vol. 4, pp. 571.29–572.4; PL 105, col. 450 A–C. The excerpts are from CSS 73.17, 73.15–16, 73.18–20, 74.20–75.22 (I.xix.2, 1, 2, 7–13). Cf. Macrobius's text, translated above, pp. 37–40.

times of the planetary orbits was immediately qualified by Dungal's insertion of a passage that stated Cicero's argument for the Sun as 'middle' in the planetary order in terms of number even though not in terms of distance. Cicero, as reported by Macrobius, had clearly set the Sun as fourth in the sequence of seven planets, and Dungal manipulated this quotation to make it seem that Macrobius agreed with Cicero's argument. In the following translation from Dungal's letter, a double diagonal line shows where he omitted several crucial lines that showed Macrobius's actual view.

> From Saturn's sphere, which is the first of the seven planets, as far as the sphere of Jupiter, there is such an interval of space that the higher planet completes a course around the zodiac in thirty years which the lower one completes in twelve. Again, the sphere of Mars is so far from Jupiter as to travel the same course in two years. And now Venus is by so much the inferior of Mars that one year suffices for it to pass through the zodiac. Now in fact, the planet Mercury is so near Venus, and the Sun so near Mercury, that these three circle through their heavenly realm in the same interval of time, that is, in a year more or less. And so Cicero called these two coursers the companions of the Sun, because in the same interval they never withdraw far from each other. The Moon fell so far below these that it covered in twenty-eight days what they did in a year.// But when Cicero wished the Sun to be fourth among the seven planets, fourth among the seven is not approximately ("fere") the middle but is precisely and in every way the middle of seven, he did not say simply 'Sun in the middle' but rather 'approximately the middle' ("fere medium") in these words: 'Next among the seven, the Sun holds approximately the middle region.' The added word qualifying this statement is not pointless; while the Sun holds the fourth place, it occupies the middle region numerically, but not in distance ("spatio").[38]

On the basis of texts alone we can see that Dungal knew the text of Macrobius's *Commentary*, as he copied many passages from it verbatim, and that he chose and arranged these passages to reverse Macrobius's meaning and to hide the preference for the Egyptian order of the planets.

What do we know about Dungal's awareness or use of Macrobian diagrams? The surviving manuscripts of Dungal's letter of 811 to Charlemagne should be our best evidence for an answer to this question.

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[38] Dungal, MGH *Epistolae*, vol. 4, p. 574.6–18; PL 105, col. 453 B-C. Here Dungal places CSS 73.24–74.4 (I.xix.3–5) in immediate sequence with CSS 75.28–76.3 (I.xix.14–15), carefully deriving a pro-Ciceronian planetary argument from Macrobius.

The earliest of these, from the first half of the ninth century, already shows the addition of other excerpts to Dungal's letter, some being further choices from Macrobius, others from Bede's *The Nature of Things* and Isidore's *Etymologies*.[39] Dungal's letter itself ignored Macrobius's description of the diagram of the seven planets placed under the signs of the zodiac. In this earliest manuscript we find the relevant text and its diagram appended to the letter. And the diagram is fully in accord with the other Carolingian manuscripts showing Macrobius's text and diagram, i.e., a diagram of the Chaldean—Ciceronian (and Plinian) order of the planets.[40] This diagram-with-text for planetary order, not part of Dungal's letter but added to it and including the Macrobian text describing the diagram's framework in detail, follows a strategy parallel to that of Dungal in his choice of excerpts regarding planetary order. The accompanying excerpt from Macrobius (I.xxi.3–7) sets out only the following elements: an outer circular band for the zodiac, divided into twelve equal segments, within which are inscribed concentrically seven circles to hold the seven planets in order and the earth in the central circle. This excerpt does not prescribe the planetary order itself, which is not found until much later in the chapter (I.xxi.24–27). The director of these early additional excerpts from Macrobius chose only enough text to give a background for the planetary order and then imposed the same order that Dungal's letter provided, placing the Sun in the middle of the sequence of the seven planets, with Venus, Mercury, and Moon below it in that order. How early was this diagram designed? Did it precede the known diagrams for the full work of Macrobius?

The earliest extant planetary diagram for Macrobius's complete *Commentary*, as we remarked above, was copied into a Tours manuscript within a space left for the diagram, under the direction of Lupus of Ferrières at his own scriptorium after receiving the manuscript from

[39] Berlin Phillipps 1784 (Rose 177), ff. 13, has Dungal's letter broken into four parts out of sequence. Additionally it has excerpts from *Commentarii* I.xxi.3–7; II.v.13–14, 16–21; II.vii.1–4; from Bede, DNR 9; from Isidore *Etymologiae* III.lviii–lix, and l.1.

[40] Phillipps 1784, f. 7r. London Royal 13.A.XI, ff. 120r–132r (s. XI ex./ XII), contains at f. 127r the Macrobian diagram with the Chaldean order; the ms. has the same excerpts from Macrobius plus one more. Monza C–9/69, ff. 55r–63r, s. X(1/2), contains Dungal's letter in proper sequence, not broken up as in the above two mss., with the same additional excerpts found in Phillipps 1784; this ms. has the same Macrobian diagrams found in the Phillipps ms. Two notices of the London ms. copy of which I was unaware in 1994 (above, n. 34, art. cit., p. 133–4) are by Stevens (Rabanus Maurus, *Martyrologium, De computo*, p. 171) and Ferrari ("La biblioteca de monastero di S. Ambrogio," p. 100).

Tours, probably ca. 840 or later.[41] The study and copying of the *Commentary* in the ninth century took place in the leading centers of northern France, including Tours, Fleury, Corbie, and Auxerre.[42] What exemplar did Lupus have for this diagram? Why did he employ a diagram that contradicted the text of Macrobius to which it was attached? What was the influence of Dungal's letter and the planetary diagram already attached to expanded copies of it by the time Lupus added such a diagram to his manuscript of Macrobius? In trying to understand and answer these questions we must remember that we have no surviving copies of the Macrobian diagram earlier than the ninth-century manuscripts we have already cited. Nor have we any indication that a corrupt textual tradition of Macrobius might have inspired the diagrams picturing the Chaldean order. Dungal's letter and the diagram subsequently appended to it offer our only positive evidence of an intention to revise the text and doctrine of Macrobius. While less than certain, a reasonable conclusion seems to be that Dungal's letter, solicited by the emperor, immediately achieved high status and was copied and enhanced by additional excerpts and diagrams. These made it a worthy educational text, appropriate for use in teaching many of the elements of cosmology and qualitative astronomy. Carrying the imprimatur of a text requested by Charlemagne as well as the repute of so notable a scholar as Dungal, this text with diagram had the advantage also of showing how Macrobius could be made to agree with the generally reigning planetary order of Pliny the Elder, which put Mercury and Venus in fixed positions below the Sun.

Reviewing the complete picture, we can say that the diagram of the Chaldean—Plinian order makes very good sense in the context of the early ninth century, when Dungal was writing to Charlemagne. There are two fixed orders involved. We have no evidence of so early a use of either Martianus Capella's work or that of Calcidius for astronomical teachings, and these two sources are the only ones that could have provided explicit accounts and justifications of heliocentric or epicyclic paths for the planets Venus and Mercury. They could be used later. Furthermore we have the interesting evidence of the Theoprotus gloss to Macrobius's *Commentary*, composed ca. 880–890, in a manuscript from

[41] Paris 6370, f. 61v. On the ms. and its diagrams, see Barker-Benfield, "Macrobius," pp. 225–7, and Bischoff, *Manuscripts and Libraries*, pp. 125, 133.

[42] Barker-Benfield, "Macrobius," pp. 225–8.

the end of the century, where Dungal's diagram is the image representing planetary order while the gloss notes marginally "when" ("quando") the Sun appears below Mercury and Venus and, subsequently, "how, truly" ("quare vere") the Sun stands next beyond the moon in accord with the Egyptian planetary order. Regarding the order of the planets, this Carolingian set of glosses followed the narrow path of explicating only what the text of Macrobius said and did not attempt to explain the apparent contradiction in the text or the diagram appearing in the manuscript.[43] Pliny's *Natural History*, an established authority, clearly adopted a fixed, Chaldean order. Macrobius himself reported that most authorities follow the Chaldean order. The viewpoint common to Dungal and the Macrobian diagrams of planetary order in the Carolingian manuscripts was clear: while it was acceptable to preserve the knowledge of Plato's Egyptian order, it was important to show that Macrobius approved of the correct order—the Chaldean, or Plinian, planetary order. Dungal and his successors did this. The Chaldean order remained the rule in the diagrams for planetary order in Macrobius's *Commentary* for at least two hundred years. The story of Dungal's reinterpretation of Macrobius is a nice example of Carolingian concern to rationalize disagreements in doctrine about the natural world and to establish a unified authoritative teaching.

5. *Macrobius: the Earth as the Center of Weight—the Rainfall Diagram*

There are other diagrams prescribed in Macrobius's *Commentary*, which do not deal with the planets but do contribute to a sense of the physical centrality of the earth and the concentric order of the surrounding celestial world. The diagram for the courses of the planets through the zodiac, especially as revised by either Dungal or another Carolingian with similar views, exhibits quite a lot of basic cosmological structure. The twelve signs of the zodiac in their sequential positions in the heavens, the concentricity of this zodiacal band (at the cosmic outer limits) with all the planetary circular paths below and the earth, the specific order of the planets from the earth to the sphere of fixed stars

[43] Bruxelles 10146, f. 135v, has the Macrobian diagram according to Dungal; the two marginal glosses appear at f. 67v ("Nota. Quando…") and f. 68r ("Quare vere…"). Caiazzo, *Lectures*, pp. 52–54, provides information on the Theoprotus gloss, based on the research of White, "Glosses in manuscripts of Macrobius."

(represented by the zodiac), and even an aesthetic sense of a stable and almost solid support of the heavens by the vertical column of planetary names between Aries and the earth—all these elements of the diagram create an image of clarity, continuity, order, and dependability. Three other diagrams described by Macrobius offer further elements of cosmological order. These are (1) a diagram emphasizing the physical centrality of the earth, (2) the climatic regions of the earth, and (3) the zones and circles of the celestial sphere, symmetrical with terrestrial circles and zones. The second and third of these diagrams appear as attachments to the letter of Dungal in its subsequent life as an introductory text for cosmology and astronomy. They accustomed readers without a background in astronomy to the constant framework of concentric circles as an ordering principle in descriptions of the heavens. The diagrams of Macrobius had special appeal as tools for visual instruction.

At the end of the first book of the *Commentary* Macrobius proposes to show that all bodies with weight fall towards the center of the world, and that the cosmic pattern of rainfall is a convincing evidence for this. Having repeated the traditional view that the earth is central and made up of the heaviest matter, surrounded by a region of air and water within the lunar sphere, which is the boundary of changeable and imperfect matter, he offers a diagram that shows the result of rejecting the doctrine that all bodies fall to the central earth. The picture, or diagram, presents an argument based upon the absurdity of the stated conclusion in order to show the error of the initial assumption (Figure 2.6). First Macrobius tells us that rain, formed by chilling of the air, falls on almost all parts of the spherical earth. "From all quarters it drops upon the earth, which is the only resting place for objects possessing weight," he writes.[44] Anyone disagreeing with this view of the direction of fall of weighty bodies would presumably argue that the rain should simply fall 'down,' meaning down in perfectly parallel lines. The picture offered by Macrobius shows clearly what is wrong with this presumption. It requires that all rain falls in the same absolute direction, not relative to the earth. Thus, according to this view, any rain that falls from 'above' the earth and from regions on either side beyond the earth's diameter would fall 'down' past the earth and to the outer, celestial sphere, which is, Macrobius says, more stupid than

[44] Macrobius, *Commentary*, trans. Stahl, p. 183; CSS 92.32–93.5 (I.xxii.9).

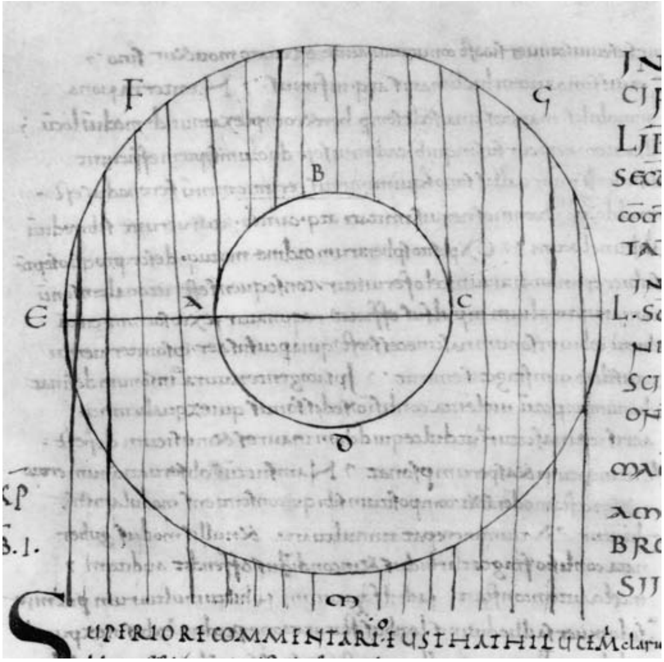

Fig. 2.6. The Correct Rain Diagram. Paris, cliché Bibliothèque nationale de France ms. nal 454, f. 56r

a bad joke.[45] For its author this argument for the absurdity of such rainfall going past the earth to the celestial sphere must have seemed forceful and conclusive. For Carolingian excerptors the use of a negative rather than a positive argument did not have sufficient power and may even have seemed confusing. Alone of these three diagrams of Macrobius, this one was omitted from the additions to Dungal's letter, and the diagram soon encountered difficulties in its own right. It came to be reproduced incorrectly, beginning with the copy by Lupus of Ferrières.[46]

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[45] "...quod vilitatem ioci scurrilis excedit." CSS 93.13–14 (I.xxii.10).

[46] Lupus's copy of the rain diagram, in Paris 6370, f. 68r, is incomplete, has an erroneous label on one band, and does not assist the argument of the text. Bruxelles 10146, f. 85r; Paris 16677, f. 41v; and Vat. Regin. 1762, f. 187v; have incorrect diagrams. The ninth-century copy of the diagram in Paris nal 454, f. 56r, is correct. The later history of the diagram shows frequent carelessness or misunderstanding, recorded by Murdoch, *Album of Science*, pp. 282–3; for further comment on this diagram, see Eastwood, "Medieval Science Illustrated," pp. 191–3, with reproductions of the diagrams in Paris 16677 and Paris nal 454.

6. *Macrobius and Dungal: Correspondence of Terrestrial and Celestial Zones*

If the diagram for the earth's centrality amid weighty matter failed to offer a direct enough pictorial instruction, the following pair proved more attractive and successful. They set forth the parallel between the zones of terrestrial climate and the demarcations of celestial regions. Carolingian copyists preserved these two diagrams in the fuller texts of Macrobius's commentary, and they appear repeatedly in the manuscripts of Dungal's letter along with descriptive excerpts as complements for an ordered picture of the world. This ordered picture gives as well an architectural framework within which the fundamentals of astrology can be fit and make sense.

The first of these two diagrams divided the earthly sphere into five bands of climate from north to south (Figure 2.7), while the second laid out in detail the correspondences between these bands and the six zones of the heavens (Figure 2.8). In each diagram a reader finds the two circles of arctic and antarctic limits and the two circles for the tropics of Cancer and Capricorn. In the second diagram, the equator is added, having been omitted in the former because it is not needed to delimit the central torrid zone of the earth, covering the whole region between the two tropics. Initially, in the first diagram, details are given about the widest, hot zone, the two cold and the two temperate zones. Macrobius devotes great attention to the symmetries in this image. Thus, for us living in the northerly temperate region, between the artic circle and the tropic of Cancer and separated by the adjacent torrid zone from the southerly temperate band, it is important to recognize that this southern temperate zone has a climate similar to ours and even similar lands and physical conditions for the human beings who must surely live there. This lengthy discussion by Macrobius affords a convenient introduction to and justification for the existence on the earth of unknown humans, whom we never see because of the central torrid zone and because of the spherical distribution of lands and peoples. These undiscoverable peoples are generally referred to as Antoeci (in the temperate zone directly below us and separated from us by the torrid zone) and Antipodes (in the temperate zone diametrically opposite us). This whole discussion is couched in a tone of reasoned order: whatever we experience in our part of the northerly temperate zone should be expected in the diametrically opposed part of the southerly zone; just as we look up towards stars with our feet towards the earth's center, so should there be persons with the same experience in that opposed part

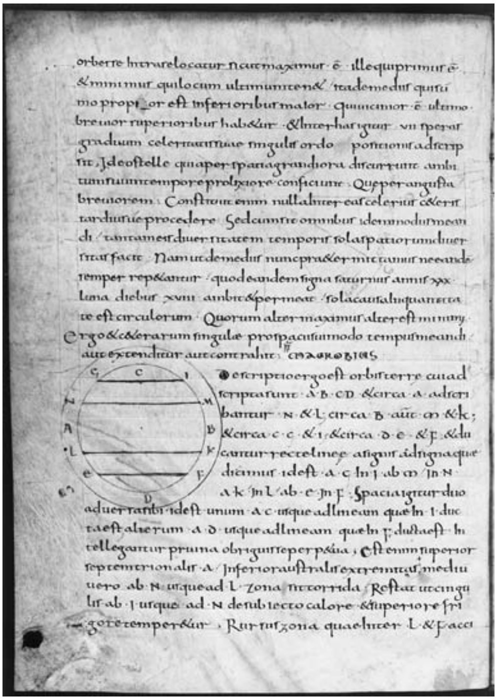

Fig. 2.7. The Five Climatic Zones. Berlin, Staatsbibliothek zu Berlin Preußischer Kulturbesitz, Handschriftenabteilung ms. Phillipps 1784, f. 7v

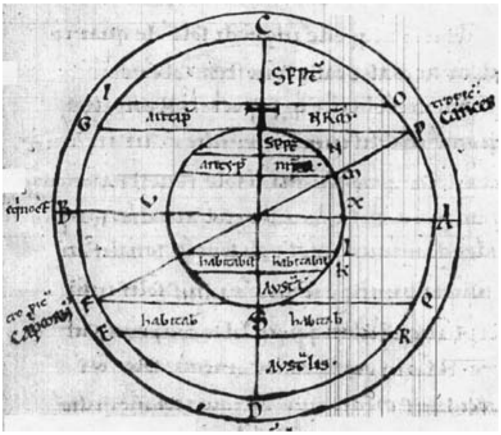

Fig. 2.8. Terrestrial and Celestial Correspondences. London, British Library ms. Roy. 13.A.XI, f. 123r

of the earth, and the persons in such locations will consider the stars which they see on the part of the stellar sphere opposite ours to be 'up' above their heads. Here again, as in the account of the meanings of 'up' and 'down' leading to the rain diagram, Macrobius provides a spherical cosmology that privileges no part of the globe, simply showing the sequential order of climatic bands and the similarities of spherically opposed positions.

The full text of Macrobius regarding climatic zones offers a varied fund of cosmological data and speculative doctrine, whereas the excerpts selected and appended to Dungal's letter in the first half of the ninth century carefully limit and simplify their source. The diagram of the five zones in the Dungal addenda copies the image of Macrobius and is followed by his detailed instructions for drawing and labeling the diagram. The excerpt next presents the reasoning from symmetry that the southern temperate zone is inhabited and then goes on to discuss the vocabulary for the south polar region and the effects of winds blowing from the north and south poles upon inhabitants of the southern temperate zone.[47] The same essential points are made in both source and excerpt, but the excerpt selects the term carefully and focuses more directly on the existence of humans—*homines*, not simply inhabitants—whom we know nothing about because of their location in the southern temperate zone. This focus may have derived from distinctively Irish interests. While neither Macrobius nor the Carolingian excerptor proceeds to discuss the implications of the existence of such persons, the repetition of this teaching would clearly attract attention and debate by anyone noticing that these inhabitants of the southern zone could not have access to the salvation promised by Christ, since they could

[47] The diagram and excerpt from CSS 112.4–17, 112.22–113.22 (II.v.13–14, 16–21) appear in mss. of Dungal's letter as follows: Monza c–9/69, f. 61ra–va; Berlin Phillipps 1784 (177), ff. 7v–8v; London Roy. 13.A.XI, ff. 127v–128v. In the first two (and earlier) of these, the letters NL (or NAL), marking the torrid zone, appear on the left side of the diagram; in the last, these letters appear on the right side just as they do in most of the full copies of Macrobius's text, including the early example in Paris 6370, f. 81r (NAL on the right). A much longer set of Macrobian excerpts from s. IX(3/4) in Bern 347 contains at f. 17v the climatic zone diagram with the letters NBL on the right and MAK on the left. The Macrobian diagrams in the Bern ms. show affinities with those of Lupus of Ferrières in Paris 6370. Cf. CSS 165, for the diagram according to the edited text, with the letters NAL to the right and the corresponding letters MBK to the left.

not know of his coming into the world. Rejections of this possibility by Saint Augustine and others occurred a number of times.[48]

Although the excerpts attached to Dungal's letter set forth, in conjunction with the letter, a very spare sketch of Macrobian cosmology, omitting numerical information, doctrine, and ideology almost completely, their focus on information connected with Macrobian diagrams provided coherent and interrelated teachings. Macrobius described the dimensions of each of the climatic zones in his diagram, but the excerpt omits this, perhaps tacitly recognizing some potential confusion and retaining sole emphasis on the radial order of the terrestrial sphere.[49]

The next topic and diagram completes the image of a zoned earth modeled on the pattern in the heavens (see Figure 2.8). Here we can benefit from a closer look at the excerpts added to Dungal's letter, itself a combination of excerpts from Macrobius with Dungal's artful weaving of them together to create a brief introduction to planetary astronomy in order to discuss eclipses. In Macrobius's complete work, the account of corresponding zones on earth and in the heavens is only part of a larger canvas that portrays the limited dry lands of the earth in contrast to the vastness of the sea, which, when combined with the vastness of time that the earth has existed, reduces individual humans to minimal importance; this is the message of *Scipio's Dream* that Macrobius seeks to elaborate. However, in the addenda to Dungal's letter, it is the excerpt on the corresponding zones of earth and heaven

[48] This was the objection raised by St. Augustine (*The City of God* XVI, 9) to the existence of such persons. Bede (DTR 34) and Isidore (*Etymologiae* IX.ii.133) questioned and denied the actual human habitation of the antipodes. The often noted case of the Irishman Vergil of Salzburg, supposedly accused (in 748) of heresy for such a belief, offers an example of more adventurous thinking. See Laistner, *Thought and Letters*, pp. 184–5; Carey, "Ireland and the Antipodes," esp. nn. 6, 8; Carey was not aware of the Carolingian excerpting of Macrobius's doctrine on this matter. See as well Caiazzo, *Lectures*, p. 32, n. 5. Also Smyth, *Understanding the Universe*, pp. 285–90, for various interpretations of the Irish belief in humans 'under' the earth. A useful introduction to the anthropological and theological views of the Middle Ages on Antipodeans and other marginal/fabulous peoples is Friedman, *The Monstrous Races*, p. 39 for Macrobian climatic zone maps; pp. 11, 12, 17, 47–8, 183 for Antipodes; pp. 188–190 for Ratramnus of Corbie's views on a different marginal and questionably human race.

[49] CSS 116.15–117.3 (II.vi.2–5). The numbers given by Macrobius place the celestial arctic circle at 54° lat., which would locate the viewer at 36° N. lat., appropriate for Rhodes. At CSS 118.2 (II.vii.4), Macrobius makes unequivocally clear that the boundary of the frigid zone is defined by the celestial arctic circle, which, if defined as the limit of never-setting stars, changes with one's latitude; this is not possible for the frigid zone as defined at II.vi.5, since it is said to be 25,200 stadia wide from south to north.

that stands as the final, capping statement of the sequence of texts. What does this mean?

Dungal's letter contains five parts, addressing the following points: (a) the sequence of the planets from the celestial to the terrestrial sphere, (b) the movements of the planets in their orbits, (c) the speeds of the planets, (d) the latitudinal movement of the planets in the zodiac, and (e) the predictions of planetary positions in the future. These points precede his explanation to Charlemagne how two eclipses can occur in a single year. That explanation closes his letter, and the first additions to it are three brief texts from Isidore of Seville that define schematically, first a solar eclipse, next a lunar eclipse, and last the necessity that the Sun move independently of the stellar sphere in order for us to have changing lengths of day and night and by implication the seasons of the year.[50] These Isidorean elements fit well with the concern of Dungal's letter to expound basic planetary astronomy, preliminary to answering Charlemagne's question.

The next excerpt comes from Macrobius (I.xxi.3–7), describing, as we have seen, the diagram for the planetary order enclosed by the stellar sphere, which holds the circle of zodiacal signs. The diagram is reconceived in accord with Dungal's revision (in his letter) of Macrobius's text on the topic of planetary order. Immediately following this are the two cosmographical excerpts from Macrobius regarding the earth's climatic zones (II.v.13–14, 16–21), first the description of the diagram, then the discussion emphasizing the habitation of both southern and northern temperate zones. After this appears an excerpt from Bede that provides fuller vocabulary defining the five climatic zones; this text is the purely descriptive one from Bede's DNR rather than Bede's attack on the notion of an inhabited southern temperate zone in his DTR.[51] Thus far, the collection of additional excerpts has supported Dungal's letter and added the new theme of celestial-terrestrial correspondence that leads to affirmation of the existence of humans in the southern region that Europeans are unable to visit. If the excerpts were to go no further, we would be left with a tantalizing suggestion about unknown dwellers on the opposite hemisphere of our earth. But the final excerpt, also from Macrobius, is much longer than any of the preceding ones

[50] Isidore, *Etymologiae*, III.lviii–lix.1–2; III.l.1.

[51] Bede, DNR 9, ed. Jones, pp. 199–200. See above, n. 48, for Bede's denial of an inhabited southern temperate zone.

and discusses extensively the correspondence of celestial and terrestrial zones, the causal connections between the heavenly zones and their underlying zones of the earth, and a host of general and specific results that we recognize on the earth. Twice in this discussion we find the dwellers of the southern temperate zone mentioned explicitly; they are simply assumed to exist and seem part of any complete cosmographical picture. Indeed, their existence enhances the reasoned nature of the symmetrical cosmic spheres in the diagram. And at the opening and ending of this lengthy excerpt comes a literary theme with nice rhetorical effect, that Vergil's works, which agree here with Cicero's, contain no error ("...Maro dixerit, quem constat erroris ignarum..."), suggesting once more the truth of what Macrobius (likewise his excerptor) has written.[52] As for the intent of the Dungal addenda, it becomes clear to the reader that this controversial view, advanced by Macrobius, is being singled out and recommended as good cosmological doctrine because of its reasoned basis in cosmic symmetry.

7. *Did Dungal Choose the Additions to His Letter?*

When Dungal wrote his reply to Charlemagne's inquiry about the possibility of two solar eclipses in one year as had been reported, specifically the year 810, he used Macrobius's *Commentary* extensively and almost exclusively as his source for basic astronomical doctrine to support an answer to the question. Dungal did not include diagrams in his reply, presumably because this would be inappropriate for epistolary writing and also because it would seem unduly pedantic—hardly a sensible tactic in writing a letter to the emperor of the West and his court. However,

[52] CSS 117.18–122.27 (II.vii.1–II.viii.8) for the full text of the excerpt. Dwellers of the southern temperate zone are mentioned at 119.13 (II.vii.11)—"australi generi"—and at 121.33 (II.viii.4)—"antoecorum". In the earliest surviving mss. of the Dungal addenda, these two references appear at: Berlin Phillipps 1784, f. 4v,15, and f. 5v,26; Monza c–9/69, f. 62rb,23, and then an omission at f. 63ra,36, where the text jumps from "tantum spatii ex perustae" to "tantundem spatii." In the latter, tenth-century ms., it seems unclear whether or not this omission was an attempt (by one copyist only) to avoid the doctrine involved, but this seems unlikely, given the inclusion in the ms. of the same teaching earlier, especially the full attention to it in the excerpt on the five climatic zones; see the Monza ms. at f. 61rb,5–7, and f. 61v,5, for the references to the southern dwellers in that prior excerpt. At least one mid-century scholar denied the doctrine by claiming the antipodes were in the northern temperate zone; see below, p. 202, n. 78.

in all three surviving copies there appear the appended excerpts from Macrobius that we have discussed, as well as the briefer excerpts from Bede and Isidore.[53] The first pair of excerpts from Macrobius, accompanied by the diagram for planetary order, clearly emphasize a point Dungal made in his letter. Let us simply call it Dungal's diagram of planetary order. The subsequent Macrobian excerpts lead to a new, debatable, and controversial point. Here we need to introduce another interest of Dungal, the poem *De rerum natura* of Lucretius. The earliest Carolingian witness of Lucretius's work is a manuscript produced at the palace scriptorium, which Dungal read and corrected.[54] What was the nature of his interest in Lucretius's poem? In part at least, it was poetical and philological. Certainly the cosmological vocabulary of the Roman author engaged Dungal's attention. At the same time, given his engagement with astronomical and cosmological matters, Dungal must have been somewhat intrigued by the atomistic and Epicurean doctrines in Lucretius's work. And would not such a curious mind have been similarly intrigued by the Macrobian and Lucretian doctrine of humans living in the southern hemisphere? Furthermore the theological implications of humans not yet having the chance to know and accept the Christian message meant that an impending end of time made no sense. Neither apocalypse nor biblical millennium should occur without the exposure of all persons to Christ's teachings.[55] There seems every reason to suppose that Dungal himself chose and added the excerpts with diagrams, at least all those from Macrobius, to his letter to Charlemagne. Such a compilation would make an especially useful text for study by advanced students under Dungal's tutelage.[56] The approximate date for Dungal's combination of these excerpts, including

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[53] The only exception to this generalization is the absence of the Bede excerpt in the London ms. For a detailed list of the parts of the letter and the excerpts, including the order in which they appear in each ms., see my description in "Astronomy of Macrobius," pp. 132–4.

[54] Long known and studied, this ms., Leiden Voss. lat. F.30, ff. 192 (s. IX in.), was only firmly connected to Dungal in 1965 by Bischoff, "Die karolingische Minuskel," p. 206. A reproduction was made early under the direction of Chatelain, *Lucretius. Codex Vossianus*. See also the study of Ganz, "Lucretius in the Carolingian Age," pp. 94–5 on Dungal, pp. 95–8 on Dungal's corrections and emendations.

[55] The biblical source requiring that all humans hear the Christian message before the Apocalypse is the gospel of Matthew 24.14, supplemented by Romans 10.14–18.

[56] Though I have reached this conclusion independently, the collection of all these excerpts under the direction of Dungal was suggested much earlier by Ferrari, "In papia conveniant ad Dungalum," p. 5.

his design for the order of the planets, with his letter to Charlemagne appears to be ca. 825 or earlier. Dungal was connected with the school at Pavia in a royal capitulary of Lothar in that year, and we know that the compilation was made during his teaching at Pavia.[57]

We can add Dungal's Irish background to the reasons he may have had for selecting and emphasizing the Macrobian view of men in the southern hemisphere. In a widely known Irish religious poem, the *Altus Prosator*, often attributed to Saint Columba, there appears the mention of dwellers "below the earth" ("orbem infra"), and this idea resonates with early Irish popular notions of fairies below the earth—actually subterranean. Whatever the emphases in the surrounding complex of ideas in early medieval Irish culture, this well-known theme needed to be eradicated or Christianized. The eighth-century Irish priest, Vergil of Salzburg, may well have had the Irish tradition in mind, if, as claimed, he taught of humans below the earth. Furthermore, Lucretius was known, thanks to the commentary of Servius (fl. ca. 400) on Vergil's works, to have written about dwellers "under the earth", which Servius opposed as unreasonable.[58] This material was available in Carolingian intellectual circles, especially in northern France and near the royal court.[59] What Dungal seems to have wished is to rationalize, by way of Macrobian cosmology, the existence of persons "below" us and possibly to show a complement to the proposed means of contact with the Antoecians and/or Antipodeans. The complement, which would make contact seem less difficult, appears in the final excerpt from Macrobius. He explains that habitation does not stop precisely at the border of the torrid zone. In fact, he writes, Meroe is some 3800 stadia beyond

[57] Ibid., p. 1. Ferrari, "Centri di trasmissione: Monza, Pavia, Milano, Bobbio," pp. 306–7.

[58] The *Altus Prosator* and related Irish literature is discussed by Smyth, *Understanding the Universe*, pp. 285–90. Carey, "Ireland and the Antipodes," surveys the stories of Vergil of Salzburg and relevant literature. For the commentaries of Servius, see *Servii grammatici qui feruntur in Vergilii carmina commentarii*; for the rejection of Lucretius, see vol. 2, p. 27 (on *Aeneid* VI, 127); in other comments Servius assumes the existence of antipodes on the opposite side of our spherical earth, e.g., vol. 2, pp. 144 (*Aeneid* VII, 226), 297 (*Aeneid* VIII, 671). Servius' commentary survives in a ms. copied at Corbie ca. 800, also in two mss. copied at Tours not long after ca. 820 as well as later mss. See Savage, "The Manuscripts of Servius," pp. 170–7; Murgia, "Critical Notes on the Text of Servius," pp. 312–3.

[59] There is a much later Carolingian reference to Dungal in an anonymous gloss on a passage of the Servian commentary on the *Georgics* of Vergil in Bern 363, f. 54r; see Contreni, *Carolingian Learning*, ch. 9, p. 768. Did this reference tie Dungal in some way to the commentary of Servius?

that border, and the Cinnamon country is yet 800 stadia farther south. The same reasoning tells us that there are human settlements north of the southern hemisphere's border to the torrid zone. While these places of habitation within the torrid zone do not come nearly together from the two sides, we are left to imagine possible means of travel and communication across the remaining, reduced width of the equatorial hot zone.[60] Dungal simply reproduces Macrobius's discussion of this subject and makes no further remark. Yet his choice to copy the full account of Macrobius here, rather than to excise and simplify as in other excerpts, supports the suggestion that these excerpts are, in fact, Dungal's own selection. And the close relationship of the Macrobian theme of people in the southern hemisphere and the Irish literary theme of people 'under' the earth, joined to the Servian discussions of the same theme in classical sources, including Lucretius, lead us to suspect Dungal's definite, personal support for the Macrobian version of humans in the southern temperate zone. Just as he chose to revise fundamentally Macrobius's account of planetary order, so he chose to select and support Macrobius's account of unknown peoples in the southern hemisphere. And in these two cases Dungal adapted or adopted diagrams established by Macrobius—important aids for teaching the doctrines.[61]

[60] Servius, *Commentarii*, vol. 2, p. 76 (on *Aeneid* VI, 532) speaks of the possibility of sailing to the Antipodes. The idea of sailing from the north to the south temperate zone is reinforced by CSS 122–4 (II.ix), where Macrobius describes the earth's land masses as four, in four equal quarters of the globe, with the ocean dividing them at the equator by encircling the globe. Thus ocean separates Africa, located wholly in the northern hemisphere, from an unknown continent in the southern hemisphere. Dungal does not extend his excerpts from Macrobius this far.

[61] Each ms. of Dungal's letter has the three diagrams in question. All three mss. have correct versions of the diagram for planetary order. All three have correct versions, despite slight variations in lettering, of the diagram for climatic zones. For the third diagram, showing the correspondences between celestial and terrestrial zones, there are difficulties. London Roy. 13.A.XI, f. 123r, has a correct design. Berlin Phillipps 1784, f. 4r, and Monza c–9/69, f. 62ra, have the same diagram, which is incorrect, failing, among other things, to place the zodiacal line through the proper endpoints for the terrestrial correspondents of the tropics of Cancer and Capricorn. The ninth-century copies of Macrobius's commentary show less trouble with this diagram. Paris 6370, f. 85v, shows Lupus's diagram to be approximately correct, though a bit carelessly drawn. Paris nal 454, f. 66r, and its copy by Hadoard of Corbie in Vat. Regin. 1762, f. 198v, are correct. The copy in Paris 16677, f. 52v, is quite erratic, partly freehand, and incorrect. Curiously, two of these last four mss. have incorrect drawings of the much simpler diagram for five climatic zones; Paris nal 454, f. 63r, and its copy in Vat. Regin. 1762, f. 195r, err by making all five zones have the same width.

8. *Macrobius: Planetary Effects on the Earth as Part of the Cosmic Order*

Dungal has offered us a distinctive example of the use of Macrobius's *Commentary* early in the ninth century. His focus was both cosmological and astronomical but quite selective. In the second and third quarters of the century we can discover other users of Macrobius, who attracted wide attention because he provided a broad Platonist view of the World Soul and the individual human soul as well as the nature, motions, and effects of the stars and planets.

Depending upon Porphyry and Plotinus as well as Plato, Macrobius provides a framework with the One, or God, as the first cause. The One, or Monad, is prior to multiplicity, before all time, and contains the patterns of created things.[62] While the Mind comes directly from the One and participates in the generation of the World Soul, it is this last being that forms the material world. The World Soul has a single nature and is prior to matter, being made from numbers, which precede the World Soul. From the first even number, two, and the first odd number, three, with their squares and cubes it creates the line, the surface, and the solid. The numbers woven into this Soul and their ratios give the Soul the ability—actually, the continuing nature—to "penetrate the whole world with its animating power and fill the solid body of the universe," instilling harmony and order from these numbers and ratios within itself.[63] The World Soul is, in fact, number moving itself. It remains undivided as it flows, or emanates, to animate the world. Life in all creatures comes from the Soul and derives from the harmony intrinsic to it. The World Soul is made from harmony, or music, and instills harmony in its creation, the forever moving celestial sphere.[64]

From the World Soul the celestial sphere has both its unending motion and the tones produced in it in accord with the Soul's harmonic makeup. Likewise the spatial intervals between the planetary spheres are set according to the ratios in the Soul, and, on this point, the Platonists reject the calculations of Archimedes, who claimed to have found the numbers of stadia between the successive planetary spheres. The Platonists insist instead on the series of intervals in the

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[62] CSS 56.6–8 (I.xiv.6), 19.24–20.3 (I.vi.7–8).

[63] CSS 20.5–9 (I.vi.9), 18.26–19.14 (I.vi.2–5), 101.18–25 (II.ii.14; see trans. Stahl, p. 191), 102.2–103.5 (II.ii.16–19).

[64] CSS 19.14–16 (I.vi.5), 20.7–11 (I.vi.9), 106.1–3 (II.iii.11), 102.30–103.5 (II.ii.19), 68.8–14 (I.xvii.8).

progressions of the numbers two and three. Referring to Porphyry's (subsequently lost) commentary on the *Timaeus*, Macrobius sets forth the following Platonist planetary intervals.

Earth to Moon = 1 basic unit
Earth to Sun = 2 × (Earth—Moon distance) = 2
Earth to Venus = 3 × (Earth—Sun distance) = 6
Earth to Mercury = 4 × (Earth—Venus distance) = 24
Earth to Mars = 9 × (Earth—Mercury distance) = 216
Earth to Jupiter = 8 × (Earth—Mars distance) = 1,728
Earth to Saturn = 27 × (Earth—Jupiter distance) = 46,656

This sequence of planetary intervals shows the application of the first two numbers, two and three, and their squares and cubes to the fundamental structure of the physical cosmos.[65] We can also note in passing that this harmonic arrangement restates the planetary sequence of Plato and the Egyptians, according to Macrobius.

The outermost celestial sphere is supreme among the spheres in that it contains all the others, and it produces and has all the virtues that flow from the divine Mind. And every star and planet as well receives the divine Mind through the World Soul. The natural and eternal movement of the celestial sphere is necessarily rotary, since the sphere embraces all spaces (*spatia*) and places (*loca*) and so can only move by rotating on its axis. The outermost sphere carries the individual stars with it, but they have their own motions as well, although these are very slow and can not be observed in a human lifetime.[66] Below the stellar sphere each planetary sphere moves at the same speed as every

[65] CSS 106.8–107.8 (II.iii.12–15).

[66] Here Macrobius has confused precession of the equinoxes, an interval of apparent stellar motion that Ptolemy calculated to be 36,000 years, with Cicero's account of the Great Year, an interval in which all the planets return to the same positions relative to each other. From an unknown source Macrobius gives a value of 15,000 years at CSS 129.8–25 (II.xi.10–12). Cicero's *De natura deorum* II, 51–53, gives a clear account of the Great Year, a purely planetary interval. In the next sections (II, 54–55) he clearly describes the fixed stars as invariant on a single rotating sphere and makes no mention of precession. The *De natura deorum* was known to a limited extent in the Carolingian world and survives in three mid-ninth-century manuscripts from northern France; see Munk Olsen, *L'Étude*, vol. 1, p. 115 (nos. 152, 210, 211). Regarding Macrobius's account of the Great Year and Dungal's use of it, see Eastwood, "Astronomy of Macrobius," p. 131; on Cicero's Great Year and Macrobius's interpretation see Callataÿ, *Annus Platonicus*, pp. 42–58, 120–7. See pp. 88–89 below for the long excerpt from Macrobius in the computus of 809 on the Great Year.

other, but they complete their revolutions in different times because of their different distances from the center.[67]

Each planet has its observable character, such as the redness of Mars and the brilliance of Jupiter, but persons who cast horoscopes find other characteristics as well. This is possible, as Ptolemy explained, because there are certain numerical ratios that support harmonious relationships among things appropriately related. These ratios are 4:3, 3:2, 9:8, 2:1, 3:1, and 4:1. Through these ratios the Sun and Moon, which are the sources respectively of sense perception and growth in the physical world, coordinate favorably with two of the other planets, Jupiter and Venus, and not at all favorably with two more, Saturn and Mars. Having no close ratios, or numerical connections, with the Sun and the Moon, Saturn and Mars are considered hostile to human life. However, this does not mean that stars and planets directly cause human actions; it means only that the motions of the planets, like the flight or cries of birds, reveal what will necessarily occur, so that we call one planet, like Jupiter, helpful and another, like Saturn, harmful.[68]

If we now combine the philosophical cosmology of Macrobius with his cosmological myth of the descent of the human soul from heaven to the stellar sphere and down through each planetary sphere, acquiring the attributes of the spheres while passing through, we can see the close relationship between humans and the celestial bodies, even if not a directly causal relationship. The mind and soul of man, says Macrobius, are not material and are given through the stars and planets by the World Soul's Mind. The attributes taken up by a descending soul from the succession of planets are these.

Saturn—reason and understanding
Jupiter—the power to act
Mars—boldness
Sun—sense perception and imagination
Venus—passionate desires
Mercury—speech and interpretation
Moon—forming and increasing bodies

[67] CSS 69.5–11 (I.xvii.13), 56.21–30 (I.xiv.8), 68.19–25 (I.xvii.10), 69.22–30 (I.xvii.16–17), 60.24–27 (I.xiv.26).

[68] CSS 76.27–78.22 (I.xix.19–27).

With these attributes, really present in it, the soul rules the body just as God rules the world, leading philosophers to make the analogy between microcosm and macrocosm. After the soul succeeds in ruling the body well and ridding itself of the evils that have attached to it in the material world, it can (at the death of the body) ascend and return to the heaven it came from.[69] This brief summary of the relationships and interactions of the human soul and the cosmos allows us to see the larger context within which the astronomical teachings of Macrobius emerge. His themes are order in the soul, the order of the cosmos, and their relationships.

Are the relationships between the individual soul and the ordered, animate cosmos close enough to justify a support for astrology based upon the *Commentary*? As we remarked above, Macrobius considers the stars and planets to be indicators rather than causes of physical effects, and he cites a text of Plotinus in support.[70] We can say that Macrobius supplies materials for astrology, when combined with other sources, but not support for or adequate doctrines of astrology. One further, intriguing material he does offer is the basic layout of the planets under the signs of the zodiac according to their houses. After describing the diagram to show how the seven planets travel 'through' the zodiac, a diagram revised by Dungal into a Plinian/Chaldean planetary order, Macrobius assigns each planet to a different sign in a sequence that is said to reproduce the teaching of the ancients about the power (*potestas*) of the planetary deities in each sign. At the birth of the world, he says, each planet was in a separate sign and thus became lord (*dominus*) of that sign. The locations, which follow the sequence of signs, are: Moon in Cancer, Sun in Leo, Mercury in Virgo, Venus in Libra, Mars in Scorpio, Jupiter in Sagittarius, Saturn in Capricorn. For the five remaining signs a second, subordinate set of allocations is added: Saturn in Aquarius, Jupiter in Pisces, Mars in Aries, Venus in Taurus, and Mercury in Gemini.[71] Neither Manilius nor Firmicus Maternus was known by the Carolingians in order to extend and complete the astrological doctrine that Macrobius introduces here, but the *Recognitiones* of Pseudo-Clement, which describes and debates a great

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[69] CSS 58.13–28 (I.xiv.16–18), 50.11–24 (I.xii.13–14), 132.10–16 (II.xii.10–11), 51.9–15 (I.xii.17).
[70] CSS, p. 78.15–16 (I.xix.27); Plotinus, *Si faciunt astra*, that is, *Enneads* II.iii.
[71] CSS 89.8–29 (I.xxi.24–26).

deal of practical astrology, circulated in Rufinus's translation and was used by Isidore, Aldhelm, Bede, Agobard, Freculf, and Hincmar among others.[72] Likewise Cicero's *De divinatione* and *De fato* were read, copied, and annotated by scholars in the Carolingian world, including Lupus of Ferrières and Hadoard of Corbie, whom we shall discuss in the following section of this chapter. For Macrobius himself, however, we should say again that he recorded elements of astrology but did not support or teach astrology.

9. *Three Carolingian Excerpts from Macrobius*

9.a. *The Paris Compend*

Recalling the excerpts by Dungal and now proceeding to look at three sets of excerpts from the second and third quarters of the ninth century, we shall find that the physical and astronomical doctrines were more widely used than the psychological or theological.

The earliest of the three groups of excerpts appears in a remarkable astronomical compendium, which is in turn part of a collection of texts on the liberal arts, especially the quadrivium. The astronomical collection survives in a Paris manuscript that contains excerpts from the Aratea, Macrobius, Pliny, Calcidius, and a complete copy of the astronomical book of Martianus Capella. This compilation, which seems best described as an advanced textbook used by selected individuals, was put together by the year 840, probably at Corbie.[73] The three authors Pliny, Calcidius, and Macrobius are handled differently than

[72] See Clement, *Recognitiones*, PG 1, coll. 1201–1474; Clemens Romanus, *Die Pseudoklementinen*, vol. 2, pp. xx–lxxx for 120 surviving mss., 9 of which are from s. VI—IX; see Books 9 (esp. pp. 266–319) and 10 (esp. pp. 328–34) for astrology.

[73] Paris 13955, ff. 46v–60r. Bibliography in Leonardi, "I Codici di Marziano Capella," pp. 443–4. A detailed study of the Columella excerpts in the ms. has concluded that, as earlier studies proposed, the ms. was probably produced at Corbie and that, according to Bischoff, most of the ms. was copied in s. IX(¾), with ff. 46v–53v (Capella, Book 8) copied in s. IX ex.; see Corsetti, "Note sur les excerpta médiévaux de Columelle," pp. 113–4, 117–8, 127–8. While one would normally defer to Bischoff's dating, it does not appear that he studied this ms. in great detail, and I prefer to follow the results of detailed study by Wesley Stevens, who concludes that the geometry and at least part of the Capella text were copied somewhere between 825 and 840 by a single scribe (his scribe IId), whom Stevens has identified elsewhere; see Stevens, "Fulda Scribes at Work," pp. 287–316; Stevens offered further clarification regarding Paris 13955 in personal communications to me on 26 February 1993 and 20 June 2002.

Martianus Capella or the Aratea, both of which appear as continuous texts. Instead, in three chapters entitled *De caelestibus circulis* (based on Macrobius and Calcidius), *De ordine planetarum* (using Macrobius, Pliny, and Calcidius), and *De vario ortu et occasu planetarum* (drawn from Pliny and Calcidius), the Paris Compend sets down the framework for and the basic doctrines of planetary astronomy.[74]

The uses of Macrobius here indicate careful forethought by the compiler. He adroitly compresses the lengthy text of *Commentary* I.xv.2–17[75] on the celestial circles, including the zodiacal paths of Sun and Moon in the occurrence of eclipses, as a clear and simple introduction to the more precise and complex elements of planetary astronomy that ensue in the three chapters. The text of Macrobius presents the Milky Way and ten other circles. These ten are (1) the zodiac (two lines define its borders and a third defines its center, the ecliptic), (2–6) the five parallels from north/arctic to south/antarctic, (7–8) two colures, (9) the meridian, and (10) the horizon. The first omission made from the text eliminates the naturalistic definitions of the Milky Way according to Theophrastus, Diodorus, and Democritus, where the Carolingian excerptor remarks that he is omitting opinions, both fabulous and naturalistic, and he then resumes with the definition of Posidonius, that the Milky Way is a flow of sidereal heat crossing the zodiacal circle obliquely, which Macrobius says is more in agreement with the prevailing view.[76] After a short passage, another omission occurs, and the excerptor inserts, "Now it [the Milky Way] intersects the zodiac in Gemini and in Sagittarius, and there are ten other circles, one of which is this zodiac, which we call *signifer* in Latin."[77] This transition, made to retain an element of the omitted portion, happens also to correct tacitly an earlier error of Macrobius, who made the intersections with the zodiac occur at Capricorn and Cancer. This silent correction shows the awareness of this Carolingian scholar, perhaps shared by many others, of a significant

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[74] The three chapters appear successively on ff. 56r,8–56v,19; 56v,19–59r,24; and 59r,25–60r,5. For the use of Calcidius in this compilation, with special attention to eccentrics and epicycles, see pp. 314–24 below.

[75] CSS 61.7–63.24 has the complete text; the Paris compend strategically omits phrases and sections.

[76] This first omission is CSS 61.15–29 (I.xv.4–6).

[77] The second omission is CSS 62.2–6 (I.xv.7–8). The excerptor inserts, "Nam in geminis ac sagittario zodiacum intersecat X autem alii circulis quorum unus est ipse zodiacus quem latine signiferum vocamus."

error by Macrobius.[78] Further omissions result in an abbreviated summary of the general conditions for eclipses[79] and the relocation of the statement that the roundness of the earth makes men at different places see different skies overhead.[80] The excerptor then proceeds to the end of the Macrobian account of the celestial circles and adds a sentence to make his transition to the planets, which become the topic in the subsequent excerpt from Calcidius. The changes made to this lengthy passage from Macrobius show intelligence and an expected readership already aware of the basic sort of knowledge that one might find, for example, in Bede's DNR. The use made of Macrobius is thoroughly introductory.

In the Paris Compend the next chapter, entitled *De ordine planetarum*, begins with an excerpt from Macrobius's *Commentary* with which we are quite familiar. This is the passage describing and comparing the planetary order of Cicero and the Chaldeans with that of Plato and the Egyptians. Previously we have seen the original and clear intent of Macrobius to present both orders and to show the superiority of the Platonist ordering of Venus and Mercury as supra-solar planets in a fixed order. Dungal, we learned, excerpted and adjusted elements of this passage to revise it in favor of the Ciceronian and notably Plinian order, which makes Mercury and Venus sub-solar planets. Here in the Paris Compend we find a different approach. As the opening section of the chapter, Macrobius's account serves to demonstrate the need for principles of order in the celestial realm, since different sequences of planets can be supposed, and there are different kinds of evidence and reasoning available for deciding which planetary sequence should prevail. Initially the compiler writes very clearly that Cicero, Pliny, and Archimedes all support the Chaldean order, with the Sun in the fourth position among the seven planets. This statement pointedly adds the name of Pliny, which exists nowhere in Macrobius's discussions of

[78] Macrobius's error at CSS 48.1–2 (I.xii.1). Bede, DNR 18, states without comment the correct crossing points in Gemini and Sagittarius, and, in the Laon glosses (s. IX¾) to Bede's DNR 18 (in Berlin Phillipps 1832, f. 5r, interlinear gloss at lines 10–11), another Carolingian scholar attributes to Isidore the error of locating the points in Capricorn and Cancer. For Bede and the gloss, see Bede, DNR, ed. Jones, p. 210, esp. apparatus XVIII,5.

[79] CSS 62.14–26 ("solis si ei...labores." I.xv.10–12) omitted.

[80] CSS 63.13–15 ("et quia...despicit." I.xv.16) omitted here, partially used at a later point.

planetary order. Following this, there appears the text of Macrobius without change and without omission until the discussion of the Moon and its light, where modest omissions occur.[81]

Because the astronomical materials in the Paris manuscript all seem to have been brought together at the same time, we can reasonably suppose that they can be read in terms of each other. This is important for the excerpt from Macrobius on planetary order, since the astronomical book of Martianus Capella contains a well-known and detailed doctrine of the two planets Mercury and Venus as satellites of the Sun.[82] With these two planets circling the Sun as their center, they can obviously be both below and above the Sun as seen from the earth. By the fourth decade of the ninth century, Capella's doctrine of circumsolar Mercury and Venus had become known and was the subject of glossing in manuscripts of the work. It is just such an understanding, not apparent at the time of Dungal's letter but recovered by the time of the Paris Compend, that made necessary a reconsideration of the two supposedly contradictory and fixed orders found in Macrobius's *Commentary*. Seen through Capellan doctrine, both Chaldean and Egyptian orders are correct. They simply represent views at different times or with different interpretations of the appearances.

The reader of the chapter *De ordine planetarum* soon discovers that the subject matter is not simply planetary sequence but the larger sense of order that pertains to all the motions of the planets. Subsequent to the passage from Macrobius, a set of excerpts from Pliny's *Natural History* presents: the regular sequence of lunar appearances, a comparison of lunar and planetary illumination, the places and time intervals of planetary stations, planetary apsides, exaltations, and latitudes.[83] Especially in dealing with the last three topics, Pliny employs the distinctions between concentric and eccentric circles as well as the structure of the zodiacal band with a width of twelve degrees. In other words, there is in Pliny's account a notable amount of reasoning through the uniform motions of bodies on circles that are seen from varying distances and

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[81] The chapter *De ordine planetarum* devotes its first sentence to stating the Chaldean order and the names of its supporters. After that appears the exact text of Macrobius, *Commentarii*, I.xix.2–9 (CSS 73.17–74.31), followed by a slightly compressed I.xix.10–13 (CSS 74.31–75.20 with omissions at lines 3–7 and 12–19).

[82] NPM 324.10–17 (VIII, 857); Paris 13955, f. 51r, 10–14.

[83] The Pliny excerpts come from *Naturalis Historiae libri XXXVII*, vol. I, ed. Jan and Mayhoff, pp. 140 (II, 45–6), 145–6 (II, 58–61), 146–8 (II, 63–7).

positions. These simple spatial explanations receive further buttressing and deepening by the excerpts from Calcidius that follow the Plinian section and are the major part of the chapter. The Calcidian paragraphs review themes from the Macrobian and Plinian sections, providing a more sophisticated, if still qualitative, understanding of planetary stations and retrogradations, epicycles and eccentrics. The material from Calcidius offers a truly geometrical basis for the claim that the appearances of irregularity in celestial motions are not really there but are the results of combinations of uniform circular motions. The reality is a fully ordered, regular set of motions.[84] In the context of the full chapter, the opening excerpt from Macrobius becomes a statement of a problem to be solved, and the rest of the chapter, along with the preceding text from Martianus Capella, demonstrates that an adequate knowledge of various kinds of circular motion will solve the conflict recorded in the Macrobius excerpt. The Paris Compend offers us an insight into a mature program of astronomical study in the middle third of the ninth century.

9.b. *The Bern Collection*

Our second collection of excerpts from Macrobius's *Commentary* survives in a manuscript from the third quarter of the ninth century, produced near Ferrières or possibly at Auxerre.[85] This text of Macrobian astronomical and geographical excerpts contains all five of the standard diagrams for Macrobius, though the second is corrupt and the fifth is incomplete, and stands as a coherent and highly useful work. It was originally part of a very large miscellany, including many grammatical works and an important text of Petronius, copied by a number of contemporary hands. With limited omissions it includes, on twenty-two folia, the text from I.xiv.21 to II.ix.10 and may well have been the

[84] The topics and texts from Calcidius may be seen in CCT 124 (c. 74: the apparent character of stations and retrogradations), 136 (c. 85: the nature of epicyclic motion), 124–30 (cc. 77–80: the solar eccentric with an explanation of the different lengths of the seasons through the year).

[85] Bern 347, ff. 41 (s. IX ¾); ff. 1r–22r for the excerpts of Macrobius. Bischoff, *Katalog*, vol. 1, p. 123, nr. 579, lists the mss. originally joined with Bern 347 in a 164–folio codex. See Homburger, *Die illustrierten Handschriften der Bibliothek Bern*, pp. 134–6; Barker-Benfield, "Macrobius," pp. 227–8. Bischoff locates the ms. originally near Ferrières; Barker-Benfield considers it an Auxerre ms. Further discussion of this ms., including its importance as the likely archetype of the abridged version of the *Commentarii*, as argued by Barker-Benfield, appears in Caiazzo, *Lectures*, pp. 17–18.

source for later manuscripts of the abbreviated, cosmological version of the *Commentary*. Essentially, a second, assistant scribe presented the latter part of the astronomy in Book One and then the geography of Book Two; meanwhile the main scribe prefixed the first part of the astronomy of Book One and then inserted the text on cosmic harmony and carefully selected supporting sections from Book Two.[86]

The excerpts from Macrobius in this Bern Collection are the work of two scribes.[87] Of the five separate parts written by these two hands, one has copied the second and the fourth parts with essentially no internal omissions, while the other hand has copied a prior, a middle, and a disconnected final part with extensive omissions.[88] In attempting to make sense of the ways in which these parts by two different copyists fit together we can first set down some simple facts. Hand 2, so-named because it is second in appearance, copied I.xx.9–xxii.13 and II.v.1–ix.7. The first of these parts begins with the measurement of the size of the Sun and goes to the end of Book One; it does not include a general account of the structure of the heavens or the order of the planets. The second part copied by Hand 2 provides the geography in the *Commentary*, avoiding the preceding account of Pythagorean numerical cosmology as well as the succeeding account of world ages. Hand 1 is much more selective than Hand 2, first copying sections from I.xiv.21–xx.8 with four noteworthy internal omissions, then copying the cosmic number doctrine omitted by Hand 2, and adding at the very end of the excerpts a brief passage on the smallness of the earth

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[86] Barker-Benfield, "Macrobius," pp. 227–8. Also, Caiazzo, *Lectures*, p. 37 (citing Barker-Benfield), points out that the inspiration for this collection of excerpts may have been the Seven-Book Computus (see pp. 88–90 below) of ca. 812, since Hand 2 in the Bern excerpts begins (f. 7ra) with a title that suggests it was copied from a title for a Macrobian excerpt found in the Seven-Book Computus, Bk. 6, ch. 5 (see n. 133 below). However, the two manuscript texts begin at very different points in the *Commentarii*, and there is a difference in the way the name of Macrobius appears in the two locations, so uncertainty remains.

[87] Barker-Benfield, "Manuscripts of Macrobius' Commentary," pp. 337–68, describes the larger compilation including Bern 347 and the hands in the ms. I have made my own description of the hands in accord with the needs of my discussion here. Hand 1 is more firm and regular than Hand 2. Hand 1 uses the rounded uncial 'd' much more often, often uses the 'rt' ligature, and at times has the open-bodied 'g'. Hand 2 makes the ampersand with a much higher ending, often clubbed or barbed.

[88] Hand 1 appears on ff. 1r–6v, 12r–16v, and 22r. Hand 2 appears on ff. 7r–11v and 17r–21v. Hand 1 copies at its 3 locations these texts: CSS 59.13–80.8 (I.xiv.21–xx.8); 95.4–109.34 (II.i.2–iv.15); and 124.1–19 (II.ix.8–10), 12.9–28 (I.iii.17–20). Hand 2 copies at its 2 locations these texts: CSS 80.8–93.28 (I.xx.9–xxii.13), 110.1–124.1 (II.v.1–ix.7).

compared to the cosmos (II.ix.8–10) and a short section from the third chapter of Book One (I.iii.17–20) on the possibilities for either truth or obscurity in dreams. In the manuscript we can see that Hand 1 made corrections to the work of Hand 2, but the reverse did not occur. And we can also see that Hand 1 shifted more than once the number of lines of text per page, while Hand 2 maintained a constant rate.[89] From these data it seems reasonable to conclude that Hand 2 copied his folia first, followed by Hand 1, the director of this project, who occasionally varied his number of lines of text per page, especially in the middle section, in order to fit as conveniently as possible with the completed work of Hand 2. With regard to the diagrams, we can see that all five are within the copy of Hand 2, that two are inadequate, and that Hand 1 either could not or chose not to improve the two diagrams needing correction or completion (the rain diagram and the world map)[90] when he made other corrections to the work of Hand 2. The compilation was divided into chapters with titles, but this process went unevenly, producing only six chapter titles, the first four of which appear on the two sides of the first folio and the last of which (at folio 12ra: *De musico stellarum modulamine*) stands for all material taken from Book Two of the *Commentary*.[91]

Perhaps the first thing to notice about the excerpts in the Bern Collection is their total exclusion of discussions of the human soul. At the same time there remain discussions of the World Soul, part of the Platonic account of the creation of the world and a much safer topic than the career of the human soul. By beginning where it does (I.xiv.21), the Bern Collection of excerpts from Macrobius avoids the mythological descent of the soul (at I.xii.13–15) and the Platonist view that the mind and soul of each human are given through the stars and planets (at I.xiv.16–18). While copying almost all the astronomy, geography, and Platonist-Pythagorean number doctrine in the following chapters as far as the terminus at II.ix.10, Hand 1 carefully excludes

[89] Throughout its copy, Hand 2 follows a 31-line plan, breaking this pattern only for diagrams or the end of a passage, with one exception; on f. 21r there are 32 lines of text in column *a* and 31 lines in column *b*. Hand 1 uses a 31-line model but diverges from it on 9 out of 23 pages, producing as few as 26 lines on a full page (ff. 14vb, 15ra–b) and as many as 33 (f. 14ra).

[90] The rain diagram (f. 11v) is useless, having only concentric circles and no indication of rain. The world map (f. 21v) is only an empty circle.

[91] Hand 1 made all the titles except for the fifth (at f. 7ra), which announces the topic, the measurement of the Sun's size, at the beginning of Hand 2's entry.

the more distracting astrological teachings at four points. Retaining the relatively commonplace knowledge that Saturn and Mars are considered harmful and that Venus and Jupiter are thought to be beneficial, Hand 1 excises the immediately preceding distinction between attributed and actual characteristics of these four planets.[92] The next omission is brief, occurring soon after the first, and covers only one clause, which speaks of the single nature of all divine beings and clearly troubled the excerptor, as it suggests an immediate question about divine being rather than maintaining a continuous flow of description and explanation.[93] Our excerpting scholar then leaves out a rather lengthy part of the text, omitting what Macrobius tells us about the effects of the Sun, Moon, Jupiter, Venus, Saturn, and Mars upon our actions and how the beneficent and maleficent planets do or do not relate to each other. This long passage offers important astrological conceptions that would certainly not lead readers towards a more Christian way or view of life.[94] Finally, Hand 1 joins with the first section of Hand 2, on determining the magnitude of the Sun, but excises a large part of an extended account of the Sun's powers. A good portion of this may seem simply superfluous, but there are at least two difficult doctrines. The power of the Sun to cause planetary stations and retrogradations, only alluded to in passing by Macrobius, obviously required either more explanation or suppression. Here we find it suppressed. Subsequently the excluded text elaborates on the idea that the Sun is the heart of the heavens (*cor caeli*) and goes on to say that the heart of the heavens is "that through which all things done by the divine reason are accomplished." This paean by Macrobius to the Sun marks it as a powerful deity, even if not the supreme god, and so makes for very troublesome reading in a text intended for astronomical and geographical instruction—even though a modest amount of Roman pagan mythology has been retained in the excerpt. Hand 1 ensures a smoother reading by eliminating this passage.[95] At the same time we must remember that he chose extensive astronomical information, including the long passage on the Egyptian and Chaldean orders of the planets, and a large amount

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[92] This excision occurs at Bern 347, f. 6va,4 (CSS, p. 76.19–32: "notandum.... prospera"; I.xix.18–19). It appears to be more than a convenience and looks like an elimination of potentially mischievous doctrine.

[93] At Bern 347, f. 6va,11 (CSS 77.5–6: "cum sit divinorum una natura"; I.xix.20).

[94] Bern 347, f. 6va,25 (CSS 77.18–78.15: "vitam.... existimetur"; I.xix.23–26).

[95] Bern 347, f. 6vb,24 (CSS 79.10–32: "nam.... vocavit"; I.xx.5–8). The quotation about *cor caeli* is translated from CSS 79.24–5 (I.xx.6).

of Platonist teaching according to Macrobius. The Bern Collection of excerpts shows two scholars at work, one apparently assigned to copy material without question and the senior copyist using a great deal of thoughtful selection, to provide an astronomical-geographical textbook from the *Commentary* that would set it in a Platonist cosmology cleansed of serious difficulties, either astronomical or theological.

9.c. *The Collectaneum of Hadoard of Corbie*

As librarian of the royal abbey at Corbie, the priest and monk Hadoard was a major figure in the mid-century development of the scriptorium and the expansion of the library.[96] He made compilations of classical authors and patristic authors and was active in emending ancient texts. Especially important for our concern is the Collectaneum he made of the philosophical works of Cicero, combined with most of Macrobius's *Commentary*, with excerpts from the arithmetic, geometry, and astronomy of Martianus Capella, and with a collection of the proverbs by Publilius Syrus.[97] For his excerpts from Macrobius, Hadoard apparently used the full text in a Paris manuscript copied at Corbie around or soon after mid-century.[98] From Cicero he compiled extracts from *De natura deorum,*

[96] While fixed dates cannot be given to Hadoard's writings, the work of various scholars has narrowed considerably the range of dates. An introduction to the contents of the Collectaneum is Beeson, "The Collectaneum of Hadoard," pp. 201–6. Study of the scripts of Corbie and Hadoard is in Bischoff, "Hadoardus and the Manuscripts of Classical Authors," pp. 39–57. Ganz, *Corbie*, surveys the larger context and discusses the work of Hadoard at pp. 58, 78, 79, 92–100, 149–50, 152. One point where a narrowing of the date for Hadoard's Collectaneum appears possible is in the relationship of Lupus of Ferrières (d. 862) to the Ciceronian works collected and excerpted by Hadoard. If Lupus used ms. F at Ferrières, which ms. in turn was Hadoard's source for his collection and was produced at Corbie from corrected mss. A and B of Cicero's works, and, in turn, these corrections were only made around or after mid-century at Corbie, then Hadoard's use of F would seem to have been near or during the 850s. This connection of manuscript uses is supported by Beeson and Bischoff and by Richard Rouse, "Cicero [Philosophical Works]," pp. 124–8. Ganz, *Corbie*, p. 62, considers this connection less certain and Hadoard's works not securely datable (p. 58).

[97] Vat. Regin. 1762, ff. 226 (s. IX 2/3). Contents and dating discussed in preceding note. One item in the Collectaneum not recognized in prior studies is the extract from the astronomy (at ff. 223r–224r), in addition to the acknowledged excerpts from the arithmetic and the geometry, of Martianus Capella; this extract covers *De nuptiis* VIII, 872–878, dealing with the details of solar motion, the equinoxes, and the four seasons.

[98] Paris nal 454, ff. 81, with many similarities in content to the Macrobius excerpts in the Collectaneum, one of the most notable being the similarly erroneous diagram (Vat. Regin. 1762, f. 195r; nal 454, f. 63r) for the climatic zones of the earth; see above,

Lucullus, Tusculan Disputations, De divinatione, De fato, Timaeus, Paradoxa, De amicitia, De oratore, De officiis, De legibus, and *De senectute*. The Collectaneum was Hadoard's private possession, available to others on request and probably offered to selected students. He tells in an introduction how he was guided by a dream to a treasure of manuscripts from which he made the selections for his book.[99]

The long and mostly continuous text, from I.v.4 to II.xvi.26, of the *Commentary* in Hadoard's Collectaneum begins with a discussion of Platonic and Pythagorean number doctrine and ends only one brief chapter before Macrobius's conclusion. The astronomy and geography are virtually intact, while strategic omissions occur elsewhere. We can look at these and get a better sense of Hadoard's attitude towards the text. Regarding the individual human soul, he retains almost everything that has literary or mythological interest, for example, Macrobius's account of the soul's acquisition of separate traits from the individual planets while passing through the spheres on its way to the earth. Hadoard records the soul's acquiring reason and understanding from Saturn and so forth on down to the lunar attribute of forming and increasing bodies. He also keeps the comfortable doctrine that the immortal soul returns to a higher state after ridding itself of the evil that has become attached to it. And he preserves the teaching that a portion of the divine mind is in the human soul, with humans alone of earthly dwellers having reason, which lodges in the appropriately spherical head of man.[100] However, when he arrives at the view that the Mind of the World Soul implants the mind and soul in man through the stars and planets, Hadoard balks and excludes this extravagant doctrine from his copy.[101]

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n. 59. On the ms. see Ganz, *Corbie*, p. 153, and sources cited there. Barker-Benfield, "Macrobius" p. 226, considers Hadoard's excerpts from Macrobius to have been taken from a child of Paris nal 454.

[99] Dümmler, MGH *Poetae latini aevi carolini*, vol. 2, pp. 683–5. Hadoard claimed to have learned in a dream where to find a "treasury" of writings by Macrobius and others, just as Scipio was said to have learned in a dream the cosmological and political wisdom of his grandfather, according to Cicero.

[100] These doctrines retained by Hadoard in Macrobius's text appear as follows. In Vat. Regin. 1762, ff. 169v,14–170r,3 (from CSS 50.11–51.2: I.xii.13–15); f. 170r,10–15 (from CSS 51.9–15: I.xii.17); f. 171v,15–22 (from CSS 56.30–57.10: I.xiv.9–10).

[101] At Vat. Regin. 1762, f. 172v,6 the omission appears. CSS 58.13–28 (I.xiv.16–18) is completely absent; Hadoard's text proceeds from "…commemorat" directly to "non ab re…."

In the astronomical portions abbreviations appear for other reasons. In reproducing the account of planetary order, with the patterns of Chaldeans and Egyptians compared to each other, Hadoard omits the opening statements, which identify the authorities with their doctrines. That is, he leaves out the names of Cicero, Archimedes, Plato, and the Chaldeans. He begins with the text, "The Egyptians, founders of all the disciplines of philosophical study, have the Sun placed between the Moon and Mercury."[102] What appears to be an innocuous, if puzzling, contraction of names, retaining only "Egyptians," holders of the correct doctrine according to Macrobius, turns out to be an interesting move by Hadoard to preserve untarnished the name of his philosophical hero, Cicero. We need only recall that the text puts Cicero and the Chaldeans on the losing side of the two positions. Macrobius's account of the debate about planetary order appears unchanged until the name of Cicero crops up again, and here Hadoard again edits the text to eliminate (and protect) this revered name.[103] At the end of the account, we know that the order of the Egyptians is the correct one, and we have the complete argument as conceived by Macrobius. We simply do not read that Cicero stands on the wrong side in the debate. Hadoard displays the same attitude later in the same chapter, where Macrobius resumed his discussion of the two competing orders and explained how Cicero placed the Sun in the middle of the sequence of seven planets but not in the middle of the space between the stellar sphere and the earth.[104] Here Hadoard simply excises the whole passage, since he clearly intends to avoid diminishing the reputation of Cicero, whose works he has chosen to comprise more than half of the Collectaneum.

Arriving at the section that describes the beneficent and maleficent planets according to astrologers—and according to Cicero—Hadoard includes most of the description of the traits of Jupiter and Venus, Saturn and Mars, and omits only a somewhat repetitive portion, then changes a verb to avoid making Cicero adhere personally to such

[102] In order to do this, Hadoard not only omits CSS 73.12–17 (I.xix.1–2), but he revises his opening sentence to produce the following: "Aegyptii omnium philosophiae disciplinarum parentes ita solem inter lunam et Mercurium locatum volunt." See Vat. Regin. 1762, f. 178v,15–16.

[103] At Vat. Regin. 1762, f. 179r,5–6 Hadoard has omitted "Cicero." He then makes the following text read, "Et ideo hae comites solis vocantur" at CSS 73.34–74.1 (I.xix.4).

[104] Vat. Regin. 1762, f. 180r,3; Hadoard omits CSS 75.23–76.1 (I.xix.14–15).

doctrines.[105] Except for an insignificant abbreviation of three lines, he also includes the next section, explaining the mathematical basis of harmonic ratios attributed to Ptolemy in support of celestial influences on the terrestrial world.[106] He continues in this vein to the end of Macrobius's long Chapter 19 and includes the material from Plotinus, which explains that signs in the heavens are indicators but not causes of human actions.[107] He also includes the line that attributes stations and retrograde motion to all seven planets, even though this is incorrect for the Sun and the Moon, and we are left to wonder whether this is an unintended slip or an index of Hadoard's limited knowledge about planetary motion.[108]

As he proceeds to the next chapter, Hadoard passes over in silence a long initial section that contrasts Plato and Cicero regarding the nature and position of the Sun among the planets.[109] He finds nothing especially objectionable in the remainder of this long chapter on the Sun, its character, significance, and measurement. He does, however, omit various sections in which Macrobius seems to include too much erudition without advancing the themes of the chapter.[110] There are very few omissions in the sections on measuring the earth's circumference and diameter, the solar orbit, and the Sun's size, which Hadoard obviously considers important.[111] Chapter 21 is copied without omission until the final sections. These omissions begin by ejecting one more reference to the difference between the planetary orders of Plato and Cicero, and

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105 At Vat. Regin. 1762, f. 180r.16 Hadoard omits CSS 76.22–26 (I.xix.18); in the next line he changes the verb "vocavit" to "dicitur."

106 The text appears at Vat. Regin. 1762, f. 180r,21–180v,8, with the insignificant omission at f. 180v,7 (CSS 77.14–17 (I.xix.22) for the omitted text).

107 Vat. Regin. 1762, f. 181r,8 marks the end of I.xix.27; Hadoard omits only the title of Plotinus' work .

108 Vat. Regin. 1762, f. 181r,5; CSS 78.18–19 (I.xix.27).

109 Omitting CSS 78.23–79.6 (I.xix.1–3), he eliminates Macrobius's labeling the Sun as "dux, princeps et moderator luminum reliquorum" but retains the labels "mens mundi" and "cor caeli" for the Sun a bit later.

110 Vat. Regin. 1762, ff. 181r,8–183r,21 covers CSS 78.23–84.28 (I.xx.1–27) with the various omissions. Omissions after the lines in the previous note appear at the following pages and lines: CSS 79.8, 79.9, 79.13–16, 79.19–22, 79.31–32, 80.7–8, 80.12–20 (Posidonius excluded, Eratosthenes and Egyptians included), 81.2–6, 81.8–10, 81.21, 81.29–82.1, 82.9–11, 83.7–10. I do not list the various corruptions of the text in this ms.

111 The long text of I.xx.11–32 is virtually complete, and the corruptions do not in general destroy the sense, though one corrupted numeral at I.xx.20 (CSS 82.14), where "cc" ("ducenta") has become "oc" in the ms. (f. 182r,13), must have caused confusion.

then go on to remove Macrobius's summary of the cosmological and astronomical topics covered so far.[112] There is nothing objectionable in this excluded material; it is simply superfluous. What is remarkable is that Hadoard has included all the astrological doctrine contained in the chapter as material suitable for a serious scholar's knowledge in the study of astronomy.

Hadoard concludes his excerpts from Book One of the *Commentary* with Macrobius's discussion of the earth's imperfect matter and the tendency of all water and earth to fall to the center of the world, which is the same as the center of the earth's sphere. He records the negative proof by way of rainfall to conclude that the center of the earth is the center of weight in the cosmos. While recounting the argument properly, Hadoard does not copy the diagram correctly, suggesting one of two things (Figure 2.9). Either he does not understand adequately what Macrobius proposes, or he finds the diagram dissatisfying. According to the correct diagram (see Figure 2.6), which follows Macrobius's argument, if the earth were not the center of weight, then rain falling from the heavens at the "underside" of the earth's sphere would fall "down" away from the earth. But this is absurd and does not happen. Since rain does fall from all directions towards the earth's sphere, it is, in fact, the center of weight and of the cosmos. If Hadoard understands the argument, then he has partially reversed the sense of the diagram and has tried to make it support the positive argument instead. Hadoard's version of the diagram has rain falling from above the earth's sphere and from below the earth's sphere towards the center. However, on both the left and right of the earth, rain is falling away towards the bottom of his diagram and, according to the argument, away from the earth. The model in the manuscript from which he copied this diagram is correct, but he has not copied it as such.[113] He seems to have wished to use the diagram to show what actually does happen rather than to show the point of the negative argument in the text. If so, he has neglected to notice that the positive form of the argument requires a diagram with rain falling towards the center from all directions, not only from

[112] CSS 89.29–91.13 (I.xxi.27–35); Vat. Regin. 1762, f. 186r,22.

[113] Hadoard's inadequate diagram appears at Vat. Regin. 1762, f. 187v; a similar diagram appears in the copy of Macrobius in Köln 186, f. 101v (s. IX ex.). The correct diagram appears in Hadoard's exemplar, Paris nal 454, f. 56r. However, moderns seem not always to have followed Macrobius's argument fully either, as the inadequate diagram in CSS 167, suggests.

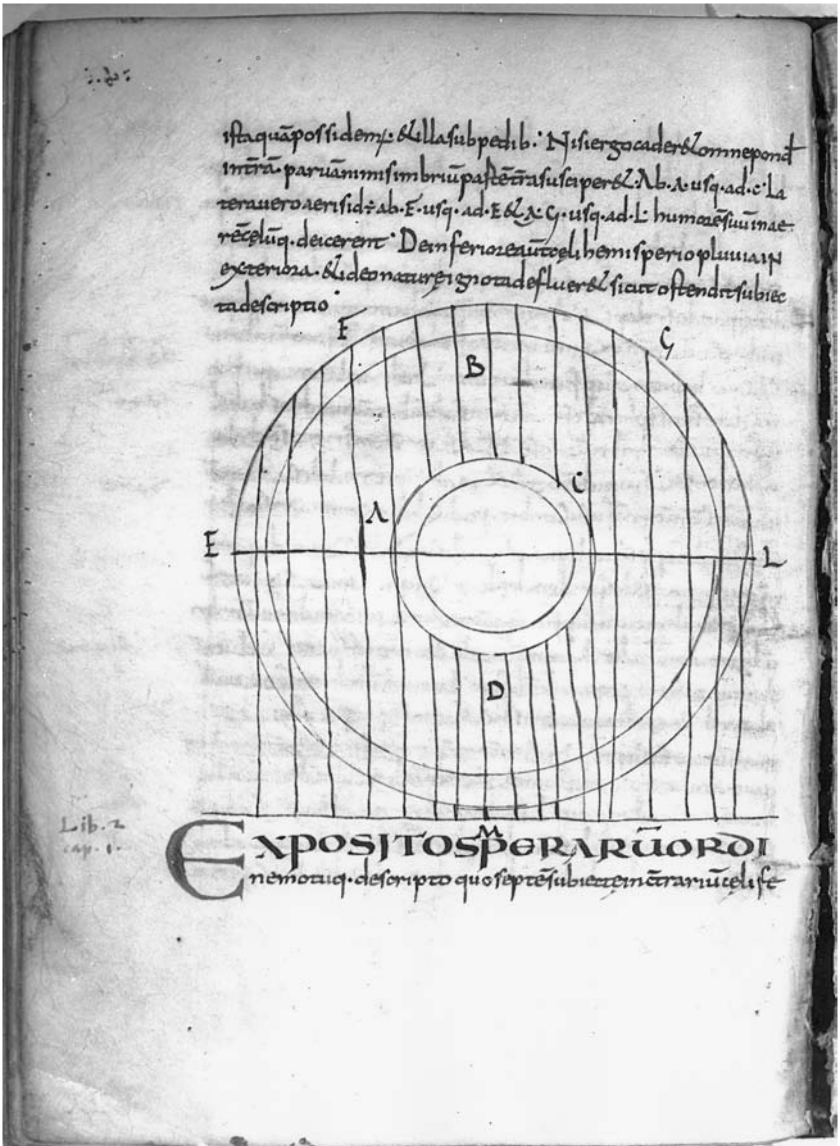

Fig. 2.9. An Incorrect Rain Diagram. Vatican City, Biblioteca Apostolica Vaticana ms. Regin. lat. 1762, f. 187v

above and below. He was not alone in failing to follow carefully the argument put forth by Macrobius, for we have seen already that Lupus of Ferrières produced a corrupt diagram in his copy of Macrobius's *Commentary*. It may be that Lupus had a corrupt exemplar before him, but this would not have prevented him from correcting it in accord with the argument. The diagram for rainfall in Paris 6370, Lupus' copy, has concentric circles and no vertical lines for falling rain.[114] It would seem to have cried out for correction, but none occurs. The answer in this and other cases of incorrect or incomplete diagrams for rainfall appears to be the peculiarity of the negative line of argument in the text, which produces a diagram of something that does not happen rather than something that does.

The geography in Book Two of the *Commentary* is retained with modest omissions. Looking at Hadoard's copy of the chapters that describe the climatic zones of the earth and the parallelism between terrestrial and celestial zones, we find no significant abbreviations of Macrobius's discussion. The argument for human inhabitants in the southern temperate zone, based upon reason but not experience because of the impassibility of the central torrid zone, appears in its full form. Hadoard copies all of the texts about the dwellers directly below us, the Antoeci, as well as those diametrically opposed to us, the Antipodes, both of which groups live in that southern habitable zone.[115] There seems to him no good reason to exclude this reasoning based on the sphericity of the earth and the symmetry on the cosmos, which leads to the interesting conclusion of unknown peoples elsewhere on the globe.

10. *A Letter to Lord B*

An anonymous and undated letter survives, apparently from the ninth century, that makes very extensive use of Macrobius to support the

[114] See above, n. 45, for Lupus's and other incorrect copies.

[115] Omitting the quotation from the text of Cicero's *Dream of Scipio*, upon which Macrobius is commenting, Hadoard begins the geographical chapters (II.v–II.x) at Vat. Regin. 1762, f. 194r,20 and continues virtually unbroken. He retains all the references to the dwellers in the southern region, as follows: ff. 195r,5–6 (CSS 112.2–3), 195v,3–4 (CSS 112.28–29), 195v,23–196r,3 (CSS 112.22–27), 196v,16–20 (CSS 115.18–24), 199r,10 (CSS 119.13), 200v,2 (CSS 121.32–33).

planetary order of the Egyptians and Plato.[116] This order, which placed Mercury and Venus in circular orbits between those of the Sun and Mars, leaving only the Moon's orbit between the earth and the Sun's orbit, seems to have been a topic of interest and possible uncertainty for some of the Carolingian *literati*. We can recall that Dungal had interpreted Macrobius's text in Chapter 19 of the *Commentary* to support Pliny's rather than Plato's order and had added to Chapter 21 an illustrative diagram presenting Pliny's order, contrary to Macrobius's preference for Plato's.[117] The location in Macrobius's text for the diagram of the planets' order, two chapters after his elaborate discussion of the Egyptian and the Chaldean orders, is exactly where the "Letter to Lord B." puts its major focus. The letter-writer addressed the work to *domino meo B.*, probably an abbot, who had a library from which the writer was borrowing books; B. was addressed as "the flower and marvel of the holy church of God" in the opening of the letter.[118] Because the author devoted the whole letter to identifying and confirming the planetary order of the Egyptians and Plato, it seems likely that he

[116] MGH *Epistolae.* Vol. 6, pp. 197–201. The letter was noted and used by Contreni, "The Carolingian School," ch. 11, p. 97; Contreni also presented part of a letter from Aurelian of Réomé, citing Isidore of Seville, to Abbot Bernard about the power of music. Flint, *Rise of Magic*, p. 139, noted (n. 29) that Macrobius was a source for the planetary harmonic intervals appearing in the first part of the letter but did not pursue the connection. Flint assumed a ninth-century date for the letter, included in Carolingian letters by the editor, Ernst Dűmmler, and I agree. It appears in St. Gallen 831, 364 pp. (s. XI), as the third (pp. 175–181) of four distinct items grouped together (pp. 169–182). The immediately preceding item (pp. 173–175) is an anonymous letter to Fredilo, who was a student of Lupus of Ferrières and came from Auxerre; following the letter to B. is a short (½ column) catalogue (p. 182) of an unknown library, beginning with a selection of biblical books that includes Judith, Tobias, and Maccabees, continuing with collections of sermons and other works for religious services, followed by a long list of classical writers, especially poets, and a few logical works; the catalogue includes separate lives of SS. Willibald and Silvester. The first of the four items in the group is titled *Regulae metricae cum exemplis* (pp. 169–72). Except for this group of four items, the contents of the codex are logical and rhetorical works of Boethius and commentaries thereon, with the further exception of pp. 260–80, containing a rhetorical work of Marius Victorinus. See Scherrer, *Handschriften der Stiftsbibliothek von St. Gallen*, p. 282, which does not mention a 12-line calendrical poem that follows immediately the Letter to Lord B. in the ms. on p. 181.

[117] See above, Sect. 4.

[118] MGH *Epistolae*, vol. 6, p. 197.36 ("flos et paradoxa sanctae Dei aecclesiae"); 'paradoxa' was in the ninth century a rather rare term, which, John Contreni has kindly suggested to me, may have been used most appositely by John Scot Eriugena in his poem *Aspice praeclarum orbem*, and I offer no better comparison; see Eriugena, *Carmina*, ed. Herren, pp. 64–6, at 66.44: "Laudibus amplificat [animus] tunc ΠΑΡΑΔΟΞΑ dei". At *Epistolae*, vol. 6, p. 198.1, the writer referred to "your most sacred hand."

was replying to a request for clarification caused by the presence of a diagram with the Chaldean (Plinian/Ptolemaic) order in a text that assumed the Egyptian (Platonic/Macrobian) order. Plausibly it was a copy of the *Commentary on Scipio's Dream* that he was returning to Lord B. with the desired clarification. And who was our anonymous writer? We have no clue, beyond the reasonable assumption that he was a clerical or monastic scholar, and rather than 'Anonymous' we shall call him 'Apa' (the acronym of *Anonymus pro aegyptiis*).

Along with his initial obligatory praise of B., Apa immediately asked to borrow a copy of Boethius's *De musica* in order to continue his studies. After attending to this important request, he opened the real body of the letter with the following statement on the order of the planets.

> According to the opinion of the Egyptians, whom Plato also followed, proceeding out from the earth the first circle is that of the Moon; beyond this comes the Sun's [circle], above this is Mercury, above which Venus is set, and above this Mars is arranged, with Jupiter and Saturn then placed in the sixth and seventh circles.[119]

While this was clearly the position supported by Macrobius in at least three locations in his *Commentary*, always explicitly associated with the Egyptians or Plato or both, Apa makes no mention of either Macrobius or the *Commentary* as his source anywhere in the letter.[120] More than likely, the unannounced and vigorous immersion into the question of the Egyptian planetary order was no surprise to B., who must have expected the discussion as a response to an earlier inquiry. Apa proceeded from his simple statement of the Egyptian order to a text of Macrobius where the order is attributed to the Platonists and is presented in terms of small whole numbers that give the intervals between the planetary orbits and their cosmic harmony.[121] Apa elaborated upon the ratios in these harmonic intervals somewhat more than Macrobius had, and then closed this first thrust of his defense of the Egyptian order with the comment that there was much more he could say, but for the sake of brevity he would not go on.[122] He next turned his focus to an earlier section of the *Commentary*, where Macrobius had briefly referred to Ptolemy's development of harmonic ratios in order to say that such

[119] Ibid., p. 198.5–8.
[120] Apa was not unwilling to mention sources, for he readily named Vergil, Servius, and Pliny, the last many times, in the course of his letter.
[121] CSS 106.20–31 (II.iii.14).
[122] MGH *Epistolae*, vol. 6, p. 198.8–35.

relationships must exist in order for proper associations to exist among things and that numbers reveal celestial effects.[123] Apa then chose to paraphrase selectively and to quote from an interesting part of the *Commentary* dealing with standard doctrines in astrology.

> Therefore we can see how, by these relationships of numbers, some stars or other stars would produce adversity or prosperity. Thus Jupiter, which is more in accord with the Sun, and Venus, which fits more by its nature and its numbers with the Moon,[124] are considered more conducive to human health. Not that they make judgments that are either benefits or evils, 'but that things which would necessarily come to pass are revealed through the motion, station, and turning back of the seven planets, just like birds in flight or at rest, which unknowingly indicate [the future] by their kind or voice or feathers.'[125]

Apa concluded his account of Macrobius's denial of causality to the stars by summarizing the usual astrological attributions to the individual planets. He then shifted his attention to the divisions of the celestial sphere, especially the zodiac, and positions of the planets in zodiacal signs.

The primary focus for the remainder of Apa's letter became Macrobius's detailed description of the twelve signs and the distribution of the seven planets so that each, except for the Sun and the Moon, was assigned to two zodiacal signs (Figure 2.10). This focus served a number of purposes. Apa first gave a lesson, expanding beyond the text of Macrobius, to explain how the sequence of risings and settings of the signs of the zodiac actually appeared to a night-time viewer.[126] He next turned to the locations of the houses of the planets, that is, their specially assigned zodiacal signs, and the astrological characteristics involved, incorporating bits of Vergil and Servius into an essentially Macrobian account[127] and emphasizing at one point how the domiciles of the Sun and the Moon in this account confirmed the planetary order of the Egyptians and Plato.[128] Apa then introduced Pliny's doctrines

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[123] CSS 77.9–18 (I.xix.21–22).

[124] Up to this point in this sentence Apa has paraphrased the latter part of *Commentary* I.xix.25 (CSS 78.3–6). He next omits the bad news about the adverse effects of Saturn and Mars, inserts an innovation, and then proceeds to quote from Macrobius.

[125] The latter part of this passage from the letter of Apa, contained in single quotation marks, seems to be a quotation, though it varies slightly from the edited text of *Commentary* I.xix.27 (CSS 78.17–20).

[126] MGH *Epistolae*, vol. 6, p. 199.10–35.

[127] Ibid., pp. 199.36–200.39.

[128] Ibid., p. 200.5–6.

of planetary apsides, exaltations, and latitudes in order to reemphasize that none of these led to a discrediting of the Egyptian order, with the Moon and the Sun closer to the earth than any of the other planets.[129] He closed his letter with the claim that the pattern of planetary assignments to zodiacal signs corresponded to the appearances of the planets as they moved in direct and retrograde motions through the sky. The Moon and the Sun were placed under Cancer and Leo respectively, and neither of them ever showed retrograde motion, but each of the other planets would be seen moving in retrograde between its two zodiacal houses, Mercury, for example, moving from Virgo to Gemini and then from Gemini back to Virgo, and so on for each of the other planets with regard to its pair of assigned houses.[130] It was, wrote Apa (following Macrobius), the shrewdness and insight of the Egyptians ("Aegyptiorum sollertia") that brought about such a successful integration of astronomical information.[131]

The circular layout of the twelve zodiacal signs in a band circumscribing a set of seven concentric planetary circles (see Figure 2.4) was Macrobius's framework for assigning houses to the planets. Apa and B. must both have had this framework in mind to follow the placing of the planets according to Apa's description, which reaffirmed and built upon that of Macrobius. The one sticking point would have been a diagram using this framework and showing Dungal's Plinian order instead of the Egyptian order. We have no surviving diagram from the ninth century that followed Macrobius's complete description of the placement of the planets in their zodiacal houses; our earliest known example comes from the twelfth century (Figure 2.10).[132] Apa set forth

[129] Ibid., p. 201.3–17. Pliny's doctrines here are described in our next chapter, Sects. 4 –5 and 11.

[130] Ibid., 201.17–25. In detail, B.'s assertion is incorrect; Pliny did not use such a pattern, and observations do not produce these intervals of retrogradation. However, the Macrobian diagram (2.10) that can be derived from the text of I.xxi.25–26 supports these correct observations: Venus and Mars have the largest retrogradations, Mercury and Saturn the smallest, Jupiter in the middle.

[131] Apa's use of the quoted phrase is at ibid., p. 201.19–20; it comes from CSS 74.9 (I.xix.5).

[132] From 133 known manuscript diagrams illustrating the passage in *Commentary* I.xxi.1–7, twelve follow Macrobius' instructions (see Figure 2.3); the earliest correct surviving example is Los Angeles Getty Museum Ludwig XII.4, f. 12v (s. X 2/2). London Harl. 2633, f. 37r, (s. XII) has protruding from a pinhole at the diagram's center a string with a knot, used to draw the twelve radial lines and the circle at the end of the radial lines. Since the text of Macrobius did not assign the zodiacal houses for the planets immediately after describing the basic diagram but only farther on at

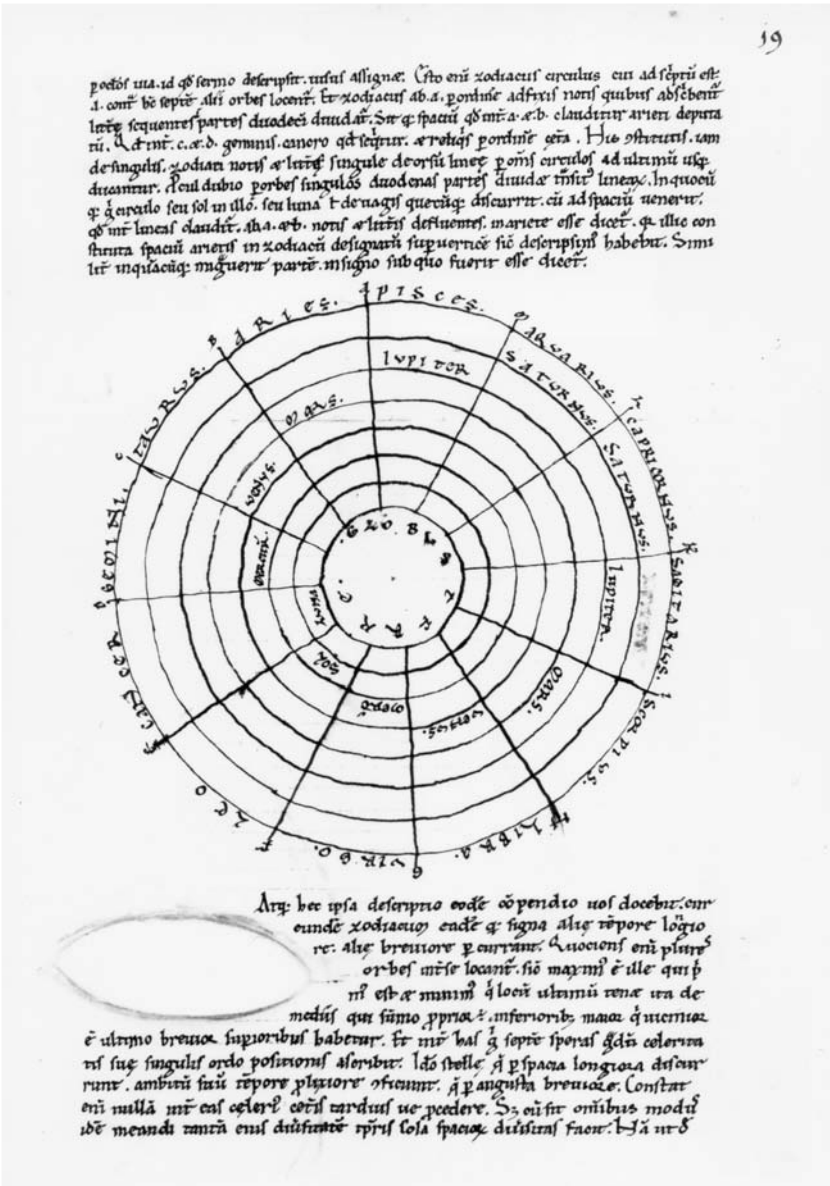

Fig. 2.10. The Planets in Their Houses. Munich, Bayerische Staatsbibliothek clm 18208, f. 19r

the Egyptian order just as Macrobius had described it; he also showed how only the Egyptian order fit the diagram properly, and how the properly understood diagram, in turn, corresponded with the planetary movements as he reported them.

11. *Extracts in Computus and in Commentaries on Bede*

The wider use and influence of Macrobius's *Commentary* appears early in the century with the selection of three excerpts on chronology and measurement for a collection of materials for the study of computus in 809. Based on a meeting of clerics at the palace in Aachen in 809 and developed more comprehensively by Charlemagne's cousin, Adalhard of Corbie, the Seven-Book Computus was completed at the royal court in about 810, or by 812 probably at the latest. The first four books (74 sections) in this compilation dealt with calendars, chronology, and related computational procedures. Book Five (12 sections) dealt with a broad variety of astronomical topics. Book Six provided seven sections, or chapters, on weights and measures from the level of economic practicality all the way to cosmic measurements. The final, seventh book was Bede's *The Nature of Things*, offered as a sort of primer on cosmology.[133] Within this mammoth compilation the excerpts from Macrobius occurred in the third and sixth books. For the first location the compiler(s) chose a long section of the *Commentary* devoted to explaining Cicero's view of the world year, or great year, an interval of

I.xxi.24–27, most manuscript diagrams do not include the double placement for each of the five planets concerned. There are eight diagrams which do so, five of which are from s. XII, the other three later. Figure 2.10, clm 18208, f. 19r (s. XII), shows this.

[133] In earlier studies this computistical collection is commonly called the Computus of 809. An interesting and useful, but incomplete, introduction to the 809 computistical conference is Jones, "An Early Medieval Licensing Examination." Although never published, the Oxford B. Litt. thesis by King, "Investigation of Some Astronomical Excerpts," surveys ably the prior literature, not only concerning the excerpts from Pliny but also concerning the computus of 809, distinguishing clearly its two resulting versions, the Three-Book and the Seven-Book Computus; see pp. 28–53 for the Seven-Book Computus, whose contents he lists. King's thesis along with relevant prior and subsequent literature is largely summarized and used by the most authoritative current writer on the topic, Arno Borst; see his "Alkuin und die Enzyklopädie von 809," in *Science in Carolingian Times*, pp. 53–78; idem, *Das Buch der Naturgeschichte*, pp. 156–65 (Seven-Book Computus), 166–76 (Three-Book Computus). While Borst's synthesis and interpretation of the texts and the manuscripts is detailed and largely dependable, it seems appropriate to note that he appears not to understand the significance of the astronomical diagrams included.

15,000 solar years, after which all the planets will appear in precisely the same positions in the sky as before.[134] This text appears amid thirteen other chapters on solar time units and measurement. Here, lacking the larger philosophical context of the *Commentary*, Macrobius's words seem simply to exemplify the greatest numerical interval that one might expect to encounter in calculating time.

The other location of Macrobian excerpts in the Seven-Book Computus is in the book on mensuration. Here in Book Six, with only seven sections, the reader finds the first three dealing with minute measurements, with gold and silver, and with wax and metals in heating processes. There follow two sections drawn from Macrobius on measuring the earth, the solar orbit, and the size of the Sun's body. The last two sections of the book cover the sizes of the Moon and the earth and are attributed to Martianus Capella. In this relatively short book on weights and measures, the preponderance of cosmic measurements seems remarkable. Indeed, while the first four books of this computus are specifically computistical, that is, concerned with time measurement in a calendrical framework, the last three books focus upon spaces and substances and at times on their measurements. In this second, cosmological framework of the Seven-Book Computus the extracts from Macrobius form a small but significant part by offering a transition from the means of measuring small objects to the ways of measuring the largest objects in the world. At the same time we today can see that Macrobius's methods were an unprofitable mixture of fragments of geometry and elaborate numerical calculations. Yet it was just this elaborate arithmetic that attracted the compilers who chose these texts.[135] Looking at these Macrobian excerpts from the early ninth century we can see that the *Commentary on Scipio's Dream* was well known

[134] Bk 3, Ch 5, taken from CSS 128.16–130.20 (II.xi.5–17). In the five originally complete copies of the Seven-Book Computus, all but one securely dated to the ninth century, the Macrobius excerpt appears at: Madrid 3307, ff.33v–34v, ca. 820, Murbach; Vat. Regin. 309, f. 77r–v (this is now the only complete surviving copy of this computus), a. 859, St. Denis; Vat. lat. 645, ff. 49r–50v, a. 830–860, at or near Reims; Monza F.9.176, ff. 47r–48r, ca. 869, Lobbes(?); Paris nal 456, ff. 89r–90v, s. X, St. Orient d'Auch. On Cicero, Macrobius, and the Great Year see above, p. 65, n. 66.

[135] The excerpts from Macrobius are at Bk 6, Chs 4–5, and come from CSS 81.10–83.7 (I.xx.14–24) and 83.7–84.27 (I.xx.25–32). They survive completely in only three and partially in a fourth of the five manuscript examples of the computus: both absent in Madrid 3307; Vat. Regin. 309, ff. 105v–106r, 106r–107r; Vat. lat. 645, ff. 78v–80r, 80r–v (the second excerpt incomplete); Monza F.9.176, ff. 78r–v, 78v–79v; Paris nal 456, ff. 187r–v, 187v–188v.

and applied quite diversely. Furthermore, at the time of the computus's compilation (ca. 810), the text of Macrobius enjoyed greater recognition for its astronomical contents than did Martianus Capella's work, which had not yet found a wide readership or following. In fact, the two chapters attributed to Capella, on the measurement of the Moon and the earth, were not quotations at all but imperfect adaptations of Capella, one of which owed a debt to the text of Macrobius as well as to Capella's.[136]

The Seven-Book Computus shows us a specialized use of Macrobius in the early part of the ninth century. For the middle and latter half of the century we can turn to commentaries on Bede's DNR for examples of borrowings from Macrobius intended to widen the meaning of Bede's text. Bede wrote this work as both a Christian and a scientific introduction to cosmology. As such, for readers in the ninth century it should have resonated well at many points with Macrobius's *Commentary*, since the latter was itself largely a cosmological text. The fifty-one short chapters of Bede's work covered the principles of Creation (1–4), the celestial, or fiery, realm (5–23), the atmospheric, or airy, realm (24–37), the realm of waters (38–44), and the realm of earth (45–51). At least thirty-eight copies of this work survive from the ninth century.[137] On the basis of an excellent study of the Carolingian commentaries, we can rather confidently identify and turn to the richest and most influential of the commentaries, a composition of the mid-ninth century, which had already experienced some pruning when copied into its earliest surviving exemplar. In this copy, the text of Bede was produced at Laon under the direction of the schoolmaster Martin Hiberniensis (d. 875) in the early to mid–860s. The pre-existing commentary, to which Martin made some additions, was copied at the same time.[138]

[136] The two sources in Capella are at *De nuptiis* VIII, 860 (for Bk 6, Ch 6) and VI, 595–598 (for Bk 6, Ch 7), but Bk 6, Ch 6 also uses Macrobius (I.xxi.12). The more precise and more extensive use of Macrobius than of Capella in the computus was noted clearly by King, "Investigation", p. 72.

[137] Bede, DNR, ed. Jones, pp. 174–84.

[138] The fundamental study, unpublished to date, of the Carolingian glosses on the DNR is Lipp, "The Carolingian Commentaries on Bede's *De natura rerum*." The glossed manuscript which I discuss here is Berlin Phillipps 1832, ff. 1r–9r. Lipp's critical edition of these glosses appears as annotations to Jones' edition of the DNR, pp. 192–234. Extensive further description of the composition of the manuscript and its glosses, to both the DNR and the subsequent DTR, is provided by Contreni, "John Scottus and Bede," pp. 111–31. Contreni makes an attractive, though tentative, argument for John Scottus as the original composer of the DNR commentary here. We

When we search through this commentary for reflections of or uses of Macrobius's work, we are surprised. By far, the most utilized classical source, though not frequently mentioned by name in the commentary, was Pliny the Elder's *Natural History*, which might be expected, since that was Bede's most heavily used classical source as well. Just as Pliny, Bede wrote in an encyclopedic manner, and each compressed much data into limited space. But after Pliny, the cosmological source most extensively used in the commentary was Martianus Capella rather than Macrobius. We can definitely find the use of Macrobius in only one gloss, a marginal comment keyed to the word "lacteus" in DNR 18, where Bede described the Milky Way, to which Macrobius devoted a lengthy discussion that went far beyond the needs of Bede's text.[139] However, Martianus Capella appears as a source in at least six places in the commentary. The first of these focused on the difference between circles on the cosmic sphere and planetary circles by pointing to the eccentricity of the earth with regard to the latter group alone. The apsides of the planets, introduced by Bede at DNR 14, set forth Pliny's list of planetary apsides, or far points. Capella used the same list, and the Bedan commentator followed Capella.[140] At DNR 16, where Bede used Pliny's doctrine of planetary latitudes, our Carolingian commentator introduced a quiet, implicit disagreement with Pliny's teaching by mentioning only those latitudes fitting within the width of the zodiac.[141] When he came to Bede's (and Pliny's) explicit statement that the latitude of Venus exceeds the twelve degrees of the zodiacal band by two degrees, the commentator did not contradict but did make ambiguous the doctrine by saying that the two degrees may be a total of two or

do not know whether Martin was responsible for the occasional omissions from this DNR commentary.

[139] Bede, DNR ed. Jones, p. 210, *annot. ad* XVIII, 2. Only the initial part of this lengthy comment (gloss C) comes from Macrobius (from I.xv.1–2, 7) while the major part appears in neither Pliny nor Martianus Capella but shows dependence upon and elaboration of the gloss of John Scottus, *Annotationes in Marcianum*, p. 74.3–4 (*ad* 77, 15).

[140] Ibid., p. 205, *annot. ad* DNR XIIII, 2 ("circuli," gloss S). Contrary to Lipp's reference to Macrobius (listing only the full chapter I.xv), this comment draws more upon Capella (NPM 321–3: VIII, 849–852). Macrobius nowhere uses the word 'apsis' and nowhere says that the earth is eccentric to planetary circles.

[141] See ed. Jones, p. 207, *annot. ad* DNR XVI, 3 ("feruntur," gloss Y). This gloss is an exact quotation from Capella (NPM 328.13–14: VIII, 867); the words "alia per .v." within the quotation, while wrong, were added in four mss. according to Willis, and they actually appear as additions in at least six early mss. It is worth noting that this added phrase in the Bedan commentary does not occur in John Scottus, *Annotationes in Marcianum*, p. 182, *ad* 457, 1.

may be two degrees on either side of the zodiac and thus a total of four.[142] When Bede turned to describe the twelve signs of the zodiac, he concluded by saying that the Sun required thirty days plus 10½ hours to pass through each sign. Our commentator turned to Martianus Capella for the information that the Sun actually may take as many as thirty two days in Gemini and as few as twenty eight days in Sagittarius, so that Bede's statement should be seen, he said, as approximately rather than precisely true, for it was an average value.[143] At DNR 22, where Bede described lunar eclipses, the commentator turned to Capella for information on the climata in order to include the appearances of the Moon from different climata and also for information on the relative sizes of the earth and Moon.[144] Finally, at DNR 47, where Bede defined eight circles of the earth delimited by gnomonics, the commentator turned to Capella's description of Eratosthenes's calculation of the earth's circumference by using a gnomon, and in a comment on Bede's next chapter, DNR 48, he made further reference to the same text of Capella to adjudicate a difference between Pliny and Capella.[145]

The results of our search through the lengthiest Carolingian commentary on Bede's DNR for Macrobian influences are quite meager. These results are not generally reversed by readings of other commentaries from the middle and later ninth century on the same work.[146] The strong preference for Martianus Capella over Macrobius as a source for astronomical details in the commentaries on Bede's DNR points to the emergence of Capella's work as the most authoritative technical source in astronomy by mid-century, rivaling Pliny as well. The evident preference for Macrobius over Capella early in the century, when the Seven-Book Computus was compiled, was reversed by mid-century, as is

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[142] See ed. Jones, p. 208, *annot. ad* DNR XVI, 5 ("binis," gloss Z). The commentator could easily have clarified, since the Plinian excerpts in the Seven-Book Computus had attached diagrams that made it clear that the latitude of Venus according to Pliny was 14°. See below, pp. 121–3.

[143] Ibid., p. 209, *annot. ad* DNR XVII, 18 ("partes", gloss B); see Capella, NPM 321.5–6, and generally VIII, 848–849; although Willis reads "xxviiii" after "Sagittarii," he notes the common manuscript variant/ correction "xxviii."

[144] See ed. Jones, p. 214, *annot. ad* DNR XXII, 6 ("maior," gloss L). The commentator used NPM 332.2–5 (c.876) and more generally 324–5 (cc. 858–859); much of this long gloss is his own composition.

[145] See ed. Jones, p. 229, *annot. ad* DNR XLVII, 2 ("circulis," gloss H). The gloss quotes essentially verbatim from NPM 209.12–21 (VI, 596–598). Also ed. Jones, p. 231, *annot. ad* DNR XLVIII, 3 ("Paulo," gloss Z).

[146] For example, the commentaries to DNR in the following mss.: Karlsruhe Aug. CLXVII, Melk 412, Paris 5543, and Vat. Regin. 1260.

neatly shown in commentaries on the cosmological work of Bede. As a technical source, but only as a technical source, Macrobius's *Commentary* receded in importance in the latter half of the century.

12. *Macrobius's Offerings and Carolingian Selections*

In commenting on Cicero's *Dream of Scipio*, Macrobius laid out a broad spectrum of philosophical, mythological, and scientific doctrines. In surveying the uses made of this material by ninth-century scholars, we can say that the Seven-Book Computus, Dungal, the Paris Compend, and the commentaries on Bede's DNR show a narrower interest, since they either focus sharply on purely computistical and astronomical questions or else admit an interest only in very basic astronomy, like the letter of Apa to B., and the elaborations of a single cosmological idea, as did Dungal's letter with additions. A broader summary of Macrobius's astronomy and geography, as in the Bern Collection, could also encompass much of the philosophical discussion attached to the physical doctrines as long as non-Christian teachings on the human soul were not included. Excluding most of the astrology and setting the astronomy and cosmology in a Platonist framework, the Bern Collection selected a wide but carefully edited panorama of astronomical, geographical, and cosmological teachings. Finally, we have seen that most of the scholars whose work we assessed saw Macrobius as a useful source for basic astronomy and geography. There appears to have been some increase over the decades in willingness to use his *Commentary* as a testimony for philosophical and theological ideas from the past that did not always agree with Christianity. Hadoard of Corbie made such choices in his extensive set of excerpts. And while the astronomy and cosmology held the higher value for Carolingians, some readers and commentators of Macrobius's work took special interest in his other offerings as well.[147]

[147] Heiric of Auxerre corrected and annotated the copy of the *Commentarii* corrected by Lupus of Ferrières. Heiric showed special interest in the topics of astronomy, cosmic harmony, and the soul. His brief notes on the text survive in Paris BNF ms. lat. 6370. On the ms. and Heiric's hand see Pellegrin, "Manuscrits de Loup de Ferrières," p. 137; Billanovich, "Dall' antica Ravenna alle biblioteche umanistiche," pp. 86–90; Bischoff, *Manuscripts and Libraries*, pp. 126–7; Barker-Benfield, "Macrobius," p. 227.

The *Commentary* of Macrobius found respect as a source for astronomy throughout the ninth century.[148] Before mid-century it could figure in technical compilations like the Seven-Book Computus and the Paris Compend. After mid-century the *Commentary* retained its reputation in cosmography and cosmology while declining in astronomy. John Scottus Eriugena knew Macrobius's *Commentary* well, using it especially in his commentary on the mythological books of Martianus Capella and disagreeing at one point with Macrobius, though not by name, on the physical influences of the celestial zones on their corresponding terrestrial zones.[149] Carolingian scholars generally made use of the *Commentary* with discrimination, and they even chose at times to make it say what its author did not say—Dungal with regard to planetary order, Hadoard concerning the differences between teachings of Cicero and Plato. These independent scholars were certainly not slaves to the authority of a classical text, although they used the text to explain the most basic motions of the planets and stars, to rationalize spatial relationships on the earth and in the heavens, and to construct for other scholars an ordered image of the world.

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[148] Helperic (not Heiric) of Auxerre, *Liber de computo* 2, (s. IX^{2}) still considered it a useful background or introductory text for young students of computus wishing to know more about astronomy; see PL 137, col. 23C.

[149] John Scottus, *Annotationes in Martianum*, p. 171.24–37, contradicting CSS 117.22–32 (II.vii.2–3), where Macrobius's doctrine fits the *astrologi* of John the Scot; see below, pp. 209–11, for further discussion.

CHAPTER THREE

PLINY THE ELDER'S *NATURAL HISTORY*: ENCYCLOPEDIA FOR CAROLINGIAN ASTRONOMY AND COSMOLOGY

Already important to Bede (673–735) while circulating in excerpts and partial copies during the early eighth century, Pliny's *Natural History* (NH) was appreciated by Alcuin, Charlemagne, and their contemporaries for supplying a tremendous increase in astronomical information. Analogously, of the earlier astronomical-cosmological works entitled *De natura rerum* (DNR) by Isidore of Seville (ca. 613) and Bede (ca. 701), it was Bede's, which made more extensive and more explicit use of Pliny, that was clearly preferred in the Carolingian world. Pliny's compendium of knowledge was a touchstone for authority in astronomy at the time of Charlemagne and afterwards and was used selectively, not slavishly, when its offerings provided what the moment required.[1] While specific, practical questions in astronomy often arose in the correspondence of Alcuin and others, the answers to those questions were sought less to build a body of technical knowledge than to confirm and reconfirm the view that God's cosmos displayed an order perceptible to human reason. Among the more effective ways developed by the Carolingians to affirm this view was the invention of diagrams that incorporated limited quantitative information but gave primary emphasis to qualitative patterns in an imagery of cosmic order. Plinian texts received such treatment early in the ninth century.

[1] An introduction to Pliny's astronomy appears in two essays in French and Greenaway, eds., *Science in the Early Roman Empire*; see Pedersen, "Some Astronomical Topics in Pliny," pp. 162–96, and Eastwood, "Plinian Astronomy in the Middle Ages and Renaissance," pp. 197–251; the latter appears in a corrected version in Eastwood, *Revival of Planetary Astronomy*, ch. 2. See ibid., ch. 3, for "Plinian Astronomical Diagrams". There is a large amount of interesting material in Borst, *Das Buch der Naturgeschichte*, esp. chs 3–5. Each of the above sources has something to say about the availability of parts of Pliny's work before the Carolingian era. That Book 18 was available to Bede only in brief excerpts on astronomy is argued well by Meyvaert, "Discovering the Calendar (*annalis libellus*)," pp. 16–25. The complexity of the question of excerpts from Pliny by Charlemagne's time finds witness in Ferrari, "La biblioteca del monastero di S. Ambrogio," pp. 84–101.

Pliny's encyclopedic range offered Carolingians detailed answers to questions about interplanetary distances, the causes and timing of eclipses, the changes in speed and brightness of each planet, and many other points. Of the thirty-seven books in Pliny's compilation, Books 2 and 18 are the essential sources for astronomy and cosmology.[2] By the later eighth century, fragmentary or incomplete manuscripts of the work had been produced that still survive, and complete copies remain to us from the ninth century.[3] An attractive copy of the first seventeen books of the *Natural History*, produced in the first half of the ninth century, probably at the royal monastery of Lorsch, exists at the Pierpont Morgan Library in New York.[4]

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[2] There is no convenient, thorough, and dependable survey of Pliny's cosmology and astronomy in these two books of NH. Stahl, *Roman Science*, pp. 101–16 offers a brief, acerbic summary. In 1862 Friese composed *Kosmologie des Plinius Secundus*, 44 pp., in which he made detailed analyses of various astronomical doctrines reported by Pliny. Friese argued that Pliny's theory of the inner planets must have assumed epicycles for these two planets. This is an argument that has appeared in more than one analysis since Friese's time, although Pliny's text does not support it. Campbell, *Plinii Secundi Naturalis Historiae liber secundus*, pp. 51–91, offers a commentary on Book 2. More useful is the commentary provided by Beaujeu, included with his edition and translation of *Histoire naturelle, livre II*. See also *Histoire naturelle, livre XVIII*, ed. and trans., Le Bonniec and Le Boeuffle.

[3] From around the year 800 comes Leiden Voss. lat. Q.69, ff. 54, with 71 excerpts from Books 2, 3, 4, and 6 at ff. 39v–46r; see de Meyier's catalogue of the quarto manuscript books, *Codices latini Vossiani*, vol. 2, pp. 159–163; Lowe, *Codices latini antiquiores*, vol. 10, nr. 1585. For an earlier discussion of the manuscript and a transcription of the full text of the excerpts see Rück, "Exzerpte aus der Naturalis Historia," pp. 257–87; Rück copied but did not identify separately the excerpt/chapter "De marte" (after "De iove", f. 39vb), which brings the total to 71 rather than 70. Two surviving parts of a continuous manuscript of the whole of Pliny's work, from s. VIII ex., are Vat. lat. 3861, ff. 173, and Leiden Voss. lat. F.61, ff. 152; these two parts (from northeastern France) now contain NH II, 187–XIX, 156 and NH XX, 186–XXXVI, 97, respectively. The parts of the text now missing at the beginnings and ends of these two halves of Pliny's work were surely present for Carolingian readers. On these two manuscripts see Lowe, *Codices latini antiquiores* , vol. 10, nr. 1580; Munk Olsen, *L'Etude*, vol. 2, p. 249; Bischoff, *Manuscripts and Libraries*, p. 64, n. 43. For some ninth-century manuscripts of Pliny see Reynolds, "The Elder Pliny," in *Texts and Transmission*, pp. 307–16, esp. 311–2. Unfortunately Borst, *Das Buch der Naturgeschichte*, pp. 360–74, gives neither page/folio numbers, nor precise contents, nor dating of any kind in his list of medieval manuscripts of Pliny. Thus a reader must struggle with Borst's references to his notes elsewhere in the book to determine which items contain material of interest, which are early manuscripts, and which are later; these internal references vary greatly in utility for readers.

[4] New York, Pierpont Morgan Library M.871, ff. 183. On this manuscript see Desanges, "Le manuscrit (Ch) et la classe des *recentiores* perturbés;" Bischoff, *Lorsch*, pp. 32–3, plate 11, describes the ms. as "Saint-Vaast-Stil aus Lorsch." This copy of Pliny lacks the preface and the beginning of Book 1; it ends at NH XVII, 178. It has no diagrams and almost no glosses added to it.

1. *Pliny's Astronomical and Cosmological Authority under Charlemagne*

In writing to Charlemagne in 798 and again in 799, Alcuin assumed that the king had access to a copy of Pliny, presumably at the royal court.[5] Charlemagne had asked Alcuin about the visibility of Mars from March to mid-July in 798 and had inquired in 799 about the apparent discrepancy between the observed phase of the Moon on 18 March and the degree of lunar fullness predicted for that date by computus. To both questions Alcuin had answered not only with an explanation but also with an appeal to Pliny as an authority. On the earlier occasion (in 798) especially, he referred to Pliny as the outstanding expositor of the motions of the celestial bodies.[6] We may understand Charlemagne's second query in more than one way. In asking about the discrepancy between observation and computistical prediction of the Moon's shape on 18 March 799, the king was certainly aware of what current practice in computus would predict. But was he looking for improvement of his understanding of computus, or for confirmation of skepticism about contemporary computistical accuracy, or for some thoroughly new kind of explanation of the lunar appearance? Quite likely, none of these. On the contrary, he seems to have been concerned about the disorder that had appeared in a presumably ordered heaven, since the observed progress and phases of the Moon should fit computistical prediction. And while Alcuin replied that computistical practice should not be modified, as this would bring divergent and non-uniform celebration of Easter, he also suggested that Pliny's astronomy might help to explain the actual observation reported by Charles, although Alcuin had no clear explanation at the time.[7]

Pliny's *Natural History* could serve as a practical astronomical guide, filled with numerical data and specific models, for such questions as the king sent to his trusted scientific consultant, Alcuin, and it could also stand as a broad-ranging cosmological authority, providing general patterns of the natural world, for contemporaries. The set of excerpts

[5] MGH *Epistolae*, vol. 4, pp. 250, 280. Bischoff, *Manuscripts and Libraries*, p. 64, n. 3, has linked the Leiden/Vatican ms. of Pliny to the royal court.

[6] MGH *Epistolae*, vol. 4, p. 250, lines 14–16: "Vel quid acutius, quam quod naturalium rerum devotissimus inventor Plinius Secundus de caelestium siderum ratione exposuit, investigari valet?"

[7] Ibid., pp. 279–80; Alcuin did not propose a physical answer, but he did not rule out the existence of one. For an analysis of this event and an interpretation within a different context, see McCluskey, "Changing Contexts and Criteria," pp. 209–11.

made around the year 800 from Books 2, 3, 4, and 6 of Pliny, at the monastery of St Gall (Switzerland), displays this alternative, cosmological function.[8] The excerpts deal with the Sun (noting its power and cosmic influence), Moon, planets, eclipses, weather, parts of the world, antipodes (the humans living there, from NH II, 161), seas, tides, Mount Aetna, earthquakes, and more. Any reader familiar with Bede's DNR would immediately recognize the similarity of contents and purpose here, even though the Plinian excerpts in this Carolingian manuscript were not precisely the same as Bede's when describing identical topics and were less carefully organized, having been taken sequentially from the *Natural History* with virtually no reordering. For a reader who already knew Bede's text these excerpts from Pliny provided additional information. Both Bede's work and this Plinian cosmological compendium offered naturalistic descriptions of the fundamentally distinct parts of the created world: the regions of fire (the heavens, with stars and planets), air (meteorology), water (seas et al.), and earth (geography, geology). Readers could see that there was a perceivable, natural order in the created world. These Plinian excerpts were copied and recopied during the ninth century.[9]

A theme briefly treated in the Plinian cosmological compendium and to which Bede's DNR had already devoted greater attention was the regular patterns of planetary motions.[10] The *Natural History* had included a long section of Book 2 (II, 59–81) on theories of planetary motion, which the Plinian cosmological compendium passed over in silence (between its chapters 16 and 17). Almost as if to fill this gap in the compendium, there appeared before the end of Charlemagne's reign a set of astronomical excerpts from Pliny that received much attention and copying through the ninth century and beyond. In fact, this new set of excerpts found wide acceptance and use following their appearance in the two large computistical collections, the Seven-Book Computus and the Three-Book Computus, that grew out of a conference held

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[8] Regarding Leiden Voss. lat. Q.69, ff. 39vb–46r, see above, n. 3.

[9] That the Plinian cosmological compilation had continued currency is shown by the same set of excerpts in Paris 4860, ff. 93bis va–98ra (s. IX–4/4), which was copied at Reichenau from a Reichenau intermediary of the mid-ninth century. On the Paris ms. see Reynolds, "Elder Pliny," p. 310 and the sources cited there, esp. Mommsen and Bischoff.

[10] Bede's chapters 14–16, extracted from the *Natural History*, deal with the apsides, colors, and latitudes of the planets. For these chapters of Bede and their sources, see Jones's edition of DNR, pp. 205–8.

in 809 at the royal court in Aachen to assess and improve the practice of computus in the kingdom.[11] It was these excerpts from Pliny, with diagrams added, that gave focus to a few elements of astronomy in the vast storehouse of the *Natural History* and provided convenient texts for copying and teaching what would become known to Carolingians as the core of Plinian astronomy. And to set the seal of approval on Pliny's work as an astronomical source during the reign of Charlemagne, the Irish monk Dungal, responding in 811 to a royal inquiry about solar eclipses in the previous year, included with his lengthy astronomical extracts from Macrobius a sort of disclaimer to the effect that, had he been able to consult Pliny's work directly, he could have provided an even more satisfying answer for the king and his court.[12] Across two decades—from Alcuin's letter of 798 to Dungal's letter of 811 and the completion of the Three-Book Computus about 818—Carolingian scholars of different stripes resorted to Pliny the Elder as a leading source for technical astronomy and for a broad cosmological education.

2. *Plinian Astronomy in the Seven Book Computus (ca. 810–812)*

The Plinian excerpts in the computistical collections resulting from the conference of 809 witnessed the multiple usefulness of his work for contemporaries. In the first of the two major compilations, the Seven-Book Computus, Plinian excerpts comprised five out of twelve chapters in Book V. Books I–IV were computistical in a clearly restrictive sense, treating time measurement in all its aspects. The last three books covered (V) stellar and planetary astronomy along with weather prediction, (VI) weights and measurements of bodies from the minuscule to the cosmic, and (VII) Bede's DNR as a scientific cosmology for Christians. The twelve chapters of Book V had the following titles and contents.

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[11] The Seven-Book and the Three-Book collections are described and discussed by Borst, *Das Buch der Naturgeschichte*, pp. 154–64 and 166–75 respectively; Borst presents a great deal of background, also some controversial interpretations. Contents of the Seven-Book Computus and their correlations with parts of the Three-Book Computus are conveniently charted by Springsfeld, *Alkuins Einfluß*, pp. 384–90.

[12] MGH *Epistolae.* Vol. 4, p. 577.14; also PL 105, col. 457B. Dungal recalled enough of Pliny to offer the general explanation appearing at *Epistolae*, vol. 4, p. 575.6–9; PL 105, 454C; derived from *Natural History* II, 57. On the general character and content of Dungal's letter, see Eastwood, "The Astronomy of Macrobius;" reprinted in idem, *The Revival of Planetary Astronomy*, ch. 5.

1. "Excerptum de astrologia Arati:" a brief survey of the constellations and their relative locations.[13]
2. "De ordine ac positione stellarum in signis:" images of forty three constellations with a brief text for each to indicate the number of stars it has.[14]
3. "De positione et cursu septem planetarum:" the order and temporal periods of the seven planets, with some further details on the subsolar planets.[15]
4. "De intervallis earum:" the interplanetary distances from the earth to the stellar sphere, giving both absolute distances and relative distances according to cosmic harmonic theory.[16]
5. "De absidibus earum:" the risings, settings, stations, and retrogradations of the five planets (excluding Sun and Moon), with explanation and locations of the apsides (apogees and perigees) of these planets.[17]
6. "De cursu earum per zodiacum circulum:" zodiacal latitudes of the seven planets, risings and settings and invisibilities of the five planets (excluding Sun and Moon), and phases of the Moon.[18]

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[13] The text of this chapter, a common Carolingian text, is printed in Maass, ed., *Commentariorum in Aratum reliquiae*, pp. 309–12; also in Dell'Era, *Una caeli descriptio*, pp. 43–6. For the best manuscript of the fifth book of the Seven-Book Computus and this text, see Madrid 3307, ff. 53r–54r (a. 820–828).

[14] The text appears in Dell'Era, *Una caeli descriptio*, pp. 49–70. See the images in Madrid 3307, ff. 54r–62v. Mütherich, "Die Buchmalerei am Hofe Karls des Grossen," pp. 50–1 for discussion of the images in "De ordine ac positione stellarum in signis" in the following mss. of the Seven-Book Computus: Madrid 3307, Monza f. 9.176, Vat. lat. 645, Berlin Phillipps 1832, and Vat. Regin. 309. For an earlier, more extended discussion and comparison of Madrid 3307, Vat. Regin. 309, and Vat. lat 645, see Neuss, "Ein Meisterwerk der karolingischen Buchkunst aus der Abtei Prüm," pp. 37–64.

[15] This excerpt from Pliny comes from NH II, 12, 32, 34–36, 38–44. The exact text appears in Rück, *Auszüge*, pp. 34–6. King, "Investigation," pp. 141–4, re-edited the text and made one significant correction to Rück's reading, replacing his "ambire" with "abire" at line 4. The text with diagram appears in Madrid 3307, f. 63r–v.

[16] From Pliny, NH II, 83, 84. The text appears in Rück, *Auszüge*, pp. 36–7; King, "Investigation", pp. 144–5, with no significant variations from Rück. The text with diagram appears in Madrid 3307, ff. 63v–64r.

[17] From Pliny, NH II, 59–61, 69, 70, 63, 64. Text in Rück, *Auszüge*, pp. 37–40; King, "Investigation," pp. 145–9, without significant variation from Rück. The text with diagram appears in Madrid 3307, ff. 64v–65r.

[18] From Pliny, NH II, 62, 66–69, 71, 75–78, 80, 78, 79, 76, 77. Text in Rück, *Auszüge*, pp. 40–3; King, "Investigation," pp. 149–53, with four significant variations from Rück at 41.8 ("scandescere" for "scandere incipient"), 42.7 ("duplato" for "duplicato"), 43.7 ("LXVIIII" for "LXXVIIII"), and 43.11 ("in locis" for "locis"). The text with diagram appears in Madrid 3307, ff. 65v–67r.

7. "De interlunio:" the time interval between last and first visibilities of the Moon as it passes through conjunction with the Sun.[19]
8. "De eclypsi lunae:" the temporal relationship of Sun and Moon at lunar eclipse, with an added sentence on the independence of solar and sidereal motions.[20]
9. "De eclypsi solis:" definition of solar eclipse.[21]
10. "De solis eclypsi quando sit:" report of eight solar eclipses with dates from 760 to 812.[22]
11. "Dimensio caelestium spatiorum secundum quosdam:" interplanetary distances equating tonal intervals with absolute distances.[23]
12. "De praesagiis tempestatum:" forecasting the weather by the Sun, Moon, stars, other meteorological events, terrestrial fires, waters, breezes, animal behaviors, and plant and tableware changes.[24]

The chapters of Book V made a nice progression from the sphere of the fixed stars down to the earth. The layout of the constellations led to details, primarily the number of stars in each, and then on to the realm of the planets. Four Plinian excerpts described the planetary region from the order and orbital periods to the interplanetary intervals and on to more complex and varied planetary motions. Lunar invisibility and eclipse followed, succeeded by a definition of solar eclipse and then a list of solar eclipses for just over fifty years (760–812). There followed a further effort to determine interplanetary distances, and finally the correlations between the weather, especially inclement weather, and the appearances of the Sun, Moon, stars, and other events. Except for the long chapter on weather predictions, the Plinian passages dealt with the planets and provided the essential knowledge for an understanding

[19] Excerpted from Isidore of Seville, *Etymologiae* III, lv. See Madrid 3307, f. 67r.
[20] Excerpted from Isidore, *Etymologiae* III, lix; III, l, 1. See Madrid 3307, f. 67r.
[21] Excerpted from Isidore, *Etymologiae* III, lviii. See Madrid 3307, f. 67r.
[22] Written in a different hand from the rest of Book V in Madrid 3307, f. 68v.
[23] This text, a reworking of the information from Pliny on intervals, appears in Vogels, *Scholia in Ciceronis Aratea*, Part 2, p. ix, from London Harl. 647, f. 20r (s. X 2/2). The text is also in Gautier Dalché, "Deux lectures et un commentaire de Jean Scot," p. 123, n. 29. See Madrid 3307, ff. 68v–69r.
[24] Excerpted from Pliny, NH XVIII, 340–365. See Rück, *Auszüge*, pp. 44–50; King, "Investigation," pp. 156–69, with eight significant corrections to Rück at 45.6 ("et" before "future"), 48.13 ("demonstravit" for "demonstrabit"), 49.1 ("aut" for "a"), 49.16 ("solito" for "soliti"), 49.23 ("qua" for "aqua"), 50.3 (expansion to "sicut"), 50.4 (expansion to "aut"), 50.11 ("nidis suis" for "nidus suos," based on early ms. variant). See Madrid 3307, ff. 69r–71v.

of their appearances. Each of these four planetary excerpts had an attached diagram that presented the content of its most characteristic and coherent data, although not necessarily containing all or even most of the verbal information in the excerpt.[25] With the four planetary excerpts and diagrams as a core, Book V of the computus set forth an elaborated picture of the structure of the heavens and the motions of its parts.

As the examples of Alcuin and Dungal showed, the astronomy in Pliny's *Natural History* was known and trusted by scholars at the royal court and elsewhere. The status of Pliny's work, however, was more that of an encyclopedic reference book than a handy digest. The virtual lack of glossing in the Carolingian copies of the *Natural History* testifies to its absence from the teaching curriculum at any level. On the other hand, Pliny's planetary theory as found in the excerpts for Book V of the Seven Book Computus filled a distinct need. Whereas Macrobius's *Commentary on Scipio's Dream* offered a well ordered picture of a cosmos of earth-centered, concentric spheres—a reassuring image of meaningful positioning of parts—there was, prior to the revival of Pliny's astronomy, only Bede's DNR to explain in a reasoned way the apparent changes in brightness and speed of the planets, caused by their changing distances from us. And while Bede's Chapter 14 described far and near points of the planets, referring to Pliny as the source for fuller explanation,[26] it seems that this information was not easily or well understood in the early ninth century, since the inclusion of Bede's DNR as Book VII of the Seven Book Computus was thought to require an earlier chapter with an explanatory diagram on planetary apsides as part of Book V in this computus. Likewise Macrobius's *Commentary* only implied and in no way described the variations in planetary latitudes within the zodiacal band, a phenomenon that Bede's DNR

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[25] In the five surviving mss. of the Seven Book Computus, only two have all four diagrams designed to accompany the four excerpts; these two mss. are Madrid 3307 and Monza F.9.176. Vat. lat. 645 has the first two diagrams, for order and intervals. Vat. Regin. 309 and Paris nal 456 have none. There are, of course, many other Carolingian mss. with copies of one or more of these Plinian diagrams, but they are not mss. of the Seven Book Computus. Despite the importance of the planetary diagrams, some late ninth-century copies of these four excerpts from the Seven Book Computus had no Plinian diagrams with them; examples are Montpellier H.334, ff. 44v–47r; Bamberg Class. 55, ff. 17r–19v; Paris 5543, ff. 131r–134r.

[26] DNR 14, ed. Jones, pp. 205–7.

elaborated on the basis of Pliny's account.[27] But again the Seven Book Computus took care to ensure comprehension of Bede's DNR 16 by setting forth not only the Plinian text but also an explanatory diagram for planetary latitudes. Here we find two important attributes of the Plinian planetary excerpts and diagrams. For Carolingian students of the early ninth century they formed a convenient abbreviation and focusing of the extensive planetary astronomy in Book 2 of the *Natural History*, which was in any case less widely available than the excerpts, and they anchored these students firmly in the most stable and easily explained characteristics of the planets by offering diagrams from which to begin their understanding.

3. *Plinian Excerpts and Diagrams for Planetary Order and Intervals*

As a group the four planetary excerpts in Book V of the computus emphasized some very simple and fundamental attributes of the planets and their motions. First and most obviously the planets moved circularly, and this immediately established an intelligibility and regularity in their motions. All four excerpts were accompanied by diagrams that placed the planets on circles and each of the motions depicted in a diagram was shown to be circular or else a definable, temporary and regular variation from a simple circular path. Positions and intervals of planetary orbits required no more than concentric circles. Apsides introduced eccentric circles, and latitudes used the more unfamiliar pattern of circles in stereographic projection. Finally, for the variations from circular motions—stations, retrograde motions, certain changes in altitude and latitude—Pliny identified the force of solar rays as the essential cause. Thus Plinian planetary astronomy as expressed in the excerpts of the Seven Book Computus built an orderly structure from circular motions in circular frameworks with a limited set of predictable added motions caused by solar radial force, a concept we shall discuss below in connection with apsides (Sect. 4).

[27] Macrobius, CSS 62.6–29 (I.xv.9–12) explains that the 'circle' of the zodiac actually has width, unlike the other celestial circles. And CSS 60.16–21 (I.xiv.25) may include, but certainly does not require, the variations in planetary latitudes as part of the "error legitimus" of the planets. For Bede, DNR 16, see ed. Jones, pp. 207–8, taken by Bede wholly from Pliny.

Plinian excerpt #1: De positione et cursu planetarum

> Suspended between the heavens and the earth at definite spacings are the seven stars which we call the wanderers (planets) from their motion, yet none wanders less than these. Saturn is the highest of these and therefore looks the smallest and revolves in the largest circle and in thirty years at the least returns to its starting point. Jupiter's circle is below and therefore faster in motion, revolving in twelve years. Third is Mars glowing like fire because of its proximity to the sun and completing its orbit in about two years. Then the course of the Sun is divided into 360 parts, but five and one-fourth days are added yearly in order for observation of the shadows of the Sun [with a sundial] to return to the initial position; and so an intercalary day is added every fourth year for the calculation of the seasons to coincide with the course of the Sun. Below the Sun travels the huge planet called Venus, which shifts its course back and forth; it passes through the whole zodiac in 348 days, never extending more than 46° (*partes*) from the Sun. Next to it in the circle below is Mercury, with a similar pattern but not as much size or power (*vis*), which orbits in nine days or less, sometimes rising before the Sun, sometimes shining after sunset, and never withdrawing more than 22° from it. Therefore the pattern of these [two] planets is distinctive and not like those [upper planets] previously mentioned, for those are often found one-fourth or one-third of the zodiac away or even in opposition to the Sun. But the last planet, the Moon, which is the most familiar to the earth, overwhelms the admiration of everyone with its constant waxing and waning, sometimes horned, sometimes halved, sometimes turned into full orb. It will be spotted and then suddenly shine clear, huge and fully rounded and then quite absent, now visible throughout the night, other times only late at night and into the daytime to add to the Sun's light. When eclipsed it is still visible during the eclipse. It is both low and high [in the heavens] and not in one way only; it is at times raised high in the sky and other times touches the mountains, now high in the north, again low in the south. Therefore it is nearest [of the planets] to the axis [and center] of the cosmos. And so with the shortest circuit it travels in 27–1/3 days the same space as Saturn, the highest planet, does in 30 years, as we have said, and then stays two days in conjunction with the Sun and on the thirtieth day at the latest sets out [again] on the same [orbital] path.[28]

This first excerpt selected from Pliny paralleled Bede's DNR 13 closely, and we may wonder why the compiler of Book V of the computus thought a separate chapter on the orbital sequence, periods, and appearances should exist here with Bede's similar description follow-

[28] Translation from Eastwood and Graßhoff, *Planetary Diagrams*, pp. 25–7; Latin text in ibid., pp. 23–5.

ing closely in Book VII.[29] This situation emphasizes that Book V was conceived as a unit and that its planetary chapters were not simply preparatory to the reading of Bede's chapters on the planets. The computus excerpt excluded the qualities of Saturn and Jupiter, which Bede had included, and also avoided any mention of the occultations of the planets by the Sun, a point on which Bede expanded in detail. The result in the excerpt for Book V, Chapter 3 of the computus was a less dense and more accessible account of planetary order and basic motions. Beginning with a statement of the definite spacing of the planets, the text proceeded from Saturn to the Moon, giving the length of each orbital period, in years for the outer planets and in days for the Sun and sub-solar planets. When Venus and Mercury were named, there appeared the definite limit in elongation of each of these two from the Sun, 46° for Venus and 22° for Mercury. This led easily to a momentary return to the outer planets to emphasize that each of these, unlike Venus and Mercury, could be seen at various times at any angle, even opposition, with respect to the Sun. And finally, the Moon, closest to us and differing from both the upper planets and the sub-solar Venus and Mercury, was described by its strikingly evident phases, conjunctions with the Sun, and occasional eclipses. While Bede's DNR 13 gave the planetary orbital periods, the Carolingian Plinian excerpt focused more upon the continual reduction of time in orbits with approach to the earth and especially upon a separation of the planets into three groups: the three outer planets and the Sun, the following two sub-solar planets, and the Moon. Their appearances and their positions were neatly and emphatically coordinated in this first of the four astronomical excerpts from Pliny.

The diagram accompanying the first excerpt was simple in the extreme and, at the same time, produced the initial knowledge needed for understanding planetary motion (Figure 3.1). In this image of planetary order, there appeared seven concentric circles with each named for its planet and a label for the earth (without a circle of its own) inside the central, lunar circle. The orbits of all planets were circular. And all were, for the moment, similar in appearance and in relationship to the earth except for their relative distances. For the purposes of initial

[29] Jones' edition of DNR, pp. 204–5, carefully identifies the sources used by Bede for DNR 13; Pliny, NH II, 32–39 (intermittently, not continuously), 41, 44, 78, 59, 61 are the sources for virtually every sentence and phrase in Bede's chapter.

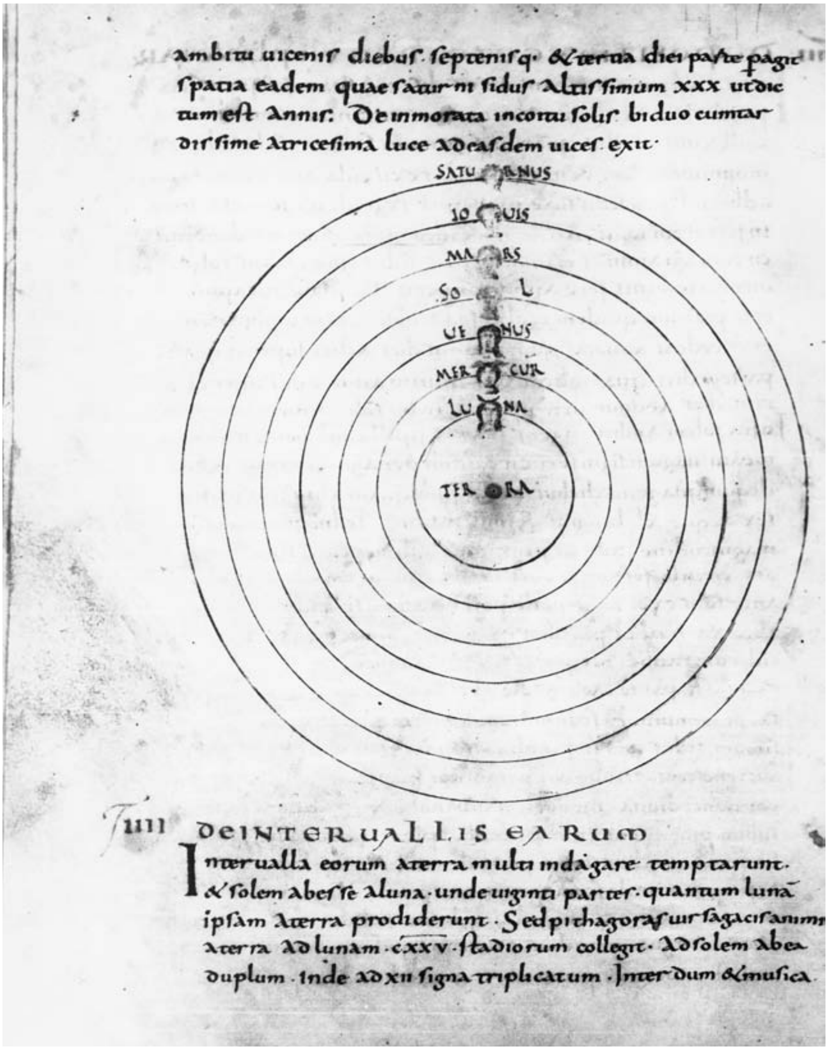

Fig. 3.1. Pliny's Planetary Order. Madrid, Bibliotheca nacional de España cod. 3307, f. 63v

study, the student seeing such a diagram was required to recognize only the sequence of the planets—Saturn, Jupiter, Mars, Sun, Venus, Mercury, Moon—from the outside in to the earth and to see no other differences among them.

The diagram for the second excerpt, on intervals of distance between the planets, directed the student's attention to two points, first that the previous diagram, for planetary sequence, was temporary and intended as a mental building block, second that the previous diagram now had to be modified, or developed, to show the intervals between the planets. Thus the second planetary diagram retained concentric circles but added an eighth, outer circle for the location of the fixed stars (the zodiac, etc.) and reset the distances between the planetary circles in order to show immediately the relative distance units (Figure 3.2).

Plinian excerpt #2: De intervallis earum

> Many have tried to discover the intervals of these [planets] from the earth and they have proposed that from the Sun to the Moon is nineteen times as far as from the earth to Moon. But Pythagoras, a man of very acute mind, concluded that from the earth to Moon is 125,000 stadia, and double that from the Moon to the Sun, and three times that [from the Sun] to the zodiacal signs. And sometimes following musical theory he calls a tone that amount from the earth to the Moon. From there to Mercury half the space, which is a semitone, and the same [a semitone] from there to Venus, from which to the Sun is one-and-one-half, which is three semitones; from the Sun to Mars is a tone (as much as from the earth to the Moon) and from there to Jupiter a half, and from Jupiter to Saturn the same amount of space. From there to the zodiac is one-and-one-half. Thus are produced the seven tones which they call the musical diapason, or octave.[30]

The text for planetary intervals was by far the shortest of the Plinian excerpts in Book V of the computus and did no more than to define in musical tones and in stadia the intervals from the earth to the Moon and between each of the planets beyond as far as the stellar sphere. The text connected the name of Pythagoras with the enterprise and equated the earth-to-moon distance with 125,000 stadia,[31] then labeled

[30] Translation from Eastwood and Graßhoff, *Planetary Diagrams*, p. 29; Latin text on p. 29.

[31] This Carolingian excerpt from Pliny differs from NH II, 83, which states 126,000 stadia. See ed. Mayhoff, *Plinii Secundi Naturalis historiae*, vol. 2, p. 154.3, which also notes the ms. variant of 125,000 stadia.

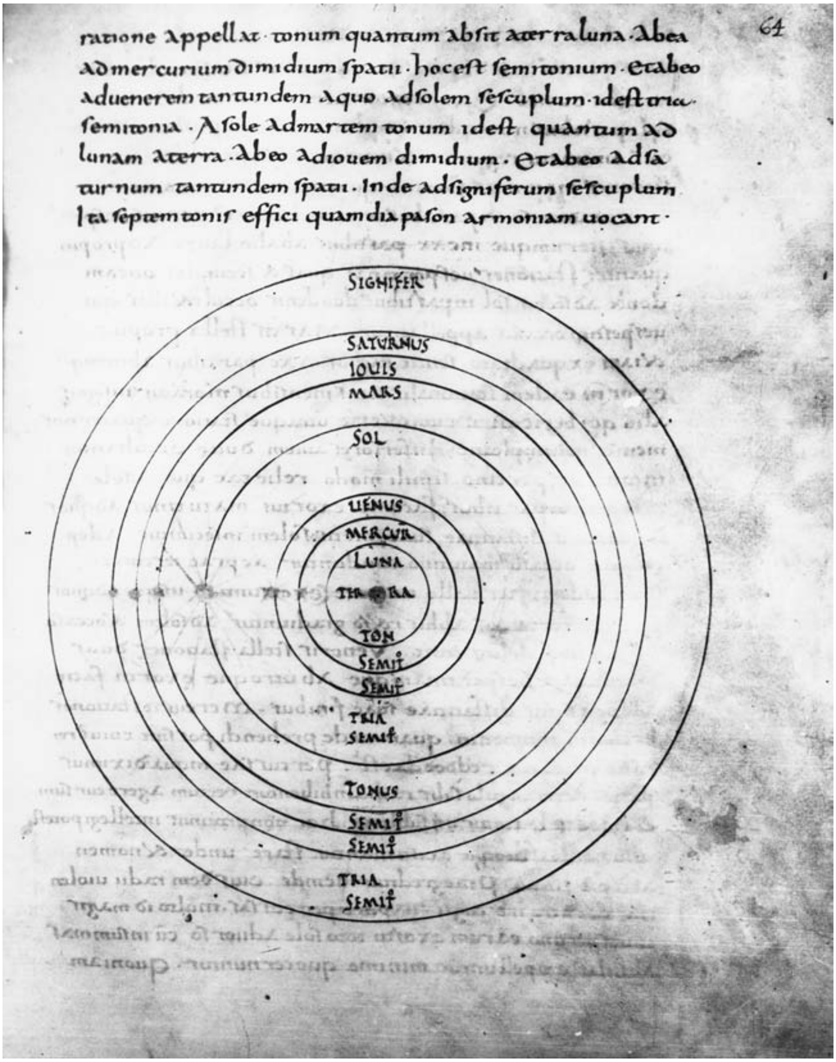

Fig. 3.2. Pliny's Interplanetary Intervals. Madrid, Bibliotheca nacional de España cod. 3307, f. 64r

the earth-moon, the moon-sun, and the sun-stellar sphere intervals as 1, 2, 3 tones respectively. While Pliny thus proposed to offer knowledge of interplanetary harmonic ratios, his text was at least as often used to find linear distances between the orbits. Both the text and the accompanying diagram identified the number of tones for each separate interplanetary interval. Both Pliny and the Carolingian excerpt gave the following intervals.

Earth—Moon:	1
Moon—Mercury:	½
Mercury—Venus:	½
Venus—Sun:	1½
Sun—Mars:	1
Mars—Jupiter:	½
Jupiter—Saturn:	½
Saturn—Stellar sphere:	1½

Pliny's total of seven tones from earth to zodiac did not fit with the initial labels of 1, 2, 3 for the units from earth to Moon to Sun to fixed stars, as many modern scholars have pointed out.[32] However, the diagram for intervals followed the text of the excerpt without a slip. The differences between ½, 1, and 1½ in relative distances were readily comprehended by readers, who found themselves with a concise picture of the planetary realm, its order and size, at the end of the second Plinian excerpt.

4. *Planetary Apsides according to Pliny in the Seven Book Computus*

Built upon the conceptual network of the first two planetary diagrams, the third diagram led students to a new way of understanding the circular orbits of the planets. Having seen the concentric circles take on different intervals in the prior diagram, the student was next prompted to conceive of the shifting of each of the planetary circles between the zodiacal band and the lunar circle to a new position with a distinct

[32] See ed. Beaujeu, *Histoire naturelle, Livre II*, pp. 172–3 for commentary on Pliny's text for problems with the interplanetary intervals reported.

and individual center. This was the diagram for planetary apsides, or far and near points with respect to the earth (Figure 3.3). These were only the astronomical positions of apogee and perigee, for the astrological exaltations, also called 'apsides,' received no mention in the Plinian excerpt. With the earth eccentric to each planetary circle, each planet, moving at constant speed, came to have a point on its circle at which it was farthest from the earth and appeared to move slowest in its orbit; the diametrically opposed point on the circle was, of course, the nearest to the earth and the place of fastest apparent motion on the planet's circle. In its simplest form this diagram assigned progressively larger circles to the planets from the earth outward; each circle's diameter passed through the center of the diagram, with the center of that diameter removed from the diagram's center and located along the midline of a specified zodiacal sign. The zodiacal signs appeared in the twelve equal segments of the outer band of the diagram. The excerpt assigned to each planet the midline of a given sign as the location for the outer apsis, or apogee, of the planet. While the excerpt provided a great deal more information than did the diagram, the diagram focused a reader's attention on the most basic characteristics of planetary motion according to the excerpt. In the two surviving copies of the Seven Book Computus that contain the apsidal diagram, each planetary circle has the planet's name on its circle under the designated sign for apogee and also shows notches to indicate the locations of the planetary apogees.[33] Here we have a pedagogical modification by way of simplification to a generic character; the diagram was intended to convey neither the quantity nor any comparative aspect of the phenomena. A student of the diagram learned only the location of the apsides. Such limits on the information available in the diagram must have made it a useful starting point for instruction—a common foundation for all the planets from which divergences could then be pointed out by reference to details in the text of the excerpt.

[33] For the apsidal diagrams in the Seven Book Computus see Madrid 3307, f. 65v, and Monza F.9.176, f. 72v. They are almost identical.

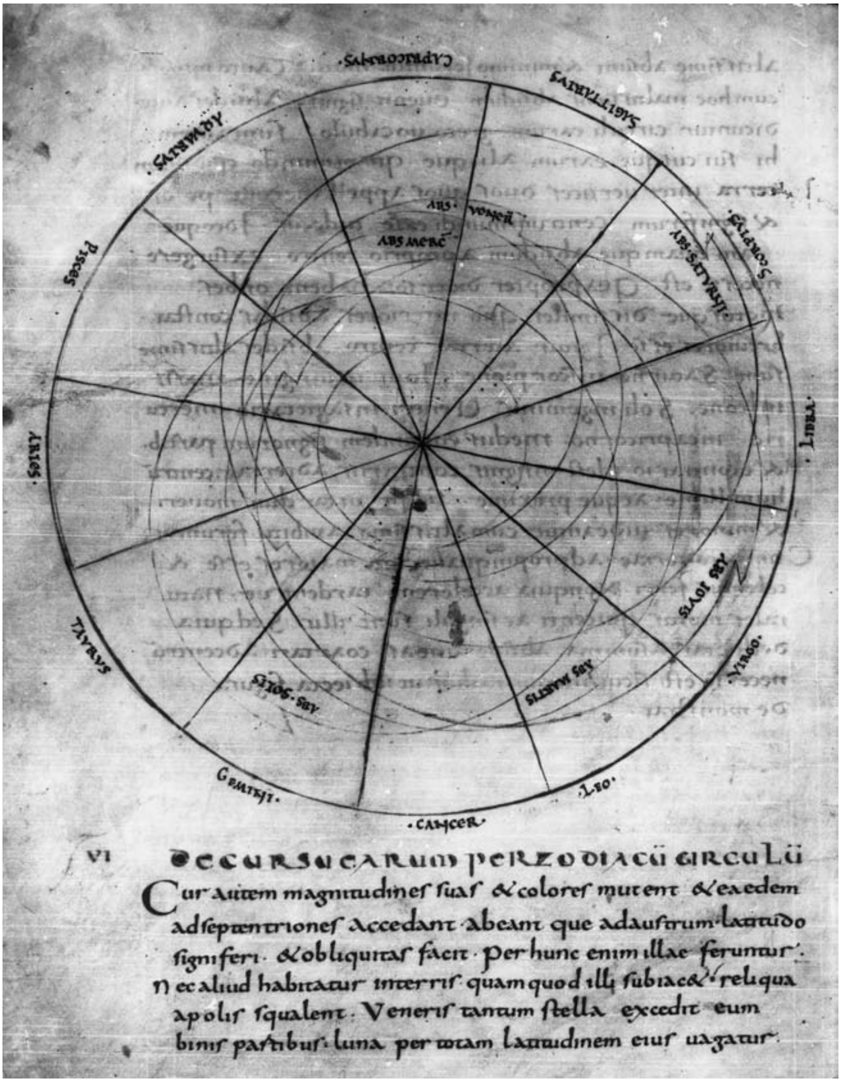

Fig. 3.3. Pliny's Planetary Apsides. Madrid, Bibliotheca nacional de España cod. 3307, f. 65v

Before exploring the details and implications of the apsidal diagram, we must look at the content of the excerpt that inspired it. The third astronomical excerpt has four parts: (1) the positions for risings, settings, and stations of the superior planets, (2) the same information for the inferior planets, Venus and Mercury, with a brief mention of their retrograde motions after evening rising, (3) the physical cause of planetary station and retrogradation, which is the force of solar rays at specific angles,[34] and (4) the locations of the individual planetary apsides and the visual effects of these. The superior planets rise at 11° from the Sun and set at an approaching interval of 12°. Their retrograde motion occurs most rapidly at opposition to the Sun (180°) and the stations at 60° (for Saturn and Jupiter) or 90° (for Mars) to either side of this. The inferior planets, being held by the force of solar rays to limited elongations from the Sun, have their greatest visible retrograde motion at evening rising, as they move away from the setting Sun. For all the planets continuous circular motion is inherent, while the process of stations and retrogradation is caused by the force of solar rays at certain critical angles. Pliny identified these angles and described the effect of station as a forced movement of the affected planet radially away from us, thus appearing as no motion at all. Following the first station of a planet, the solar ray then pressed upon the planet sideways, pushing it backward in retrograde motion until the second station, when the planet could then resume its normal movement. Visually this effect is greater at evening rising, when an inferior planet is moving away from the Sun, and is much less at the position of apogee, when the planet is at its greatest distance from us. Pliny remarked only on the angles of the effective solar rays, not on any relationship between the strength of solar rays and the distance of the affected planet from the Sun. Neither in this excerpt nor elsewhere in the *Natural History* did Pliny consider other zodiacal locations for planetary apogees; in other words, he proposed permanently fixed planetary apsides. The excerpt concludes with Pliny's list of planetary apogees, or far apsides, to make precise these locations of lesser retrograde effect, emphasizing

[34] Beaujeu, ed., *Histoire naturelle*, p. 158, n. 1, points out that Pliny's idea of active solar rays appears in the works of Vitruvius, Lucan, and Censorinus and seems to be a late Babylonian notion transmitted by Posidonius to Varro. See Schiaparelli, *Scritti sulla storia astronomia antica*, vol. 3, p. 88, where the editor, Luigi Gabba, added a note to introduce the suggestive term 'heliodynamic' to label this solar dominance that Pliny adopted from the Hellenistic Stoic tradition.

the eccentricity of each and the reduction of visual arc under any fixed angle as a planet moves on its eccentric circle closer to the earth.[35]

Plinian excerpt #3: De absidibus earum

> The three planets which we said are above the Sun are hidden while traveling with it, then have morning risings never more than 11° away from the Sun; subsequently, directed by its rays they make morning stations at trine, or 120°, called first [stations], and next in opposition at 180° they make their evening risings. And again at 120° approaching on the other side they make evening, or second, stations. Then the Sun overtakes and obscures them at an interval of 12°, known as their evening settings. The planet Mars, being nearer [the Sun than the others], senses the rays at 90° after each rising and remains stationary in the zodiac for six months, otherwise for two months, while the other two [superior planets] do not remain at station even four months. The two planets below the Sun are similarly obscured at evening conjunction, and they make their morning risings at the same number of degrees from the Sun, at which from the greatest limits of their distance they follow the Sun. Overtaking the Sun at morning setting they are obscured and are not seen. Once again in the evening they rise at the same interval as far as the limits we have stated, from which they retrogress towards the Sun and disappear in their evening setting. The planet Venus makes two stations morning and evening from each rising from the farthest limits of her elongation. Mercury's stations take too brief a time to be seen.
>
> The cause of this must be made known here separately. Struck at that angle we stated and by a triangular solar ray, they are prevented from continuing a direct course and are pushed upwards by the fiery force [of the ray]. We cannot see this directly, and thus they are perceived to stop, and so they receive the name of station. The violence of the same ray then moves ahead and compels the affected planets to go backwards. This occurs much more at their evening risings, when moving away from the Sun, when they are driven into their fullest apogee and are least visible, for they are farthest away and are producing the least [visible] motion. So much the less when this occurs in the most distant signs of the apsides. In the Greek language the circles of these [planetary paths] are called

[35] For a summary and assessment of Pliny's planetary theory, also the complementary matter in Papyrus Mich. 149, see Neugebauer, HAMA, vol. 2, pp. 802–8. Neugebauer preserves Pliny's language but insists on inserting the theory of epicycles into Pliny's account of apsides (p. 805) in order to make it more correct. This does not help us understand what the Carolingians found in Pliny. Neugebauer, p. 802, n. 5, points out that Pliny's apogees for the sun and outer planets fall in the same signs as given by the Almagest. Neugebauer could find no source for Pliny's apsides for Mercury and Venus.

> apsides. These are not the same as those of the sidereal sphere, since the earth is between two *vertices* that they call poles and is seen to be at the center of both the sidereal sphere and the zodiac. Thus it is necessary that each one of the apsides rise from its own center; wherefore they have different orbits and different motions, since the inner apsides are smaller circles. Therefore from the center of the earth the apogees are: Saturn in Scorpio, Jupiter in Virgo, Mars in Leo, Sun in Gemini, Venus in Sagittarius, Mercury in Capricorn, at the midpoints of these signs, and on the contrary in the opposite signs being the lowest and closest to the center of the earth. Thus it happens that they seem smaller and to be moved slower when they travel in their highest pathway and to be larger and to move faster when they have approached nearer to the earth. This is not because the natural motions, which are definite and unique to each planet, accelerate and slow down, but because lines drawn from the outer apsis (the apogee) towards the center must crowd together, just like the spokes in a wheel, as the figure below shows.[36]

Returning to the apsidal diagram (Figure 3.3) provided for the Seven Book Computus V, 5, we should now study it more closely, noticing its strengths as an educational device and its peculiarities. The two surviving diagrams attached to the ninth-century copies of the computus reveal a notable element, the use of notches to mark the apsides. The two examples that we have, the Madrid and Monza codices, come from different centers at somewhat different times, the former at Murbach by the year 828, the latter perhaps at Lobbes around 869 (or from mid-century onward in any case). There is no reason to assume the same scribe or director for the two. On the contrary, we can assume that each was an independent copy of a prototype that no longer survives, since both the Monza and the Madrid diagrams present the notches in exactly the same zodiacal locations. Why did the prototype of the apsidal diagrams in the Madrid and Monza codices add these notches? Was the original diagram (ca. 812) similar? Why did two different scriptoria and sets of users of the Seven Book Computus at two different times retain this device?

These are interesting questions, and they lead us to look for further evidence of early apsidal diagrams, which we find in an incomplete and disordered copy of the Seven Book Computus (a. 820) in a Paris manuscript where the standard diagrams for the other three Plinian

[36] Translation from Eastwood and Graßhoff, *Planetary Diagrams*, pp. 34–5; Latin text on pp. 33–4.

planetary excerpts are accompanied by a curious and non-standard apsidal diagram (Figure 3.4).[37] In this design the five planets with stations and retrograde motions are clearly separated from the Moon and the Sun, which have none. The Moon's circle is the innermost concentric circle, while the Sun's is the eccentric circle that cuts the lunar circle. None of the circles in this diagram was labeled, which tells us that the diagram was abandoned before completion, and we shall soon see why. Without labels, are these planetary circles identifiable in the Paris manuscript diagram? Yes, because we have two other early apsidal diagrams with which to compare the Paris example. To begin with, we can say that the Paris diagram was drawn crudely and carelessly. We can mark the notches in the Monza apsidal diagram and then compare these readings with the unlabeled apsidal circles in the Paris apsidal diagram.

Figure 3.3 (Monza F.9.176)	Figure 3.4 (Paris nal 1615)
Saturn—Scorpio & Taurus	Scorpio/Libra & Taurus
Jupiter—Virgo & Pisces	Libra & Aries
Mars—Leo & Aquarius	Leo/Cancer & Aquarius
Sun—Gemini & Sagittarius	none present
Venus—Sagittarius & Gemini	Sagittarius & Gemini/Cancer
Mercury—Capricorn & Cancer	Capricorn & Leo

While the locations for apogee and perigee correspond with the notches in Figure 3.3, the notches in Figure 3.4 do not always correspond with the actual apogees and perigees of their circles as drawn. Thus in the latter diagram the point on the Mercury circle farthest from the center (apogee) is on the radial line separating the signs Libra and Scorpio, not at all close to its notch in the diagram. Again, the Jupiter circle in Figure 3.4 shows the notches fitting the apogee and perigee perfectly, but unfortunately the correct signs for Jupiter are Virgo and Pisces—one full sign clockwise for each. There are further inaccuracies in the Paris manuscript diagram, and its failure to follow carefully what must have been a better exemplar resulted in the abandonment before completion

[37] Paris nal 1615, f. 160v. The ms. has an *annus praesens* of 820 on f. 154r, which was pointed out by Stevens, "A Double Perspective," pp. 15–16, n. 29. A later ninth-century apsidal diagram combining elements of the Paris and Monza diagrams is Vat. Rossi 247, f. 200r.

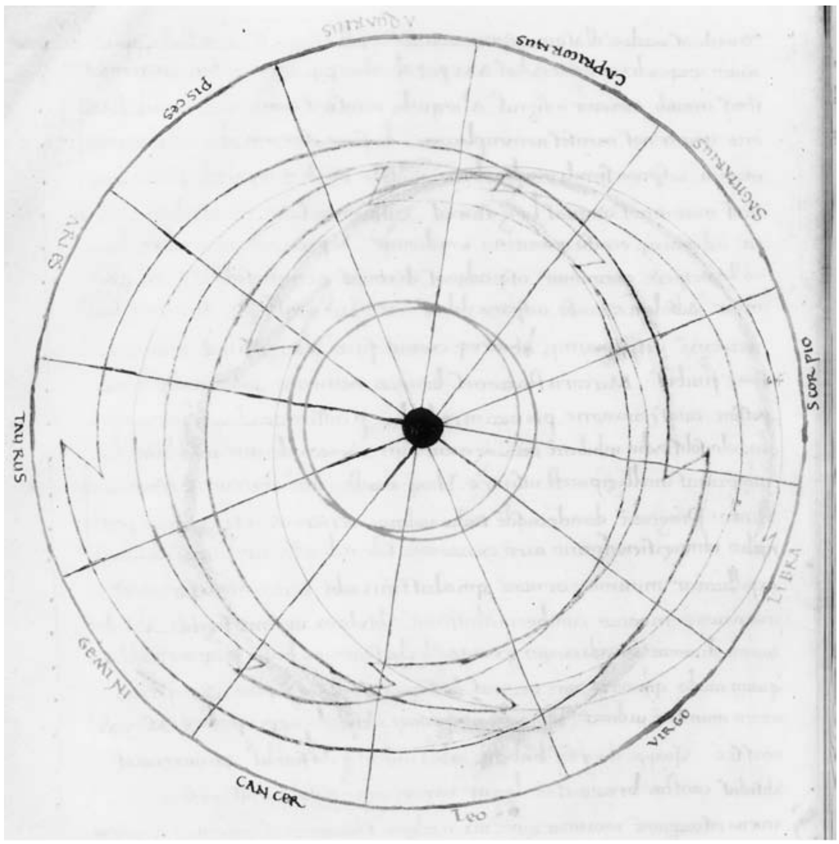

Fig. 3.4. Pliny's Planetary Apsides. Paris, Bibliothèque nationale de France, ms. nal 1615, f. 160v

of this diagram in Figure 3.4. But before we abandon it, we need to consider the implications of its circles for the Moon and the Sun. The lunar circle poses no problem; it is the small concentric circle with no notch. The Paris apsidal diagram shows the Moon's circle the same as every other (correct) Plinian apsidal diagram, concentric with the earth because the Moon has no apsides. The eccentric circle that cuts the lunar circle can only be the circle for the Sun. How can this be, since it is supposed to have apsides, though not retrograde motion, and appears integrated with all other eccentric circles in virtually all other apsidal diagrams? To answer this we need to look at the evidence we have.

For early apsidal diagrams we have the Madrid (820–828) and Monza (ca. 869) examples, which are virtually identical and which locate all apsides correctly in accord with Pliny. We also have the Paris example (820), which has an eccentric circle without notches for the Sun, and does not orient this circle towards the zodiacal sign of Gemini as its apogee. We do not know exactly what the original diagram (812) looked like, and we can only assume—and we shall assume—that it was drawn to represent the apsides in accord with the excerpt. From the appearance of all other early medieval apsidal diagrams derived from the Plinian excerpts of the Carolingian computus, we can confidently say that the Madrid and Monza examples are much closer than the Paris example to the general type. On the other hand, the Paris diagram (Figure 3.4) shows a special concern with the solar circle. Why is this so? By isolating the solar circle from the five other planets with apsides, the designer could point more swiftly to the difference involved, the absence of stations and retrograde motion from solar apsidal motion. This figure's designer may have considered the notches to be markers for stations and retrogradations. The designer of Figure 3.4 wished to heighten the difference between the solar and other circles. He drew hurriedly, and saw before finishing that his modifications of the apsidal diagram in his exemplar held too many flaws. Unlike the other three Plinian planetary diagrams in the Paris codex, the apsidal diagram was not labeled and completed. The other planetary diagrams in this codex were made with thoroughly standard form and detail and inspire no questions of the sort raised by the apsidal diagram. We have evidence that at least one subsequent scholar accepted the doctrine that all seven planets have stations and retrogrades. Hadoard of Corbie's Collectaneum retained Macrobius's statement to this effect, and Hadoard possibly saw an apsidal diagram from the Seven Book Computus that supported this view.[38]

This sort of imagery of planetary orbits not limited to simple geocentric circles, was subtle, complex, and strange for most literate persons in the first half of the ninth century. They were much more accustomed to numbers and numerical calculations about distances than to concepts of varying motions in space based on geometrical arrangements. The wide distribution of texts on arithmetic, computation, and music compared to that of specifically geometrical texts supports this view. The poverty of geometrical content in ninth-century textbooks as varied as Cassiodorus's *Institutiones* and Book VI (on geometry) of Martianus Capella's *De nuptiis Philologiae et Mercurii* strengthens the same interpretation.

Astronomical significance of the notches

The direct solution to any complications introduced by the notches in the apsidal diagram was to eliminate the notches, and this happened during the third quarter of the ninth century as witnessed by the cosmological materials brought together in the Bern Collection, based primarily on Macrobius's *Commentary*.[39] The senior and more accomplished scribe of the manuscript, Bern 347, determined after finishing his selections from Macrobius to add the four planetary excerpts with their diagrams from the Seven Book Computus. Consonant with his assuredness in excerpting Macrobius, he seems to have chosen to simplify his copy of the apsidal diagram and in the process to improve its form by omitting the notches on all planetary circles (Figure 3.5). It is notable that the earliest surviving copy of the clarified apsidal diagram appeared in a cosmological collection devoted to emphasizing the reasoned order of the cosmos; the diagram enhanced significantly that sense of reasoned order. This improved apsidal diagram inspired others to imitation in at least three other surviving copies over the late

[38] While Hadoard made no reference to a Plinian text or diagram, it is reasonable to see an intersection of erroneous teachings here. See above, p. 79. At Corbie, Hadoard had access to a variety of mss. with educational, including astronomical-computistical, texts. See Ganz, *Corbie*, pp. 59, 124–58.

[39] On this collection of material from Macrobius's *Commentary* and its origins, see pp. 72–6 above.

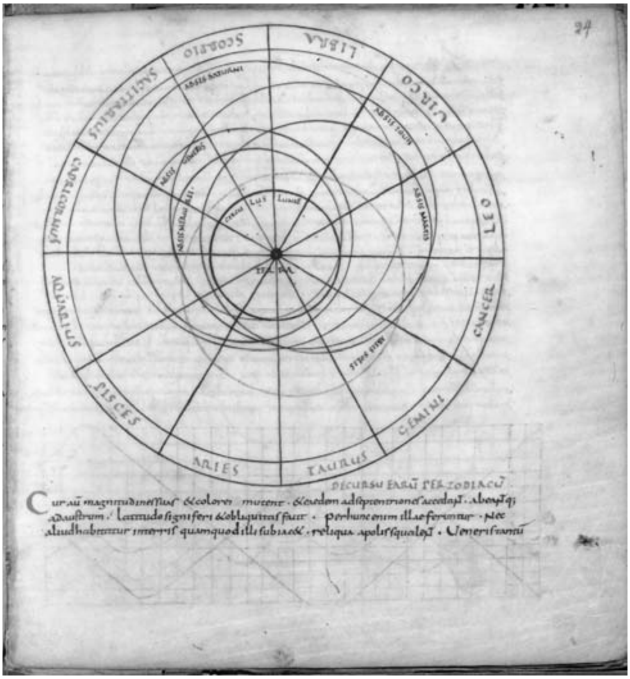

Fig. 3.5. Planetary Apsides Simplified. Bern, Burgerbibliothek cod. 347, 24r

ninth and tenth century and was the basis for a further modification in its form, to be introduced below.[40]

5. *Planetary Latitudes according to Pliny in the Seven Book Computus*

Seeing that the degree of difficulty of adequate pictorial representation rose sharply in the shift from the diagram for planetary intervals to the diagram for planetary apsides in the Seven Book Computus, we may marvel at the increase in degree of difficulty and ask new questions

[40] Oxford Canon. class. 279, f. 33v; see Hunt, *The Survival of Ancient Literature*, pp. 53–4, nr. 103. Paris 5239, f. 125v; see Gaborit-Chopin, *La décoration des manuscrits à Saint-Martial*, p. 204. Strasbourg 326, f. 124r. The last two of these are computistical collections, and their apsidal diagrams are virtually identical, indicating that one was copied from the other; the Paris ms., tentatively dated to ca. 950, is probably the later of the two.

when seeing the diagram accompanying the Plinian excerpt for planetary latitudes. Here we find a level of sophistication that has, in fact, brought modern commentators to grief, for more than one historian of the twentieth century has looked at the early Plinian latitude diagrams, composed in a circular form, and concluded confidently—and incorrectly—that these were simply images of individual planetary orbits longitudinally in the heavens.

The excerpt served by the latitude diagram was the longest of the four planetary excerpts from Pliny. Although like the relevant chapters by Bede, DNR 15–16, in its central theme,[41] the Pliny excerpt for the computus paid far greater attention to observed variations of latitude and altitude, risings and settings, than did Bede, who had also drawn his texts from Pliny's *Natural History*. The fourth astronomical excerpt opened with a question and an answer that focused the reader upon an elaboration of the answer and upon the many examples that followed. The question was, "Why do they [the planets] change their sizes and colors and approach to the north and depart to the south?" The answer followed immediately upon the question and informed the reader, "The latitude and obliquity of the zodiac make this happen." The zodiac sets the northern and southern limits for habitation of the earth, and the seven planets oscillate up and down across different widths of the zodiacal band. The excerpt immediately identified the part of the twelve-degree band covered by each planet, noting that one planet, Venus, actually exceeded the band by two degrees. Thereafter the excerpt described risings and changes in latitude for all the planets and distinguished latitude from altitude (above the horizon) for the two inner planets. Rising and setting times followed. A short paragraph devoted to the Moon alone covered phases and conjunctions with the Sun. A final paragraph defined maximum and minimum intervals of planetary invisibility, listing the various causes of invisibility.

Plinian excerpt #4: De cursu earum per zodiacum circulum

> Why do they [planets] change their sizes and colors and approach to the north and depart to the south? The latitude and obliquity of the zodiac are responsible. Because of this, those things happen, nor is any place on earth inhabited unless it lies beneath it [the limits of the zodiacal

[41] See DNR, ed. Jones, pp. 207–8; DNR 15: *Quare Mutent Colores*; DNR 16: *De Zodiaco Circulo*.

band]; all else is dessicated by [closeness to] the poles. The planet Venus surpasses it [the limit] by 2°; the Moon travels across the whole width [of the zodiacal band] but does not exceed it at all. Mercury is quite different from these, not traversing more than 8° of the 12° of zodiacal latitude, nor are these equally divided but with two in the middle, four above, and two below. The Sun moves unevenly in the middle, in a serpentine path between two degrees. Mars travels 4° in the middle, Jupiter the middle degree and two above it, and Saturn two like the Sun.

The three upper planets from morning rising begin to ascend the band of the zodiac, that is, to approach northward, and from evening rising to descend, that is, to depart southward. A solar ray coming on the other side from above presses down towards the earth with the same force with which it pushes up towards the heavens, so much does it depend on whether the rays come from below or from above. Venus likewise increases in latitude from morning rising and begins to descend at evening, in morning setting to decrease its altitude, and at evening station to go backwards and at the same time to decrease in altitude. From morning rising Mercury ascends in both ways, that is, in latitude and in altitude; from evening rising it decreases in latitude and follows the Sun at an interval of 15°, remaining almost motionless for four days. Next it descends from its altitude and goes back from its evening setting to its morning rising. And just this one [planet] sets in as many days as it rises. Venus rises in fifteen times as many days as its setting. On the other hand Saturn and Jupiter take twice as long to set as to rise, and Mars sets in four times as long. Such is the variety of nature.

The planet Mars never makes a station when Jupiter is located 120° from it and only rarely when Jupiter is at 60°, but the two planets rise together when they are in the signs of Cancer and Leo. Mercury makes infrequent evening risings in Pisces and most often in Virgo, morning risings in Aquarius but hardly ever in Leo. Its retrograde does not occur in Taurus and Gemini and not within the first 25° of Cancer.

In no other sign than Gemini does the moon make conjunction twice with the Sun; in Sagittarius they have no conjunction at all. The very last visibility and the first new moon are observed on the same day or night only under the sign of Aries. It [the Moon] is sensitive to change in the angle of impact of solar rays. At quadrature from the Sun half of the Moon is shining; at trine one-third part travels hidden; at opposition it is full. And again in waning it shows the same shapes at the same intervals, moving according to the same reasoning [,unlimited in elongation from the Sun,] as the three supra-solar planets.

The planets Saturn and Mars are not invisible for more than 170 days, Jupiter no more than 36 days, with the minimum for each of these being ten days less. For Venus [the maximum is] 69 days or a minimum of 52, for Mercury 12 or a maximum of 17. Why are they not seen? Conjunction with the Sun, [occultation at the] crossings of the apsides, and the extreme distances of orbits are known causes, since they [planets] are obscured at these points. Then maximally, for many days the planets are not seen

> when stationary at the crossings of apsides and at the farthest distances of their orbits. And so they make their way in the press of the Sun, and although weakly they nevertheless descend [towards us]. And among all the planets the path of Mars is the most unobservable.[42]

The Plinian latitude diagram for the Seven Book Computus survives in the same manuscript books of that computus as the apsidal diagram.[43] The composer wanted no uncertainty about the reference of the diagram and so inserted it immediately after the part of the excerpt that listed as numbers the latitudes of the planets.[44] The specific character of his diagram is strikingly apt and also, to moderns at least, quite unexpected. The designer set down the planetary latitudes in a design approximating—we might say 'attempting'—stereographic projection (Figure 3.6). This design used the southern point of the axis of the ecliptic as the projection point for locating planetary paths through the zodiac. The image we find uses a framework of thirteen equally spaced concentric circles to represent the twelve degrees of width of the zodiac, the largest circle being the lower edge of the zodiacal band, closest to the southern axial projection point, and the smallest circle being the upper, northern edge of the zodiacal band. The designer placed each planetary circle eccentrically so that its inclination to the plane of the ecliptic, which is the centerline of the zodiacal band, as well as its exact location on the zodiacal band could be read by counting the number of concentric circles between this centerline and the apogee and the perigee of the planetary eccentric. For example, an eccentric circle that has its apogee touching the outer circle of the zodiacal framework and its perigee touching the inner circle would have a latitude of twelve degrees; this was the lunar circle in the Plinian latitude diagram, since the Moon's path was supposed to define the width of the zodiacal band. Different numbers were provided in the excerpt for the other planets and their latitudes, determining the location and amount of eccentricity for each planetary circle in the diagram, which we can see in Figure 3.6. Mercury's latitude stretched from circle 3 to circle 11, Venus' latitude from 1° beyond the band on one side to the same

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42 Translation from Eastwood and Graßhoff, *Planetary Diagrams*, pp. 39–40; Latin text on pp. 38–9.

43 See Madrid 3307, f. 66r; Monza F.9.176, f. 73r; Paris nal 1615, f. 161r. The Paris example has no unusual characteristics, but it lacks a latitudinal circle for Mars. Our discussion here will refer only to the Madrid and Monza examples.

44 The full excerpt for latitudes appears in Madrid 3307, ff. 65v–67r, and in Monza F.9.176, ff. 72v–74r.

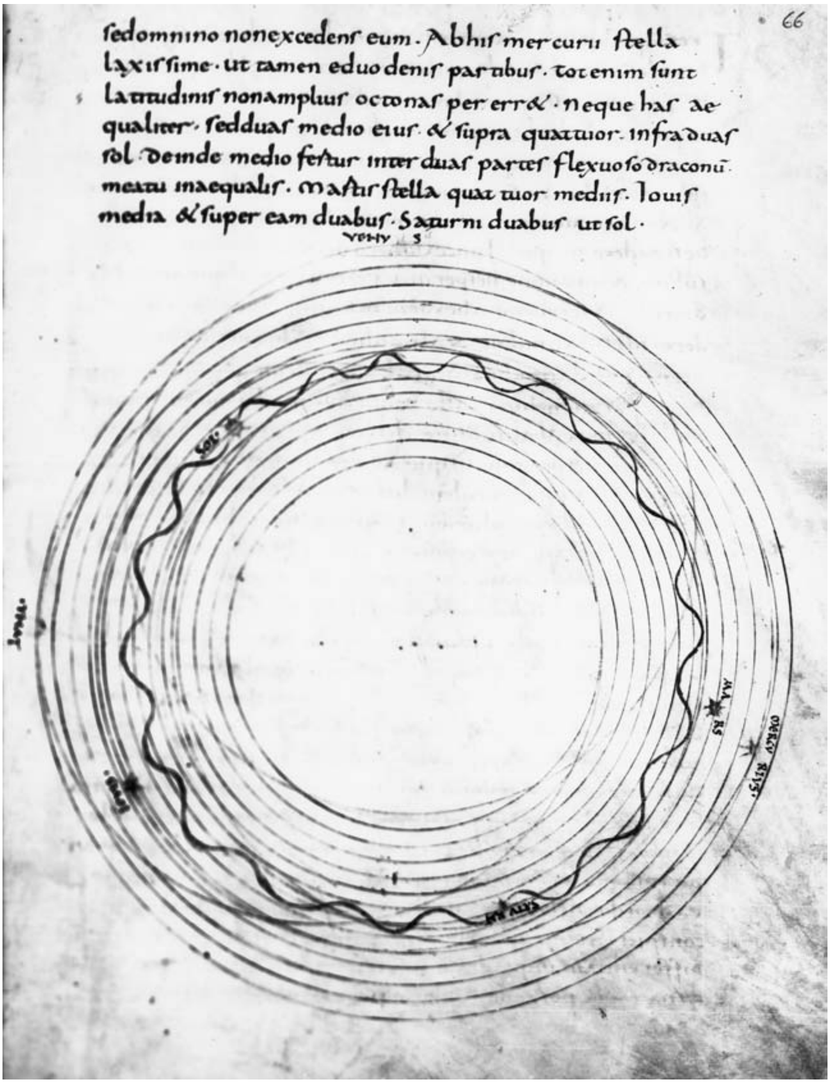

Fig. 3.6. Pliny's Planetary Latitudes (circular). Madrid, Biblioteca nacional de España cod. 3307, f. 66r

extension beyond the other side; the sun followed a serpentine path 1° to either side of the central, ecliptic line; Mars stretched from circle 5 to circle 9, Jupiter from circle 6 to circle 9, and Saturn the same 2° in the middle as the Sun. The beauty of such a diagram is that it preserves the longitudinal element, though not the radial distance, of each planet's orbit while presenting the latitudinal element, the eccentricity, as the most evident characteristic.

Where did this knowledge of stereographic projection, albeit imperfect, come from? We have no Latin text extant from the ninth century—nor any time from late Antiquity through the tenth century for that matter—that explains how to construct or use a stereographic projection. Yet we find the use of stereographic projection in two closely related sources in the early ninth century. One is this diagram accompanying the excerpt for planetary latitudes in the Seven Book Computus. The other appears in one of the two manuscripts of the so-called Three Book Computus, copied by the year 818 at Salzburg under Archbishop Arn.[45] This second example of stereographic projection, imperfectly realized, appears in a planisphere, that is, a planar representation of the constellations on the celestial sphere. We shall discuss further the Three Book Computus below, but our present concern is limited to this example of an imperfect use of stereographic projection. A modern analysis of the planisphere has revealed that, while the projection point is the celestial South Pole, there are elements that do not follow either modern or stereographic projection canons.[46] Arguing for a continuous Latin tradition of knowledge based either directly or indirectly upon the construction of Roman anaphoric clock discs, John North pointed out the existence of additional circles beyond the

[45] See above, pp. 4–8, for background to the two computi emerging from the computistical conference of 809. For further discussion of the Pliny excerpts in the Three Book Computus, see below (this chapter). On the Three Book Computus see King, "Investigation," pp. 3–27, and Borst, *Buch der Naturgeschichte*, pp. 170–5. The stereographic usage appears in Munich 210, f. 113v, and not in its exemplar, Vienna 387. A very good color reproduction of the planisphere appears in Bullough, *The Age of Charlemagne*, p. 129. In passing, the reader may note that this is an eleven-constellation zodiac, the sign of Libra actually being the claws of Scorpio (noted, among others, by Macrobius in CSS 72.8–9 [I.xviii.13]).

[46] North, "Monasticism and the First Mechanical Clocks," pp. 386–8. Regarding North's larger point about the continuity of such knowledge, we can add that his reference to Berlin Phillipps 1830, ff. 11v–12r, part of a large astronomical-computistical manuscript owned by Martin of Laon, is excellent evidence of continued and perhaps improved practical knowledge of stereographic projection in the middle of the ninth century.

expected set for a planisphere. A prominent eccentric circle to the left, crossing the zodiac at Sagittarius and Gemini, is the Milky Way. The equator is, inappropriately for this projection, not concentric with the tropics. Yet an ability of the designer here to lay down circles stereographically is evident. Thus in the second decade of the century two closely related computistical texts made use of this unusual form of projection. In the case of the planisphere, stereographic projection of the celestial sphere was an ancient tradition. However, in the Plinian latitude diagram, application of this projection to the planetary circles was thoroughly novel, and we may wonder whether there was any connection between the two instances of this method of representation. Given that stereographic projection was described in Ptolemy's *Planisphere*, a text well known in the contemporary Byzantine world, the question of Greek influence from the East can at least be raised. While there is neither reference to Ptolemy's text nor any evidence to suggest its presence in Carolingian Europe, we do know of embassies traveling from Aachen to Byzantium and from Byzantium to Aachen. We have a very specific reference by the Irish monk Dungal, writing from Saint Denis in 811 to Charlemagne, to a bishop from Constantinople with astronomical interests, who had recently visited the emperor at the Aachen court. Such a person would surely have entered into discussions with court scholars about current intellectual concerns, and one of the safer topics of the time was the question of how best to represent the latitudes of the planets in a graphic form.[47] Of the choices available

[47] For Dungal's letter see MGH *Epistolae*, vol. 4, p. 570; also in PL 105, coll. 448–9. On embassies in both directions between Byzantium and the Carolingian royal court under Charlemagne and Louis the Pious, see McCormick, "Diplomacy and the Carolingian Encounter with Byzantium," pp. 25–30, where we find that Byzantine episcopal embassies included sizeable entourages, probably in the range of 25 to 40 persons, with at least a few members of the intelligentsia, and that they usually stayed at the Frankish court from several days up to about three months. The *Annales regni Francorum* refers explicitly to a legation to the royal court from the emperor Nicephorus in 811; see below, n. 158. There are difficulties identifying which embassy from Constantinople would have included the bishop who carried the information about the eclipses. Dölger, *Regesten der Kaiserurkunden*, vol. 1, p. 47, nr. 383, might well fit, except this and the previous undated legation (nrs. 382, 383) are rejected as false records by Lounghis, *Les ambassades Byzantines en occident*, p. 160, n. 3. Perhaps the most likely of the recorded embassies was that of fall 810, which arrived at Aachen in October; if this legation stayed through the end of November, the visible and striking solar eclipse would have elicited much discussion. See ibid., pp. 159–60; Dölger, *Regesten der Kaiserurkunden*, p. 46, nr. 371; if the embassy of 811–812 was the occasion (Dölger nr. 385, Lounghis pp. 160–1), then the dating of the letter to Dungal (MGH *Epistolae*, vol. 4, p. 570) must be corrected.

to us, the personal contact between a knowledgeable Byzantine cleric and an inquisitive Carolingian court scholar seems the most likely to have led to the circular design for planetary latitudes in the Seven Book Computus.[48]

6. *The Astronomical Perspective in the Three Book Computus*

The place of the four planetary excerpts from Pliny in the Seven Book Computus was clear. As we remarked before, they succeeded two chapters on the constellations and were followed by chapters on the specific phenomena of the Moon and Sun, distances between planets, and the prognosis of the weather from phenomena of the heavens and on the earth. Neither Macrobius nor Isidore of Seville provided anything like the specificity of Pliny's accounts of planetary motions. Bede's DNR approximated much of what appeared in the Plinian excerpts but offered less explanation and certainly lacked the four diagrams that made the planetary excerpts of the Seven Book Computus such excellent tools for instruction. Book V of this computus represented a move to incorporate a distinctly astronomical, or geometrical, component into the practice of computus in order to expand the meaning and understanding of a phrase like 'celestial order'. The central element in this geometrical understanding was the set of four Plinian excerpts with their planetary diagrams. This move towards geometrical explanation in astronomical topics was not accepted equally by all interested scholars. The cool response by some appeared in the collection of materials into an alternative compilation, the Three Book Computus, a few years after 812, when the Seven Book Computus began to circulate. Adalhard, abbot of Corbie, (753–827) a scholar of many parts, who was committed to carrying out the royal will to reform computus, had led the way by coordinating the composition of the Seven Book Computus, most

[48] One anonymous reviewer of my interpretation rejected completely the notion of stereographic projection here and pointed out that a polar projection of the zodiac would give the inner circle a diameter about 81% of the outer circle and give the zodiacal band a width less than 10% of the total diameter of the circle. This mathematical objection is unpersuasive, since the character of the Plinian diagrams is pedagogical and reductive. Mathematical precision in the spacing of the concentric circles would make the diagram more difficult to read and to copy. In claiming an influence of stereographic projection I am not claiming to find an adequate representation of such a projection.

likely at the Aachen court. And if Arno Borst's suggested chronology is right, then the year 810 or perhaps 811, when Charlemagne was also addressing his astronomical inquiry to Dungal at Paris, was precisely when the Plinian excerpts were finalized and when their diagrams were produced.[49] It was after the death of Charlemagne and at the time of a new attempt at monastic reform in 816 that the compilation of the Three Book Computus occurred, carried out by a close friend of Alcuin, Arn, abbot of Saint Amand (since 782) and archbishop of Salzburg (785–821).[50] He tried to reduce the innovations in computus.

The Three Book Computus offered a different and more conservative path into computistical literacy. It proceeded from a first book of ninety-nine chapters on calendrical calculation to a second book of eleven chapters on astronomy in addition to weights and measures, then closed with a copy of Bede's DNR.[51] Formally this looked quite similar to the contents of the Seven Book Computus. However, the material following the strictly computistical opening books (I–IV) of the Seven Book Computus differed in important ways from the material appended to the opening computistical book of the Three Book Computus. Comparing Books V–VI of the former with Book II of the latter reveals the following. The astronomical material was clearly determined by surveying Book V of the Seven Book Computus and then selecting and modifying it. The first five chapters, listed again here, would seem to be the same.

1. "Excerptum de astrologia"
2. "De ordine ac positione stellarum in signis"
3. "De positione et cursu septem planetarum"
4. "De intervallis earum"
5. "De absidibus earum"

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[49] Borst, *Das Buch der Naturgeschichte*, pp. 156–8. While his dating is couched in qualifiers, Borst writes with much confidence on this, and similarly regarding Adalhard's activity. I am happy to subscribe to his suggestions here. On the other hand, Borst's suggestion (p. 157) that a number of scientific works came to the Corbie library fairly early ("wenig später") in the ninth century must be considered with caution and some skepticism.

[50] Borst, *Das Buch der Naturgeschichte*, pp. 170–4.

[51] Ibid., p. 171, argues for an alternative format, claiming that the computus was conceived and compiled as a single book of 111 chapters (those comprising Books I–II in the Three Book format), with Bede's DNR as a distinct entity, not part of the computus. King, "Investigation," pp. 3–27, sets out the Three Book format, and I follow his interpretation.

The second in this list was again illustrated artistically as in the Seven Book version, giving the numbers of stars in parts as well as in the whole of each constellation. The succeeding three chapters were the same as the first three of the Plinian planetary excerpts in the Seven Book format.[52] At this point the compilation changed and by-passed the fourth planetary excerpt, devoted to latitudes, and presented the following three chapters before turning to weights and measures.

6. "De caelestibus spatiis secundum quosdam"
7. "De temporum mutatione"
8. "De praesagiis tempestatum"

Of these three chapters, the first and last are copied from the Seven Book Computus,[53] and the middle one is a new excerpt from Pliny. Meanwhile the compiler has omitted the four chapters entitled *De interlunio, De eclypsi lunae, De eclypsi solis*, and *De solis eclypsi quando sit* (chapters 7–10 of Book V).[54]

The only addition to the astronomical chapters taken from the Seven Book Computus was the chapter *De temporum mutatione*, a selection of moderate length from Pliny that described the lengths, dates, and characteristics of the four seasons.[55] Following Pliny's text the excerptor gave the numbers of days and hours for three of the seasons, in the process getting one wrong, and gave no length at all for the fourth. These intervals were:

94 days 12 hours = vernal equinox to summer solstice,
nothing reported = summer solstice to autumnal equinox,
89 days 3 hours = autumnal equinox to winter solstice, and
90 days 3 hours = winter solstice to vernal equinox.

The error in the number of days from fall equinox to winter solstice—Pliny had reported 88 days 3 hours—meant that any attempt to

[52] For these initial five items, copied from the Seven Book Computus, see above, nn. 13–17. They appear in the Three Book Computus in Vienna 387, ff. 115r–116v (1), 116v–120v (2), 120v–121v (3), 121v (4), and 121v–122v (5).

[53] For item 6, see above, n. 23; for item 8, see above, n. 24. They appear in Vienna 387, ff. 124r, 125r–127v.

[54] For these four, see above, nn. 19–22.

[55] From Pliny, NH XVIII, 220–223, 225, 275, 276–277. Text in Rűck, *Auszűge*, pp. 43–4; King, "Investigation," pp. 154–5, with one modest variation from Rűck at 44.4 ("bruma" for "bruma a"). The text appears in Vienna 387, f. 124v.

determine correctly the omitted number for the previous season would fail.[56] The correct calculation should yield 91 days 12 hours for that omitted interval. The focus here was clearly on the numbers, both for lengths and for dates, and we should notice that there is significant difference when compared to Bede.

Bede's DNR did not report the lengths of the seasons, but his DTR 30 had placed the four seasonal turning points at the eighth degree of each of the four zodiacal signs of Aries, Cancer, Libra, and Capricorn. Bede then recorded the four transitional dates as the twelfth of the kalends of April, July, October, and January, resulting in seasonal lengths of 91, 92, 92, and 90 days, beginning with the spring equinox.[57] Bede's approach emphasized the regularity of the seasons and offered no cause for the modest variation—much more modest than Pliny's—that he found in the numbers of days in the four seasons. The inclusion of the new Plinian excerpt, *De mutatione temporum*, in the astronomical section of the Three Book Computus introduced an unexplained variation, more evidently divergent and irregular than found in the computistical tradition, that would only produce trouble in the absence of a rationalization for it, which the compiler showed no concern to provide.

The astronomical section of Book II in the Three Book Computus presented a profile for astronomy very different from the corresponding section, Book V, in the Seven Book Computus. Nicely characterized as an arithmetical highpoint among computus collections,[58] the Three Book Computus managed to retain much of the astronomical content of its predecessor and yet to shift the emphasis of that material towards a sense of order based solely upon naming, numbering, and counting. This held true for the first two chapters, which, first, listed constellations in sequential order and, second, proceeded through a set of constellations and listed the number of stars in each and the numbers of stars in certain parts of many constellations but did not go further and specify the precise location of each star in each constellation. As for the Plinian planetary excerpts, the excision of the chapter

[56] See Pliny, NH XVIII, 220 (ed. Le Bonniec, p. 131), where the mss. seem to have a lacuna. The editor notes the variant in the mss. for the number "LXXXVIIII." King, "Investigation", p. 154, finds no ms. variant for the incorrect number in the Carolingian excerpt from Pliny.

[57] DTR 30, ed. Jones, pp. 371–6, esp. 375.86 f.

[58] Borst, *Das Buch der Naturgeschichte*, p. 166, adopts the label "arithmetische Zuspitzung" for the Salzburg compilation, or Three Book Computus, and proceeds to argue for this interpretation of its purpose, pp. 166–74, esp. 172. Borst's interpretation does not develop the points I proceed to make here about the astronomical section.

on latitudes went hand-in-glove with dropping the chapters on lunar and solar eclipses. Although luni-solar phenomena, eclipses were not essential to the main enterprise of computus, and an eclipse could only occur when both Sun and Moon were on the same plane (the ecliptic) with the earth. The latitudinal course of the Moon determined when this would occur. Thus the removal of the latitudes excerpt and the luni-solar eclipse chapters constituted a single step in focusing the astronomical material more closely upon an order of sequence and number. The remaining planetary material was the set of chapters concerning sequence, harmonic intervals, and apsides.

The treatment of the planetary diagrams carried over from the Seven Book Computus holds special interest. Obviously the latitudes diagram disappeared with its excerpt. The diagram for planetary order also disappeared. The compiler chose to use the diagram for planetary harmonic intervals (the same as Figure 3.2 above) to illustrate the chapter on planetary order as well. In principle, this would seem acceptable, but it disrupted the attempt in the prior compilation to provide a sense of gradual development and complication in the planetary diagrams. In the Three Book Computus a reader found simply one static diagram for both the order and the harmonic intervals of the planets.[59] One further diagram was needed, the diagram for planetary apsides. Since the change in a planet's size, or brightness, along with its speed in the heavens was obvious to careful viewers, the Plinian excerpt, which identified a regular location for each planet's far point and slowest apparent motion, had to be retained. And because the account ended with a reference to a subsequent diagram, that diagram was also meant to be preserved.[60] However, the compiler, or perhaps the subordinate scribe, of the Three Book Computus made an egregious error in choosing the diagram to accompany the apsidal excerpt. The diagram was obviously never completed, and a reader might conclude that haste alone had caused this result. However, we find the same diagram in both copies of the Three Book Computus (Figure 3.7), and it has nothing to do with planetary apsides. It was, in fact, the circular framework

[59] The diagram appears in Vienna 387, f. 123r; see also its copy in Munich 210, f. 123r.

[60] Although Pliny made no use of nor reference to planetary diagrams in his *Natural History*, the Carolingian excerptor constructing the apsidal excerpt for the Seven Book Computus had chosen to add a diagram and had ended the excerpt with the added clause, "ut subiecta figura demonstrat."

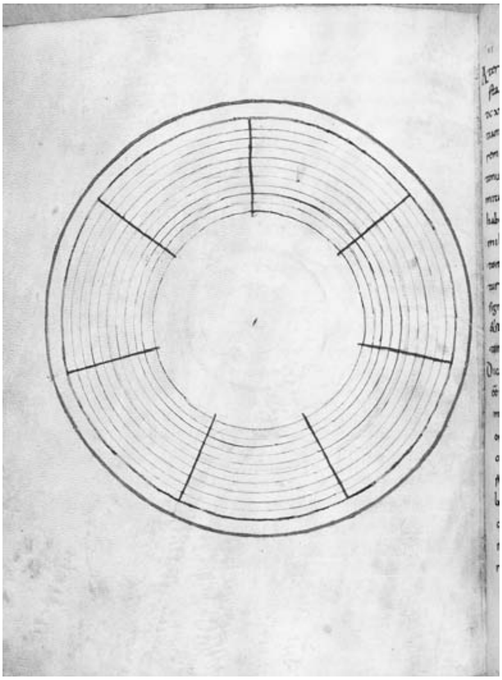

Fig. 3.7. Frame of Martyrological Rota for Apsides. Vienna, Österreichische Nationalbibliothek, Bildarchiv, cod. 387, f. 123v

for a martyrological rota, found at the beginning of the Seven Book Computus.[61] That such an erroneous choice occurred, and that it was not corrected in the second copy of the Three Book Computus, made some time after the original copy, tells us and must have signaled to Carolingian readers that the diagrams were of minimal importance. When we see that the diagrams were fundamental to the program of

[61] When I first described this design, I did not recognize its origin; see my "Plinian astronomical diagrams," pp. 150–2 (image of the diagram on p. 151). The martyrological rota, found in Book I of the Seven Book Computus, is described briefly by Borst, *Das Buch der Naturgeschichte*, p. 159, but not recognized as the origin of the erroneous planetary diagram in the Three Book Computus. The complete original diagram appears in the Seven Book Computus in Monza F.9.176, f. 9r. It is worth asking why the same erroneous diagram was copied into both Vienna 387, f. 123v, and Munich 210, f. 123v; this fact should complicate discussions about the copying of the latter ms. from the former, since there are some noteworthy differences between these two, mostly identical manuscripts.

the Plinian planetary excerpts in the earlier computus, because the diagrams made explicit the geometrical reasoning behind the information in the four planetary excerpts, we can recognize the traditionalist tendency involved in the shift from the planetary astronomy of the Seven Book Computus to the planetary astronomy of the Three Book Computus. It was a shift from geometrical explanation to arithmetical and positional enumeration.

The third book of the Three Book Computus, like the seventh of the Seven Book Computus, was a copy of Bede's DNR. The most notable change in the presentation of this work of Bede was the addition of images to it. Images were not part of Bede's original composition, nor were copies of this work frequently illustrated in the ninth century, but this specific Carolingian example chose to add five illustrations, three of which were adaptations of images used in Isidore of Seville's DNR. Figures for (1) the five climatic zones, (2) the four elements with the three continents of the known world, and (3) the twelve winds were derived from Isidore's DNR 10, 11, and 37 respectively.[62] These three Carolingian images have at least one important attribute in common.[63] They are not explanatory but figural, presenting information in attractive visual formats with cultural clues designed to aid memorizing. They do not offer a guide to naturalistic analysis. Similarly, Isidore's *rotae* in his DNR were visual mnemonics, not diagrams of either the kinematics or the dynamics of nature.[64] This concern with sequences

[62] See Isidore of Seville, *Traité de la nature*, pp. 210 bis, 212 bis and 216 bis, 296 bis. The Carolingian figure for the four elements uses parts of two different images included by Isidore in his DNR 11 for the four elements. The design for the five climates has been changed to ensure that readers do not assume a continuity between the arctic and antarctic regions. Clear Carolingian awareness that Isidore's diagram assumed a spherical earth appears in the direct visual parallel posed in a manuscript of Macrobius's *Commentary* between Isidore's diagram and Macrobius' diagram of the climatic zones; see Bruxelles 10146, f. 136r (s. IX ex.–X in.). The 12-wind image is a complex design with overtones of a Gospel book in its layout—four different male images (four ages, in fact) in four corners around a mandorla—and also suggesting the twelve apostles, but named as winds.

[63] For the Three Book Computus these three figures appear in Vienna 387, ff. 133r, 134r, and 140r; in Munich 210, ff. 132r, 132v, and 139r. The other two figures, inserted into Bede's DNR 19 and DNR 20, appear at Vienna 387, ff. 137r, 138r and Munich 210, ff. 136r, 137r. Both are calendrical rotae, not physical explanations. McCluskey, *Astronomies and Cultures*, p. 62, Fig. 12, nicely shows how the first of these two rotae (for DNR 19) was adapted to the Christianized feasts of the mid-quarter days; the mid-quarter days were previously identified as significant days in the calendar by Pliny, NH XVIII, 222.

[64] The presumption by Borst that Alcuin made some significant contribution to the

and mnemonics is akin to the arithmetical outlook of the Three Book Computus, a focus more on computation than on physical and conceptual explanation.

7. *Plinian Astronomical Diagrams with the Cosmology of Macrobius*

While the Plinian planetary diagrams were born as parts of the encyclopedic Seven Book Computus, they underwent a fundamental transformation in form at the time of their association with the cosmological-cosmographical excerpts from Macrobius's *Commentary on Scipio's Dream* as found in the Bern Collection.[65] This creative combination of Pliny excerpts with extensive selections from Macrobius certainly existed at and was perhaps also produced at the abbey of Saint Germain in Auxerre by the later ninth century. The models for the Macrobian diagrams in the Bern Collection were very likely the diagrams in Paris 6370, an early and important manuscript of Macrobius's *Commentary*, corrected first by Lupus of Ferrières and later by Heiric of Auxerre. Lupus also had supervised the addition of the Macrobian diagrams to the Paris manuscript.[66] The scholarly descent and influence from Servatus Lupus to Heiric to associated scholars at Auxerre in the later ninth century is well attested. The director of the Bern Collection, after creating a broad cosmological textbook from Macrobius, revised each of the diagrams accompanying a Plinian excerpt with the aim of improving its clarity and consequent ease of absorption. The result was an increased emphasis on sequence, hierarchy, regularity, and balance as distinguished from the detailed content of the diagrams. This effort led to a number of tenth and early eleventh century combinations of Macrobian cosmology and Plinian excerpts with diagrams.[67]

development of astronomical diagrams is based upon the description of a lost figure, attached to one of his letters. See Borst, *Das Buch der Naturgeschichte*, p. 150, n. 62. The evidence is in MGH *Epistolae*, vol. 4, pp. 249–53; there Alcuin refers to his *figura* at pp. 252–3 and gives its purpose at pp. 250–1; it is a lunar rota whose purpose is computational. This design does not depict the structure or workings of nature at all and is not in the same category as the Plinian planetary diagrams.

[65] See above, pp. 72–6.

[66] See above, p. 46.

[67] We can find at least eight surviving early examples of this combination with revised Plinian diagrams in these mss.: Bern 265, Geneva (Cologny) Bodmer 111, Munich 6362, 6364, 14436, Oxford D'Orville 95 (palimpsest), Vat. Palat. 1577, and Zűrich Car.C.122. From this tradition the revised Plinian diagrams expanded their influence

Each revised planetary diagram in the Bern Collection diminished the visual and conceptual effort needed to grasp the essential information contained. The new forms for the first two diagrams removed the framework of stellar sphere with planetary orbital circles completely. In place of the equally spaced concentric circles for planetary sequence there appeared at the end of the first Plinian excerpt a set of seven unadorned circles horizontally, each labeled with a planetary name in Plinian sequence, the central solar circle being larger than the equal-sized six remaining discs (Figure 3.8). The greater size of the Sun's body made it appear dominant in accord with Pliny's frequently repeated emphasis on solar radial force as controller of anomalies in planetary motion. This horizontal sequence conveyed the information more quickly than its predecessor, emphasizing the balanced sequence of three sub-solar, the solar, and three supra-solar bodies. Instead of the carefully spaced concentric circles to accompany the excerpt for planetary harmonic intervals there appeared at the end of the excerpt a vertically arranged list of nine levels, from the earth through the seven planets to the stellar sphere, with the size of each interval—tone, semitone, etc.—written between the relevant planetary levels; the comprehensive name *ARMONIA* was written vertically alongside (Figure 3.9). The list focused a reader's eye more quickly on the pertinent data and suggested a hierarchical order by its verticality. These replacements for the first two diagrams retained a sense of order and suggested that a student no longer required the more cumbersome diagrammatic form originally used for such simple spatial concepts. However, when the creator of these innovations turned to the diagram for apsides, he recognized a more troublesome element in the prior diagram and, as we have explained above, removed the zigzags from the diagram (see Figure 3.5).[68] This clarification focused the viewer's attention upon the geometrical arrangement, avoiding the non-geometrical element of the zigzags, and heightened the sense of geometrical rationale in the diagram. For the fourth and final Plinian excerpt the director of the Bern Collection made a startling change, and he seems to have

and were copied into computistical collections, e.g., St. Gall 250 (later insertions), and even into mss. of Bede's DNR, e.g., Zűrich Car.C.176.

[68] We should also notice that the Bern Collection has as one of its editorial points the removal of Macrobius's ambiguous mention of stations and retrogradations from the text. The omitted passage in Macrobius is at I.xx.5 (CSS 79.10–16), and the omission occurs at Bern 347, f. 6vb,24.

Fig. 3.8. Simplified Diagram for Planetary Order. Bern, Burgerbibliothek cod. 347, f. 22v

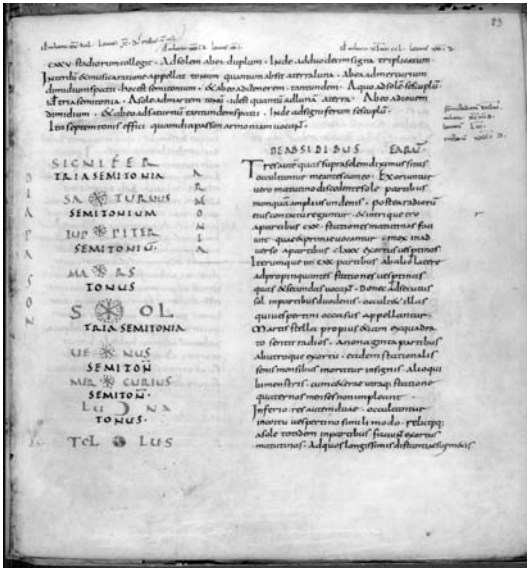

Fig. 3.9. Simplified Diagram for Intervals. Bern, Burgerbibliothek cod. 347, f. 23r

hesitated at least to the extent that he preserved the original diagram for planetary latitudes while preceding it by a new one, which was to prove amazingly successful in the long run. In the spirit of immediate visual recognition, he transformed the circular diagram, a stereographic projection, into a rectangular chart in which scholars could find the Plinian latitudes directly by reading each planetary name, arranged vertically at the left side, and counting the relevant vertical spaces of the grid, laid out in a block of twelve vertical and thirty horizontal squares (Figure 3.10). When we examine this new diagram carefully, we discover that it is not a graph, despite its superficial similarity to a modern graph. Rather, the design presented only one significant variable, the assigned Plinian value for latitude, for each planetary line; this value is the vertical component. There is no common horizontal component. Each curve's longitude is proportional to its own latitude. A lunar cycle has a longitude greater than does a cycle of Mars simply because the vertical component, the lunar latitude, is greater than that of Mars. At the same time, the planetary curves across the grid strongly suggest regularity and balance. The ease of reading this form of latitudes diagram as well as its suggestions of cosmic order must have pleased both its inventor and his students. The elements of order—balance in radial order between earth and stars, balance of inner and outer planets with respect to the Sun, centrality and dominance of the Sun in the planetary order, interplanetary distances set in simple tonal ratios, balance between planets with smaller orbital circles and greater latitudes and planets with larger orbital circles and smaller latitudinal inclinations—were partly quantitative but even more qualitative, with their continual emphasis on images of regularity and balance.

Each of these improvements introduced in the planetary diagrams that were attached to the Bern Collection must have brought quicker recognition by a reader, if the reader could be assumed to have learned already some basic concepts. Where the first stage of the diagrams (in the Seven Book Computus) made visually explicit the centrality of the earth, the circularity of orbits, and the regular spacing of successive orbits, the second stage of the diagrams assumed the knowledge of these theoretical elements by the viewer and offered a more easily perceived statement of the Plinian data—planetary sequence, intervals, apsides, and latitudes—all within a presumed conceptual framework that no longer needed to be pictured. Assuredly the new versions of the diagrams for planetary sequence and intervals could not be turned into more complete images in a reader's mind without this presumed

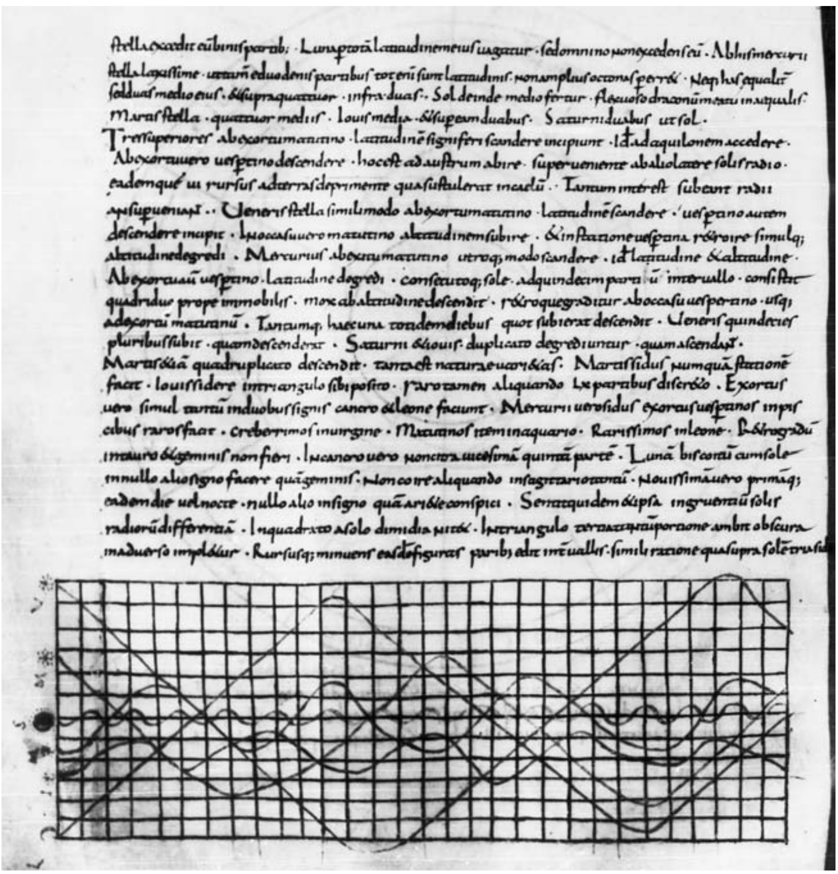

Fig. 3.10. Rectangular Grid for Latitudes. Bern, Burgerbibliothek cod. 347, f. 24v

framework. Likewise, without such assumptions a viewer of the diagram for apsides might well, and wrongly, conclude that he was looking at the plotting of actual orbits with mutual intersections of all the planetary circles—a rather harrowing threat to planetary survival! And anyone looking at the rectangular latitudes diagram was expected to recognize the assumptions about the planetary framework as well as the further assumption that the zodiac is a band wrapped around the earth on the outermost sphere. The use of these assumptions by the designer of the Bern Collection seems to show a distinct advance in student preparedness over the intervening half century or so between the Seven Book Computus and the Bern Collection. Another way to say this is that students of such materials as those in the Bern Collection, a varied and literate selection of related cosmological and cosmographical information that included the four Plinian excerpts, were apparently expected to have a more complete understanding of the basics of astronomy than were students of computus.

One further step in the development of the Plinian planetary diagrams emerged in the tenth century in a large number of apsidal diagrams produced mostly in southern Germany (and/or Austria and Switzerland).[69] Again in conjunction with the text of Macrobius, the planetary excerpts with their diagrams, now in their second stage, evolved a new version of the diagram for apsides. This new form assumed the viewer's prior knowledge of the correct sequence of all twelve zodiacal signs and economized radically on the design by omitting the six signs under which no planetary apogee occurred. The six signs with planetary apogees were then reordered for ease of viewing and also for more attractive appearance (Figure 3.11). The result, as we see in this example, allowed a reader to identify with great ease each planet's apogee and its matching zodiacal sign. There was also a tendency, though not consistently, to make the apsidal circles more eccentric and of equal size. While a desire for pedagogical effectiveness presumably inspired this new form of apsidal diagram, decorative patterns came to be a more apparent concern by the later tenth and eleventh centuries. The earlier examples of this more abstract form of apsidal diagram occurred only in the cosmological framework of

[69] Detailed study of the following development appears in Eastwood, *Astronomy and Optics*, chs. 5–6, including 8 figures.

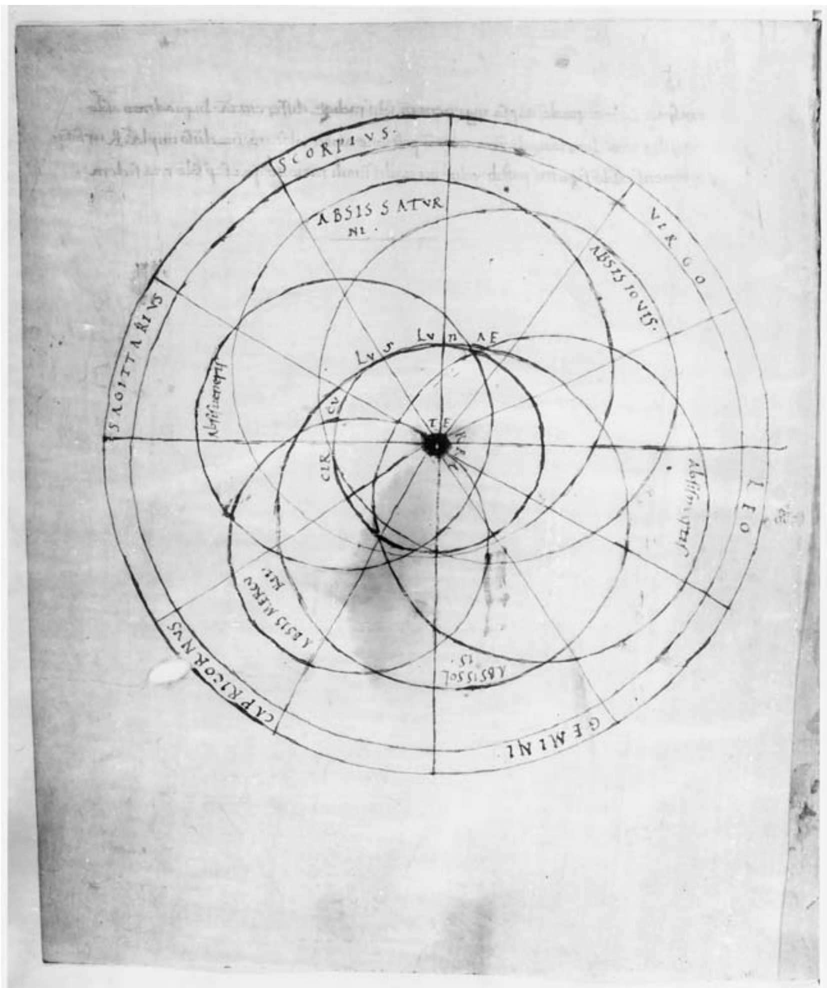

Fig. 3.11. Apsides under a Reordered Zodiac. Munich, Staatsbibliothek clm 14436, f. 60v

Macrobius, with later examples, from the later tenth century onward, appearing in both this and computistical contexts.[70]

8. *Doctrines of Celestial Influence in the* Natural History

Books 2 and 18 of the *Natural History* contain very many accounts of celestial influences and portents. Pliny, however, took care to explain that such phenomena as eclipses, comets, new stars, battle lines in the sky, etcetera, occurred according to the regular forces of nature and did no more than point to events that would happen rather than causing the events in some way. With regard to human affairs, the heavens could only presage (II, 97). What a reader does find in the *Natural History*, most consistently in Book 2, is a vast physics of celestial effects, primarily by the luminaries but also by the motions of cosmic spheres which in turn cause regular winds and their effects. Although he would seem to have resisted the label of astrology, Pliny's physical theory was largely Stoic with overtones of astrology.[71]

[70] Examples of this apsidal diagram with reordered zodiac accompanying texts of Macrobius's *Commentary* are Munich 14436, f. 60v; 6364, f. 24r; 6362, f. 74v; Geneva (Cologny) Bodmer 111, f. 39v; Oxford D'Orville 95, f. 31r (palimpsest); Zűrich Car. C.122, f. 41v; Bern 265, f. 58v; and Vat. Palat. 1577, f. 81v (also with Books 6–8 of Martianus Capella in this ms.). It is noteworthy that these are the same eight manuscripts that adopted the second stage of Plinian planetary diagrams (above, n. 67), but the Bern Collection's apsidal diagram did not use the reordered zodiac. Examples of this diagram used in computistical compilations are St. Gall 250, p. 23 (where an empty page was filled with this diagram and a Macrobian diagram below it, neither being connected to any surrounding text, obviously added some time after the computus was compiled); Zűrich Car.C.176, f. 192v; and Madrid 9605, f. 12r. The St. Gall and Zűrich examples here are alike in having a rare and erroneous assignment of an apogee to the moon; this error resulted from a confusion of Pliny's lists of apogees and planetary exaltations, filtered through an emendation in mss. of the text of Bede's DNR 14.

[71] See *Histoire naturelle Livre II*, ed. Beaujeu, pp. xviii–xx; ibid., p. 158, n. 1, identifies Pliny's idea of active solar rays in Lucan, Censorinus, Vitruvius, and Varro (from late Babylonian via Posidonius). Pliny's celestial forces seem to fit well with the Stoic concept of *tonos*, regarding which see Bloos, *Probleme der stoischen Physik*, pp. 65–73, and Hahm, *Origins of Stoic Cosmology*, pp. 169–3. On the astrological doctrines of 'influence' see the very useful essays of North, which, however, do not discuss Pliny or Roman astrology: "Celestial Influence—the Major Premiss of Astrology," and "Medieval Concepts of Celestial Influence." For a careful study of some Babylonian backgrounds to Greco-Roman astrology, which inadvertently shows how far the Carolingians were from horoscopic astrology, see Rochberg, "Elements of the Babylonian Contribution to Hellenistic Astrology."

In the cosmic system of the *Natural History* the most potent and obvious celestial power is the Sun's, and that is where one must begin a survey of celestial influences according to Pliny. Early in Book 2 (II, 10–13) he stated these important cosmological principles.

> As regards the elements . . . they are . . . four in number: topmost the element of fire, . . . next the vapour (*spiritus vitalis*) which the Greeks and our own nation call by the same name, air (*aer*)—this is the principle of life, and penetrates all the universe and is intertwined with the whole; suspended by its force (*vis*) in the centre of space is poised the earth, and with it the fourth element, that of the waters. . . . [the earth] being alone motionless with the universe revolving around her she both hangs attached to them all [other, upper bodies] and at the same time is that on which they all rest. Upheld by the same vapour (*spiritus*) between earth and heaven, at definite spaces apart, hang the seven . . . planets . . . . In the midst of these moves the sun, whose magnitude and power (*potestas*) are the greatest, and who is the ruler not only of the seasons and of the lands, but even of the stars themselves and of the heaven ("nec temporum modo terrarumque sed siderum etiam ipsorum caelique rector"). Taking into account all that he effects, we must believe him to be the soul (*anima*), or more precisely the mind (*mens*), of the whole world, the supreme ruling principle and divinity (*numen*) of nature.[72]

When he presented a theory of planetary stations and retrogradations, Pliny made the force of solar rays the cause of these events, but he also included the latitudinal motion of the planets through the zodiac as an effect of solar power (II, 59–77). In this complicated and somewhat confusing account, after a planet's morning rising, the Sun's rays were said to cause the first station by striking the planet (one of the three outer planets) triangularly, that is, at an angle of 120°, where the planet was thrust directly away from the earthbound observer and so appeared to stand motionless. Thereafter, the planet was pressed in a backward direction (retrograde) through the point of opposition (180°) and evening rising until it reached another station (at 240°). At second station the planet was reported to be pressed directly down towards the earth by solar force, since the rays had changed to come from above rather than below. The two inner planets were said to show stations and retrograde motions at opposite times to the outer planets in their sequences of risings and settings but again to be ruled by the force of

[72] Pliny, *Natural History*, vol. I, trans. Rackham, pp. 177–9; Rackham followed the edition of Detlefsen (1866). Pliny's 'spiritus' is his version of the Stoic pneuma with *tonos*.

the Sun's rays. In addition, Mercury and Venus had limits (*margines*) in their longitudinal elongation from the Sun, apparently enforced by the rays of the Sun. This restriction by the Sun of its two lower neighbors was assumed without comment by Pliny.[73] The planets increased their latitudes beginning with morning rising and decreased their latitudes from evening rising, in both cases because of the pressure of solar rays. Disturbed by this intermingling of effects in Pliny's account, the Carolingian excerptors who established the four planetary excerpts separated at least partially the longitudinal effects of solar rays (the stations and retrogrades) in the apsidal excerpt, from the latitudinal effects in the fourth excerpt, on latitudes.[74]

If the Sun is the primary source of celestial influence, the other luminaries have their own effects, especially in the sublunar world. Pliny reports that earthly things that tend upward towards the heavens are pushed down by the force of the stars (*vis siderum*), which force at the same time will draw upward things that do not rise spontaneously, moisture for example (II, 103). Regular causes of rains and storms come from the heavenly bodies, and just as the Sun controls the seasons of the year so does each of the other stars have a power (*vis*), which determines its effects in the realm below the Moon according to the star's nature and which is exercised through that star's motions (II, 105–106). Not only the planets have this power, but also the fixed stars, whenever they are impressed by the approach of planets or enhanced by the impact of rays (II, 106). Likewise there are points in some zodiacal signs with their own powers, examples being the equinoxes and solstices, at which times notable effects occur on earth (II, 108). The moon causes the tides in the seas; then there are the varied influences of the Moon at its different phases, whereby shellfish increase and decrease in size in parallel with the moon, which affects especially the organs and growth of bloodless animals, but others as well (II, 109–110, 212–223). It even happens that fires fall from the stars (*ignes stellarum*) into clouds, causing

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[73] For the Carolingians the cause of this bounded elongation became an open question after the spread of the astronomy of Martianus Capella, which described Mercury and Venus with orbits centered on the Sun.

[74] See above, the third and fourth Plinian excerpts from the Seven Book Computus. For a fairly detailed description of the useful astronomy that can be distilled from Pliny's mixture, see Pedersen, "Some Astronomical Topics" (above, n. 1); my goal here is different in trying to present Pliny as he was perhaps read and understood in the Carolingian world.

storms, thunder, and lightning. At the same time, these storms, coming from the stars and having regular causes, should be distinguished from storms coming from breaths pressed out of the earth. The latter are accidental and ineffectual, while the former come from the heavens and are predictive (*fatidica*) (II, 112–113). Finally, although gusts of air (*flatus*) occur locally, a wind (*ventus*) is regular, like the trade winds. Winds are caused by the contrary motions of the planets moving eastward as the celestial sphere turns westward, also by the varying impact of planetary rays in the air; winds may even originate in and descend from a planet or a fixed star (II, 116).

According to Pliny, cosmic phenomena do not cause events in human history, but they do cause predictable effects in the human environment, and careful study will allow us to be prepared for these. In addition, many phenomena of the heavens are distinctively prophetic for humanity, even though not determinative. Among these phenomena the most striking are eclipses and comets, which deserve detailed attention. Both solar and lunar eclipses, the causes of which we have full knowledge, signify changes for rulers and kingdoms (II, 47–57, 98). Comets, as Pliny reports expansively, appear in various shapes and for various intervals of time. They may be born and die, or they may continue to exist, like planets. He follows tradition on these and other omens. Comets clearly portend future events, whether death or disorder, or victory and glory (II, 89–94).[75] Other lights appear in or descend from the heavens—meteors, multiple suns or moons, blood in the sky—and these cause terror and fear though not the events they portend (II, 96–101). Among occurrences of the air around the earth, thunderbolts are among the most notable, but their prophetic significance is not always clear or probable (II, 138–144). However that may be, thunderbolts are ultimately celestial effects, for they are the discharge of fire to the earth from Jupiter resulting from the coming together of excessive moisture from Saturn with excessive fire from Mars (II, 82).

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[75] Both Isidore of Seville and Bede repeated this bit of general prognostication. See Isidore, *Traité de la nature*, p. 273.86–88 (DNR 26.13); Bede, DNR 23, ed. Jones, p. 216.2–4.

9. *Plinian Cosmology and Astrology among the Carolingians*

Unlike Macrobius, Pliny proposed to explain a wide variety of quite specific astronomical phenomena in naturalistic and sometimes geometrical terms. If his doctrines of celestial influence did not always convey clear understandings of how nature achieved its effects, he nonetheless made clear his anti-magical stance. Divination he labeled a fraud (XXX, 14–15). The magical art he found to be infamous, invalid, and vacuous ("intestabilem, inritam, inanem esse") (XXX, 17). And when magicians pretended to offer true medicine speciously with the addition of astronomical vocabulary, prescribing magical applications according to zodiacal positions of the sun and moon, they were to be dismissed out of hand (XXX, 96). The only thing that astrological medicine achieved with certainty, according to Pliny, was the amassing of a great fortune for the astrologer (XXIX, 9).

Pliny's pervasive view of the cosmos and deity emerged early and clearly in the first substantive book of the *Natural History*. Like philosophers and theologians from Xenophanes of Colophon to Saint Augustine and beyond, Pliny ridiculed and condemned the penchant to make gods like humans, especially in their weaknesses.

> To believe even in marriages taking place between the gods, without anybody all through the long ages of time being born as a result of them, and that some are always old and gray, others youths and boys, and gods with black complexions, winged, lame, born from eggs, living and dying on alternate days—this almost ranks with the mad fancies of children; but it passes all bounds of shamefulness to invent acts of adultery taking place between the gods themselves, followed by altercation and enmity, and the existence of deities of theft and of crime.[76]

Certainly, he maintained, god is beyond human nature and understanding (II, 14).[77] If god is the world itself, a view to which Pliny inclined, god is perfect, sacred, immeasurable, "finite and resembling the infinite, certain of all things and resembling the uncertain, . . . at once the work of nature and nature herself."[78] Perfection of morality and knowledge is assumed here, just as the physical perfection of the overall structure of

[76] NH II, 17; trans. Rackham, p. 181; cf. NH II, 15.

[77] See trans. Rackham, p. 179: "Whoever God is—provided . . . [he is other than the world (*mundus*)]—and in whatever region he is, he consists wholly of sense, sight and hearing, wholly of soul, wholly of mind, wholly of himself. To believe in gods without number . . . [is the] height of folly."

[78] NH II, 2; trans. Rackham, p. 171.

nature is assumed. And god is ultimately reasonable: he does not and cannot end his own existence, make mortals eternal, change the past, or create a mathematical contradiction such as having $2 \times 10 \neq 20$ (II, 27). The theological tendencies of Pliny's Stoicizing outlook, with a less than personal or caring deity, could not give comfort to ninth-century readers, but the moral tendencies might offer more reassurance. He condemned the human tendencies to believe either in a world ruled by chance or in a world ruled by an inexorable divine determinism (II, 22–23). Neither god nor nature worked to control in detail the doings of human beings (II, 20, 27). A moral nature, created by God, ordered according to divine reason and perceivable by human reason, was an image that Alcuin and others could use to make the study of the physical cosmos, especially the heavens of the stars and planets, an important stepping stone to higher wisdom.

Encouraged by Pliny's larger view of nature and assisted by his arguments for the reasonable nature of specific parts and events in the celestial order, Carolingians found it possible to go beyond predecessors like Bede in adopting elements of Pliny's teaching about the cosmos. Bede's DNR summarized Pliny's doctrines and data on planetary apsides and latitudes. Both Isidore (DNR 26.13) and Bede (DNR 24) described comets and reported the traditional view that these portents in the heavens foretold disease, famine, flood, or the demise of a ruler; such omens in the skies did not threaten at all the Christian teaching of human free will. But among the planetary doctrines which Bede rather surely omitted by design in his extracts from Pliny was the doctrine of exaltations, which potentially involved a more active human calculation of celestial effects. Pliny recorded two different kinds of apsides for the planets. On one hand, as we have already seen, he described the paths of all planets other than the Moon as following separately centered eccentric circles, thereby producing their near and far points from the earth, the perigees and apogees. He located these planetary apsides in definite signs of the zodiac and precisely at the middle of the signs concerned. But on the other hand, he identified another set of apsides for all planets, including the Moon, which had nothing to do with distances, real or perceived, from the earth. These were the *apsides altissimae alterae*, properly called exaltations, and referred to zodiacal positions of maximum planetary influence (II, 65). For them he gave the following locations.[79]

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[79] It is worth noting that for these data at II, 65 each of the three widely cited

Saturn—Libra 20°
Jupiter—Cancer 15°
Mars—Capricorn 28°
Sun—Aries 19°
Venus—Pisces 27°
Mercury—Virgo 15°
Moon—Taurus 3°

Carolingian familiarity with and interest in these exaltations was evident in the reign of Louis the Pious, when the Aachen court scriptorium and artists produced the beautifully decorated manuscript of Germanicus's translation of the Aratea, now housed in the University Library in Leiden.[80] Near the end of the codex a page was inserted with a planetary configuration that appears to locate the planets on a date in the year 816. The planetary configuration itself was constructed from two characteristically Carolingian astronomical diagrams, a Plinian apsidal diagram and a Capellan diagram of circumsolar inner planets (Fig. 3.12).[81] The two concentric circles around the Sun, bearing Mercury and Venus, stand out immediately to a viewer, and these were definitely part of the original design, despite the lack of text along these two circles. The designer clearly intended to encase a great amount of current planetary doctrine in the larger image. He knew and considered important the concept of circumsolar inner planets, described in detail by Martianus Capella. The overriding teachings of planetary astronomy in the configuration, however, were those of Pliny and were drawn from the *Natural History* itself, not from the excerpts in the Seven Book Computus. This becomes clear when we observe the full extent of the

editions differs in some details from the other two. See ed. Beaujeu, p. 28 (also commentary, pp. 151–2); ed. Jan-Mayhoff, p. 147; ed./trans. Rackham, p. 212; I follow the Jan-Mayhoff edition, which at this point is most true to the ms. tradition.

[80] For date and origin of the codex, see the following, which are only the more up-to-date of a long list of scholarly studies of the Leiden Voss. lat. Q.79. Verkerk, "*Aratea*: a review of the literature," pp. 276–80; Bischoff, *Aratea Kommentar*, pp. 14, 65; Mütherich, "Book Illumination at the Court of Louis the Pious," p. 597.

[81] The earliest argument for this image as a dating device appeared in an article published in 1983, reprinted with corrections in Eastwood, *Revival of Planetary Astronomy*, ch. 4. A major correction in the date itself was proposed in 1990 by Mostert and Mostert, "Using astronomy," who presented the date of 18 March 816. Assuming that the planetary positions were observed, the configuration must at least have been sketched out soon after the date, the observations themselves having been made because of a special significance of the date.

texts inscribed along the apsidal circles for the planets. For each planet except the moon, which has no apogee or perigee according to Pliny, the apsidal circle was oriented so that its apogee fell under the sign assigned to it by Pliny. At the same time, the medallion for each planet, showing a painted image of the planetary deity, was placed under the sign that indicated its position on the signified date in 816. Along the apsidal circle for each planet the designer inscribed the planet's orbital period in years, or number of days for the Sun and lower planets, the signs for apogee and perigee, the position of exaltation, the location of first station, and its number of degrees of latitudinal motion in the zodiacal band. For example, Saturn was succinctly described thus.

> The planet Saturn makes its circle in 30 years, which is farthest away in Scorpio, nearest in Taurus. It has its own exaltation in the 20th degree of Libra, has a station in trine, that is, 120° away from the sun. For latitude in the zodiac it has its degrees in the middle of it [the zodiac] and no farther.[82]

This was not a verbatim excerpt. The creation of such a text required careful extraction of the data from Pliny and then rephrasing in the designer's words. Also, the names of the signs for perigees were added, as they were not in Pliny's text. This sort of addition testified further to a pedagogical intent. We can observe that the listing of the data for Mercury and Venus, which included apogees and perigees, applied only in Pliny's system, not in that of Martianus Capella, since circumsolar planets circled in relation to the Sun rather than to the earth, and their apogees would therefore vary. The texts for the inner planets also recognized the relevant phenomenon of limited elongation from the Sun, reported by both Pliny and Capella.[83] Surrounded by the classicizing lettering and illustrations of the Aratea, itself a didactic poem, the planetary configuration added a convenient didactic summary of currently held teaching about the seven planets. And what we should

[82] "Stella Saturni peragit circulum suum annis xxx, qui attollitur in scorpione, deprimitur in tauro. Habet eandem absidem suam in librae parte vicesima, fit stacionalis in trigono, id est partibus cxx a sole distans. Latitudinum zodiaci suas non amplius partes in medio eius pervagatur." This text with translation, and all others in the Leiden planetary configuration, can be found in Eastwood, *Revival of Planetary Astronomy*, ch. 4, pp. 7–9.

[83] In the Leiden planetary configuration, the limit for Mercury's elongation is absent apparently because of spatial difficulties when the texts were written into the design. See Pliny, NH II, 72, and Martianus Capella, *De nuptiis* VIII, 880–882, for the elongations of Mercury and Venus.

notice here is the inclusion of exaltations in this summary, an element of Pliny's doctrine of the planets that neither Bede nor the Seven Book Computus chose to disseminate. It was an intrusion of Plinian astrological doctrine that could not have escaped attention. This inclusion pointed to the ominous significance of certain positions of the planets in addition to their natural motions. While the design and space of the Leiden planetary configuration on the page would not allow elaborate doctrinal text, a pointed reference to exaltations could serve to signify a larger body of relevant doctrine. Not only the motions but also the bases for influences of the planets were carefully entered into the Plinian texts inscribed on the planetary circles in this image.

To what more specific concern do we owe this intrusion? What contemporary events might clarify its significance for us? Modern historians of the Carolingian dynasty and kingdom have come to see and to emphasize the determination of the Carolingian family and its supporters to devalue the preceding, Merovingian dynasty.[84] At the same time, moderns have recognized a degree of uncertainty and occasional extreme distress on the part of King Charles and his successors regarding their acceptance by God and the nobility as fully legitimate rulers.[85]

In his earlier years King Charles showed no special interest in the stars or astronomy, but beginning about 798 (at approximately 56 years of age), having in mind the problems of the Empire, he initiated a computistical and astronomical correspondence with Alcuin.[86] Thinking back two decades and more, Einhard later wrote in his *Life of Charlemagne* that the king "...invested a great deal of time and effort studying...particularly astronomy with him [Alcuin]. He learned the art of calculation and with deep purpose and great curiosity investigated the movement of the stars."[87] We may suppose that Charles had already undertaken by 798 the studies that Einhard mentioned. In any case, the concern for celestial order and the search for omens and portents,

[84] McKitterick, "Political ideology in Carolingian historiography," p. 165 and other sources cited there.

[85] See Hen, "The Annals of Metz and the Merovingian past." The composition (by ca. 821) and role of Einhard's life of Charlemagne in Louis's reign are perceptively discussed by Innes and McKitterick, "The writing of history," in *Carolingian Culture*, pp. 203–8.

[86] See above, nn. 5–7; Alcuin's replies to Charlemagne's queries included references to Pliny. But the king had more than just astronomy on his mind. For a larger context see Nees, *A Tainted Mantle*, ch. 5, on the Roman question at the Frankish court.

[87] *Charlemagne's Courtier*, p. 32 (*Life*, 25).

in the heavens or elsewhere, marked the reigns of Charlemagne and Louis the Pious. We have a fine example in the Seven Book Computus, Book V, Chapter 10, where we find the record of eight solar eclipses from 760 to 812 in a text put together in about 812. Their dates, based on observations, and calculated positions according to the text in the Madrid manuscript (with modern corrections in parentheses) were as follows.[88]

760, August 15—28° of Leo (correctly, 26°)
764, June 4—18° of Gemini (correctly, 17°)
787, September 17 (correctly, September 16)—1° of Libra (correctly, 26° of Virgo)
807, February 11—26° of Aquarius (correctly, 27°)
810, June 7 (correctly, June 5)[89]—21° of Gemini (correctly, 17°)
810, November 30—14° of Sagittarius (correctly, 13°)
811, April 27 (fictitious; new moon on April 26)—no position given
812, May 15 (correctly, May 14)—28° of Taurus (correctly, 27°)

All six Carolingian copies of the Seven Book Computus preserved the same list with remarkably few copying errors.[90] In general, the annalists of the day did not embellish falsely or imaginatively events such as solar

[88] Comments on these eclipses, and others that were not recorded, can be found in Schove, *Chronology*, pp. 156–66, 174–81. The problem of locating solar eclipses annually just before Charlemagne's death, noted by Schove at p. 181, is solved by the creation of a solar eclipse for 811 in this list; cf. below, Einhard's statement, at n. 94. Many Carolingian calendars indicated the date of the entry of the Sun into each sign of the zodiac; see, for example, Wallis, *Bede: The Reckoning of Time*, pp. 380–91; Borst, *Kalenderreform*, pp. 254–98. Carolingian determination of the zodiacal positions of the Sun was according to arithmetical rules of computus; see Bede, DTR, 16 & 18, also Rabanus, *De computo*, 39, 40, 42. Springsfeld, *Alkuins Einfluß*, p. 242, presents the data for these solar eclipses with the zodiacal positions according to Bede DNR, 17 (Springsfeld, *Alkuins Einfluß*, pp. 399–400, provides the Bedan table of solar positions through the year). Springsfeld, ibid., p. 242, insists on the Bedan position of 29° Taurus for the eclipse of 812; the ms. has 28°.

[89] For this controversial date, see p. 99, n. 12, above; p. 175, n. 161, below.

[90] For the text of Book V, Chapter 10, Madrid 3307, f. 68v, is the standard text for comparison with the others. Monza f. 9.176, f. 74v, has two errors in copying numerals; Vat. Regin. 309, f. 202r, is the same as the Madrid ms.; Paris nal 456, f. 178r–v, and Paris nal 1615, f. 151v, make different errors in copying the final numeral in the text; Vat. Lat. 645, f. 72v, makes three errors in copying numerals at various points in the text. The Royal Frankish Annals appears to be the essential source for this chapter in the Seven Book Computus, but there is one striking insertion, an otherwise unrecorded (fictitious) solar eclipse for 27 April 811; the report omits one kind of datum, the zodiacal location, found in the other seven eclipses recorded here and is already suspect for this reason.

eclipses.[91] Yet the Annals of Quedlinburg could amalgamate the eclipse of 787 with certain events of 786—Charles's entry into Italy, the sign of the cross on men's clothing, the death of Archbishop Lull, and many other signs—while other annals did not similarly misdate this eclipse.[92] However, the recorded great mortality at Fulda in 807 was not linked to that year's eclipse, nor was the death of many cattle, reported in 810 by the Weissenburg Annals, connected to an eclipse of that year.[93] When Einhard looked back at the last years of Charlemagne's life, he pointedly referred to the portents.

> There were so many signs of his approaching death that not only other people but even he himself knew that the end was near. For three straight years near the end of his life there were frequent eclipses of the Sun and Moon and a dark mark was seen on [the face of] the Sun for a space of seven days.[94]

The Seven Book Computus had presented eclipses of the Sun for the years 807 and 810–812; another solar eclipse was reported by the Byzantines for 813. These sources provided Einhard with more than enough ominous evidence. And the spot on the Sun was another portentous event from 807, which the Frankish Royal Annals attributed to the planet Mercury's position in front of the Sun, for over a week (fortuitously, an empirical support for the Plinian, subsolar location of Mercury, if such support were desired).[95] Einhard went on to recount the tale of the meteor that passed from right to left, an ominous direction, across the sky in 810 during Charlemagne's last campaign against the Danes. The king's horse suddenly collapsed, throwing Charles to the ground, obviously reported for Einhard's readers as a sign of the approaching end of the king's life and reign.[96]

During the reign of Charlemagne's son, Louis the Pious (814–840), one of the royal biographers, known to us only as 'the Astronomer,'

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[91] See, for example, the conclusions of Draelants, *Éclipses, comètes, autres phénomènes*, pp. 141–9, from a study of 600 years of medieval records for the regions of modern-day Belgium, which shows Carolingians and persons in other eras trying to observe with care and avoiding associations with either magic or determinism.

[92] MGH *Scriptores*, vol. 3, pp. 38–9; other annals added that "blood flowed from heaven and earth" in 786.

[93] Ibid., p. 41.

[94] *Charlemagne's Courtier*, p. 36 (*Life*, 32).

[95] *Quellen zur karolingischen Reichsgeschichte*, vol. 1, p. 84. It was almost certainly a sunspot and certainly not the planet.

[96] *Charlemagne's Courtier*, p. 36.

included a variety of cosmic omens in his account of the emperor's rule. The Astronomer clearly liked to connect human events with the natural, especially celestial, world, as he showed in fixing even ordinary events in the calendar by identifying contemporary astronomical events.[97] In 817, a time of continuing warfare, he reported a lunar eclipse at the second hour of the night on 5 February, a portentous group of comets in the constellation Auriga, and the death of Pope Stephen IV.[98] In 818 the Astronomer recorded the death on 3 October of Queen Irmingard after a long illness and a solar eclipse that preceded her death on 8 July.[99] In 823 there occurred a number of prodigies: an earthquake at Aachen, unearthly sounds heard at night, a girl fasting for twelve months without any food, frequent and unusual lightning bolts, stones falling from the sky with hail, and great sickness among men and beasts, all of which together were seen to require expiatory actions, including fasting, prayers, and rich alms.[100] In the summer of 827 a defeat of imperial forces followed the appearance of an aurora of terrible blood-red and fiery battle lines in the night sky, and the death of Pope Eugene in August was followed within 40 days by that of his successor.[101] To the two lunar eclipses on 1 July and Christmas Eve in 828 was added in the same year the delivery to the emperor from his Gascon lands of a strange wheat which had neither a long grain nor the roundness of peas and was said to have fallen from the skies.[102]

The year 837 presented an important omen to the Astronomer. On the feast of Easter (1 April) an unhealthy and sad portent appeared in the form of a comet in the sign of Virgo. Not moving like any planet, this comet, known to moderns as Halley's Comet, could be seen passing through the five successive signs from Virgo to Taurus during its

[97] Thus for the ninth year of Louis's life (786) the biographer noted that Louis remained with his father until the Sun turned from the summer solstice towards the fall equinox. See Astronomus, *Vita Hludowici* 4, ed. Tremp, p. 296.4–7 (hereafter AVL). The Astronomer did not seek out and record any portents occurring before Louis's reign began. For another survey of and commentary upon the Astronomer's report of portents, see Dutton, *Charlemagne's Mustache*, ch. 4, esp. pp. 104–8; I thank him for sharing it with me before its publication.

[98] AVL 27, pp. 370.11–372.3. The Royal Frankish Annals reported simply "a comet" in Auriga.

[99] AVL 31, p. 388.2–5; the correct date of this eclipse was 7 July.

[100] AVL 37, pp. 420.11–422.2. The editor points out the Astronomer's incorrect paraphrase here of the Royal Frankish Annals; see p. 421, n. 519.

[101] AVL 41, p. 440.9–11, 15–16.

[102] AVL 42, p. 450.8–11.

twenty-five-day visit.[103] When the comet appeared to halt in the head of Taurus, under the feet of the constellation Auriga, the emperor, who had been watching, sought out the Astronomer and demanded to know what he thought about this event. Louis was clearly concerned about the standard view of comets, that they foretold a change of regime and the death of the ruler.[104] This view, repeated by the most respected of contemporary scholars, Hraban Maur (ca. 780–856), had been a topos even in Antiquity, repeated by Isidore and Bede as well as Hraban and others.[105] Regarding this appearance of Halley's Comet, Lupus of Ferrières (ca. 805–862) answered quickly a letter received on 29 April from the monk Altuin in order to assure him that the portent, while fearsome, was ambiguous and uncertain.[106] Einhard, writing to the emperor later in the summer and following a Viking attack, had heard pessimistic opinions from other observers about the comet and thought that it was a portent of an approaching punishment from God for the great amount of sins in the realm and alluded to the possibility of escaping such punishment by undertaking acts of penance and prayer.[107] Einhard's suggestion clearly fit the path that Louis had chosen in the face of the comet's appearance, for although the Astronomer's initial attempt to disabuse Louis of his fears did not succeed,[108] the emperor himself took heart and spent the night in prayer. Early in the morning he called together his court officials and ordered them to distribute generous alms to monks, canons, and the poor; he also called for masses to be said, not for his own benefit but for the welfare of the Church. Louis then went hunting in the Ardennes and returned later with unusually great bounty, so the Astronomer learned.[109] Without

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[103] AVL 58, pp. 518.14–520.6.

[104] AVL 58, pp. 520.7–522.10.

[105] For the same view in Pliny, Isidore, and Bede, see above, at n. 75. For Hraban see Rabanus Maurus, *Martyrologium. De computo*, pp. 262–3 (*De computo* 52); Rabanus completed this work in 820.

[106] Loup de Ferrières, *Correspondance*, vol. 1, pp. 68–70. Lupus repeated the standard view that comets signify approaching disease, famine, and/or war, noting that the Holy Scripture said nothing about them, and referred to uses by Vergil and Josephus of comets as portents of great disasters, but Lupus then went on to cite Pompeius Trogus's mention that a comet predicted the rise to greatness of King Mithridates (p. 68).

[107] MGH *Epistolae*, vol. 5, pp. 129–30.

[108] AVL 58, p. 522.10–12; the Astronomer quoted the prophet Jeremiah (10.2) to the effect that followers of the Lord should not fear the signs in the heavens though the gentiles may fear them.

[109] AVL 58, pp. 522.12–524.12. Ashley, "The Power of Symbols: Interpreting

the same extended detail, the Astronomer reported a major comet in the constellation Scorpio for 1 January 839, which he connected in his mind with the death of Louis's son Pippin on the preceding 13th of December.[110] The final omen reported, certainly the most significant for the Astronomer's subject, was the striking total eclipse of the Sun at midday on Wednesday, 5 May 840; Louis died the following month, on 20 June, and the preceding total eclipse was conceived as a parallel whereby "that greatest light among mortals . . . would soon be taken from the world, and without him the world would be left in darkness and distress".[111]

The Astronomer's life of Louis the Pious shows us how a careful observer of the heavens, who was not unduly committed to the idea that portents above signify events here below, could record observations of the natural world in detail and with care and then place them in tandem with human events to which they seemed in retrospect to be clearly connected. The author placed himself in only one of the portentous situations that he reported, the appearance of the comet of 837, which he carefully tailored to the credit of the emperor. Just as his contemporaries, Lupus for example, the Astronomer knew that texts of the Holy Scripture might be read to oppose a strong or deterministic view of the historical effects of such unusual celestial appearances. The emphasis upon comets in the omen literature of the Carolingian world was due in part to the thoroughly mysterious nature of comets. Hraban Maur wrote in his computus about eclipses purely as explicable astronomical phenomena, excluding of course an unnatural and miraculous eclipse—a divine intervention—like that at the Crucifixion, but he had no natural explanation for comets and chose to follow the pagan wisdom of the ancients in this. Hraban's computus was written for limited scientific purposes, and thus his view of eclipses was purely naturalistic. On the other hand, when human and unusual celestial events corresponded in time, it was always prudent to look for divine

Portents," pp. 41–8, interprets the text, admittedly composed many years afterwards, as an account of Louis' assertion of moral and symbolic leadership.

[110] AVL 59, p. 528.6–9.

[111] AVL 62, p. 544.5–19. On this eclipse see Schove, *Chronology*, pp. 187–8. The final phrase of the quotation came from Isaiah 5, 30; the larger conception was the darkening of the Sun at the Crucifixion, for which comparison Isidore of Seville, DNR 20, 3 (ed. Fontaine, pp. 249–51) was a convenient reminder.

signals, and Hraban did not disagree with this common view.[112] So the Astronomer followed his contemporaries as well as Pliny and other authorities in seeing eclipses as signs just as surely as comets and other cosmic events. As Einhard had written of a series of eclipses in the years immediately before the death of Charlemagne so the Astronomer pointed to the powerful impression of the total eclipse at midday some weeks prior to the death of Louis the Pious. That eclipse had made the stars temporarily visible in the middle of the day, and the Astronomer carefully reminded readers that, while startling, this was a fully natural event although a portentous one as well. It was retrospective vision that gave the clarity needed to make the proper connection with the death of the emperor.

Pliny the Elder's view of the interconnections between the macrocosm and the microcosm, between the natural world and human events, fitted well with Carolingian views and helped make Pliny an important source, even though ninth-century Christian scholars might choose a different rationale than Pliny had. He also remained a treasury of information for elaborating the varieties and particularities of such events as eclipses of the Sun and the Moon.[113] Among these was the very old popular belief that a lunar, or even a solar, eclipse was an attack which the onlookers could help to overcome by raising a great clamor. This notion was alluded to by Vergil, described by Tacitus, and retailed by medieval scholars and bishops, who often explained the event and condemned the popular belief.[114]

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[112] He devoted a chapter of his *De universo* to portents (VII, 7), in which he wrote that portents are not against nature but only contrary to what we know of nature (PL 111, col. 195C); we should not dispute the portents recorded in the books of the pagans, for whatever occurs in nature is in accord with the will and order of God (col. 199A–B).

[113] As Hraban shows us in *De computo* 47, ed. Stevens, p. 258, by repeating part of Pliny, NH II, 180 to exemplify where an eclipse will and will not be seen.

[114] Pliny, NH. II, 54; Vergil, *Georgics* 2.478: "lunae labores"; Servius, *Commentarius in Vergilii Georgica*, II, 478, ed. Thilo, p. 264.1–13; Tacitus, *Annals* I, 28.1–2; attribution to Maximus, bishop of Turin (d. 466), *Homiliae* 100–101 (PL 57, coll. 483–90); Caesarius, bishop of Arles (d. 543), *Sermones*, I, 67–68; Bishop Eligius of Noyon (d. 660), *Vita Eligii* II, 16, p. 707.2–4; in the *Indiculus superstitionem et paganiarum* (a. 743) appears "De lunae defectione quod dicunt vince luna,," MGH *Leges*, vol. 1, p. 20; in Einsiedeln ms. 281 (s. VIII), the *Homilia de sacrilegiis* 16, ed. Caspari, *Eine Augustin fälschlich beilegte Homilia*, p. 10; Rabanus, *Homilia* 42 (PL 110, coll. 78C–80A); Euraclus, bishop of Liège (959–971), as told by Reinerus, *Vita Euracli* 4, ed. Pez, coll. 161–2; summarized in the penitential (1008–12) of Burchard of Worms, *Decretum* XIX, 5 (PL 140, col. 960C–D).

Pliny and the Carolingians agreed in their handling of portents, but the use of astrology by the Carolingians requires further definition. We know that the *Recognitiones* of the Pseudo-Clement of Alexandria circulated in the early Middle Ages and among the Carolingians, but the use of its astrological materials by scholars of the ninth century remains obscure. Bede referred to it, and nine manuscripts of the sixth to ninth centuries still survive.[115] In Books 9–10 of the *Recognitiones* we find many sections especially concerned with astrology in its strong, deterministic version. In one, an old man, believing and well versed in horoscopic astrology, offered the following bit of lore.

> ...when Mars, holding the center in his house, regards Saturn quarterly, with Mercury towards the center, the full Moon coming upon him, in the daily *genesis*, he produces murderers, and those who are to fall by the sword, bloody, drunken, lustful, devilish men, inquirers into [sacred] secrets, malefactors, sacrilegious persons, and such like; especially when there was no one of the good stars looking on. But again Mars himself, having a quarterly position with respect to Venus, in a direction towards the center, while no good star looks on, produces adulterers and incestuous persons. Venus with the Moon, in the borders and houses of Saturn, if she was with Saturn, and Mars looking on, produces women that are viragos, ready for agriculture, building, and every manly work, to commit adultery with whom they please, and not to be convicted by their husbands, to use no delicacy, no ointments, nor feminine robes and shoes, but to live after the fashion of men. But the unpropitious Venus makes men to be as women, and not to act in any respect as men, if she is with Mars in Aries; on the contrary, she produces women if she is in Capricorn or Aquarius.[116]

Further on in the text, the figure of Clement, who held to an Augustinian view that argued for the superior strength of free will, produced a test that showed astrologers to be not simply wrong but charlatans.[117] This attractive argument claimed that *mathematici* would produce configurations of the heavens to match whatever situation you presented to them and would do so even when you presented two opposing situations for the same person at the same point in time.

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[115] Bede, DNR 26, ed. Jones, p. 217 (also in Isidore, DNR 36.2, ed. Fontaine, p. 293). *Die Pseudoklementinen*, ed. Rehm, pp. xvii–cxi. Among the mss. of s. IX are Munich 52, ff. 144 (ca. 820); Paris 9517, ff. 190; Salzburg Stift S. Peter a.IX.27, ff. 231 (s. VIII–IX); and Karlsruhe Aug. LXXIX, ff. 131.

[116] See ibid., pp. 267–8 (*Recognitiones* IX, 17). Translation in *The Ante-Nicene Fathers*, vol. 8, p. 187.

[117] *Recognitiones* X, 11–12, ed. Rehm, pp. 331–4.

Since the argument of the *Recognitiones* was clearly anti-astrological, we need not expect Carolingian scholars to have adopted its astrological vocabulary, though it was eminently desirable to understand its contents. The text did not tell its readers how to produce an astrological chart. The 'charts' we have from the early Middle Ages are a very few planetary configurations like the Leiden Aratea configuration of 816 (see Figure 3.12), where Pliny's information about exaltations appeared. In other words, Carolingians appropriated Plinian doctrines of planetary influences in two senses, the sort of influence exercised by the moon on lower animals and in the tides and the sort of influence that physicians learned with regard to physiological humors,[118] but determinative influences on human action were not accepted, just as Pliny himself did not accept them. Pliny's utility, even in the matter of celestial influences, was in providing more examples and information while standing in general accord, at least on the matter of astrology and its related doctrines, with Carolingian scholars.[119] Just as in the case of the *Recognitiones*, the exaltations in the Plinian diagram in the Leiden Aratea set forth information about an astrological doctrine that was supposed to be well known in order to recognize it clearly and reject it intelligently.

The absence of astrological practice in the early Western Middle Ages has been widely accepted, primarily on the grounds that adequate tables, a method for determining planetary longitudes, and a method for calculating the ascendant sign were all absent before the introduction of Greco-Arabic astronomy in the twelfth century. But in an important study David Juste has reversed this assumption not only by reminding us that solar and lunar longitudes were readily produced by standard computistical methods but also by showing us that at least a few ninth-century scholars knew a text that gave instructions for calculating planetary longitudes as well as rising signs.[120] What remains to be discovered

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[118] Very familiar examples of this occur in Bede, DTR 30 and 35, ed. Jones, pp. 372–4, 392–3.

[119] Note that while Pliny accepted the doctrine of direct influences of planets, especially the Sun and the Moon, upon the sublunar world, he explicitly denied the doctrines of astrological medicine that claimed to find identifiable influences of the Sun and the Moon on the basis of the zodiacal signs through which they passed in their orbits; see NH XXX, 96.

[120] See n. 88 above for examples of calendars and methods for finding solar longitude. See especially Juste, "Neither Observation," pp. 181–222, esp. 212–15. Juste identifies three ninth-century manuscripts copied in northern France and containing a text that uses the age of the world along with the planetary periods and planetary

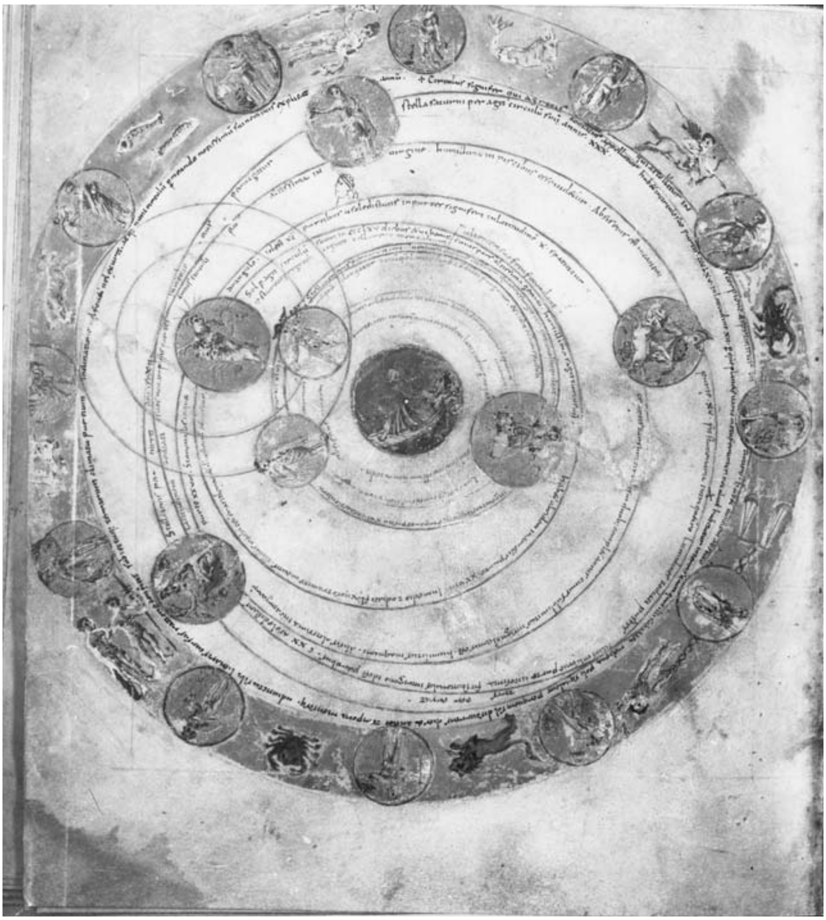

Fig. 3.12. Planetary Configuration dated 18 March 816. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. Q.79, f. 93v

is the purpose that any ninth-century user of such a text would have, for we have no evidence of a clearly astrological application of the text before the eleventh century. Nor do we have Carolingian horoscopes. The presumably astrological vocabulary of the day was generalized and incomplete for astrological purposes. A good example can be found in Hraban's little tract on divination, in which he defined types of astrological forecasting and said that *horoscopi* were simply those who divined on the basis of the hour of birth. Hraban was apparently unaware of the precise meaning of 'horoscopus' as the point of the zodiac rising on the horizon at the time of birth.[121] Pliny completely ignored this sense of the term, using it only in its adjectival form, 'horoscopicus,' to describe the changes in shadow lengths of the Sun at midday for different latitudes (II, 182), a position supported by a scholar soon after the mid-ninth century.[122] Astrology in its late ancient or its late medieval sense appears absent from the Carolingian world. Portents, interpreted in the accepted non-causal way, were as widely noticed and taken to heart by Carolingians as by ancient observers. We can even say that the discovery and reporting of portents in nature was part of the quest to find connections between the macrocosm and the microcosm and thereby record the continuing concern of God, as fearful as that might occasionally be, for the doings of his people on earth.

10. *Plinian Cosmology and Doctrines of the Winds*

The cosmological sources of early medieval ideas about winds included ultimately both Aristotle and Seneca along with others, but the clearest and strongest influences upon Carolingian writers were Isidore of Seville and Pliny.[123] Isidore preserved a distinction similar to Pliny's

positions at the Creation in order to determine any later planetary positions; of these three manuscripts, two provide as well a means to find the ascendant. Such a method obviously ignores the anomalies of planetary motion.

[121] Rabanus, *De magicis artibus* (PL 110, col. 1098C–D): "Horoscopi dicti, quod horas nativitatis hominum specularentur, dissimili et diverso fato." Hraban lifted this and its lengthy surrounding text (coll. 1097D–1099B) verbatim from Isidore of Seville, *Etymologiae* VIII.ix.9, 18–VIII.ix.35, 7 (ed. Lindsay). Hraban apparently saw no need to update this text.

[122] A marginal gloss to Martianus Capella's geometry (VI, 594–5) added: "oroscopa grece, latine orispica vel orarum speculativa, orologia horarum spatia quod ore ibi eligantur." See Leiden BPL 88, f. 110v.

[123] Isidore, DNR 26, ed. Fontaine, pp. 293–5. Pliny, NH II, 112–116, 119–134;

between a *flatus* and a *ventus*, the former being lighter and also having a local cause, while the latter had a more cosmic origin. However, Isidore immediately used the term 'ventus' to label all sorts of large movements of air, unlike Pliny's usage. Where Isidore finally ended the distinction between the two types was in his *Etymologies* in a discussion of the nature of air (*aer*). He distinguished between higher, celestial and lower, terrestrial air qualitatively, with the celestial air being "subtle" and incapable of causing or transmitting the congelation, turbulence, and variety of meteorological disorders that are found in the terrestrial air.[124] As we have noted above, Pliny's cosmological views placed primary natural agency in the heavens, whether in the constellations, the Sun, or individual planets, while natural effects from earthly sources, such as exhalations from caves or valleys or deserts, received no larger significance in his system. The essential distinction between celestial and terrestrial causes in his view was that the former were regular acts of nature, while the latter were causes that followed no rule and varied unpredictably. Pliny recognized winds, or gusts of air (*flatus*) as he emphasized, that came from dryness on the earth or exhalations from bodies of water, also from mountain ridges and valleys and from

XVIII, 326–365. For a helpful introduction to the ancient traditions of meteorological prediction and explanation see Taub, *Ancient Meteorology*, chs. 2–3. On the medieval Arabo-Latin tradition see Bos and Burnett, *Scientific Weather Forecasting in the Middle Ages*. Obrist, "Wind Diagrams," pp. 35–41, has pointed out that the late ancient teachings penetrating the early Middle Ages included Aristotle's *Meteorology*, Seneca's *Natural Questions*, Vitruvius's *On Architecture*, and elements of other sources. But we have no manuscript and no clear textual citation in the West of Seneca's doctrine on winds before the 12th century, and the relevant doctrine of Aristotle's *Meteorology* only became known in the latter half of the 9th century in little-used manuscripts. See Hine, "The Younger Seneca: *Natural Questions*," pp. 376–8. On the Aristotelian texts see d'Alverny, "Les 'Solutiones ad Chosroem';" in 2 Latin mss. of s. IX¾, Paris 13386 (prov. Corbie) and Paris 2684, a long chapter 7 of the *Solutiones* excerpted Aristotle's *Meteorology* (in translation), and chapter 10 discussed winds primarily in Aristotelian terms. For the edited texts of these two chapters see *Prisciani Lydi quae extant*, pp. 77–88, 98–104.

[124] Isidore, DNR 26.1: after giving the example of creating a 'flatus' by waving away a fly with a fan, he wrote, "When it occurs from a more hidden motion of celestial or terrestrial bodies across a great space of the world, it is called a 'ventus,' coming from the different parts of the sky and its names correspondingly diverse." In the later *Etymologiae* XIII.vii.1, he distinguished two regions of air absolutely: "Hic autem partim ad terrenam, partim ad caelestem materiam pertinet; nam ille subtilis, ubi ventosi ac procellosi motus non possunt existere, ad caelestem pertinet partem; iste vero turbulentior, qui exhalationibus humidis corporescit, terrae deputatur; quique ex se multas species reddit." Here Isidore seems to have set aside Pliny's view by associating substance with cosmic region.

caverns (II, 114–115). However, he went on to press his distinction between two types of moving air.

> But there is a great difference between a gust of air (*flatus*) and a wind (*ventus*). The latter, regular and blowing steadily, and felt not by some particular tract only but by whole countries, and not being breezes nor tempests but winds—even their name being a masculine word—whether they are caused by the continuous motion of the world and the impact of the stars traveling in the opposite direction or whether wind is the famous breath (*spiritus*) that generates the universe by fluctuating to and fro as in a sort of womb, or air whipped by the irregular impact of the planets and the non-uniform emission of their rays, or whether they issue forth from these nearer stars which are their own or fall from those stars which are fixed in the heaven—it is manifest that the winds too obey a law of nature (*lex naturae*) that is not unknown, even if not fully known.[125]

This sense of difference continues through the succeeding sections of Book Two of the *Natural History*, where even storms and whirlwinds are classified as *flatus*, coming from exhalations from the earth, and are said to be irregular and without cosmological significance (II, 131).

Pliny remarked upon the four cardinal winds and the development first of a four-wind order, then of a twelve-wind order, in the heavens. The latter he found unduly elaborate and supported instead an eight-wind order that had existed for some time. He then described in detail a great variety of winds in terms of cardinal, calendrical, astronomical, and/or geographical significance (II, 119–130). In Book 18, a book devoted to agriculture, to astronomical guidelines for sowing crops, and to winds and various means of forecasting weather, Pliny described in detail how to make a wind rose (XVIII, 326–339). Most important was the initial line of north-south orientation, determined by midday shadows, with a small circle, or umbilicus, around its central reference point. The east-west line could then be drawn as a perpendicular through the center of the umbilicus. Next should be drawn two intersecting lines of equal length and perpendicular to each other, dividing equally the four quadrants produced by the four cardinal lines. With each of the eight radial lines from the umbilicus drawn ten feet in length, a circle with radius of ten feet could be drawn from the umbilicus to produce an eight-part wind rose. Pliny's reason for preferring the eight-wind rose to any other was its cosmological relevance. He pointed out that

[125] Pliny, NH II, 116, trans. Rackham, pp. 257–9. See Kroll, "Plinius und die Chaldäer," pp. 1–3.

a person standing at the center of the rose would find that sunrise occurred on the summer solstice at the northeast point of the rose, on the equinoxes at the east point of the rose, and on the winter solstice at the southeast point of the rose. Regarding any active cosmological function of the winds, Pliny seems to have looked at them as forces that balanced each other but not as creative forces. Since winds exist, Pliny strove to understand how they are structured to fit into and support the natural order rather than to threaten it. He gave the names of the winds as he progressed around the eight-pointed rose, first the Latin name and then the Greek (also II, 119).

North—Septentrio/Aparctias
Northeast—Aquilo/Boreas
East—Subsolanus/Apheliotes
Southeast—Volturnus/Eurus
South—Auster/Notus
Southwest—Africus/Libs
West—Favonius/Zephyrus
Northwest—Corus/Argestes

Around the year 800 the compiler of a set of seventy-one excerpts from Books 2–6 included a lengthy section on winds.[126] He did not repeat the distinction between *ventus* and *flatus* but did select three of Pliny's alternative causes of winds: the impact of the stars (*sidera*) against the general turning of the world, the cosmic breath that is the basis of all things, and the beating of the air by the planets (*errantia sidera*) and the multiform impact of their rays.[127] In subsequent paragraphs the compiler named and described various winds, focusing in a section entitled "the nature of winds" on the relative salubrity of each wind and ending with Pliny's rule that the winds blow in their turns, usually in a sequence of oppositions, but when a wind begins just as that one next to it ceases then this sequence follows the course of the Sun, from left to right (when facing south), i.e., from east to west. Also, the

[126] See p. 96, n. 3 above; Voss. lat. Q.69, ff. 41va–42rb; ed. Rűck (1898), pp. 266–9 (nrs. 24, 28–35).

[127] Ibid., p. 266 (nr. 24): "sive adsiduo mundi incitato et e contrario siderum occursu nascuntur, sive hic est generalis rerum naturae spiritus huc illuc tanquam in utero aliquot vagus, sive disparili errantium siderum ictu radiorumque multiformi iactu flagellatus aer." (II, 116)

excerpt continues, "the Moon on its fourth day normally determines the monthly order of the winds."[128] This early Carolingian set of excerpts chose to employ a fair amount of Plinian doctrine on this topic, incorporating a celestial or cosmic origin of winds, names and characteristics of winds, and a strong sense of order determined among the winds by the Moon. Such a selection of excerpts showed an early awareness that winds could be a problem in the cosmic scheme unless they were clearly delineated and ordered.

The solution recognized by this Carolingian excerptor followed the lines of Isidore's outlook on winds and ignored the approach of Bede. In DNR 26, Bede decided to eliminate Pliny's cosmological framework for the winds, still found in part in Isidore's DNR 36. Bede retained Pliny's sense and description of winds as *flatus* (NH II, 114), completely avoided the distinction of terms ('flatus' and 'ventus') for wind, and also omitted Pliny's connection of true winds to celestial causes, preserving only the notion that the names of the winds derive from the directions in the heavens. By doing all these things, Bede effectively tamed the winds and reduced them to one more item in the description of the realm of air, like rain or hail or the rainbow.[129] However, Bede's approach did not influence the compiler of the Pliny excerpts.

Although Pliny himself preferred the eight-wind rose, he gave the names of the additional winds for the twelve-wind rose (II, 120), and it was a twelve-wind pattern, well entrenched in the vulgate form of a wind rose by late Antiquity, that Isidore adopted for his *De natura rerum* (ca. 613).[130] The wind rose as well as the other *rotae* found in Isidore's DNR did not appear in Bede's DNR. By Carolingian times the design

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[128] Ibid., pp. 268–9; the compiler abbreviated Pliny, NH II, 126–8.

[129] Notably, in DNR 25 (*De ventis*), Bede reiterated an Isidorean clarification and distinction of upper and lower airs, but he used it in such a way as to relegate all of Pliny's effects of winds to the lower, disorderly realm of air: "Superior vero et serenus aer caelo, inferior autem qui exalationibus humidis corporascit terrae deputatur; ubi sunt ignis, grando, nix, glacies, et spiritus tempestatum, quae Dominum de terra laudare iubentur." (ed. Jones, p. 217.10–13) Cf. Isidore, *Etymologiae* XIII.vii.1 (quoted in n. 123 above).

[130] Vitruvius (*De architectura* I, 6, 12) detailed the design of an 8–wind rose; Seneca, Suetonius, and Vegetius used the 12-wind rose, based on an account by Varro. Isidore used all of these sources, esp. Suetonius, for DNR 37. See Kaibel, "Antike Windrosen," pp. 584–7, 601, 621, 624. While Obrist, "Wind Diagrams," cites a large number of sources, in addition to Kaibel's article I would emphasize the utility of Robert Böker, "Winde," REA, ser. 2, 8 (1958), coll. 2371–2381; Masselink, *De Grieks-Romeinse Windroos,* pp. 133–9 (Pliny), 159–160 (Suetonius—Isidore), 160 (Bede); and Raff, "Die Ikonographie der Windpersonifikationen."

for this wind rota in Isidore's work had evolved into a few distinct but not widely different forms. Isidore himself listed the twelve winds from a diagram, naming them in trios based on the four cardinal winds and reading the names of the two subsidiary winds in each trio as being 'on the right' and 'on the left' in a way requiring the observer to be outside, not inside, the resulting diagram of winds. Beginning with the north polar trio he gave these names, with the Latin name first.[131]

Circius/Thrascias ('on the right')
Septentrio/Aparctias—North
Aquilo/Boreas ('the other side')
Vulturnus/Caecias ('on the right')
Subsolanus/Apeliotes—East
Eurus/[Eurus] ('on the left')
Euroauster/Euronotus ('on the right')
Auster/Notus—South
[Austroafricus/Libonotus][132]
Africus/Lips ('on the right')
Favonius/Zephyrus—West
Corus/Agrestes ('on the left')

Virtually all wind *rotae* illustrating Isidore's work before and during the ninth century oriented the winds so that the east wind, or Subsolanus, was at the top, a familiar orientation for readers of medieval maps (Figure 3.13).[133] The Holy Land was to the east (for Europeans); the Sun rose at the Creation on the equator in the east; legends placed Paradise in the east; early medieval 'T–O' maps had Asia at the top, with Europe and Africa at the bottom.[134] Another constant element in

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[131] DNR 37.1–4, ed. Fontaine, pp. 295–7.

[132] This wind is absent from Isidore's text, which mistakenly named "Euronotus" for this position; the correct information appears in the accompanying rota. See ed. Fontaine, p. 297.17–18 (text), p. 296 bis (wind rose).

[133] The only exceptions to this rule that I have encountered appear in Bruxelles 9311–9319, f. 85v, an orderly image where Septentrio is at the top (ms. from St. Amand or nearby); and Karlsruhe Aug. CCXXIX, f. 175r, a disorderly image with errors, where Africus appears at the top (ms. from Italy). Both these mss. are from s. IX¹⁄₃. On these two images see n. 142 below. Charlemagne took an active interest in the study of the winds, according to Einhard (*Vita Karoli Magni* 29), and gave vernacular names to the twelve winds, beginning the list with the east wind, Subsolanus/Ostroniwint, as in most diagrams.

[134] A graphic example appears in the wind rose for Isidore's DNR in Vat. Regin.

the *rotae* was the central circle, inside the radial sectors, or 'rose' petals, that held the wind names. This circle, empty in many Isidorean wind roses and containing purely decorative elements in others,[135] recalled the umbilicus, or central circle, in Pliny's directions for constructing the wind rota (XVIII, 327). A Plinian element in some early Isidorean wind roses was the presence of a man's head in profile facing to the right in the central circle. The head represented the person establishing the wind design according to Pliny's initial instruction, where one was told to stand facing south (XVIII, 326), which, in the Isidorean rota meant facing to the right, where the southern wind was always placed in these examples.[136]

For Pliny, of course, the winds were cosmic forces, and this received graphic reemphasis with the insertion within the central circle of two words arranged as intersecting perpendiculars, MUNDUS and KOCMOC/KOCMOS, the Latin and Greek terms for the whole world, or cosmos (see Figure 3.13). These appear in at least six early Isidorean wind *rotae*, including four of the very early manuscripts (before ca. 800) of DNR.[137] The youngest and last of these six, Laon 422, was probably composed in northern France during the reign of Louis the Pious.[138] Here not only do we have a remarkable image (Figure 3.14), breaking away from the more conservative line of Isidorean wind roses, but we also have a reinforcement of its innovative character in the text itself. The four cardinal winds, here as naked persons with wings at the tops of their heads, with the East wind (Subsolanus) at the top of the rota, stand upon a cosmic square within the central circle with the

1260, f. 39r (s. IX), where the central circle is a 'T–O' map with Asia at the top with the East wind above it.

[135] The central circle is empty in the designs of the following early mss.: Bern 249, f. 61v; Bern 610, f. 41r; Besançon 184, f. 46r; Basel F.iii.15a, f. 11r; Basel F.iii.15k, f. 18r; Vat. Regin. 310, f. 18v. The central circle has only decorative elements in the following early mss.: Bamberg Nat. 1, f. 35v; Vat. Palat. 834, f. 82r; Vat. Regin. 255, f. 18v.

[136] Examples in early mss. are: Munich 14300, f. 18v (reproduced in ed. Fontaine, p. 296 bis); 16128, f. 35v, Obrist, "Wind Diagrams," Fig. 4; Paris 6413, f. 27v.

[137] Bern A92.20, f. 2r (s. VII–VIII), Obrist Fig. 7; Paris 6400G, f. 142r (s. VII–VIII), Obrist Fig. 6; Cambrai 937 (olim 836), f. 59v (s. VIII); Laon 423, f. 29r (s. VIII); Bern 224, f. 172vb (s. IX1/3); Laon 422, f. 5v (s. IX1/3), Obrist, "Wind Diagrams," Fig. 25.

[138] Laon 422 was ruled in old style and does not seem to have been at Laon in the Middle Ages; for these points I thank John Contreni in a personal communication of September 1979. Dell'Era, "Una rielaborazione dell'Arato latino," p. 271, places this ms. between 800 and 830. The wind rota in Laon 422 is discussed by Obrist, "Wind Diagrams," pp. 66, 70–1; it also appears on the title page of Fontaine's edition of Isidore's DNR.

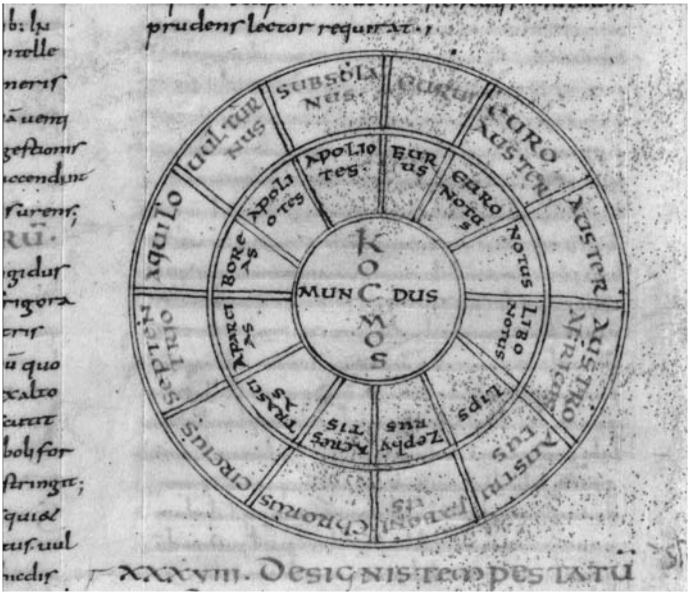

Fig. 3.13. Twelve-Wind Rota with Central Cosmic Perpendiculars. Bern, Burgerbibliothek cod. 224, f. 172vb

words MUNDUS and KOCMOC arranged diagonally with this square inside the central circle. The eight subordinate winds—their heads are grasped in a dominating manner by the cardinal figures—do not stand within the central circle.[139] Moreover, the placement of this rota and its associated text in Isidore's work betray a special importance. The two chapters on the winds are DNR 36 and 37 in the standard version of the work. In this manuscript there has been a very clear and premeditated removal of these chapters from their usual places and reinsertion as Chapters 7 and 8, directly after the six initial chapters on time intervals. Standing in this new position, the chapters on the winds precede the chapter *De temporibus*, which is the first chapter describing the parts and characteristics of the cosmos. Furthermore, the table of contents explicitly places and numbers the wind chapters as the seventh

[139] For the importance of cardinal directions and the use of squares and quaternaries of many sorts in Carolingian cosmological thought and diagram, see Bronder, "Das Bild der Schöpfung und Neuschöpfung der Welt." For an interesting figural example by Rabanus Maurus see his *In honorem sanctae crucis*, ed. Perrin, p. 68.

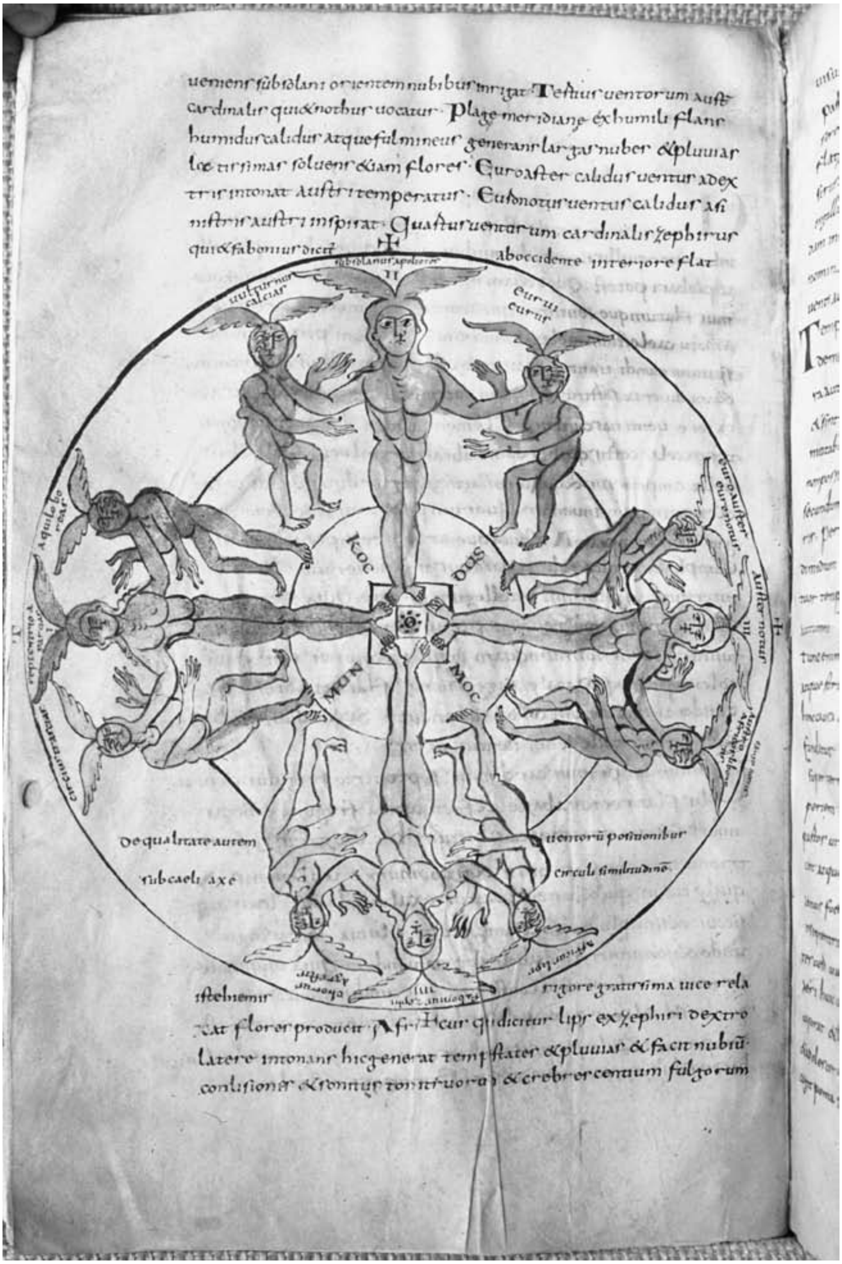

Fig. 3.14. Twelve-Wind Rota with Personified Cosmic Winds. Laon, Bibliothèque communale ms. 422, f. 5v

and eighth of the forty-six chapters listed.[140] What this relocation of these chapters, along with the striking image of the winds presented, tells the reader is that a major force—a major ordering force—of the physical world is being described here, at the very beginning of Isidore's description of the parts of the cosmos. The message must have been taken to heart, as we find a wide variety of wind designs influenced either directly by this rota of Laon 422 or by another image in the same tradition.[141]

While Pliny's orientation assigned the winds a significant place among cosmic forces acting in the sublunar realm, the Carolingian development of wind doctrine and wind designs was many-sided, as Obrist's study shows, and not all of the new developments enhanced the notion of a cosmic power in the winds.[142] At least one tradition that emerged

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[140] Laon 422, f. 1r–v for the table of contents.

[141] See Obrist, "Wind Diagrams," pp. 66 ff. Obrist provides 12 wind diagrams from Carolingian and earlier times (Figs. 3–10, 19, 21, 24–25) and a total of 34 for the whole Middle Ages. Her study goes far beyond my aims here, which are to describe the Carolingian tradition, especially that part which I believe derives from Pliny the Elder, though with much admixture and fertilization from other sources. Regarding the rota of Laon 422, I do not claim that this image was responsible for all the subsequent figures that show similar elements, but the Laon text and figure were surely an example of a conscious choice to make more explicit the cosmic importance of the winds, and this was a reaffirmation of Pliny's views. For some later examples of this tradition, see Obrist's Figs. 26, 28, 30, and 33. Her study also identifies influences of both the Isidorean tradition and the Vegetian (*De re militari*) tradition in computistical collections. An Isidorean wind rota inspired by the Vegetian design appears in the text of the DNR included in a large astronomical-computistical collection in Cologne 83 (II), ff. 219, at f. 141r, as noted by Obrist, p. 48 and her Fig. 5. One small annotation to her study concerns her Fig. 8 (p. 47), from Basel F.III.15a, f. 22r, which is not in any way a part of Isidore's DNR in that ms. Ff. 1v–16v of the ms. contain DNR 15 (acephalic)–48, with an Isidorean wind rota on f. 11r (our Fig. 3.15), quite unlike the wind rota on f. 22r. Folio 17r has medical recipes; ff. 17v–18r contain a book list; ff. 18r–23v contain a set of cosmological designs without texts, at least one of which has internal contradictions (f. 18v), while another is incoherent (f. 20r); the wind rota on f. 22r is, as Obrist notes and describes in detail, a Vegetian wind design; ff. 24r–29v contain Isidore's *Differentiae*; ff. 29v–31r, 32r have excerpts from a letter of St. Jerome; f. 31v has a blessing; f. 32 r–v has a text on the five universal church councils. Another tradition of texts on winds, quite unlike Pliny's, is that of Hippocrates, *De aeribus, aquis et locis*, translated from Greek into Latin ca. 500 and represented by two surviving Carolingian mss. For the text see Kűhlewein, "Die Schrift ΠΕΡΙ ΑΕΡΩΝ ΥΔΑΤΩΝ ΤΟΠΩΝ," pp. 254–8 for the text on airs (most commonly rendered *flatus*); for the early manuscript tradition see Pearl Kibre, "Hippocrates Latinus," pp. 123–6, and subsequent volumes of *Traditio* (vols. 32–38) for later manuscripts.

[142] Especially useful for information on the post-Carolingian developments in wind doctrine and diagrams are the works of Maurmann, *Himmelsrichtungen im Weltbild des Mittelalters*, and Liebeschűtz, *Das allegorische Weltbild der heiligen Hildegard*. Liebeschűtz, pp. 81–2, refers to Greco-Roman sources for planets moving the winds and also for

in the Isidorean wind *rotae* tied the winds to names of the months, an association of twelve winds with twelve months, and offered either no further guide to the reader about cosmic significance or only a modest suggestion in the central circle of the design. The essential pattern was simply three concentric circles of names (months, Latin wind names, Greek wind names) around a central circle, with the wind Subsolanus usually at the top and usually paired with the month August (Figure 3.15).[143] This design associated the winds with the human ordering of the passage of time but nothing more.

To depart from the Plinian connection and explore the large spectrum of doctrines and diagrams about winds that appeared and evolved during and after the Carolingian era would take us far beyond our chosen limits. Certainly the penetration and spread of Isidore's teachings on the winds, including his wind diagram, was tremendous, indicated by a copy (ca. 900 or later) of the famous planetary configuration in the Leiden Aratea (see Figure 3.12), newly surrounded at its four corners by four Isidorean *rotae*, three very much like Isidore's originals and the fourth a highly elaborated Carolingian wind rota.[144] The Plinian line of interpretation of cosmic winds reached the Carolingian world through Isidore of Seville and played a major part in the ideology about winds but had a more subdued place in the emergence of a variety of wind

winds moving the planets, and at p. 82, n. 2, he quotes from Michael Scot on the four cardinal winds ruling the heavens (Munich 10268, ff. 21–22). Maurmann, p. 55, notes that Hildegard of Bingen and the Ethiopian Book of Enoch both ascribed the rotation of the universe to the winds. The spread of wind doctrines in the high Middle Ages is suggested by a comment in the lower margin of Basel F.IV.32, f. 96v (s. XIII), at the end of Macrobius's *Commentary*, naming the 12 winds and associating each name with a "celestial cause".

[143] The following variations occur in the five examples I have seen. Bamberg Patr. 61 (olim HJ.IV.15), f. 99v (s. VIII–2/2), has Subsolanus at the top associated with the month October; "TERRA" is written in the central circle. Our Fig. 3.15 (s. VIII ex.—IX in.) includes the four cardinal directions written outside the outer band of names of the months. Bruxelles 9311–9319, f. 85v (s. IX1/3), places Septentrio at the top with the month of May; the central circle has "MUNDUS" inscribed horizontally. Karlsruhe Aug. CCXXIX, f. 175r (s. IX in.), has Africus with February at the top, a decorated cross in the center, and errors in the names of the winds resulting in the absence of the pair of names Corus/Agrestes. Paris 10616, f. 74r (a. 796–799), arranges in three concentric bands, separated by circular lines, the Greek names, the Latin names, and the names of the months.

[144] Boulogne 188, f. 30r; the planetary configuration is enclosed by Isidorean diagrams illustrating chapters of his DNR: five climatic zones (upper left), lengths of daylight at solstices and equinoxes (lower left), planetary periods (upper right), and a highly developed wind rota (lower right) that includes extensive texts from DNR 37 for the individual winds; for more detailed description see below, pp. 411–17, Fig. 6.19.

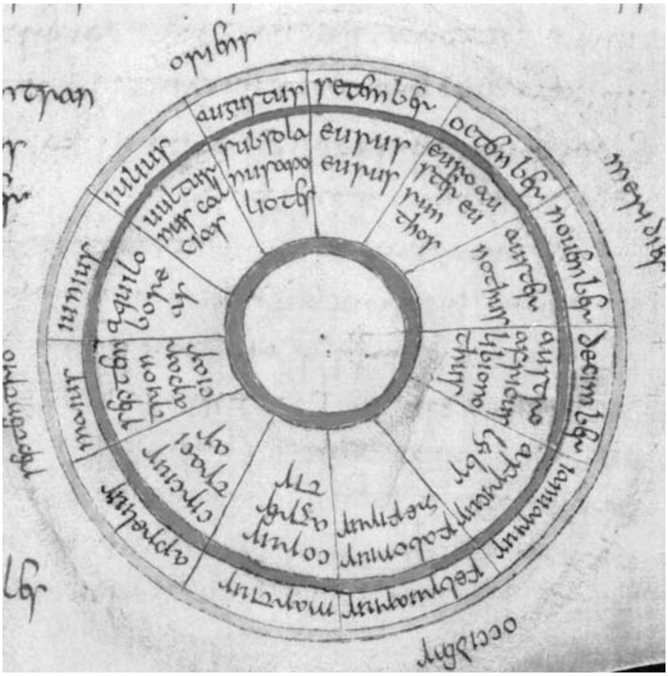

Fig. 3.15. Twelve-Wind Rota with Coordinated Twelve Months. Basel, Universitätsbibliothek ms. F.III.15a, f. 11r

diagrams. Pliny's theme of winds produced by celestial forces was central. The Carolingians developed a more active aspect of the theme, drawn from other sources, in order to make the winds a more positive and more pervasive part of the cosmic picture. In many cases, the new views directly reversed Pliny's statements, thereby making winds move the cosmos, move the planets, and cause seasonal changes.[145] A final, apocalyptical view of the winds came out in a commentary on *Revelation* 7:1–3 by Alcuin, who identified the four angels that temporarily held back four winds at the four corners of the earth from destroying the earth and sea as the body of the devil, or four worldly empires—the Assyrians, Persians, Macedonians, and Romans. The four winds then become in Alcuin's words the same as the four empires and the same

[145] One of the sources for such a reversal of Pliny's view was Macrobius, *Commentary*, II.iv.4 and II.iv.7, speaking of a wind, or breath (*spiritus*), that moved the outer spheres more powerfully and the lower spheres more weakly in relation to the distance of the acting *spiritus* from its source.

as the four beasts of *Daniel* 7:2–3, to wit, all were the body of Satan.[146] Here we have stepped beyond our Roman sources into biblical interpretation.

11. *Foretelling the Weather and Predicting Eclipses at the Time of Charlemagne*

Whereas the development of wind diagrams led Carolingians away from Pliny via Isidore and other sources, the concern to foretell the weather, a fundamental need in any agricultural society, kept Carolingians close to a text from Pliny that followed immediately upon his directions in Book XVIII for laying out a wind rota. The final astronomical excerpt from Pliny in both the Seven Book and the Three Book Computus was *De praesagiis tempestatum* (*On Weather Predictions*), drawn from NH XVIII, 340–365, the closing sections of his lengthy book devoted to agriculture.[147] In hierarchical order, Pliny discussed four ways of reading the heavens to predict the weather: from the Sun, the Moon, the stars, and the group thunder-lightning-clouds-mists.[148] From observations of phenomena on the earth Pliny then added weather predictions on the basis of fires and lamps, behavior of the sea, behaviors of fishes, birds, and other animals, and a few other peculiar signs.[149] While the earthbound signs are intrinsically interesting, the signs in the heavens are more significant and more extensive in the Plinian text. Prognostication from the Sun, Moon, or stars was on the basis of air quality, cloud color, cloud shape and density; the appearances of the Sun and its rays rather than the activity of the sun told the observer what winds, storms, or rains to expect. The same sorts of observations

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[146] Alcuin, *Commentarii in Apocalypsin*, IV.vii.1 (PL 100, coll. 1128D–1129B).

[147] See n. 24 above on this excerpt; review nn. 13–24 for the dominance of Plinian over other sources in the 12 chapters of Book V of the computus. After compressing the introductory comments in NH XVIII, 340–341, the Carolingian compiler carried over the full text of 342–365, eight pages in the edition (1972) of Le Bonniec and Le Boeuffle (see pp. 170–8). Carolingians preferred Pliny to the available weather fragments from the Aratea of Germanicus or Avienus; for those see, e.g., Bischoff, *Aratea Kommentar*, pp. 152–6.

[148] For these topics see, respectively, NH XVIII, 342–346, 347–350, 351–353, and 354–357, the predictions from the Sun and Moon being more precise and comprehensive than the others.

[149] These four groups of predictive phenomena appear respectively at sections 357–358, 359, 361–364, and 360 plus 365. An example: NH XVIII, 361 tells us that dolphins leaping in a calm sea foretell wind from the direction from which the dolphins come.

were prescribed for the Moon, but Pliny called for special attention to appearances of the Moon on its fourth day, repeating a statement of Varro and beliefs of the Egyptians regarding the importance of the fourth day of the Moon for predicting winds, storms, and rain.[150] Observations of the stars—their apparent movement, clarity, brilliance, twinkling, or obscuration—could similarly be categorized to predict winds, storms, and rains as well as good weather. A brief review of the contents of Book V of the Seven Book Computus (Section 2 above) reveals the relationship of *De praesagiis tempestatum*, the final chapter of Book V, to the first two chapters, which identify and locate the constellations. While the constellations had other uses as well in Carolingian astronomy, their importance, along with the Sun and Moon, as indices for weather prognostication was immediately obvious to any user of this computus collection. Indeed, suggestions for completely naturalistic predictions of future, orderly celestial events arise throughout Book V of the computus: relative planetary speeds, varying brightness (distance) of the planets in their orbits, changing elevations of planets with respect to the ecliptic (and horizon), lunar phases, solar and lunar eclipses, and weather in relation to the appearances of celestial bodies. These provided not only basic elements of astronomy for scholars but also a *vademecum* for the cleric wishing to impress others by explaining simply and clearly in naturalistic terms such a broad spectrum of events in the heavens—events that could be mysterious, troublesome, and disturbing to unlearned persons. Not only could the learned cleric explain, but he could also predict in a general way, the appearance or change in appearances of things in the heavens. Analogous naturalistic predictions, grounded upon astronomical and meteorological as well as medical knowledge, were taught by the Hippocratic text *Airs, Waters, Places*, which circulated in a Latin translation during the ninth century and advertised to its readers that they could learn to explain different bodily constitutions and susceptibilities to ailments on the bases of designated times of the year, climatic variations, prevailing winds, and other environmental conditions in conjunction with humoral doctrine. There is a striking parallel between the itinerant physician of *Airs, Waters, Places* and the learned cleric using *De praesagiis tempestatum* and

[150] This extended account of the Moon's fourth day (XVIII, 347–349) explained the somewhat cryptic statement of NH II, 128, which announced simply, "de ratione eorum [ventorum] menstrua quarta maxime luna decernit." Bede, DTR 25, explicitly contradicted such predictions from the fourth day of the Moon.

other Plinian weather doctrines to explain a meteorological event to an unlettered Carolingian congregation.[151]

The question of when and how a learned cleric might use his knowledge of such teachings on weather forecasting arises with the harangue of Agobard, bishop of Lyon, *Against the Foolish View of the People about Hail and Thunder*.[152] Agobard told of encountering a crowd in his diocese (ca. 815–816) who were on the verge of stoning to death four persons for attempting to steal the grain knocked down by a recent hail storm. These persons had been apprehended after supposedly falling from an airship that had brought them from the realm of Magonia, and they were said to be responsible for the destructive storm as well. Agobard stepped in to confront the crowd and claimed to have brought the leaders to confusion by careful questioning of the evidence and reasoning for the belief that the four unfortunates had paid *tempestarii* (storm-makers) to bring the disaster upon the crops. The bishop then expanded upon the topic of human control of the weather for readers of his tract. Even though the belief in *tempestarii*, who would bring about storms by incantations, was practically universal in the area of Lyon, Agobard made it clear that he held no such belief and that the weather came from God, not humans, reciting from many places in the bible the divine acts or commands that produced meteorological events of all sorts, especially violent storms.[153] He argued that experience and reason showed that no one could bring rain when it was desired for the crops, nor could any one call down an immediate hail storm to destroy enemies threatening him on the road. The claims that storms could be created by humans were absurd and impious. Thus Agobard argued, and his position most likely persuaded his clerical readers though probably not the people of his diocese. Significantly, Agobard did not try

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[151] For the text and early manuscripts of the *De aeribus, aquis et locis*, see n. 140 above. The text states the importance of astronomy and knowledge of the seasons and weather prediction for prognosticating human physiological changes and ailments at cc. 2, 10, 11, 24 (Kühlewein, "Die Schrift," pp. 254–5, 262–4, 273–4), and applications of these kinds of knowledge abound throughout the text.

[152] PL 104, coll. 147A–158D; Agobard of Lyon, *Opera omnia*, pp. 1–15, based on the sole ms. of s. IX–X. An excellent account and interpretation of the event and the text appear in the study of Dutton, "Thunder and Hail over the Carolingian Countryside;" revised version in idem, *Charlemagne's Mustache*, ch. 7; partial translation in *Carolingian Civilization*, pp. 189–91. A brief summary appears in Russell, *Witchcraft in the Middle Ages*, pp. 82–3.

[153] Regarding *tempestarii* some interesting examples appear in the study by Lecouteux, "Les maîtres du temps: tempestaires, obligateurs, défenseurs et autres."

to give a naturalistic explanation of the hail storm that had destroyed the field of grain but instead was satisfied to demonstrate the inability of supposed storm-makers to produce on demand a result beneficial to the people at large. Popular and pagan credulity was his primary target in a bid to replace it with acceptance of a natural world that was controlled completely by a single divine power, the all-powerful god of Christians. Neither Agobard nor the Carolingian clergy in general treated popular concerns about severe weather dismissively as we see in the provision of a special mass for driving away thunderstorms in the Gregorian Sacramentary.[154] Further evidence of clerical attention to such fears and tactics to treat them within a Christian framework appears in the pseudo-Alcuinian book on the divine office, which prescribed for the Sunday after Easter the distribution of small, molded wax lambs (both the material and the symbol being precious), blessed by the priest, that could be placed in fields and vineyards as protection against thunder and lightning.[155]

What could Plinian doctrines about the causes of weather have added to Agobard's diatribe? Looking even closer at hand, we should review what Bede and Isidore of Seville wrote concerning bad weather and its prediction. Bede's *De natura rerum*, we remember, was the ultimate book of the Seven Book Computus. In DNR 25–36, Bede composed descriptions—sometimes explanations—of air, winds, the order of the winds, thunder, lightning, the places where lightning occurs, the rainbow, clouds, rain storms, hail, snow, and, finally, foretelling both storms and good weather. What might this have told Agobard? Bede followed a distinction made in Isidore's *Etymologies* that described a supra-lunar and imperturbable realm of air above the region of lightning, rain, and storms, leaving the sub-lunar air, a different substance, to demons as well as to meteorological phenomena. This included all activities of winds, quite unlike Pliny's doctrine of celestial *ventus* and terrestrial *flatus*; thus Bede defined any wind simply as a disturbance of the air ("Ventus est aer commotus et agitatus.")[156] Proceeding beyond this, he gave essentially Plinian and naturalistic definitions of thunder, lightning, clouds,

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[154] Dutton, *Charlemagne's Mustache*, p. 182.

[155] Pseudo-Alcuin, *De divinis officiis*, PL 101, col. 1224D (c. xxi).

[156] Bede, DNR 25–26 made the Isidorean Christian distinction between upper and lower airs along with the consequent placement of all winds and their effects in the lower realm. The distinction seems to have been made primarily to accommodate the vocabulary of the Latin Bible, with its various uses of 'caelum' and the occurrences in the *caelum*; see Bede, DNR 25; also p. 158, n. 123 above.

hail, and snow. Hailstones, for example, Bede defined as coming from raindrops, solidified in the air by a frigid wind; he said that hail dissolves quicker than snow and falls more often in daytime than at night.[157] When it came to predicting weather, Bede compressed a selection of prognostications found in Isidore's DNR 38, omitting Isidore's names of his sources and his opening religious metaphor. Bede also reversed the order of Isidore's presentation to approximate a Plinian order: first observations of the Sun, next the effects of three winds, followed by observations of the Moon, and finally observations of the sea and of dolphins.[158] For the prognostication of a hailstorm, however, Bede was at a loss, since Isidore did not provide this information and Pliny's Book 18 was mostly unavailable. The excerpt *De praesagiis tempestatum* in the Seven Book Computus, however, did contain Pliny's statement, "When clouds settle down on the tops of mountains, the weather will be stormy.... When there is heavy white cloud...a hailstorm will be imminent" (NH XVIII, 356),[159] especially when a north or northwest wind blows (II, 126). Over a longer interval, Pliny predicted that the rise of the constellation Arcturus, forty days before the fall equinox, will almost always be accompanied by a hailstorm (II, 106). From Bede then, Bishop Agobard might well have retailed for the crowd at Lyon a naturalistic account of the production of hail, adding to it the signs for the onset of hail according to Pliny, but this was neither his wish nor what was called for. In fact, as his own account made clear, both he and the crowd were concerned with identifying the initiator of the natural process, not the nature of the process. Thus in this affair, a knowledge of the processes of nature could serve Agobard well in reassuring himself of the wholly natural character of a destructive hailstorm, but it was not the knowledge needed to deal with an angry crowd. Agobard's situation was very different from Hraban's explanation of the process of an eclipse to his disturbed crowd. Similarly, the Plinian sources, while useful enlargements of the compact chapter of Bede on weather prediction, were limited to more serene environments and different questions than those presented by Bishop Agobard of Lyon.

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[157] DNR 34 (ed. Jones, p. 222); drawn directly from Pliny, NH II, 152.

[158] Bede DNR 36 (ed. Jones, pp. 222–3); cf. Isidore DNR 38 (ed. Fontaine, pp. 299–303). This selecting and reordering of materials is an especially nice example of Bede's care in composing a chapter.

[159] Rűck, *Auszűge*, p. 48.22–25; King, "Investigation," pp. 164.124–165.127; NH, ed. LeBonniec & LeBoeuffle, pp. 175–6.

The interest in prognostication is the other side of the coin of understanding the order of the heavens. Adequate understanding of the movements of the stars and planets was a goal of the larger educational program of Alcuin in support of Christian preparedness in the face of heresy and paganism. But in the decade between Alcuin's death and Charlemagne's the scope of adequate astronomical understanding expanded sufficiently to raise the expectations of many, including the emperor himself, that the order of the heavens in the future as well as in the present could be confidently determined. In one area, this had been possible and widely practiced for centuries, that is, in the composition of computistical tables and the ready prediction of dates in the future for Easter and other Christian feasts, built upon arithmetical formulae and rules for the dating of luni-solar coincidences and spring equinoxes. In Charlemagne's last decade questions arose more vigorously about the prediction of other celestial phenomena, such as eclipses and the positions of planets. An event we have considered before and should discuss further in this regard was the exchange between the emperor and Dungal about two solar eclipses in the year 810.[160]

We recall that Charlemagne learned in 811 from a visiting bishop from Constantinople that there had been in the year 810 not only the solar eclipse observed in Western Europe on 30 November but also another solar eclipse on 7 June. The emperor was surprised. More than that, he may well have been disturbed by the approximate coincidence of the first eclipse with the death of his son Pippin, king of Italy, on 8 July 810.[161] Dungal, while certainly showing no surprise, made no allusion to any recorded, direct observation of the earlier eclipse. And his letter to the king mentioned no ominous nature for either eclipse. Although the interval between these two solar eclipses was short, it was in no way miraculous or mysterious. These possibilities, lurking behind the emperor's inquiry, needed to be put aside without question. At the same time, if the two eclipses were quite natural and according to the known rules of astronomy, an explanation of their occurrences must be produced. After presenting an account of an orderly planetary

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[160] See above, pp. 46–7, nn. 34–35; p. 99, n. 12; p. 125, n. 47.

[161] The potential for imperial concern about an ominous connection here was remarked by Werner, "*Hludovicus Augustus*: Gouverner l'empire chrétien," in *Charlemagne's Heir*, pp. 28–9. As Werner notes, the death of Charlemagne's son Charles, king of Neustria, on 4 December 811, just one year after the second of the reported eclipses of 810, likely aroused even more concern.

heaven, especially the motions of the Sun and the Moon through the zodiac and with respect to the ecliptic, on the basis of extended quotations and rephrasings of Macrobius's *Commentary* and data from Pliny on solar and lunar latitudes,[162] Dungal turned to the question of the double eclipse and predicting eclipses in general. He surely knew Pliny's statement of an eclipse cycle of 223 months, since he quoted from the same paragraph of the *Natural History*, but he omitted this datum. At the same time he noted that we must recognize that an eclipse may be visible only in the southern hemisphere or, if in our hemisphere, will be seen only in some places and can remain unseen for various reasons.[163] He then quoted Pliny, "...an eclipse of the Moon sometimes occurs in the fifth month following the last one, and a solar eclipse in the seventh month following."[164] At the end of his letter to Charlemagne, Dungal summarized his account of the solar eclipses of 7 June (actually on 5 June) and 30 November 810, using language that made it clear he used computistical reasoning—an arithmetical summing of days in the lunar months backwards to the first of the moon in June from the thirtieth of the moon in November, which he took as the beginning of the seventh month (in Roman counting) in the interval stated by Pliny—to find the precise date of the first of the two eclipses.[165] And he followed this immediately by reemphasizing that although it may not have been seen—it had not been seen in the West—the eclipse nonetheless certainly had occurred.[166]

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[162] PL 105, col. 454B; MGH *Epistolae*, vol. 4, p. 574.39–41. Pliny, NH II, 66–67, for planetary latitudes. This information was also available in the collection of texts emerging from the computistical conference of 809 at Aachen, found in the Seven Book Computus V, 6 (*De cursu earum per zodiacum circulum*); see above, pp. 100, 119–26.

[163] PL 105, col. 454B–C; MGH *Epistolae*, vol. 4, pp. 574.43–575.4. Cf. Pliny, NH II, 56.

[164] PL 105, col. 454C; MGH *Epistolae*, vol. 4, p. 575.6–7. Pliny, NH II, 57.

[165] PL 105, coll. 456D–457A; MGH *Epistolae*, vol. 4, p. 576.38–42.

[166] There has been critical comment ever since the seventeenth century to the effect that neither Dungal nor anyone else in the West could have observed an eclipse on 7 June (or 5 June, the corrected date), faulting him for excessive credulity or worse. This seems to be pointless criticism. It is true that Dungal's letter, disseminated and copied in the following decades, became the basis for the recording in contemporary annals of a solar eclipse in the summer of 810. But as Ismael Bouillau pointed out long ago (see PL 105, coll. 447–8), the first of the two eclipses could only have been seen from the southern hemisphere, and this is the sort of situation that Dungal clearly had in mind with his two—not one but two—statements that a solar eclipse may well not be seen by one who knows (by calculation) of its occurrence, retaining Pliny's explicit notice that the lunar shadow may not even fall on the earth. The bishop from Constantinople seems to have mentioned only the occurrences, not observations. He

As important to Dungal as the explanation of two eclipses in the previous year 810 was the question of predicting eclipses into the future. He wrote enthusiastically of the possibilities of astronomical expertise, if developed to the level achieved by the ancients, allowing one to predict twenty[167] or a hundred or a thousand years into the future. Indeed, Cicero and Macrobius referred to the World Year, a cycle of 15,000 years after which all stars and planets would be in the same positions as they were at the beginning of the cycle.[168] The delight of such knowledge was in its assurance that the heaven created by God was an ordered celestial world and was there to be known through human reason. Prediction of the orderly events in the heavens should be expected.

12. *The* Natural History *in Carolingian Astronomy and Cosmology*

Pliny's work was known in complete versions before the end of the eighth century and thereafter. A mainstay for Bede in his composition of *De natura rerum*, which in turn was extensively used in schools throughout the ninth century, the *Natural History* was used and cited not only in Carolingian commentaries on Bede's work but also in commentaries on the more advanced astronomical work by Martianus Capella, Book 8 of his *De nuptiis Philologiae et Mercurii*. Anonymous comments on Capella's astronomy as well as the commentaries by John Scot Eriugena and Remigius of Auxerre referred to Pliny in elaborating

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was likely referring to calculations, perhaps geometrical rather than computistical, but only calculations. See Schove, *Chronology of Eclipses*, pp. 177–8; Newton, *Medieval Chronicles*, pp. 595–6; McCluskey, *Astronomies and Cultures*, pp. 133–4. In the *Annales regni Francorum*, in MGH *Scriptores*, vol. 1, p. 198, we find for the year 810 two solar eclipses with ms. agreement on the date of 30 November and four different ms. dates for a summer eclipse: 8. id. Iul. (1 ms.), 7. id. Iul. (1 ms.), 8 id. Iun. (6 mss.), 7 id. Iun. (8 mss.). For the year 811 we find the mention of a diplomatic exchange with the emperor Nicephorus of Constantinople, which may well have been the occasion for the visit of Dungal's *Constantinopolitanus episcopus*; regarding Byzantine legations to Charlemagne see p. 125, above. There were, in fact, three solar eclipses in 810, though only one was visible in Western Europe.

[167] In this sequence of three numbers, the "20 years" seems to be a rounding up of the 223-month cycle of eclipses that Pliny mentioned and Dungal knew; see Pliny, NH II, 56. Such rounding of numbers was rhetorically appropriate for the statement Dungal was making.

[168] PL 105, col. 456B–D; MGH *Epistolae*, vol. 4, p. 576.16–27. Dungal's long quotation came from Macrobius, *Commentary* II.xi.10–15. On the Great Year according to Cicero and Macrobius, see above, p. 65, n. 66.

Capellan astronomy.[169] Extensive excerpts of cosmological and astronomical materials were made from the *Natural History* in the anonymous compilation ca. 800 and for both of the computus collections that followed the computistical conference of 809. Alcuin, Dungal, and later scholars found Pliny an essential source for doctrines and data on the Sun, the Moon, the planets, and constellations. He provided details on eclipses and fundamental viewpoints on astrology, all of which fitted into Carolingian scholarly studies. Certainly the astronomical excerpts taken from Pliny for the Seven Book Computus contributed widely to ninth-century understanding of planetary motions, providing both basic data and innovative diagrams for guidance on the ordered structure of the heavens. The Carolingian search for more and more understanding of the world around them found the *Natural History* to be a gold mine of information to construct through diagrams an imagery of regularity and balance in all the arrangements in the heavens, and to predict certain natural events in both the permanent heavens above and the atmospheric skies of their more immediate environment.

[169] In the anonymous commentary found in Leiden Voss. lat. F. 48, ff. 79v, 81r, 81v we find five explicit references to Pliny in commenting on Capella's astronomy. John Scot Eriugena, *Annotationes*, pp. 180, 182 referred to Pliny three times and uses him elsewhere as well (pp. 169, 178, 179). At the end of the century Remigius, *Commentum*, vol. 2, pp. 280, 282, 283 mentioned Pliny's name three times as his source. These mentions are only the surface of a deeper debt of ninth-century scholars to Pliny.

CHAPTER FOUR

MARTIANUS CAPELLA'S SYNOPSIS OF ASTRONOMY IN *THE MARRIAGE OF PHILOLOGY AND MERCURY* AND ITS MAJOR CAROLINGIAN COMMENTARIES

When John the Scot (Eriugena) wrote his commentary on the nine books of Capella's *De nuptiis Philologiae et Mercurii* (*The Marriage of Philology and Mercury; De nuptiis* hereafter), probably during the 850s, the astronomy of *De nuptiis* had come to be the leading authority in its discipline.[1] Early in the century there appeared explicit references to and uses of Capellan astronomy, but these were few and paled in significance compared to the extent and frequency of use of Macrobian and Plinian astronomical materials at the time. We can point to at least three examples of limits in the use of the astronomical book (Book 8) of *De nuptiis* in the first quarter of the ninth century. First, the very spare selections from Capella compared to the fuller choices from Macrobius in the Seven Book Computus of 810–812 show the relative significance of these sources at the time.[2] Second, the deluxe manuscript of the Aratea that dates perhaps to 816 contains in its final astronomical image a heliocentric pattern for the planets Mercury and Venus that clearly derived from Capella's astronomy, but the configuration in which it resides represents a planetary design according to Pliny with Plinian texts inscribed on the planetary circles. There is no Capellan text of any sort inscribed on the heliocentric circles or anywhere else in this design from the second decade of the century.[3] In short, an essentially

[1] The views of Lutz, Liebeschütz, and others on the date of John's commentary are summarized in Eastwood, "Astronomical Images and Planetary Theory," p. 24, n. 6. Scholarly opinions on the two versions of John's commentary and their relationship are briefly surveyed in Eastwood, "Johannes Scottus and Astronomy," pp. 315–16, n. 12.

[2] See above, pp. 88–89. Extended quotations from Macrobius appear in Bk. 6, Chs. 4–5; briefer and less precise uses of Capella's text (from *De nuptiis* VIII, 860 and VI, 595–8) appear in the same chapters of the computus. King, "Investigation," p. 72, remarked upon this contrast in the use of these sources.

[3] See Leiden Voss. lat. Q.79, f. 93v, for the image in the Aratea. The image and its Plinian contents are briefly discussed above, pp. 146–8, also Figure 3.12. A fuller discussion of both the Plinian and Capellan contents of this design first appeared in Eastwood, "Origins and Contents of the Leiden Planetary Configuration," pp. 4–23,

Plinian astronomical design carried a Capellan element anonymously, without discussion or explanation. The third example of limited use of Capellan astronomy early in the century appears in the absence of any reference to a pattern of circumsolar paths for Mercury and Venus by Dungal in his handling of Macrobius's account of the appearances of Mercury and Venus with respect to the Sun. Dungal saw that account in terms of two possible orders of the planets, and both were fixed orders.[4] He could have accommodated both a sub-solar and a supra-solar position for Mercury and Venus and thereby harmonized the Ciceronian and the Platonic planetary orders, had he adopted the pattern of Martianus Capella, but he did not, and he gave no sign of knowing about such a pattern. So it is reasonable to assume that in 811 Dungal knew nothing of Capella's circumsolar design for the two planets. This certainly fits our understanding of the extent of Capellan influence in astronomy before ca. 825.

If positive Capellan influence is hard to find in the first quarter of the century, the manuscripts of *De nuptiis* provide further evidence. Of seventeen surviving manuscripts, with sixteen containing all nine books and one with a complete copy of Book 8 alone, only one manuscript is generally agreed to have been written as early as the second quarter of the century, while four come from the middle of the century, possibly earlier, and the rest are from the latter half.[5] In other words, the work of Martianus Capella began to be copied widely only at or just before the middle of the century, and a dozen copies still survive from the second half of the ninth century.

1. *The Capellan Allegory: Its Ramifications for Study of the Arts and Cosmology*

The nine books of *De nuptiis* begin with two books seen as pedagogical allegory by many Carolingian readers. The characters of the allegory, Philology and Mercury, represented for ninth-century readers wisdom (*sapientia*) and eloquence (*eloquentia*), united in marriage to stand for the

reprinted, with a correction for the astronomical date presented in the planetary configuration, in idem, *The Revival of Planetary Astronomy*, ch. 4 (see also corrigenda).

[4] See above, pp. 43–52.

[5] I do not include here the two destroyed/unusable Chartres mss. from the ninth century, nor do I consider the fragmentary ms. from the Kremsmünster Stiftsbibliothek, which has only a part of Book 8 alone and none of the planetary astronomy.

seven disciplines of liberal erudition coming together with the ability to present them orally; also, that Mercury and Philology combined the trivium and quadrivium respectively.[6] The significance of this sort of wisdom was domesticated in the minds of contemporaries who agreed with a Carolingian anonymous *De nuptiis* commentary, formerly attributed to Dunchad, that pointed out that Mercury could not marry Pallas, who represented the highest wisdom, but could only be joined with Philology, who signified our discursive knowledge of visible and invisible things.[7] Subordinated to this allegory, the characters, objects, and events of the narrative in Books 1–2 of *De nuptiis* were seen variously as literary, mythological, and philosophical items of erudition—safe for scholarly investigation. However, Martianus Capella seems to have intended to advance a much bolder outlook, what may have been "a crypto-pagan mystagogic compendium," as much theological and theurgic as it was literary or philosophical.[8] In the ninth century Prudentius of Troyes was unusual in recognizing the aggressive pagan agenda of Martianus.[9]

A full discussion of the narrative in Capella's first two books, devoted to the search by Mercury for a bride, the selection and divine approval of Philology as the bride, Philology's purification and divinization, and the marriage festivities, would require us to survey a remarkable body of late ancient doctrine about knowledge, the soul, the gods, rituals, myths, and the physical cosmos.[10] For our purposes we may say that the first of the two allegorical books presents a many-sided picture of

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[6] Nuchelmans, "Philologie et son marriage."

[7] All references to *De nuptiis* will be to NPM, followed by the page and line numbers in Willis's edition. At NPM 57.6–7 (II, 217), the commentator wrote, "Pallas in significatione summae sapientiae quae incorruptibilis et incomprehensibilis est ponitur. Phylologia vero inferior intelligentia per quam intelligimus res visibiles et invisibiles significatur. Quae tunc Mercurio copulata Pallas [non] est quia inferior sapientia cum sermone comprehenditur; a summa sapientia, quae incomprehensibilis est, removetur." See Dunchad, *Glossae in Martianum*, p. 13, lines 29–36.

[8] Shanzer, *Commentary*, p. 43, is the source of the quoted phrase; her commentary is rich with information and insights.

[9] Prudentius, *De Praedestinatione*, PL 115, col. 1294, where Prudentius noted Capella's use of a Varronian natural theology condemned by St. Augustine; remarked by Shanzer, *Commentary*, p. 43.

[10] For interpretations and philosophical study of Books 1–2, see esp. Gersh, *Middle Platonism*, vol. 2, pp. 597–646, with extensive bibliography; Shanzer, *Commentary*; Lenaz, ed., *De nuptiis Liber secundus*, for a full introduction, translation, and commentary. For extensive bibliography on the text and the medieval tradition of Martianus, see Gersh, *Middle Platonism*, vol. 2, pp. 597–601. Gersh, pp. 605–8, proposes to treat the allegory under the headings of theology and psychology and proceeds to give a lucid set of schemata that give clearer meanings to much of the allegory.

the cosmos and that the second book lays out a complex of doctrines about the soul, two themes which are fundamental to Macrobius's *Commentary* as well. There are overlapping topics across the two books of allegory, such as a description of the planetary order in Book I when Mercury shows to Virtue the planetary streams flowing from heaven and another in Book II when Philology ascends through the harmonically distributed spheres to the outermost limit and then to the Milky Way for her wedding ceremony.

Stephen Gersh has argued that Philology and Mercury stood in Capella's mind for the human and the divine souls and, more specifically, that Philology represented the rational, distinct from the non-rational, part of the human soul, which actively participated in its own divinization.[11] As the rational part of the human soul, Philology acted by vomiting up a tremendous amount of literature, all the arts and sciences, which had created a heavy weight in her chest. As soon as she ejected this learning, she was given a "round and living sphere" ("globosam animatamque rotunditatem") that "looks like an egg inside" ("ipsa species ovi interioris"), apparently signifying the return to Philology of full knowledge of the created cosmos in a new form when she drank the contents of the sphere, which referred back to an earlier passage where Martianus mentioned a sphere containing an image of everything in the natural world.[12] This return to Philology of the arts and sciences occurred more explicitly at the end of the allegory where Mercury's wedding gift to her was the seven liberal arts.[13] From this perspective what made the whole allegory a compelling body for study in the Carolingian world was its combination of elaborate detail about the contents and interrelations of the parts of the physical and spiritual cosmos along with its suggestion that full knowledge of the seven arts, or disciplines, was an essential basis for a rational, philosophical understanding of the divine world, that is, for the human mind's understanding of God.

Within the allegory of Books 1–2, prior to the direct, encyclopedic descriptions of the disciplinary books, an atmosphere of religious

[11] Ibid., pp. 638–43.

[12] NPM 21.8–13; 43.9–15 (I, 68; II, 140); Gersh, *Middle Platonism*, vol. 2, pp. 622–3, 642 n. 224, 640–3.

[13] NPM 57.6–14 (II, 217–218); while not fully explicit here, the members of Mercury's household that come forth in this passage turn out to be the maidens that represent and introduce the subsequent seven books of the liberal arts in Martianus Capella's work.

initiation existed in conjunction with an air of special, almost secret, knowledge about the arrangement and workings of the world. In comparing Boethius's *Consolation of Philosophy* (524/526 C.E.) with *De nuptiis* 1–2, Danuta Shanzer has pointed to Boethius's conscious reflection upon and disapproval of the Capellan means of ascent to heaven through pagan mystical rites. And Boethius showed marked preference for systematic philosophical doctrine over the non-Christian initiate's religious knowledge as represented by the Capellan muses, associates of Philology, who were made by Martianus at one point to drown out the discordant noise of Greek philosophy.[14] *De nuptiis* offered in its first two books bases both for the claim of rational philosophy to primacy and for the claim of pagan religious rituals and myths to unveil the higher truth. The second of these claims created a problem whose Carolingian solutions we must discuss later in this chapter.

When we compare Martianus's cosmology in the allegory (Books 1–2) to his cosmological doctrine in the *astronomia* (Book 8), two different perspectives appear. Early in his *astronomia* Martianus says in apparently unambiguous terms that the cosmos is an all-containing sphere made up of the traditional four elements with the earth in the lowest, or cosmically central, position.[15] He then proceeds to speak of five spherical layers, including the earth, and the outermost is the aether, distinct from the layer of fire. An inclined belt with the paths of the Sun, Moon, planets, and zodiacal signs is traced out in this ethereal region. Its nature is that of tranquillity, and it is also called starless (*anastros*), because it contains no asterisms.[16] His concerns here seem to be to distinguish the substance of the ethereal realm from that of all lower spheres and to emphasize the physical continuity of this substance, not divided physically by any conceptual, or theoretical, designations like circles or zodiacal signs. Yet the apparent distinction between fire and aether here is clouded by a prior mention of aether and fire together, set over against air, water, and earth. Martianus introduced the maiden Astronomy approaching in a hollow ball of ethereal light, also described as a hollow concentration of transparent fire.[17] In Capella's account the sight of this creature stupefies the deities inhabiting the aerial, aqueous,

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[14] Shanzer, *Commentary*, pp. 31, 35–6, 38–41; NPM 56.11–20 (II, 213).
[15] NPM 309.1–2 (VIII, 814).
[16] NPM 309.7–14.
[17] NPM 307.6–7 (VIII, 810): "globus quidam lucis aetheriae et concava perspicui ignis aggestio."

terrestrial, and subterranean realms, and the pointed conjunction of aether and fire seems the most remarkable physical cosmological implication here.[18] Philosophically this has Stoic backgrounds, and it also relates to a passage in Book 2 of *De nuptiis*.

In Book 2, after obtaining immortality and while ascending the heavens, Philology calls upon Hera as ruler of the kingdom of the air, where deities fly and where there are "souls luminous with colliding atoms," to explain the inhabitants and activities of the aerial region. It turns out not to be where birds fly or anywhere below the peak of Mount Olympus, all of which is the lower air (*humilis aer*).[19] In the air above the mountains live different sorts of superhuman beings, partly or wholly divine (*dii*). Hera, also known as Juno, proceeds to describe a wide variety of beings, including demons of all sorts, in this condensed account that Martianus draws from Apuleius and others.[20] Pluto rules the air from the Moon to Earth. Three classes of these beings exist from the Earth out through the planetary region. First, demigods and heroes, partly divine, range from earth to the middle of the air, which is limited by the Moon's orbit. Second, between the Moon and the Sun a lower class of *dii*, fully divine, live and dispense prophecies, dreams, and portents, speaking through omens and signs. This realm is evidently aerial in nature, since the demigods can only rise up to the middle of the air, and the higher *dii*, above the middle group, are fiery in nature. The subsolar deities, making up the middle group, serve the upper gods and with them assign a particular *genius* to each human being. The third group, the upper *dii*, are limited specifically to the region beyond the Sun and below the ethereal, outer sphere; being above the Sun's orbit, they are purer and unperturbed by worldly affairs. It is these higher deities that arrange the *arcana* of hidden causes. Martianus presents us with a picture of elemental regions from the earth to the sphere of the

[18] NPM 307.12–13.

[19] NPM 45.16–20 (II, 149).

[20] NPM 46.1–49.1 (II, 150–165). Willis's source notes to these sections indicate many texts in which to learn more about the specific *dii* mentioned here. Stahl and Johnson, trans., *Martianus Capella*, vol. 2, pp. 51–4, offer helpful source notes along with a translation of this discourse by Juno. The best single location to begin a study of the late ancient pagan doctrine of demons, who were considered by pagans and Christians alike to be the specific and proper inhabitants of the air, is *The God of Socrates* by Apuleius (mid-2nd century). An excellent introduction to the late ancient Christian religious doctrine of demons is St. Augustine's occasional tract *On the Divination of Demons*, written between 406 and 411; Augustine discussed demons in more detail in Book 9 of *The City of God*.

fixed stars, and the aether is not part of the substellar world. There is an igneous, or fiery, region between the Sun and the stars and then an aerial, graduated region below the Sun's orbit down not only to the Moon but to Mount Olympus. This sort of scheme has affinities with other Roman authors, including Pliny. Faced with the remarkable detail in this picture, we should not easily discount it when we find the different but unclear Capellan description in Book 8.

Book 1 contains an episode that lends further strength to the assumption that Martianus supposes the planetary realm to be elemental rather than ethereal. After passing through Apollo's grove, Mercury and Virtue, in search of the god of the Sun in order to get advice on a suitable mate for Mercury, come to seven streams flowing down from heaven.[21] Their number and their colors make it obvious that these streams are the planets.[22] In an illuminating commentary upon the passage Danuta Shanzer has pointed out the Neopythagorean identification of the mythical river Styx with the seven planetary spheres.[23] She shows the use by the Neopythagorean Numenius (ca. 170) of the idea of rivers for expiation by condemned souls in a synthesis of elements found in Plato's *Gorgias* 524A, *Republic* 611C, and *Phaedo* 111D ff.[24] Numenius conceived the realm from the earth to the fixed stars as a mythical earth with the true heaven beyond the fixed stars. Such a cosmography placed the paths of the planets within the mythical earth, where they would stand for the Platonic rivers of expiation. The notion appears also in Servius and Favonius Eulogius, approximate contemporaries of Martianus Capella.[25] Shanzer works out a likely source in the Chaldean Oracles for Numenius's conception and concludes, "It seems likely that Numenius took the . . . metaphor [of streams] from the Chaldeans and developed it, in the context of an exegesis of *Republic* X, into the theory that the planetary spheres and the infernal rivers could be equated."[26]

[21] NPM 7.14–8.21 (I, 14–15).

[22] On the colors of the planets, which is an astrological concern relating to their influences, see Bouché-Leclercq, *L'astrologie grecque*, pp. 313–5; Boll, *Antike Beobachtungen farbiger Sterne*, pp. 19–26; Bidez, "Les couleurs des planètes," pp. 257–77.

[23] Shanzer, *Commentary*, pp. 187–201 (Appendix One: "The Planetary Streams"). I am thoroughly indebted to this account for the interpretation that follows.

[24] Ibid., pp. 189–91.

[25] Ibid., pp. 188–9.

[26] Ibid., pp. 192–3.

The rivers in Martianus's story of the cosmic voyage of Mercury and Virtue suggest a planetary realm of materiality and change. The Capellan rivers are related to souls on earth, which are caught in the river of material existence and so have died insofar as they have lost awareness of their prior, immaterial being. The planets affect them, buffeting their fortunes about. The Numenian scheme of infernal streams shows the planetary realm to be as much wound up in change as the sublunar world of our earth. In similar fashion Macrobius referred approvingly to Neoplatonists who followed such a Numenian pattern, distinguishing the truly blessed souls, who stayed aloft above the fixed stars, unlike other souls who gradually slipped into thoughts of earthly existence and descended through planetary spheres, assuming successive ethereal envelopes of associated corporeal cares.[27] However, this view of psychic involvement in the planetary spheres did not lead Macrobius to conclude that these souls were thereby directly enmeshed in corporeal corruptibility. On the contrary, he pointed out that such psychic involvement was only a preparation for earthly life and remained in the unchangeable aether as long as it was restricted to the supralunar regions. Even so, the pessimism of the Macrobian as much as the Numenian conception of the planetary realm was real and could draw reinforcement from purely physical doctrines that described the planetary realm not as aether but as one or more of the four elements. Pliny's *Natural History* contributed to such an outlook, with its assignment of the elements fire and air to the celestial regions. The soteriology of Martianus Capella definitely supports a belief that the planetary realm is not ethereal but elemental, made up successively of air and fire.

Turning again to the contradiction between the religious mythology in Books 1–2 and the cosmology of an ethereal planetary region in Book 8, we conclude that the latter was intended for the *astronomia*, but there is no explaining away the appropriateness of elemental regions of fire and air for the planets in his religious mythology. Also, we should notice that Martianus makes no use of the ethereal nature of the planets in order to explain their motions in general or in detail. That is, he is not interested in nor does he mention the Aristotelian doctrine of opposition between terrestrial and celestial bodies in material makeup and characteristic motion. We find in the *astronomia* nothing about a natural and unceasing circular motion of the planets. All we learn is

[27] Macrobius, CSS 47.9–21 (I.xi.10–12).

the simple fact of their material difference—terrestrial or ethereal. At the very least this leaves us with the impression, nowhere contradicted, that the cosmological significance of an ethereal planetary realm is minimal for Martianus Capella.[28] The positive attributes of the aether in his astronomical text are two: (1) beauty, in the description of the maiden Astronomy,[29] and (2) tranquillity, which is made responsible for the aether's outermost position among the material spherical realms.[30] With such limited attention to aether's properties, Martianus appears to deny to the fifth kind of matter anything like its status for Aristotle. The Capellan aether does not guarantee unending motion for the planets but seems to take its qualities from the stars and to depend upon them rather than they upon it for any importance. In reflecting on the different doctrines of Martianus about the material nature of the planetary realm, we can see a relationship between the mythical-religious and the astronomical characterizations. In each he uses the attributes appropriate to his subject. In religious mythology he emphasizes gradation and association with the earth. Here only the outermost fixed stars are ethereal, that is, tranquil and thoroughly beautiful, while the planets are fiery, aerial, or even aqueous. But in astronomy the planets are clearly part of the beauty of the heavens, and Martianus there reinforces the connection between stars and planets by emphasizing the common material environment of both. He chooses variously the material of the planetary region to fit the character of the planets in his discussion—mythological and religious gradations on one hand and astronomical commonality on the other.

2. *Astronomy's Relations to Arithmetic and Geometry*

The *astronomia* has the aura of an authoritative handbook. However, it is not a handbook for beginners, for it omits certain basic information such as the names of the signs of the zodiac, which are, says Martianus, too well known to bother with.[31] Each book of *De nuptiis*

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[28] In his book on geometry Martianus refers to the outer sphere of aether, but the only intent is to emphasize the wonder and beauty of the sight; no opposition between terrestrial and celestial regions appears. See *De nuptiis* VI, 584 (NPM 205.11–12).

[29] NPM 307.7 ff. (VIII, 810–811).

[30] NPM 309.12–13 (VIII, 814): *tranquillitas*.

[31] NPM 317.2–3 (VIII, 839): "signorum duodecim nomina, quod vulgo nota." This kind of information was clearly presented in the zodiacal configuration diagram

begins with a section that maintains a reference to the allegory and its closing presentation of Mercury's maidens of the liberal arts, and at the opening of Book 8 Martianus prefaces the introduction of the maiden Astronomy with parting praises of the preceding maiden, Arithmetic. She is described as "the procreator of the gods." Pythagoras, Plato, and their followers have worshiped her. Mercury takes the greatest pride in Arithmetic.[32] And when we look back briefly at the introduction of Arithmetic at the opening of Book 7 we find that she alone inspires a moment of unease among the deities; she creates awe with the rapidity of her calculation and with the significance of number as the foundation of the natures of created being.[33] Likewise, looking ahead at the introduction of the maiden Harmony in Book 9, we see again the fundamental position of number in the microcosm and the macrocosm.[34] When the stage is finally ceded to Astronomy in her own book she appears holding a measuring instrument in one hand and in the other a book "with the preset paths of the planets and their forward and retrograde motions together with the fixed axes of the poles."[35] Subsequently the figure of Astronomy shows us that she considers the numerical calculation of planetary orbital speeds more significant than any cosmological model of planetary motion.[36] Martianus makes clear his pride in his own calculatory knowledge when he sets down the details of his calculation of the Moon's diameter and the size of the lunar orbit.[37] The high status of numbers, arithmetic, and calculations emerges clearly from Martianus Capella's books on the quadrivium. The relative importance of numerical calculations and geometrical

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of Macrobius, CSS 164 (ref. I.xxi.3 ff.): "et quia facilior ad intellectum per oculos via est…"

[32] NPM 302.6–15 (VIII, 803).

[33] NPM 260.25–262.24 (VII, 728–731). For the impression created by her ability to calculate see NPM 261.10–15. On the absolutely fundamental nature of her knowledge for both religion and philosophy see 260.26–261.2, 261.8–10, and 262.6–12. Regarding number as the basis of created beings see 262.4–6 and 262.13–20.

[34] NPM 353.25–354.18 (IX, 922–924).

[35] NPM 307.18–20 (VIII, 811): "praemetata divum itinera et cursus recursusque siderei cum ipsis polorum cardinibus."

[36] NPM 323.7–16 (VIII, 853).

[37] NPM 325.2–326.6 (VIII, 859–860). Given (a) the size of the circles involved in the earth's circumference and the lunar orbit and (b) the reduction of the calculation to small whole numbers, there is nothing wrong with the Capellan physical assumptions in the process of these calculations. What is amazing is Martianus's belief that he has a correct relationship between the length of the lunar orbital arc and the length of the arc of the Moon's shadow on the Earth. Cf. Stahl, *Martianus Capella*, vol. 1, p. 191 n. 66; Stahl and Johnson, *Martianus Capella*, vol. 2, p. 334, n. 78.

models, or theorizing, in Capellan astronomy becomes a question for us to consider.

To understand the kind and extent of mathematical activity in Capellan astronomy, we need to explore the apparent purposes of Martianus across the mathematical books in *De nuptiis*. In the first of these Lady Geometry initially comes in view holding a geometer's rod and a globe. We hear more about the globe and a great deal about the abacus which has been brought in for the mathematical arts; the geometer's rod would be used to draw diagrams on the abacus.[38] Regarding the globe in Geometry's left hand, the attention of the reader is immediately called as well to the peplum she wears, since both globe and peplum reveal the patterns and the dimensions of the heavens. Geometry appears first as a very specific celestial geometry, not as a more generic discipline. And her peplum is described as showing

> the magnitudes and orbits of the heavenly bodies, the dimensions, intersections, and outlines of the celestial circles, and even the shadow of the earth.... It was marked with many figures—to serve the purposes of her sister Astronomy as well—numbers of various kinds, gnomons of sundials, figures and designs showing intervals, weights, and measures.[39]

As for the globe, it contains "a likeness of the starry heavens... the intricate patterns of the celestial sphere, its circles, zones, and flashing constellations, were skillfully set in place."[40] Geometry is enraptured by the imagery of the heavens, but turns quickly to the abacus as her essential tool for displaying her knowledge of the earth.[41] Among her very first words are these.

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[38] NPM 204.7–8 (VI, 580); 202.19–23 (VI, 575).

[39] NPM 204.9–10, 13–15 (VI, 580–581); trans. Stahl and Johnson, *Martianus Capella*, vol. 2, p. 218.

[40] NPM 205.1–4 (VI, 583); trans. Stahl and Johnson, *Martianus Capella*, vol. 2, p. 219.

[41] The abacus, used widely in Antiquity and the Middle Ages, was a table, or tablet, covered with fine sand or powder in which lines or figures could be drawn; it was used in geometry and arithmetic as well as astronomy. Its development into an elaborate numerical calculating table began already in the ancient world. For an introduction and further bibliography, see Teeuwen, *Vocabulary of Intellectual Life*, pp. 353–4. Martianus mentions the abacus many times in the book of Geometry (VI, §§ 575, 579, 582, 706, 722–724) and once each in the books of Dialectic (IV, 337) and Arithmetic (VII, 725). Cassiodorus, *Institutiones*, ed. Mynors, p. 150 (II.v.11) refers to the use by astronomers of fine colored sand ("in pulvere colorato") for diagrams. Cicero, *De natura deorum*, II, 48 refers to "eruditum illum pulverem" for geometrical diagrams.

> I must explain my name to counteract any impression of a grimy itinerant coming into this gilded senate chamber of the gods and soiling this gem-bedecked floor with dirt collected on earth. I am called Geometry because I have often traversed and measured out the earth, and I could offer calculations and proofs for its shape, size, position, regions, and dimensions. There is no portion of the earth's surface that I could not describe from memory.[42]

Here we have a description of a discipline that seems as well named geography as geometry, and the subsequent discourse of the maiden throughout Book VI reinforces this view. From the shape of the earth to the use of sundials to the measurement of the earth's circumference, from definitions of antipodeans and antoecians to the sizes of inhabited regions and through a survey of the Mediterranean world along with tales of the marvelous inhabitants of the extreme north and the wonders and monstrous peoples of inner Africa and the margins of the world, Martianus retails a great gathering of travel information that leads us to suspect that there is little mathematical science in this discipline.

Most of the mathematics we find is arithmetical calculation. The first of Geometry's calculations involves Eratosthenes's determination of the earth's circumference. Eratosthenes had obtained his result on the basis of a simple geometrical procedure that identified a measured arc of the earth's circumference subtended by an angle equal to the angle of the shadow of a gnomon placed at a known latitude at noon on the summer solstice. When we read the Capellan version of Eratosthenes's work, we find only the multiplication of two numbers to get the full circumference from a known arc length. The geometrical procedure for determining the angles is not presented and may not have been understood by Martianus.[43] Closely following this first measurement of the earth's circumference, Geometry turns again to the subject and repeats the same kind of process, multiplying a measured segment of 500 stadia, given as the length of an arc of 1° of the earth's surface, by 360 and then multiplies further in order to obtain the number

[42] NPM 206.14–20 (VI, 588); trans. Stahl and Johnson, *Martianus Capella*, vol. 2, p. 220.

[43] NPM 209.18–21 (VI, 598). See the comments in trans. Stahl and Johnson, *Martianus Capella*, vol. 2, pp. 223–4, nn. 39, 40. Lozovsky, "*The Earth Is Our Book*," pp. 120–32, discusses the Carolingian commentators' responses to this Capellan passage and their implications; the Carolingians certainly could not reconstruct Eratosthenes's procedure and dwelled solely on the arithmetical calculations.

of Roman miles around the earth.[44] It is the arithmetical work with numbers and the actual measurements that interest Martianus, not any geometrical approach. The relationship between geometry and arithmetic receives a revealing characterization near the end of Book VI where Lady Geometry begins to describe her content in terms of points, lines, surfaces, definitions, theorems, and so forth.

> Every affirmation that I make which extends to infinity is distinguished by numbers or lines, which are acknowledged to be either corporeal or incorporeal. For the one we apprehend solely by our intellects, and the other we apprehend by sight. The first class, [intellectual and incorporeal,] which arises from the rules and reckonings of numbers, is assigned to my sister Arithmetic. The second class is the linear and demonstrable knowledge drawn from this dust [of the abacus], begotten indeed from incorporealities, and, fashioned into manifold perceptible shapes from a slight and scarcely comprehensible beginning, it is elevated even into the heavens.[45]

Here geometry's admittedly incorporeal beginnings in dimensionless points and lines without width transform quickly into visible, corporeal objects, e.g., her earth measurements and consequent soiled shoes. Where arithmetic's objects tend to remain abstract and disembodied, geometry's objects seem hardly able to avoid visualization and concreteness, according to Martianus. As examples of what a geometer does, Martianus offers the contents of geography and cosmography. Precise numerical measurement of bodies and specific narrative description of places are the activities of the geometer in these cases.

Only in the very last sections of her discourse does Geometry introduce a geometry that uses points, lines, planes, and solids as well as definitions, constructions, and proofs.[46] The Capellan view of geometry seems nicely summarized in Cassiodorus's more concise description, composed perhaps a century after *De nuptiis*. When Cassiodorus passed from arithmetic and music to geometry and astronomy, he consciously stepped from the realm of being and the nature of being into the realm of specific, visible objects and their order in created spaces. His four paragraphs on the contents of geometry begin with the statement,

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[44] NPM 213. 8–20 (VI, 609–610).

[45] Stahl and Johnson trans., *Martianus Capella*, vol. 2, p. 264; NPM 250.25–251.5 (VI, 706).

[46] Geometry's presentation of elements of the mathematical discipline as such is limited to sects. 708–724 of Book 6; in Willis's edition, Book 6 covers pp. 201–258, and these final geometrical sections cover only pp. 251–8.

> Let us now come to geometry, which is the theoretical description of figures and also the visible proof possessed by philosophers. . . . The Holy Trinity employs geometry when it grants various species and forms to its creatures which it has even now caused to exist. . . . Whatever is well ordered and complete can be attributed to the properties of this science.[47]

Here Cassiodorus gives high status to geometry but at the same time makes it a tool at the secondary level of divine creation, the level of ordering and completing that which already has being accorded to it. The origin and much of the current use of geometry, Cassiodorus maintained, is in measurements of the earth and its parts. By contrast, Cassiodorus saw arithmetic as the "origin and source" ("fons et mater") of the other mathematical sciences, which "depend for their being and existence" ("ut sint atque subsistant") on arithmetic. He agreed with and built on Saint Augustine, who, in commenting on the Book of Genesis, said that prior to creation, numbers were in the Creator, and that measure, number, and weight give order to all things.[48] Not only has God ordered the world according to weight, number, and measure, as was famously said in the Book of Wisdom, but Cassiodorus linked number with the goodness of divine creation and pointed out that the evil works of the devil cannot be ordered by weight, number, and measure. Furthermore it is number and the ability to calculate numerically that are the basis of reason and distinguish us from the other animals.[49]

The precision of numbers and their varied manipulations surely impressed both Cassiodorus and Martianus Capella, but each of these men showed as well a belief in the foundational character of number as compared to the derived nature of geometrically ordered space. One

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[47] Cassiodorus Senator, *Introduction*, p. 197 (II.v.11); *Institutiones*, ed. Mynors, p. 150: "Nunc ad Geometriam veniamus, quae est descriptio contemplativa formarum, documentum etiam visibile philosophorum. . . . sancta Trinitas, quando creaturis suis, quas hodieque fecit existere, diversas species formulasque concedit. . . . Quicquid enim bene disponitur atque completur, potest disciplinae huius qualitatibus applicari." The account of geometry appears in the paragraphs numbered II.v.11 to II.vi.3. In II.vi.4 Cassiodorus deals with astronomy, not geometry; the introduction of astronomy appears here at the end of ch. vi, because it is an application of geometry.

[48] St. Augustine, *De Genesi ad litteram*, IV.iii.7; see *La Genèse au sens littéral en douze livres*, ed. Agaësse and Solignac, pp. 288, 290.

[49] The first two quoted phrases about arithmetic appear at *Institutiones* pp. 132.21 (II. iv.1) and 140.16 (II.iv.7); p. 90.16–17 (II. praef., 3) for the denial of numerical order to diabolical works; p. 141.4–7 (II.iv.7) for arithmetic as the basis of human reasoning.

example from the astronomy of Martianus, to which we shall return later for more analysis, is his treatment of the lengths of the seasons of the year. The exact number of days from winter solstice to summer solstice is given as 185¼ and from summer to winter solstice as 180. Following this information we learn that the explanation for this difference in the two halves of the year is the eccentricity of the earth to the Sun's circle.[50] No diagram is offered nor does Martianus direct the reader how to lay out a geometrical pattern for this explanation. The numbers stand as independent facts here, while the geometry is imprecise and left to the imagination—or lack thereof. Another way to understand this Capellan view might be to consider the numbers as the phenomena and the geometry as the means of saving the phenomena, that is, providing ordered spatial descriptions but not the causes of their being. Martianus frequently offers qualitative, incomplete, and at times ambiguous geometrical accounts of the phenomena, suggesting that he values the numerical phenomena more than the geometrical descriptions.[51]

The astronomical circles Martianus describes have much more than a conveniently hypothetical reality. He considers the paths of moving stars and planets to be the results of physical natures and forces, producing real circular orbits for these bodies. An outstanding example is his account of the orbits of Venus and Mercury, which are the only planets accorded epicyclical paths, wherein Martianus first describes the orbits as circles centered on the Sun rather than the Earth and then proceeds to explain that the two planets have bounded angular elongations from the Sun because of the Sun's active force that prevents these nearby planets from escaping to positions of quadrature and opposition with respect to the Sun in the way that Mars, Jupiter, and Saturn do.[52] The Capellan conception here is one of circles that do not stand as adequate accounts of the observed phenomena but rather as real

[50] NPM 331.3–7 (VIII, 873).

[51] This is not to say that Martianus has little use for geometry. He identifies and describes many celestial, sidereal, and planetary circles along with both eccentric and, in the cases of Mercury and Venus, epicyclic motions, but he does not make much use of geometrical reasoning. He most often aims to produce numerical results: orbital lengths, time intervals, distances, and ratios.

[52] We shall deal with the Capellan description and explanation of the paths of the inner planets in full detail below. Suffice it to say now that Martianus does not use epicycles to describe all retrograde planetary motions, only those of Mercury and Venus, which shows us another example of the limited status of geometry in Capellan astronomy.

results of physical force. An account of the forces is an explanation. An account of the circles is only a description of what has happened, not a cause of the observed motion. As Martianus sees it, the geometry of these planetary motions derives directly from the physical causes rather than being constructed from the observations.

3. *Capellan Cosmology and its Carolingian Reception*

What astronomy did a ninth-century student learn from *De nuptiis*? We can begin with the physical structure and properties of the cosmos according to Martianus in order to provide a clearer picture of the foundations for his astronomy. At the same time we want to look at glosses and comments added to the Carolingian manuscripts of *De nuptiis*. The earliest noteworthy glosses occur in a set initially attributed to an Irish bishop Dunchad, later to the Irish scholar Martin of Laon, and more recently, with less insistence, to Heiric of Auxerre or Lupus of Ferrières or others.[53] As Mariken Teeuwen has argued, these glosses can very reasonably be called the Anonymous gloss or commentary, since there is no widely accepted view on authorship. She considers very tentatively the possibility that this collection of glosses began as an authoritative, encyclopedic composition by a group of scholars at a Carolingian court, perhaps at the court of Louis the Pious or Charles the Bald.[54] Our own study of the Carolingian manuscripts of the text of Martianus Capella with the Anonymous commentary, focusing primarily on the *astronomia*, lends support to Teeuwen's hypothesis and finds no points of disagreement with her arguments in its favor. Nonetheless, the commentary also went on to function as a basis for teaching astronomy from the text of Martianus. In the discussions of the Anonymous commentary that appear below, we shall refer for convenience to two early stages of development and dissemination of the commentary as the first

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[53] Extensive scholarly research on the authorship of this set of glosses, which appear in a group of mss. identified below, has sprung from interest in the uses of Martianus Capella's text, the survival of classical sources in the Carolingian world (especially with reference to the mythological materials in Books 1–2), John the Scot Eriugena, Irish scholars on the continent, and in the many possible candidates for originator of the glosses. A very dependable summary, with bibliography, of the debates over authorship is Teeuwen, *Harmony*, pp. 33–40.

[54] Teeuwen, *Harmony*, pp. 145–50; she emphasizes the speculative character of this hypothesis, while she gives rather persuasive arguments in its support.

and second versions, or stages, along with separate references to later manuscripts and known commentators. The so-called first and second versions are found in two pairs of manuscripts with distinctive positions in the early tradition of glossed Capellan texts. The earlier pair, which I shall call the first version of the Anonymous, is made up of the Leiden manuscript Vossianus lat. F.48 and the Besançon manuscript 594, but there is no proof that either of these is the original version of the Anonymous commentary. The Vossianus is simply the earliest extant copy, and the Besançon manuscript is very closely related to it, the two perhaps based directly upon the archetype.[55] The second pair of manuscripts, which constitute what I call the second version of the Anonymous, is made up of the Leiden manuscript BPL 88 and the Vatican manuscript Reginensis 1987, which copied exactly the text of the commentary in BPL 88.[56] The first version of the Anonymous clearly existed before 850 and perhaps as early as the 830s, while the second version must have been produced by mid-century, for John the Scot appears to make use of it and to react occasionally against its teachings in his commentary on the cosmology and astronomy in *De nuptiis*. In the same circle, Haimo of Auxerre (d. ca. 875?) referred to Martianus Capella by name in his *Commentary on Paul's Letter to the Galatians*, written in the 840s or 850s, in terms that suggest his use of the Anonymous commentary. Haimo's reference indicates the use of the Anonymous at Auxerre perhaps by mid-century or earlier.[57] The

[55] Regarding these two mss., which constitute what I call the first version, see Teeuwen, *Harmony*, pp. 60–71, 88–103, and the stemma on p. 147. The commentary to Book 8 in these two mss. shows one highly distinctive trait. There are two different hands that produce the marginal glosses for the commentary in the Vossianus (V), and all the marginal glosses produced by Hand 1 (the earlier) but none of the marginal glosses produced by Hand 2 appear in the margins of the Besançon (Be) ms. Be apparently copied from V, although Be also copied from another source. It is noteworthy that Be has two marginal astronomical diagrams that appear in V and no other ms.

[56] On these two mss., which I call the second version, see Teeuwen, *Harmony*, pp. 103–26 and the stemma on p. 147.

[57] Haimo's reference ("ut Martianus asseverat"), found in PL 117, col. 669 A–B, is noted by Heil, *Kompilation oder Konstruktion?*, pp. 302–8, esp. 306; Haimo wrote in part, "Nam Graece hac GALA dicitur." In the first version of the Anonymous we find the gloss *ad* galaxias (ed. Willis 312.3): "gal lac et grece et latine profert" (Voss. lat. F.48, f. 76v,21); and in the second version the gloss *ad* galaxeas: "Gal:Lac GALAXEUS" (BPL 88, f. 157r inner margin). Perhaps the closest to Haimo's wording is BPL 36, f. 107r outer margin, *ad* Galaxeas: "Gala grece lac inde galaxeas candidus, et lacteus circulus adeo conspicuus...;" glosses probably from Lorsch, s. IX². I thank John Contreni for calling my attention to Heil's reference. Regarding Haimo, see Iogna-Prat, "L'oeuvre d'Haymon d'Auxerre," in *L'École carolingienne d'Auxerre*, pp. 157–79; also Contreni, "By lions, bishops are meant; by wolves, priests," pp. 53–6.

ninth-century commentaries to which we shall make frequent or continual reference are these.

First version of the Anonymous (before 850)—
Voss. lat. F.48 (the Vossianus) and Besançon 594
Second version of the Anonymous (ca. 850)—
BPL 88 and Vat. Regin. lat. 1987
John Scottus, *Annotationes in Marcianum*, ed. Lutz (1939)
John Scottus, *Glosae Martiani*, Book 1, ed. Jeauneau (1978)
Commentary influenced by the Anonymous (s. IX¾)—BPL 87
Commentary influenced by the Anonymous (s. IX^2)—BPL 36
Commentary influenced by the Anonymous (s. IX^2)—Paris 13955
Remigius of Auxerre, *Commentum in Martianum Capellam*, ed. Lutz (1962–65)

Martianus Capella followed the most common ancient cosmological tradition, positing the earth as a spherical stationary body and like a point in the middle—it stood in the lowest position—of the cosmic sphere to provide support for the whole world.[58] In describing the celestial globe carried by Lady Geometry, Martianus referred in passing to a lawful order of the heavens that kept all the heavenly bodies in their proper places.[59] It was also Geometry who pointed out that many kinds of visual observations confirmed the doctrine of the sphericity of the earth. Here it was the combination of a variety of observations, with each supporting an inference of terrestrial sphericity and all leading to the same conclusion, that overthrew individual arguments like the direct observation of a flat horizon and inferentially of the whole earth. Martianus presented four specific kinds of observation in favor of the sphericity of the earth and two against its flatness.[60] His negative arguments were (1) that all celestial bodies do not become visible to all persons in all lands simultaneously and (2) that the lengths of night and day on any given date at all places on the earth are not the same. Positively, he cited four observations: (1) the variation in rising and setting times of the stars, (2) the visibility of a constellation in the northern sky simultaneous with its invisibility a great distance to the

[58] NPM 205.5–6 (VI, 584): "tellus, quae rapidum consistens suscipit orbem, puncti instar medio haeserat ima loco."
[59] NPM 205.19 (VI, 585): "omnia compar habet paribus sub legibus ordo."
[60] NPM 207.4–209.10 (VI, 591–595).

south, (3) the difference in time at which an eclipse of either the Sun or the Moon is observed along an east-west line, and (4) the need to replace the gnomon in a sundial for any change in terrestrial latitude of more than five hundred stadia (312,500 feet) because of the change in shadow lengths. Carolingian scholars before the middle of the ninth century read and glossed this set of Capellan arguments in the Anonymous commentary, which tagged the Capellan text with a marginal index, "Argumenta ad confirmandum" ("confirming reasons").

The earliest surviving, or 'first,' version of the Anonymous commentary provided a marginal pair of diagrams to elucidate the conclusion of Martianus.[61] One diagram (Figure 4.1) showed a circle labeled, "a disc, the earth is not like this" ("discus, non ita terra"), and below the circle was drawn a figure like a teardrop, or an oval, carrying the label, "the earth is like this" ("ita terra"). Glosses to the relevant text, beside which the images stood, explained how to imagine the oval shape. The Anonymous told readers to think of an egg (*ovum*).[62] What might at first seem to be a flat oval becomes, with attention to the gloss, a three-dimensional shape in contrast to the flat disc above it. The fact that eggs have a variety of shapes, some more elongated and some almost spherical, appears not to have troubled the glossator, who thought to contrast a familiar rounded body with a disc and to expand the awareness of his readers as well.[63] The images and the vocabulary clearly troubled some scholars. The oval figure did not last long in the gloss tradition. The slightly later, or second, version of the Anonymous commentary omitted these two images for the shape of the earth, the disc and oval.[64] Furthermore all reference to the troublesome 'ovum' was literally erased from the gloss in this later variant either by order

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[61] Leiden Voss. lat. F. 48, f. 54r; Besançon 594, f. 45r.

[62] NPM 207.2–3 (VI, 591): "...neque concavam...sed rotundam, globosam etiam...." The explanation appears in Leiden Voss. lat. F.48, f. 54r,11–12, *ad* rotundam: "instar ovi"; a marginal gloss adds, "scilicet, in modum ovi."

[63] The choice of an egg to represent the spherical shape of the earth may also have been influenced by Cassiodorus's mention of Varro's description of the cosmos as egg-shaped. See Cassiodorus, *Institutiones*, ed. Mynors, p. 157.11–14 (II.vii.4). Pliny, NH II, 7, contradicts the notion of an egg-shaped *mundus*.

[64] For this later variant of the Anonymous, omitting the two images, see the Reims ms. (s. IX¾) Leiden BPL 88, f. 109v, and its direct copy (s. IX ex.) Vat. Regin. 1987, f. 82r. The oval earth did not disappear completely from the mss. of *De nuptiis*, however. An egg-shaped earth reappeared in the large planetary diagram included in the Florence Laurenziana ms. San Marco 190, f. 102r, (s. XI in.), Fig. 5.4 below, as well as its three fifteenth-century copies. One of these copies (Vat. Urb. lat. 329, f. 139v) is reproduced by Eastwood and Graßhoff, *Planetary Diagrams*, p. 139.

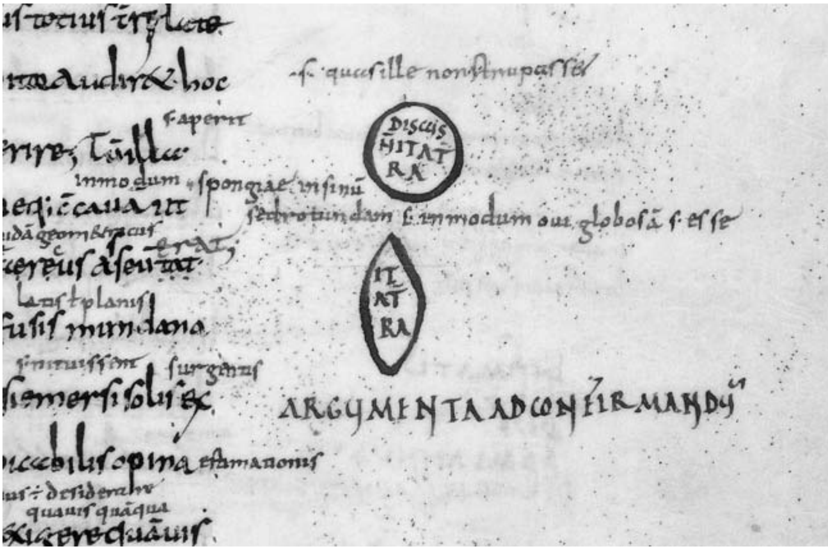

Fig. 4.1. Two Shapes for the Earth. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 54r

of its overseeing director or not long afterwards by direction of the head of the scriptorium where an exact copy of the commentary was produced.[65] Most likely, the introduction of an egg shape provoked more questions, if not humorous remarks, from students and other readers than were desired. Subsequently, neither John the Scot nor Remigius of Auxerre made any mention of an oval earth in commenting on this text of Martianus.[66]

To explain the cosmic centrality of the earth Martianus maintained that elemental earth had already been in the middle in the primeval chaos and remained there as the other elements separated and took their places around earth. Further, he argued that this cosmic central position is also the bottom, for just as the central earth supports (*sustinet*) radii (*lineae*) to the cosmic sphere so the earth is pressed in (*constipatur*)

[65] This action is nicely attested by the existence in Leiden BPL 88, f. 109v,16, of the almost eradicated gloss "scilicet in modum ovi" *ad* "rotundam", and the complete absence of any such gloss or erasure in the copy made in Vat. Regin. 1987, f. 81v,14. At both these ms. locations one finds the gloss *ad* globosam: "id est spericam," a clear indicator of the heightened concern to avoid ambiguous or troublesome meaning.

[66] See Johannes Scottus, *Annotationes*, p. 137, and Remigius of Auxerre, *Commentum*, vol. 2, p. 134. Lutz used Adolf Dick's edition of Martianus; the reference is 292.17–19 (ed. Dick).

equally from all directions by the cosmic sphere. He then offered the common sense observation that all weighty bodies fall to the earth, including rain and snow. To complete his argument about the earth's position Martianus turned to the well-known and measured lengths of day and night at the equinoxes and solstices. At equinox the night and day are equal, while at either solstice the length of day equals the length of night at the opposite solstice, and this relationship of diurnal and nocturnal lengths at opposing points of the zodiac is constant for all positions of the sun through the year. One can only make these observations if the earth is at the center.[67] This combination of reasons from cosmogony, physical theory, and commonly agreed observations may not have been as carefully constructed as Macrobius's proof of the earth's location as the bottom of the world, but Capella's reasonings were more readily absorbed than those of Macrobius on this point by Carolingian readers.[68]

The Anonymous commentary, preceding that of John the Scot, shows no questions about and only modest glossing of this Capellan text.[69] John the Scot used more space commenting on it. He paraphrased and added at least one notable simplification, transforming the Capellan argument about the earth as the bottom of the cosmic sphere into an argument about the earth's centrality in the zodiacal circle.[70] John thereby, perhaps unknowingly, deemphasized the physical in favor of the more strictly astronomical side of Capella's arguments.[71] Remigius

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[67] NPM 210.1–25 (VI, 599–601).

[68] For Macrobius's proof, see above, pp. 52–4, and below, pp. 378–81.

[69] The Anonymous commentary to this Capellan text varies. See Besançon 594, f. 45v,14–28; Leiden Voss. lat. F.48, ff. 54v,22–55r,9; Leiden BPL 88, f. 111r,15–v,17; Vat. Regin. 1987, ff. 82v,22–83r,21. The second version (BPL 88 and Regin. 1987) provided a separate marginal index ("Positio terre") for this section of the text. The section received no marginal discussion.

[70] Johannes Scottus, *Annotationes*, pp. 141.14–142.2, esp. 141.22–23 *ad* dum paribus (NPM 210.8; VI, 599): "…a trecentis sexaginta partibus signiferi…." The effect of John's change was, of course, to eliminate any argument in favor of the earth as the bottom of the cosmos for falling weights. Neither Martianus nor John the Scot attempted to demonstrate in the sense that Macrobius had that heavy bodies fall to the earth from all directions in the cosmos.

[71] Although hardly systematic, the arguments of Martianus cover the three astronomical alternatives demonstrated to be untrue by Ptolemy, *Syntaxis*, I, 5, in arguing for the centrality of the earth in the cosmos. Ptolemy, moreover, separated the question of the astronomical center from the question of the physical center of falling weights. In *Syntaxis*, I, 7 he devoted a lengthy discussion to this question of the center for falling bodies, which Capella treated so briefly. We do not know whether Martianus knew Ptolemy's discussions of these questions, though he probably did not. Carolingians surely did not.

of Auxerre took material from both the Anonymous and John, including this simplification from sphere to plane by John, and elaborated the lengthy text on the earth's position with additional synonyms and literary parallels but without further conceptual modification, attending more to the expansion of the student reader's vocabulary.[72]

With the argument made for the earth's position as both the center and the bottom of the world, the place to which all weights, including rain and snow, fall from all directions in the heavens, Martianus could reasonably introduce the topic of the habitability of different regions of the earth. Adopting the traditional encyclopedist's view of five climatic zones from pole to pole on the earth along with the doctrine that the central zone, continually under the Sun and always exceedingly hot, was supposedly uninhabitable, Martianus taught that diametrically opposed regions on the sphere were alike, as were regions in the same climatic zone on opposing hemispheres. In this he followed both Macrobius and Pliny the Elder as well as others and insisted that humans lived diametrically across the earth (antipodeans) from us as well as in our own climatic zone though on the other side of the globe (antichthones). Martianus completed the symmetry of the global image by pointing out that our antipodeans had their own antichthones (antoecians in relation to us Europeans), thus identifying four similar regions with similar climates and similar inhabitants.[73]

The Capellan pattern of four inhabited quarters of the globe agreed with that of Macrobius, but, unlike Macrobius's, did not ensure clear understanding with a diagram.[74] The relevant gloss to Capella in the Carolingian Anonymous commentary did not offer a diagram and provided minimal assistance to any reader who might be confused. A reader's prior knowledge might have been heavily influenced by Isidore of Seville and Bede, both of whom disagreed with the ancient encyclopedists' acceptance of inhabited antipodes.[75] However, the acceptance

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[72] Remigius, *Commentum*, vol. 2, pp. 140.26–141.29.

[73] NPM 211.2–212.9 (VI, 602–606). See CSS 112.22–29 (II.v.16–17), 115.18–24 (II.v.33), 119.13 (II.vii.11), 121.32–33 (II.viii.4) for references to antipodeans and antoecians. While not mentioning by name either antipodeans or antoecians, Pliny, NH II, 161, referred approvingly to the "literate" theory of a sphere inhabited all around as against the "vulgar" view that those opposite us would fall off such an earth. Also, Servius' commentary on *Aeneid* VI, 532 affirmed inhabited antipodes; see Servius, *In Vergilii Carmina Commentarii*, vol. 2, pp. 75–6.

[74] CSS 112.3–17 (II.v.13–14), 115.3–24 (II.v.31–33).

[75] Isidore, *Etym.* IX.ii.133; Bede, DTR 34.

of Macrobian views about humans at the antipodes by Carolingians like Dungal early in the century and Hadoard at mid-century tells us that the views of Isidore and Bede were not considered the last word in this matter.[76] The first stage of the Anonymous gloss on Capella identified the antipodeans as those persons living diametrically opposite us on the earth. The second version of the Anonymous, following a potential ambiguity, chose to place "the antipodes" opposite us in our own climatic zone in the northern hemisphere.[77] This transformation occurred because of a different interpretation in the meaning of 'our antipodes' in the statement, "Our antipodes experience with us a common period of winter and the heat of summer...," even though the sentence continued with the declaration that the 'common experience' occurred at an interval of six months. While it is plausible that this novel interpretation of the antipodes may have been a desperate attempt to avoid admitting that the southern hemisphere was inhabited by humans, we have insufficient evidence to pursue the hypothesis.

The commentary of John the Scot repeated the position taken by the second version of the Anonymous and added an explanation, which was lacking in the Anonymous commentary. As John understood it, readers should indeed imagine that 'antipodes' referred primarily to the region and to the inhabitants diametrically opposite us (Europeans) on the globe. John recited the four habitations according to Martianus; in addition to our quarter of the globe, there were "our antipodes" and the antoeci and the antichthones. John understood that these were spatially relative terms, based upon the location of the speaker. But he also knew and revealed what certain (*quidam*) other commentators had said in explaining this text, and he almost certainly had in mind

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[76] For Dungal and Hadoard see above, pp. 55–63, 82.

[77] The first version of the Anonymous, identifying antipodes as those diametrically opposite us, glossed "nobis obversi antipodes" (NPM 211.19–20) as "contrapositi in brumali circuli (*sic*)." See the mss. Voss. lat. F.48, f. 55r,20, and Besançon 594, f. 46r,9, for this. The interpretive shift found in the second version, glossing the same text and evidently quite intentional, appears with "contrapositi in solstitiali circulo;" a supporting gloss appears further on in the second version at "antipodes autem nostri" (NPM 212.3–4), interpreting "nostri" by "id est, nobis vicini." See the mss. BPL 88, f. 112r, lines 14 and 20; Regin. 1987, f. 83v, lines 13 and 19; for the two glosses on Martianus's text (VI, 605 and 606). We should notice that no gloss of any kind appears at the subsequent mention of antipodes in the *astronomia*, presumably because only the astronomical, not the geographical or anthropological, significance is involved there; even so, it means there was no perceived ambiguity or difficulty in the astronomical meaning of 'antipodes.' See NPM 331.16 (VIII, 874), at Voss. lat. F.48, f. 81r,17, and BPL 88, f. 165v.

the second Anonymous version. Furthermore his use of 'quidam' in this case very likely meant he recognized, just as we have found, that there were different views in the existing versions of the Anonymous commentary. Regarding the text beginning "Antipodes autem nostri," John wrote,

> And if he [Martianus] had said: Those who are opposite us to the east, at one and the same time we and our antipodes [to the east] experience the summer and winter season. Certain persons interpret this text thus: At the same time we and our antipodes have summer and winter, but there is not the same length of days and nights for us and for them.... And if it be understood in this way, we have two antipodes, one to the east and one under the sun at our winter solstice.[78]

Remigius of Auxerre copied exactly John the Scot's account of the divergent understanding.[79] Throughout this development of glossing and commentary, no question arose about the reality of inhabitants at our antipodes. The attention of these Carolingian scholars was focused on the placing of antipodes, along with antoeci and antichthones, and on the lengths of sunlight and darkness as well as the climatic conditions in the different locations involved.

Martianus presented different parts of his cosmology in different books of *De nuptiis*. The shape, location, and distribution of parts of the earth, which we have just discussed, appeared in Book 6, his *geometria*. In the mythological books, cosmological doctrines and assumptions about the stars and planets, as we described earlier, did not correspond with his teachings in the *astronomia*, Book 8.[80] Turning now to the Capellan Book 8, we find that after a preliminary discourse about the discipline of astronomy Lady Astronomy initiated her account of the discipline with a brief summary of relevant cosmological doctrines. The cosmos is a sphere composed of four elements, arranged in spherical layers around the motionless earth, which is both central and the bottom. In

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[78] See John Scot, *Annotationes*, p. 143.22–33: "ANTIPODES AUTEM NOSTRI ac si dixisset: Illi qui contra nos sunt in oriente uno eodemque tempore nos et nostri antipodes aestivum et brumale tempus sustinemus. Quidam ita intelligunt hunc locum: Uno eodem tempore nos et nostri antipodes estivum et brumale tempus sustinemus sed non eadem prolixitas dierum et noctium nobis et illis est....et si sic intelligatur, duos antipodes habemus, id est orientales et brumales." The comment contains further details of the differences between the two locations. This understanding of the place of the antipodes appears in an early twelfth-century image attached to a copy of Dungal's letter; see above, p. 56, Figure 2.8.

[79] Remigius, *Commentum*, vol. 2, p. 144.3–13.

[80] See above, pp. 186–7.

traditional order Martianus described the elemental layers of water, air, and fire around the earth, and the rotation of the whole cosmos around the fixed earth forms these elemental layers into their spherical shapes, which are approximate and not limited by exactly circular or rigid boundaries. In a fifth, outermost ethereal layer the inclined paths of the sun, moon, planets, and stars of the zodiac circle around. The Capellan text at this point received a number of Carolingian glosses and commentary that show a concern not simply to offer synonyms but to clarify an imprecise account. Let us first consider the useful, modern translation of the text by Stahl, which suggests some of the difficulties that the Carolingian reader, in the absence of guidance from contemporary glosses, would probably have experienced.

> The universe is formed in the shape of a globe composed entirely of four elements. The heavens, swirling in a ceaseless and rotary motion, set the earth apart in a stationary position in the middle and at the bottom. I would not disdain, at the very outset of my discourse, to give heed to the physical philosophers who do not believe that the softness of rarefied bodies is drawn and divided by its very condensations into certain set paths and intervals of circles; but rather that the natures of these bodies, coalescing by their own surgings, are diffused the entire way around in globular layers. The physical philosophers declare that the first envelopment is that of water, the second of air, the third of fire, arranged around a midpoint which they call the center. And coming next is a fifth agglomeration of corporeal matter, in which the shining heavenly bodies have their courses, in a region where the inclined paths of the sun, moon, planets, and zodiac are drawn; in the philosophical schools the last is referred to as the 'circular billow.' The very calm of that realm keeps its position outermost and its course an encompassing one; it is called 'starless' from the fact that it is studded with no constellations. If each belt of the encompassing substances is found to be homogeneous, no circle can waver from its ethereal orbit.[81]

If we next look at Martianus's original text with the accompanying glosses added by the Anonymous, we can see that much has been clarified, even though there also occurred a curious misunderstanding of a phrase with a Greek term. In the following text, the glosses of the first stage of the Anonymous commentary appear in parentheses after the words or phrases which they gloss. Some of these glosses give simpler synonyms. Some complete the sense of a word or phrase. Some offer

[81] Stahl and Johnson, trans., *Martianus Capella*, vol. 2, pp. 318–9 (VIII, 814–815).

elaboration for clarity. In addition, a picture of the four elemental layers—fire, air, water, earth—was placed in the margin (Figure 4.2).

> Mundus igitur ex quattuor elementis isdemque totis in sphaerae modum globatus terram in medio imoque defixam (stabilem) aeternis caeli raptibus (motibus) circumcurrens (dum circumcurrit) circulari (rotunda) quadam ratione (similitudine) discriminat (id est, ambit vel discernit). Quamquam auscultare physicis in ipso astruendi (disserendi) limine (introitu doctrine mee) non dedigner, qui subtilium (celestium) corporum (aeris ignis et aque) teneritudinem (molliciem) suis coactibus (revolutionibus curvationibus) circumductam in quasdam sectas (divisas) vias et circulorum intercapedines non aestimant disparari (non dubitant dividi), sed (scilicet, estimant) suis fluctibus (motionibus) adhaerentes (sibi ipsis) naturas (elementorum) undiquesecus (ex omni parte fluctus ignis flamma et aquarum undae) globoso (rotundo) ambitu orbibusque diffundi (ut in se ipsa reflectuntur, scilicet, globosis), quarum (scilicet, naturarum) circa medium, quod dixere centron (medietatem), aquae (aque oceanum) primum aerisque sequens (proconsequentem), tertium ignis cyma (nomen auctoris) commemorant, et tunc (scilicet, commemorat in loco) quinto quodam corporeae (corporalis) substantiae temperamento aetherios (celestes) circumvolare fulgores (ignes), quo (id est, quinto) loco solis (scilicet, obliquitas), lunae ac siderum (id est, planetarum) signiferique orbis se obliquitas circumducit (id est, volvit), quod κυκλοφορητικόν (nomen proprium) cyma (nomen proprium) gymnasia (feminini generis) retulerunt. Cuius naturae (vel temperamenti, id est, liquide) tranquillitas (subtilitas) etiam illum eximum (ultimum omnium, id est, firmamentum sphericum) tenet ambitoremque cursum, qui ex eo, quod nullis sideribus (sursum stellatos) oculatur (id est, apparens), anastros perhibetur (vocatur). Si igitur sui similis (conclusio, eo quod uniuscuiusque aelementi natura in se consistat) omnis circumagentium (id est, volubilium) naturarum ambitus reperitur, nulli possunt aetherium tractum (ductum cursum) circuli variare.[82]

Looking over the extensive addition by the Anonymous of helpful words and phrases, we can see that much clarity was gained. At times it amounted only to reassurance, as with the synonym 'motibus' for 'raptibus' in the first sentence. Elsewhere a bit of uncertainty disappeared when the gloss told the reader that Martianus was introducing his own view (or the one he favored) after the word 'limine' in the second sentence. At other points the glosses reminded the reader of the subject of a clause, provided the exact meaning of an imprecise term ('planetae' for 'sidera'), suggested an unexpected similarity of fire

[82] NPM 309.1–16 (VIII, 814–815). For these interlinear glosses see Voss. lat. F.48, f. 76r,14–22; the glosses are fuller here than in Besançon 594, f. 67v, which has a variant of the 'first version' of the Anonymous commentary.

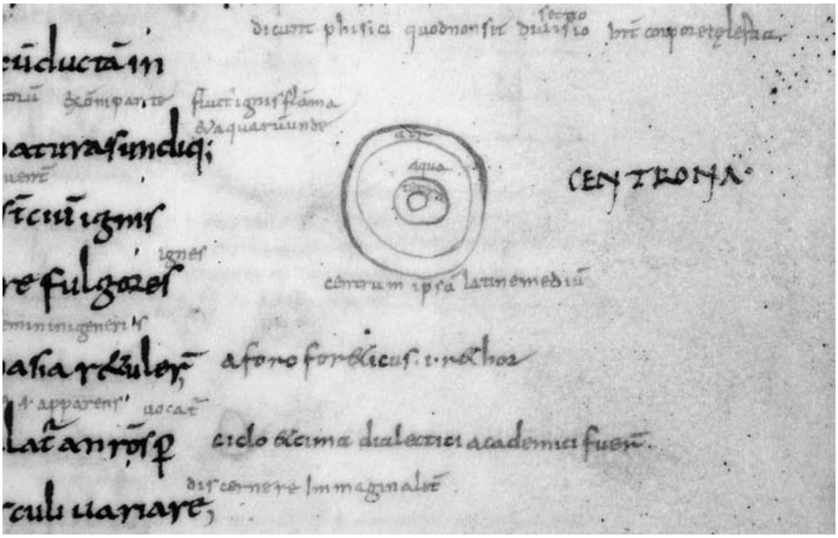

Fig. 4.2. Four Elemental Regions (Fire unlabeled). Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 76r

to water (the wavelike flux of *ignis flamma* and *aquae undae*), and gave a distinctive orientation to a word's meaning ('subtilitas' for 'tranquillitas'). In the last of these examples the gloss provided a substantial quality to replace a vague sense of quietude; the outer, ethereal layer clearly had a character qualitatively different than those elemental layers below it.[83] What the glosses achieved was a simpler and more solid sense of the ordered layers of physical elements with the planets and zodiac located in the ethereal region beyond the four elements. Furthermore the outermost part of the ethereal layer was the enclosing firmament ("firmamentum sphericum"), above the stars ("sursum stellatos"). Without these Carolingian glosses, this summary picture of the heavens could hardly have been realized.

The glossator also contributed a drawing of the four elements (Figure 4.2), which was not successful. Presumably added without planning, this image shows four roughly drawn concentric circles with their labels misplaced and incomplete because the central circle was made too

[83] The second version of the Anonymous, BPL 88, f. 156r,2, added further clarity on this point by glossing "naturae" (NPM 309.12) with "scilicet, liquide aeterie" followed immediately by "tranquillitas" glossed with "subtilitas" in order to emphasize that the outer cosmic layer be understood as ethereal, fluid, and of extreme subtlety.

small to contain the label 'terra,' which was placed in the next band and so on with the remaining labels, leaving no band to be labeled 'ignis.' This picture was not copied into any of the other manuscripts of the first and second versions of the Anonymous, and it appeared in only one other ninth-century manuscript of *De nuptiis*—with appropriate corrections added.[84]

While we recognize the valuable aid provided by the early glosses for a clearer physical understanding, we can also turn our attention for a moment to the imaginative misapprehension surrounding the Greek term in the Capellan text, translated by Stahl as 'circular billow'. The manuscripts tend to Romanize the lettering, and the manuscript (Vossianus lat. F.48) with the first stage of the Anonymous commentary latinizes the word as "cycloforeticus." Etymologizing the word, the glossator imagined the first part of the word to refer to a person and the second part to refer to the activity or profession of the person. The unfamiliar term 'cyma' that followed was included and made into another person with the same profession. The result was an explanation provided by the earliest contributor to the commentary. He wrote that 'cycloforeticus' referred to someone named 'ciclo,' a rhetorician ('foreticus,' i.e., performing in the forum), along with his fellow, named 'cima;' the two persons, Ciclo and Cima, were identified by a note in the margin of the page as academic dialecticians.[85] Thus we find identified as Academic (Platonic?) philosophers and as public disputants, or dialecticians, the teachers of the Capellan cosmological doctrine of

[84] Besançon 594, Leiden BPL 88, and Vat. Regin. 1987 omit it. Neither Paris 8671 nor Leiden BPL 36 have the diagram. Only Leiden BPL 87, f. 119v upper left corner, contains it, showing four concentric circles with unequal intervals, labeled correctly as *terra, aqua, aer, ignis*, apparently added by a later hand, and including the following divisive modification of the glosses we noted on this topic by the first Anonymous: "sicut unda coniungitur unde, ita aer et ignis suis partibus similes sunt."

[85] Voss. lat. F.48, f. 76r,20: "cycloforeticus." The marginal comments in this ms. are clearly distinguishable as two different handwritings, and the earlier hand wrote these comments. In the outer margin: "a foro foreticus, id est, rethor;" and just below: "ciclo et cima dialectici academici fuerunt." BPL 88, f. 156r inner margin, renamed the two persons: "Cydo et cyma dialectici achademici fuerunt." Oxford Laud. 118, f. 74v,15, *ad* foreticus: "id est, rethor a foro;" and outer margin: "cydo et cyma achademici fuerant." John the Scot chose not to adopt this misunderstanding, but Remigius of Auxerre did retail it, copying from the version in BPL 88. See Remigius, *Commentum*, vol. 2, p. 253.5–6: "Cydo et Cyma dialectici Achademici fuerunt." Another important representative (s. IX^2) of the Anonymous commentary on Book 8 followed the Vossius ms. spellings in its presentation of this comment; see Paris 13955, f. 47v, outer margin, *ad* cima: "cyclo et cyma dialectici academici fuerunt."

the four elements surmounted by the fifth, the most subtle aether, in which the planets travel.

Returning to the cosmology in this passage from Martianus's *astronomia* along with its Carolingian readings, we find that Scottus and Remigius both paid a great deal of attention to it. It was Scottus who specified important definitions and a revision of part of the Capellan doctrine in his discussion, to be followed later by Remigius. John the Scot made a clear and decidedly different distinction of the elemental layers between the earth and the outer limit of the world. He brushed aside the view favored by the Anonymous commentary and used the doctrine found in Martianus's mythological books (Books 1–2). For John the five layers in order from earth outward were earth, water, lower air, upper air, and fire; he equated the name 'fire' with the name 'aether.'[86] His use of the divided aerial region had many precedents, but its most obvious was in the discussion of demons and angels and their places in the cosmos. At the same time he did not consider the outer elemental realm of fire, containing the planets and stars, to be subject to the same corporeal effects as the lower elemental layers close to the earth. Instead he agreed with the evident direction of the Anonymous commentary in conceiving the ethereal, or in John's case

[86] John, *Annotationes*, p. 172.11–16 (NPM 309.9–10): "QUINTO QUODAM LOCO Quattuor sunt mundi loca secundum numerum elementorum, sed quinque describuntur propter divisionem aeris in duo spatia, hoc est in illud quod adpropinquat aque et telluri et in superiorem partem que etheri appropinquat quae pars vocatur ignis. Ergo sic est ordo: terra aqua aer, qui dividitur in duas partes, ut diximus, et in quinto loco est ignis." Remigius copied this comment verbatim, *Commentum*, vol. 2, p. 252.29–34. See above, pp. 184–7. John maintained the duality of aerial layers as well as the equivalence of *aether* and *ignis* later in Book 3 of his *Periphyseon*, ed. Jeauneau, pp. 163 (733B), 173 (740B). CCT 171.19–172.7 (c. 129), stated the division of air into a finer layer and a denser and moister layer and also the placement of fire above aether, considered to be the denser part of the uppermost elemental substance. St. Augustine, *De Genesi ad litteram*, III.vi.8, divided the air into upper, purer air and lower, grosser air, probably drawing this from Apuleius; see *La Genèse au sens littéral*, ed. Agaësse and Solignac, vol. 1, p. 222. A reason for the division appears at *De Genesi ad litteram*, III.x.14, where Augustine said that the fallen angels descended to the realm of humid, variable (lower) air; ed. Agaësse/Solignac, vol. 1, p. 232. Isidore, *Etymologiae*, VIII.xi.16–17, repeated Gregory the Great's view that before their fall the demons had celestial bodies ("caelestia corpora gerebant") while afterwards they were turned into bodies of the lower, gloomier air ("nec aeris illius puriora spatia, sed ista caliginosa"). John seems not to have been influenced by Calcidius on demons in CCT, cc. 129–136, nicely analyzed by Somfai, "The nature of daemons," pp. 129–42. Images of darkly colored demons/devils appeared frequently from the ninth century onwards, in psalters, e.g., 17 such images in the Stuttgart Psalter (ca. 820, St. Germain des Prés), and elsewhere, along with the growing popularity of homilies and lives of the saints.

the fiery, region to be of such purity and subtlety that neither heat nor cold existed there.[87] He preferred the argument of those called *fisici* (physical philosophers) over against the *astrologi* (astronomers) and believed that the Sun's rays would cause no heat in the aether or fire, and only when they descended to the layers of earth, water, and air would the rays generate heat in those more corpulent bodies below the clouds. Furthermore the clouds cannot descend lower, even though they are cooler than the air below, because reflected solar rays prevent them from doing so.[88] Remigius followed John's commentary on these points almost word for word without further elaboration.[89] And finally, with regard to the word 'elementum' itself, we should notice that the commentaries of both John and Remigius did not carry an etymology added to the first version of the Anonymous by the second of two glossing hands. Distinguishing the Latin and Greek terms for 'element' ('aelementum' and 'stochia'), the glossator identified 'lima,' meaning 'whence anything is formed,' as the Latin root of the word.[90]

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[87] John, *Annotationes*, p. 172.18, emphasized that Martianus's "aetherium tractum" was "subtilius," although in this gloss he was simply agreeing with the Anonymous's gloss on the "tranquillitas" of aether.

[88] John, *Annotationes*, pp. 171.35–172.7. This ninth-century version of global warming is the latter part of a long comment *ad* intercapedines (NPM 309.6; VIII, 814): "…fisici.…diversitatem qualitatum, caloris frigoris temperantiae, circa terram esse dicunt. In superioribus autem partibus nec calor nec frigus nec temperantia sed similes per omnia natura, nam et ipse sol in ea parte in qua est nihil urit et expers totius caloris est; radii autem ipsius quando descendunt ad inferas mundi partes ubi corpulentiam naturae invenire possunt, ibi incendunt et operantur et calorem et flammas gignunt. Nam ideo nubes elongantur a terra quia repercussio radiorum non permittit eas descendere, ex hoc ergo apparet quia calidior est inferior quam superior." Remigius copied this verbatim except for two minimal improvements, *Commentum*, vol. 2, p. 252.9–16. For the preceding part of this comment, see n. 93 below. Regarding the correctness of the *fisici*, John wrote in *Annotationes*, p. 180.15, "Fisici vero, id est naturalis veritatis inquisitores.…" John's source for the notion of solar rays heating the air below the clouds more than the upper air is uncertain. D'Alverny, "Les «Solutiones ad Chosroem»," pp. 145–60, called attention to the presence of at least two copies (s. IX¾) of the *Solutiones*, which has Latin versions of Greek scientific materials, including some Aristotelian meteorology. Paris 2684, ff. 101r,21–107r,25, and Paris 13386, ff. 199r,1–202r,1 (N.E. France), have the meteorological chapter, but the latter of these is now incomplete, having lost leaves between ff. 199–200. In the former ms. see ff. 105r,2; 105v,22; and 106r,6 for references to the effects of reflected solar rays. For the printed text see ed. Bywater, *Prisciani Lydi quae extant*, pp. 77–88, esp. 83, 85; the part of this text now missing from Paris 13386 extends from p. 77.29 to 85.24 in the printed edition.

[89] Remigius, *Commentum*, vol. 2, p. 252.9–16 (ethereal vs. lower regions), 252.30–34 (five elemental layers).

[90] This gloss appears in Voss. lat. F.48, f. 76r inner margin: "aelementum latine cuius grecum est stochia; dictum aelementum a lima unde aliquid formatur." At this point

More generally, John elaborated on a difference between the *astrologi* and the *fisici* in his discussion of possible boundaries between the elemental layers in the world. Martianus had begun his substantive account of astronomy (at VIII, 814) with a convoluted and obscure obeisance to the physical philosophers and suggested their greater rectitude in describing the physical elements as homogeneous belts that surround the earth without any actual circles defining precise boundaries or distinct paths in these belts. He seems to have meant that there are, in fact, no real or visible circles in the physical heavens and that the circles described by astronomers are mental, or theoretical, constructions to provide a means to represent the observed phenomena. John's elaboration clarified the Capellan suggestion, following a brief comment by the first Anonymous, and emphasized the fictive nature of the circles used by astronomers. However, John then proceeded to give an example of the conclusions made by the *astrologi* that he considered incorrect and contradicted by the *fisici*. The argument he criticized had been advanced by Macrobius with regard to the correspondence of celestial and terrestrial regions, illustrated in the *Commentary on Scipio's Dream* with a clear diagram to show these correlations (see Figure 2.8). Macrobius proposed the following.

> The nature of the heavens (*caelum*) determines temperate and extreme zones in different parts of the earth, and the property (*qualitas*) of cold or heat that inheres in any part whatsoever of the heavens (*aether*) at the same time permeates that part of the earth directly below it. And because those different regions which are defined by precise limits are called zones in the heavens (*caelum*), one must in the same way imagine zones

it is absent from Besançon 594, Leiden BPL 36, BPL 87, BPL 88, Paris 8671, Paris 13955, and Vat. Regin. 1987. The gloss exists in a different form in a gloss of s. IX¾ to Bede's DNR 4: "Secundum autem Ambrosium, latinum nomen est et derivatur ab eo quod est elimo, id est formo, et quod nos elimentum dicimus, Greci stochium." See Bede, DNR, ed. Jones, p. 195, gl. K, and Contreni, "John Scottus and Bede," p. 120, n. 85. The source of both these glosses lies earlier in the Anonymous commentary in Book I; Voss. lat. F.48, f. 2r outer margin, *ad* namque elementa (NPM 1.8): "Ambrosius dicit a limo limas inde elementa aliquando enim semina retinet in natura rerum aliquando solvit ut crescant. Ilen grece dicitur materies (*gl.* Sicut Isidori dicit quia stochia grece, latine elementa) unde invisibilia cuncta procedunt." BPL 88, f. 3r outer margin: "Ambrosius dicit, a limo limas, elimenta ilen grece dicitur materies unde invisibilia cuncta procedunt, aliquando enim semina retinet in natura rerum, aliquando solvit ut crescant. In una eademque re et ligat et solvit…;" exactly the same appears in BPL 87, f. 2v outer margin. Neither John nor Remigius adopted this comment.

> here [on the sphere of the earth]. . . . Here again we reduce the effort of demonstrating what we mean by using a diagram (*pictura*).[91]

Macrobius, then, stood for the *astrologi* in Scottus's critique—a notable categorization that suggests the status of the *Commentary* not only in John's mind but also in the world of Carolingian intellectual life ca. 850. Certainly in the ninth century Macrobius's name carried weight as an astronomical and cosmological authority, and both the first and the second versions of the Anonymous, followed by John and Remigius, referred to him explicitly for the equation of Apollo with *mens mundi* (world mind) and *princeps et dux orbium ceterorum* (prince and lord of the other orbs).[92] John responded to the Macrobian doctrine he opposed as follows.

> What do I say concerning the upper parts of the world which are so like each other that no part can be distinguished from another? On this matter the *astrologi* and the *fisici* diverge. Physical philosophers (*fisici*) say that the three elements which encircle us are of a fluid (*liquida*) nature without any differences marked by circles and without [internal] diversity of parts. The astronomers (*astrologi*) on the other hand try to impose circles and to distinguish from each other the parts having a fluid nature and they imagine as circles the differences they call intervals (*intercapedines*) and the paths [of these circular bands] as diversities of properties (*qualitates*). Therefore they say there are circles in the heavens (*caelum*). Indeed, they call the middle part of the whole world (*mundus*) uninhabitable because of excessive heat, and they call the extreme parts of the heavens frozen and

[91] CSS, p. 117.22–32 (II.vii.2–3). The diagram described in II.vii.4 is presented in ed. Willis, p. 166, and in trans. Stahl, p. 209.

[92] NPM 53.8 (II, 193); BPL 88, f. 31v outer margin; *ad* trina: "Macrobius apollinem NOYCTET (*gl.* mens mundi) vocat quasi principem et ducem orbium ceterorum." Voss. lat. F.48, f. 17v,25 : "Macrobius. NYCTHT quasi ducem et principem orbium ceterorum." Voss. lat. F.48, f. 17v lower margin: "Macrobius apollinem rustet (*sic*) vocat, id est, mentem mundi quasi ducem et principem orbium ceterorum." John Scottus (Oxford ms. Auct. T.2.19, f. 46v,14–16) glossed the full line at NPM 53.8, following the first Anonymous: "Macrobius. Appollinem NYCTHT vocant quasi ducem et principem orbium ceterorum. . . ." Remigius, *Commentum*, vol. 1, pp. 200.25–201.1, elaborated further, referring to Macrobius and to John Scottus. We can also find Remigius referring to Macrobius for an eleventh circle on the celestial sphere; n. 100 below. A material reminder of Macrobius in conjunction with Martianus appears in the planetary configuration (according to CSS, pp. 84.29 – 85.30, 89.8–29 [I.xxi.1–4, 24–26]) added later to BPL 88, f. 2r, a Macrobian traditional image added to a copy of *De nuptiis*. The figure places the planets in Plinian order, distributed around the zodiac according to Macrobius's instructions. The Plinian/Chaldean planetary order was the only one used in the Macrobian image in s. IX and most of s. X. Also, the emphasized Christian cross on the vertical line between Aries and Taurus seems to date the image to s. X–XI.

> uninhabitable (sic) because of excessive cold. Likewise they conceive two habitable bands (*circuli*) between the hot and the cold. The philosophers (*fisici*) deny all this, since they say that the diversity of properties—hot, cold, temperate—occurs [only] near (*circa*) the earth. . . .[93]

Distinguishing the views of astronomers from those of philosophers was the point from which Martianus Capella and the Carolingian glossators along with him would launch into a presentation of basic concepts and definitions for the study of astronomy. But the cosmological foundation proposed by Martianus had come to have much clearer outlines because of the ninth-century commentators. The Anonymous stated a differentiation of the celestial from the terrestrial realm, and John the Scot developed the concept. This was not an Aristotelian distinction of two completely opposite regions, yet it held some of that character. The Carolingian commentators on *De nuptiis* saw the outer realm, whether aether or fire, as basically different from the lower elemental realms, not only in specific elemental properties (of earth, water, etc.) but also in susceptibility to elemental effects. Thus fire would not burn in the outermost, fiery or aetherial, region; it would burn a material object only in the lower regions. The outer region, reserved for the planets and stars, was one of purity and absence of transience, or at least so the Carolingians claimed in their more general cosmological teaching. Such teaching corresponded well with the doctrines they had found in the writings of Macrobius and Pliny.

[93] We note that the first Anonymous, at Voss. lat. F.48, f. 76r outer margin, had commented thus: "Dicunt phisici quod non sit divisio (*gl.* sectio) inter corpore celestia." John, *Annotationes*, p. 171.24–37: "Quid dicam de superioribus mundi partibus quae tantae similitudinis sibimet sunt ut nulla pars possit discerni ab altera? In hoc ergo discernuntur astrologi et fisici; fisici dicunt tria elementa quae ambiunt et liquidae naturae esse sine ullis circulorum diversitatibus et sine diversitate partium. Astrologi autem circulos conantur astruere et partes liquidae naturae a semet ipsis discernere et differentias quas intercapedines vocant et vias ductas diversitates qualitatum circulos fingunt, ideo dicunt circulos in caelo esse. Dicunt enim mediam partem mundi inhabitabilem prae nimio calore; dicunt extremas caeli partes frigidas et inhabitabiles prae nimio frigore. Fingunt etiam duos circulos inter frigiditatem et caliditatem habitabiles. Hec omnia negant fisici quoniam diversitatem qualitatum, caloris frigoris temperantiae, circa terram esse dicunt. . . ." Remigius, *Commentum*, vol. 2, pp. 251.32–252.10, copied the above verbatim. See n. 88 above for the continuation of this comment. John's discussion of the fluid nature of the orbs and their lack of diversity of parts resonates with the much more precise, later scholastic discussions of the continuity or contiguity of celestial orbs; See Grant, *Planets, Stars, and Orbs*, pp. 289–93, 344.

4. *The Framework of the Heavens and the Stars (§§ 817–849)*

Capella divided his *astronomia* into two large sections of almost equal length, treating first the celestial framework and the fixed stars and secondly the seven planets.[94] And while the leading Carolingian commentaries devoted about equal space to interlinear glossing in the stellar and the planetary sections, each of these commentaries added noticeably more, long marginal comments to the planetary than to the stellar sections.[95] The planets clearly provided more lemmata than did the stars in Carolingian studies of Capellan astronomy. Nonetheless the descriptions and explanations of the celestial framework demanded and received much attention from ninth-century scholars. Martianus identified and discussed the following six topics for sidereal astronomy.

1. Definitions of the ten circles of the cosmos (§§ 817–826)
2. The intervals of the five celestial parallels (§§ 827–831, 837)
3. The positions of the five great circles (§ 832–836)
4. The thirty five constellations (§§ 838–839)
5. The risings and the settings of the constellations (§§ 841–845)
6. The inequalities in the lengths of days and nights through the year (§§ 846–849)

In naming the ten circles of the cosmos, Martianus first defined five parallels on the sphere, each of which has all points equidistant from the pole and has the polar axis as its center. On the celestial sphere the first (for us in the northern hemisphere) is the circle defined as the limit

[94] Book 8 contains an introductory section (§§ 803–813), followed by the opening cosmological point we have just discussed (§§ 814–815), initiating Capella's presentation of the celestial framework including the fixed stars (§§ 814–848), and brought to a close by the third section (§§ 849–887). In Willis's edition these three sections occupy pages 302–308, 309–321, 321–337 respectively. Stahl, *Martianus Capella*, vol. 1, pp. 171–201, offers a useful summary of and commentary on Martianus's astronomy.

[95] Willis, NPM p. xxviii, divides Book 8 into sections similar to those below but with more divisions than I use. I assume here that the Anonymous commentary and those of John the Scot and Remigius of Auxerre are the leading commentaries of the Carolingian era. Other ninth-century commentaries on *De nuptiis*, such as those found in Leiden mss. BPL 36 and BPL 87, show some signs of influence by the Anonymous, but in the *astronomia* they are much less full than the Anonymous. Because of the great influence of Remigius's commentary in later times, a reasonable sign of long-term importance of each commentary composed prior to Remigius would be its influence on Remigius. The Anonymous and John the Scot's commentary clearly head the list in any such estimation.

of stars that are visible throughout the night (*septentrionalis*, or arctic). The next circle, the northern tropic (*solstitialis*), is defined by the northernmost limit of the Sun's path through the year. The third circle, the largest of the five, is the equator (*aequinoctialis*), and at the two times of the year when the sun is located on this circle we have days and nights equal in length. The fourth circle, the southern tropic (*brumalis*), is the opposite of the second circle and marks the southernmost limit of the sun's annual path. Finally, the fifth (*australis/antarcticus*) is diametrically opposite the first circle and marks the limit beyond which we can see no stars at all. In glossing this section of Martianus's text, the first version of the Anonymous attended to clarifying and elaborating the astronomical vocabulary of the text. For example, the celestial poles, "polos," were glossed as "in unum cardinem, id est, arcticum et antarcticum" ("on a single axis, that is, the axis of the arctic and the antarctic"), and "finitoris" was glossed as "orizontis" ("horizon"). Synonyms appeared for many words in order to clarify or expand a student's vocabulary, for example, "dividunt" for "discriminant," "dicentur" for "promentur," and "extremitates" for "circumferentias." At only one point in this section did the first Anonymous version go so far as to add a mythological gloss, pointing out that the figure of Astraeus was the son of Atlantis.[96] The second version of the Anonymous did not repeat the alleged paternity of Astraeus, settling for the simpler legend that he was the Greek who first reported positions for the stars; the second version repeated most of the interlinear glosses found in the first.[97] Even John the Scot restricted himself to the same sort of glosses here, including Astreus as "discoverer" ("inventor") of the stars.[98] It is only when we turn to Remigius that we find a scholar who compiled a remarkably large set of glosses, designed essentially to provide either a synonym or a definition for almost every word or phrase that could bear one. He repeated both bits of information about Astreus that he found in the first version of the Anonymous. He also added proudly the notice that Macrobius had included an eleventh circle, the *anabibazontis*, a bit of information which Remigius fabricated on the basis of his own misunderstanding. Macrobius had indeed named an eleventh circle, the meridian

[96] These interlinear glosses appear in Voss. lat. F.48, f. 76v.
[97] In fact, both the first and second versions offered the marginal gloss to 'Astreus' as a Greek "qui primo positiones stellarum invenit." See BPL 88, f. 156r–v for the second version's glosses.
[98] John, *Annotationes*, p. 173.1–15.

circle (*meridianus*), which like the horizon is not fixed.[99] To rename this eleventh circle, Remigius took the Greek term 'anabibazontis' from a location much later in the text of Martianus, who had referred to the ascending lunar node (*anabibazontis*) for an eclipse. Remigius defined the Greek term by adapting a gloss from the Anonymous on this Capellan text regarding the lunar node.[100] The elaborately derived addition by Remigius, which produced an incorrect name for the meridian circle, was very much in the spirit of his commentary, incorporating whatever morsel of vocabulary he found or imagined to be relevant that would fatten the body of information.

After the five parallels Martianus described two colures, the zodiac, the Milky Way, and the horizon to conclude his list of ten celestial circles. Each colure is a circle passing through both poles, with the two circles at right angles to each other. One colure originates at 8° of Aries and the other at 8° of Cancer. The zodiac is tangent to the *solstitialis* and the *brumalis* parallels, cuts the equator twice at unequal angles, and furnishes the pathway for the Sun, the Moon, and the five planets. He described the Milky Way as a circle larger than the zodiac, evidently not appreciating that all great circles, such as these two, must be equal in size, since they are laid out on the celestial sphere with its center as their center. Finally he described the horizon as the circle that varies at every time and place and that divides upper and lower hemispheres from our point of view.

To this unprepossessing set of descriptions the different Carolingian commentaries chose to provide at least some variety of additions along with many common synonyms, definitions, and elaborations. All the other glossators followed the explicit lead of the Anonymous in labeling *colurus* as an incomplete (*inperfectus*) circle, simply because, as Martianus

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[99] Macrobius, CSS 63.8–10 (I.xv.15).

[100] Remigius, *Commentum*, vol. 2, p. 255.9–13 *ad* decem...circulos (NPM 310.15–16; VIII, 817): "Macrobius vero addit undecimum, id est, anabibazontem, hoc est sursum scandentem vel ascendentem...." The term 'anabibazontis' does not appear in Macrobius but in Martianus, NPM 330.6 (VIII, 871). There it is glossed by the Anonymous (Voss. lat. F.48, f. 80v,26) as "id est, sursum ascendens et obsistens soli." At NPM 328.20–21 (VIII, 868), Remigius (*Commentum*, II, 283.20–21) glossed the passage of the Moon northward across the solar path: "ASCENDENSQUE scilicet in septentrionem, IPSAM SOLAREM LINEAM id est anabibazontem." He repeated the last gloss at 284.25 et seq. Subsequently, in glossing "ΑΝΑΒΙΒΑΖΟΝΤΑ ΣΥΝΔΕΣΜΟΝ" at NPM 330.6–7 (VIII, 871), the second version of the Anonymous (BPL 88, f. 164v,21) along with John the Scot (*Annotationes*, 183.16–17) and Remigius (*Commentum*, vol. 2, p. 285.27–28) agreed on the precise gloss "ascendentem coniunctionem."

noted, each colure passes under the earth and so is partly unseen from our location in the northern hemisphere.[101] Many agreed in glossing "definita" as "decreta" and "decusantes/decursantes" as "deducentes" along with other such synonyms.[102] The first version of the Anonymous, however, was unusual in labeling "non nescio" as the figure of speech "litotes," where the second version glossed it simply as "id est, scio."[103] In addition to the etymology for "galaxeas," the word for Milky Way,[104] the first version of the Anonymous carried a diagram to show the difference between a right angle and other angles, clarifying if necessary the meaning of the passage that describes the circle of the zodiac cutting the celestial equator at unequal angles (Figure 4.3). This diagram must have seemed a superfluous elaboration to other Carolingian glossators of the text, as none copied it or offered an alternative.

John the Scot was modest in glossing the text for these five great circles except for one location. Where Martianus described the zodiac as the circle "which provides the path for the Sun and the Moon along with the five planets," John chose to expand on the phrase "the path for the Sun and the Moon" and, in passing, to introduce a datum from Pliny the Elder that contradicted what Martianus reported later in the *astronomia*. John wrote,

> We should note in this place why he [Martianus] said 'for the Sun' [first] whereas it is not the Sun but the Moon that determines the width of the zodiac. Indeed the Sun illuminates only the two middle degrees (*partes*) of the zodiac and does not pass through them on a straight line (*aequaliter*) but like a serpent across these two middle degrees, that is, in a wavelike course. The Moon, however, illuminates the twelve degrees of the zodiac; Venus overruns it by two degrees; and therefore the determination (*mensura*) of the zodiac is assigned to the Moon and is twelve degrees.[105]

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[101] NPM 311.9; Voss. lat. F.48, f. 76v; BPL 36, f. 106v; BPL 87, f. 120r; BPL 88, f. 156v; Besançon 594, f. 68r; Paris 13955, f. 48r; John Scot, *Annotationes*, p. 173.16–17; Remigius, *Commentum*, vol. 2, p. 256.26–7.

[102] NPM 311.11, 15. E.g., Voss. lat. F.48, f. 76v, and BPL 88, f. 156v.

[103] Ibid. Litotes is understatement. Remigius, *Commentum*, vol. 2, p. 256.30, reported the information from both.

[104] See above, p. 195, n. 57, for examples.

[105] John, *Annotationes*, pp. 173.29–174.3 (VIII, 825): "QUI SOLI LUNAEQUE Notandum est in hoc loco cur dixit soli, nam sol latitudinem signiferi non mensurat sed luna. Duas enim medias partes solum modo latitudinis signiferi sol lustrat nec eas aequaliter sed more draconis currit inter illas duas medias, id est flexuoso cursu. Luna autem duodecim eius partes lustrat; Venus autem excedit in duabus partibus; igitur mensura signiferi lunae tribuitur quae est in XII partibus. [*more geometrico*. Geometres si circulum fecerit primo punctum in medio ponit inde aliunde lineam ducit.]" We

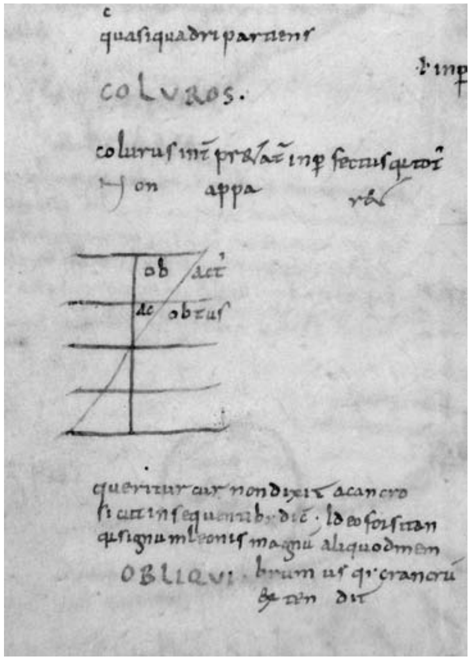

Fig. 4.3. Obtuse and Acute Angles where the Zodiac and Equator Intersect. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 76v

This introduction of the latitudes of the Sun, Moon, and Venus in order to specify the width of the zodiac and present the single case of planetary excess, Venus, would seem at first to have been no more than an example of erudite excess by Scottus. However, John's precise description of the Sun's path was not that of Martianus, who subsequently defined the path of the Sun as exactly the central line of the zodiac, while John preferred Pliny's account of the Sun following a serpentine path through the two middle degrees of the zodiac with the central line as an axis.[106] We must also notice that John chose the

find exactly the same text in Bern BB cod. 331, f. 77r,33–38, an Auxerre ms. (s. X) of John's commentary. Looking at both Martianus's text and at Remigius's commentary, it becomes obvious that the final part of John's comment in Lutz's edition, which I have enclosed in brackets, should be a separate gloss, beginning with the Capellan text "more geometrico," and proceeding with the subsequent text that Lutz reports; it should be marked with the page and line numbers 435, 7 (from Dick's edition).

[106] NPM 315.3–4 (VIII, 834): "…de sole…qui per mediam circuli eiusdem lineam

latitude for Venus, two degrees beyond the zodiacal band (one extra degree on each side), that he knew from Pliny's *Natural History*, despite Martianus's assignment of a latitude of 12°, just like the Moon's, to Venus.[107] Given the clear disagreements between John's gloss to *De nuptiis* VIII, 825 and Martianus's later statements at *De nuptiis* VIII, 834 and 882, combined with John's silence regarding the Capellan latitudes of the Sun and of Venus, we can see that John had a definite intention, although we may not understand his motive fully. He did not name Pliny when he gave the latitude of the Sun as 2° and of Venus as 14°, and he did not explicitly contradict Martianus's latitudes when they were given. Yet we can assume that contemporary scholars using John's commentary would have noticed the conflicting statements. Perhaps the most we can surmise is that John preferred Pliny's data on the planetary latitudes but did not want to contradict Martianus openly. In this case we can see the introduction of the Sun's and Venus's latitudes by John in a place quite removed from the sections where Martianus listed them as examples of diplomatic skill and scholarly assertiveness on the part of John the Scot.

How did Remigius deal with the same texts of Martianus? He copied John's comment on the Sun, Moon, and Venus in the zodiac verbatim (as far as "…in XII partibus"). Like John he later skipped over Martianus's mention of Venus's latitude of 12° but did not follow John's tactic with regard to the Sun's latitude.[108] Beyond these topics, many of Remigius's glosses on the descriptions of the ten circles of the celestial sphere seem to have derived from the Anonymous, although Remigius developed a much fuller set of glosses than his predecessors.[109]

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solus fertur." Pliny, NH II, 67, reported the latitude of the Sun's path through the zodiac thus: "sol…medio fertur inter duas partes flexuoso draconum meatu inequalis." This appeared also in the widely circulated set of astronomical excerpts from Pliny in the Seven Book Computus (ca. 812). John carefully avoided disagreeing with Martianus's statement (VIII, 834) of the Sun's exact path through the zodiac; see *Annotationes*, p. 175.10–12.

[107] Pliny, NH II, 66; also in the Seven Book Computus. NPM 334.15 (VIII, 882). Cf. *Annotationes*, p. 185.1–4, where John adroitly avoided any mention of Venus's latitude.

[108] Remigius, *Commentum*, vol. 2, pp. 258.3–9 (VIII, 825), 291.20–24 (VIII, 882). On the solar latitude see *Commentum*, vol. 2, p. 263.5–7 (VIII, 834), and texts at nn. 114–117 below.

[109] Regarding this, one may compare Remigius, *Commentum*, vol. 2, pp. 254.28–258.25, to Voss. lat. F.48, f. 76r,29–76v,25, for NPM 310.12–312.10 (VIII, 817–826).

Very many of these Remigian glosses are synonyms, rephrasings, and insertions of understood words—references, nouns for pronouns, verbal completions, etc.—in order to help set vocabulary, grammar, and information (and perhaps comprehension) in students' minds.

Turning again to the five parallels on the celestial sphere, Martianus next described their paths through the constellations and the spaces between them. He began with a description of his mental process of drawing the arctic circle through the northern constellations, and, of course, this process was not carried out on an abacus, but the imagery of his account was very much that of a string with one end pinned to a central point and the other end tied to a marker that moves on a plane (or sphere) at a constant distance from that point and thus traces out a circle. His account of the constellations, or parts of constellations, that the parallels crossed was straightforward, and the Carolingian glosses to this section of the *astronomia* were generally unexceptional. The Anonymous, John the Scot, and Remigius all tended to gloss common words and grammatical constructions rather than the constellation names themselves. The Anonymous, for example, glossed only Engonasin, Ophiucus, Equus, Andromeda, Heniochus, and Argo in the long list of constellations intersecting the five celestial parallels. Of these six names, one (Argo) received a translation ("Navis"), one (Equus) a proper name ("Pegasus"), one (Andromeda) an identification ("uxor Persei cuius mater Casiepia"), two (Engonasin, Heniochus) their more familiar names ("Hercules," "Ericthonius"), and one (Ophiucus) a translation and an etymology ("id est, Serpentarii; ofi serpens").[110] Of particular interest is the Christian expansion of the last of these in the second version of the Anonymous as well as in John the Scot's and Remigius's commentaries. The second Anonymous version added that the constellation named Ophiucus, or Serpentarius, is connected with Eve, associated with the serpent in the Garden of Eden, but according to the fables with Ops, sister and wife of Saturn. This is repeated by John and Remigius but not by most other ninth-century glossators.[111]

[110] For all these see the first version of the Anonymous; Voss. lat. F.48, f. 77r,5, *gl. ad* offiuci (NPM 313.2).

[111] Leiden BPL 88, f. 157v inner margin: "Opho Greco loquor hinc ophis serpens quia locutus est cum eva vel secundum fabulas cum ope." John, *Annotationes*, p. 174. 19–21: "OFIUCHI id est serpentarii qui tenet 'όφιν, id est serpentem; φωνέω loquor, inde 'όφις serpens dicitur eo quod locutus fuit cum Eva; secundum vero paganos cum Ope, uxore Saturni." See Ovid, *Metamorphoses*, p. 219 (IX, 497–498): Saturn married Ops, his sister. Remigius, *Commentum*, vol. 2, p. 259.31–34 combines wording from both the

When Martianus defined quantitatively the intervals between the parallels, he offered the distances in ratios of small whole numbers, producing a sequence of numbers as follows. If we take a circle through the poles and divide it into 72 equal segments, then from each quadrant of 18 parts Martianus assigned 8 to the interval from the pole to the first parallel, arctic or antarctic, and 6 parts to the next interval. The interval between tropic and equator held the remaining 4 parts. Martianus did not carry out the computation for the obliquity of the ecliptic, but, when computed with his set of intervals, the obliquity is 20°.[112] His values also indicate an approximate latitude of 40° (the Hellespont?) for the location of an observer claiming his intervals. A much more normal set of intervals would be 6, 5, and 4 parts of a quadrant of 15 (a full circle having 60 parts), which sets the ecliptic at an inclination of 24° to the equator. This value was common among Hellenistic astronomers. In glossing this text of Martianus on the size of the intervals, Carolingian scholars showed an interest only in naming the ratios. Both versions of the Anonymous as well as John and Remigius carefully specified that the ratio of 8 to 6 is a sesquitertian proportion. John and Remigius but not the Anonymous proceeded to label the subsequent ratio of 6 to 4 as a sesquialter proportion. Clarifying the Capellan account, which was unduly labored, was the essential pedagogical goal here, although not all glossators identified both ratios.[113]

The positions of the five great circles—two colures, zodiac, Milky Way, horizon—were laid out by Martianus with minimal elaboration. He named the constellations associated with the colures but not those of the zodiac and only two associated with the Milky Way. As he noted, the horizon is not fixed in the sky and so has no assigned constellations. Neither the Anonymous nor John the Scot made much of these

Anonymous and John in glossing Ofiucus. No such elaborated discussion of Serpentarius associated with Eve and/or Ops appears in BPL 36, BPL 87, or Paris 13955.

112 NPM 315.11–21. Stahl, *Martianus Capella*, vol. 1, pp. 181–2, reviewed Martianus's intervals between the parallels and remarked that they were not the norm among Greek astronomers. Neugebauer, HAMA, p. 590, n. 2, noticed this Capellan peculiarity and simply rejected it, saying that these ratios should be emended. This does not tell us where Martianus got these numbers and seems to assume that an error crept into the mss.

113 Voss. lat. F.48, f. 77v,11; BPL 88, f. 158v outer margin; John, *Annotationes*, p. 175.20–29; Remigius, *Commentum*, vol. 2, p. 264.2–17. BPL 36, f. 108r, interlinear gloss to "similis" is "sesqualtera"; marginal glosses identify the sesquitertian ratio. BPL 87, f. 121v, and Paris 13955, f. 49r, identify only the sesquitertian.

circles as described by Martianus, but Remigius did repeat one point that he had made earlier and, he thought, needed reemphasis. Where Martianus defined the middle line of the zodiacal belt as the path of the Sun alone, Remigius claimed that Martianus was disagreeing with all the astronomers (*astrologi*), who had said that Saturn travels along the same path as the Sun.[114] Remigius was, of course, referring back to the passage where he had followed John the Scot in defining the zodiac by the latitude of the Moon's course as well as the Sun's path in the middle.[115] However, the point raised by Remigius becomes interesting when we remember the precise facts involved. In commenting on *De nuptiis* VIII, 825, Remigius had followed John with the description given by Pliny for the solar path as a serpentine line along the two middle degrees of the zodiac, that is, one degree to either side of the mid-line.[116] Subsequently Remigius remarked that Martianus disagreed with all other astronomers, since they supposedly agreed that Saturn's course is the same as the Sun's through the zodiac, along a serpentine path in the manner prescribed by Pliny, who had indeed given Saturn's path a latitude of 2°, just like the Sun's path, but had not equated the courses of these two planets in all other details.[117] Remigius appears to have ignored here the distinction between the two attributes of the solar orbit, its latitude and its serpentine motion. His reason for ignoring this distinction seems not to have been his carelessness in reading the text but his familiarity with a very common tool for instructing students in the doctrine of Plinian latitudes, the diagram added to the excerpt as it appeared in Carolingian computistical collections. Usually the diagram intended to represent the planetary latitudes according to the Plinian excerpt showed no separate path for Saturn and simply carried the planet's name near the Sun's path (e.g., Figure 3.10).[118] The

[114] NPM 315.4 (VIII, 834). Remigius, *Commentum*, vol. 2, p. 263.5–7: "QUI scilicet sol, PER MEDIAM CIRCULI EIUSDEM id est signiferi, LINEAM SOLUS FERTUR. Dissentit ab omnibus astrologis. Dicunt enim alii quod etiam cum eo Saturnus eat." Like the Anonymous and John, the commentaries of BPL 36, BPL 87, and Paris 13955 make no such comment on this point in the Capellan text.

[115] Above, p. 217, n. 108 for Remigius; p. 215, n. 105 for John's comment.

[116] Remigius, *Commentum*, vol. 2, p. 258.5–7 (VIII, 825): "Duas enim medias partes solum modo latitudinis signiferi sol lustrat nec eas aequaliter, sed more draconis currit inter illas duas medias, id est flexuoso cursu." See above, n. 114, for Remigius's glosses on VIII, 834.

[117] Pliny, NH II, 67: "... Saturni duabus ut sol."

[118] More examples of this presentation of Saturn in the latitude diagrams are reproduced in Eastwood, *Revival of Planetary Astronomy*, ch. 2, Figs. 8–10, and Eastwood and Graßhoff, *Planetary Diagrams*, p. 37.

Plinian teaching and diagram were widespread, and copies of Bede's *De natura rerum* and collections of computus texts would be Remigius's likely sources. His reference to the teachings of "other astronomers" certainly would not include Macrobius or Calcidius.

In a cursory list of the constellations, Martianus followed the Hellenistic tradition that zodiacal constellations should be listed separately and the others—he gave the number thirty five—should be divided by the zodiac into northern and southern constellations. In fact, he listed nineteen to the north, following Aratus, and then gave fourteen to the south to arrive at a total of only thirty three rather than the thirty five he promised. Furthermore he chose not to name the twelve zodiacal signs, saying that they were well known. As William Stahl has pointed out, ancient constellation lists varied quite a bit, and Martianus should be criticized here only for failing to provide the number of names that he proposed initially.[119] The Anonymous glossed these names lightly, attending mostly to their alternate names and two times to the cases of proper nouns (Ariadnes—genitive, Nixos—nominative). John the Scot offered even less glossing on this section than the Anonymous, while Remigius, predictably, engrossed his commentary with a great number of alternate names and brief explanations.[120]

Only at the end of his list of constellations did Martianus mention a fact about the zodiac that students might not yet know. There are twelve signs of 30° each, but, he noted, the number of constellations in this belt is eleven. "For Scorpio occupies its own space with its body and the space of Libra with its claws.... What we call Libra, the Greeks refer to as Chelae [the Claws]."[121] This interesting addition, readily explained by the difference between actual star formations and the equipartition of a circle into twelve parts, often appeared in ancient texts. Aratus had noted the spread of Scorpio over the two signs, Scorpio and Libra, as had Macrobius. Hyginus had added the explicit notice that this reduced

[119] Stahl, *Martianus Capella*, vol. 1, pp. 182–3, discusses briefly the lists of Aratus, Hyginus, Ptolemy, and Geminus. Our concern here is to notice the impact of Martianus's information on the Carolingian readers rather than to determine his sources or his adequacy.

[120] NPM 315.22–316.19 (VIII, 838). Voss. lat. F.48, f. 77v. John, *Annotationes*, pp. 175.30–176.7. Remigius, *Commentum*, vol. 2, pp. 264.25–265.26. The commentary in Oxford Laud. 118, f. 76r,14–19, numbers the constellations, calling attention to the total of thirty three.

[121] Stahl, *Martianus Capella*, vol. 2, pp. 326–7 (VIII, 839); NPM 316.21–317.2.

the number of constellations to eleven. Servius, commenting on Vergil's *Georgics*, had expanded this information to attribute the number eleven to the Chaldeans, who, he claimed, did not choose to make all the signs of equal length, giving one 20° and another 40°, while the Egyptians chose to have twelve signs of equal length. Finally, we can note that the *scholia Strozziana* to the Latin Aratus, which originated before Pope Gregory I, carried much the same information as Servius's comment.[122] The Anonymous commentary did no more than clarify precisely the Capellan wording ("chelis" = "brachiis") and repeat the result in different words ("quantum in figuram unum est signum, quantum autem in spatium duo sunt signa scorpius et libra"). At this point John was relatively taciturn. For Remigius the Chaldeans were responsible for giving two signs to one constellation, a datum he may have garnered from more than one of the possible sources. Both John and Remigius then provided an analysis of the word Chelae that also exists in at least one other commentary from the later ninth century.[123] Not only Martianus's brevity of treatment but also the paucity of Carolingian

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[122] Aratus, *Phaenomena*, ed. Martin, p. 78.546. Macrobius, CSS 72.8–9 (I.xviii.13). Hyginus, *De astronomia*, ed. Viré, p. 133.172–175 (IV, 5); for a ms. example, see St Gall 250, p. 623.11–13 (s. IX²). Servius, *In Vergilii carmina*, ed. Thilo and Hagen, vol. 3, p. 140.8–13 (*In Vergilii Georgica*, I, 33): "Aegyptii duodecim esse adserunt signa, Chaldaei vero undecim: nam scorpium et libram unum signum accipiunt, chelae enim scorpii libram faciunt. iidem Chaldaei nolunt aequales esse partes in omnibus signis, sed pro qualitate sui aliud signum XX, aliud XL habere, cum Aegyptii tricenas esse partes in omnibus velint." Germanicus, *Aratea cum scholiis*, ed. Breysig, p. 187.25–28: "libram autem Caldaei dicunt non esse principaliter signum, sed partem esse scorpionis. Aegyptii vero, qui hac scientia ceteris gentibus eminent, eam principaliter pro signo accipiunt." For knowledge of the Strozziana before Gregory's time, see Meyvaert, "Gregory the Great and Astronomy," pp. 137–45, esp.141.

[123] Voss. lat. F.48, f. 78r outer margin. John, *Annotationes*, p. 176.9–10. Remigius, *Commentum*, vol. 2, p. 265.31–33: "Hic secundum Chaldeos loquitur qui dicunt unum idemque esse signum Scorpium et Libram." John, *Annotationes*, p. 176.11–12, gave increased precision on the Greek word for Claws: "ΧΕΛΥΣ si per e longam scribitur, brachium significat, si per brevem, labium." BPL 88, f. 159v outer margin, had offered this as the etymological novelty, "cheile per ebreum labia significant;" in passing we must at least ask whether the glossator imagined that the Hebrew language was involved here. Remigius, *Commentum*, vol. 2, p. 266.1–2, building on John here, elaborated, "ΧΗΛΗ si per H longam scribitur, brachium significat, si per e brevem, labia, unde et Achilles dictus est a tenuitate labiorum, vel quasi sine labiis." BPL 87, f. 122r, offered much the same as Remigius here, first with an interlinear gloss to "undecim" (NPM 316.20) that reads, "secundum caldeos loquitur," and then with an outer marginal gloss that reads, "Si brachiis chelis. Si labris chilis. Unde achilles a tenuitate labrorum dictus est. Nam chile labrum est." The precise relationship of BPL 87 and Remigius on this point seems unclear, but I suggest that the BPL 87 gloss was prior. In any case, I shall resist the temptation to comment on the introduction of Achilles into the discussion.

commentary and supplement make it obvious that a reader or student was expected to have previously read and been instructed in the texts, computistical and sidereal (Aratea, Hyginus), that gave a sound knowledge of the zodiac and the constellations.

Martianus provided almost nothing from the Aratean tradition of placing constellations in one or another parallel zone on the celestial sphere, but in the succeeding section he settled more into details in describing the risings and settings of the constellations.[124] The Carolingian commentaries found relatively little to say about the Capellan statement of risings and settings as such. The Anonymous offered a few grammatical glosses, a few synonyms, and a very few expansions to clarify meanings. John the Scot chose to gloss almost nothing—there is one gloss—at this point. Remigius added more, but even he simply included more of the same sort of gloss that the Anonymous provided.[125] With regard to the lengths of rising and setting times, Martianus gave values for rising and setting times of the twelve signs of the zodiac that were correct for a latitude somewhere between Alexandria and Rhodes. Rhodes is 5° north of Alexandria, and the longest day is one half hour longer than at Alexandria. Martianus's datum for the length of the longest day and his data for rising times can be compared to those given for Rhodes by Ptolemy and Manilius respectively.[126] These rising and setting times were, of course, for just one latitude, and Martianus did not explain or even imply how they might be obtained. The times he gave for the risings and settings are as follows.

Sign	*Rising Time*	*Setting Time*
Signs Rising Vertically & Setting Obliquely		
Cancer	2–1/12 hrs	1–11/12 hrs
Leo	2–1/3 hrs	1–2/3 hrs

[124] NPM 317.15–320.6 (VIII, 841–845).

[125] NPM 317.15–319.2 (VIII, 841–843). Voss. lat. F.48, f. 78r. John, *Annotationes*, p. 176.14–17. Remigius, *Commentum*, vol. 2, pp. 266.30–268.2.

[126] Ptolemy, *Syntaxis*, II, 6, 11 (trans. Toomer, p. 86) for the longest day (14½ hours) at Rhodes. Manilius, *Astronomica*, III, 275–300; see trans. Goold, pp. lxix–lxx, for rising times, the longest and shortest of which match the Capellan data for Rhodes while the intermediate rising times indicate a lower latitude. Stahl, *Martianus Capella*, vol. 1, p. 185, reports the view of Otto Neugebauer that Martianus's rising times in VIII, 844–845 were obtained by arithmetical interpolation rather than from observation. In any case these data do not fit at all with the zodiacal inclination and latitude indicated by VIII, 837 (at n. 112 above).

Virgo	2–2/3 hrs	1–1/3 hrs
Libra	2–2/3 hrs	1–1/3 hrs
Scorpio	2–1/3 hrs	1–2/3 hrs
Sagittarius	2–1/12 hrs	1–11/12 hrs

Signs Rising Obliquely and Setting Vertically

Capricorn	1–11/12 hrs	2–1/12 hrs
Aquarius	1–2/3 hrs	2–1/3 hrs
Pisces	1–1/3 hrs	2–2/3 hrs
Aries	1–1/3 hrs	2–2/3 hrs
Taurus	1–2/3 hrs	2–1/3 hrs
Gemini	1–11/12 hrs	2–1/12 hrs[127]

Our Carolingian scholars did not challenge or examine Martianus on any of the times given and saw their primary task to be repeating or explaining the numbers, especially the fractions of an hour. The Anonymous not only followed Martianus closely and emphasized that signs which rose transversely and set vertically must *necessarily* rise faster than they set but also added a curious marginal diagram (Figure 4.4) and gloss at this point.[128] The left, oblique line in the diagram has six small vertical markings. The oblique angle evidently meant that the line should represent signs rising or setting transversely, and the six little marks stood for six sequential signs; this grouping of the signs appeared in the subsequent marginal gloss. However, the designer seems to have decided to make the other three lines in the diagram represent only the speed of rising or setting. Thus he placed four small marks at supposedly equal intervals on each of these three remaining lines, two verticals and one oblique, to represent the four hours that would result from adding the rising and the setting times of any sign. These three lines appear to stand between two imagined parallels and therefore to show that an oblique passage, covering a greater distance in the time of four hours than a vertical passage, is faster. The subsequent gloss asserted, "Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius rise vertically

[127] NPM 319.3–320.6; § 844 presents the data for signs rising vertically, §845 for oblique risings.

[128] At NPM 319.4–5: "nam quae transversa oriuntur et recta occidunt, celeriores ortus habent quam occasus," the gloss to "habent" reads "scilicet, necesse est," in Voss. lat. F.48, f. 78v,1. The primary glossing hand wrote an index gloss here in the outer margin reading "DE DIVERSITATE ORTUS OCCASUSQUE SIGNORUM" and inscribed the diagram with an appended gloss immediately below it.

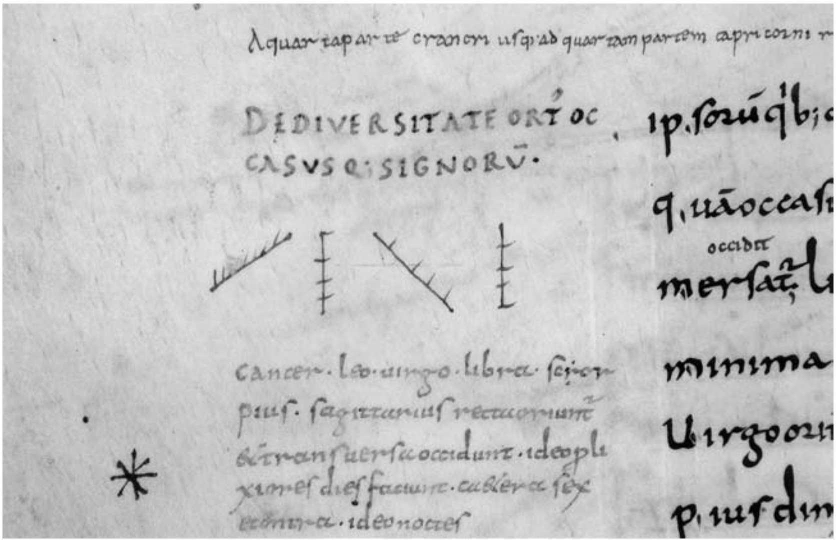

Fig. 4.4. Transverse and Vertical Risings (and Settings) of the Signs. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 78v

and set obliquely, thus making longer days; the six other [signs do] the opposite, and thus the nights [are longer]."[129] Once again we find that a hastily conceived diagram in the first version was not adopted in the second version of the Anonymous or in any other Carolingian commentary on the Capellan *astronomia*. The diagram attempted to say too much and required more explanation than the text it was intended to clarify.[130]

The verbal glosses of the first version were precise, limited, and clear. For example, where Martianus said economically that signs "rise more slowly," the Anonymous gloss added, "to wit, than they set." Where Martianus wrote more loosely that a rising sign "winds with little inflexion" ("parva inflexione curvetur"), a gloss to explain "with little inflexion" said "that is, to rise vertically" ("id est, recte oriri")

[129] NPM 318.8–320.6 (VIII, 844–845). Martianus here stated the exact rising and setting times of each of the twelve signs, while the marginal gloss in the first version of the Anonymous (Voss. lat. F.48, f. 78v outer margin) put them all into two groups: "cancer. leo. virgo. libra. scorpius. sagittarius recta oriuntur et transversa occidunt. ideo prolixiores dies faciunt. cetera sex econtra. ideo noctes." He emphasized a larger sense of balance and mutual relationship rather than numerical precision.

[130] The diagram (Fig. 4.4) in the Vossianus ms. does not appear in Besançon 594, BPL 36, BPL 87, BPL 88, Paris 13955, or Vat. Regin. 1987.

and the synonym given for the verb "winds" was "moves/is moved" ("moveatur"). For the fraction "one half plus a sixth part" ("semis et sexta parte") the gloss was "two thirds" ("due tertiae sunt semis et sexta pars"). For "occidit duabus horis et xiima parte horae" a gloss occurred simply to make the expansion from "xii ma" to "duodecima."[131] When John Scottus glossed the Capellan text for the rising and setting times of the signs, he provided information to make the various additions and subtractions completely obvious. He pointed out that the word "deunce" meant the lessening of an hour by one twelfth, which is an "uncia;" he subsequently glossed "a sixth part" as "two unciae" and "a third part" as "four unciae." He also pointed out that the quantities stated for the rising and setting of any zodiacal sign give a total of four hours.[132] Remigius, in turn, used all the glosses that he found in John's commentary, added many from both versions of the Anonymous, and composed more of his own, such as equating one half hour with six unciae.[133]

The last topic Martianus dealt with before ending his account of sidereal astronomy was the inequalities in the lengths of days and nights through the year, a matter closely related to the previous discussion of various rising times for zodiacal signs. As Martianus reminded his audience, all signs are of equal length and there are always six signs above the horizon, which suggests that days and nights should be of equal duration, but days and nights vary in length. The example given by Martianus (for an undisclosed latitude just above Alexandria), had 14–1/6 hours of daylight at summer solstice and 9–5/6 hours of daylight at winter solstice. We should not suppose that the signs may be of different lengths to explain these data, for we can measure the signs by observation and confirm their equality. But the Sun requires 32 days to transit Gemini, only 28 days for Sagittarius, and intermediate amounts in the intermediate signs, so perhaps the Sun should be assumed to move at varying speeds through the signs? Martianus raised this question as a transition from sidereal to planetary astronomy, and he answered it immediately by proposing that the Earth is eccentric to the Sun's orbit and is the center of the zodiacal circle, thus explaining

[131] These interlinear glosses appear at Voss. lat. F.48, f. 78v,2–9; the text is NPM 319.6–18.

[132] For all these glosses see *Annotationes*, p. 176.23–31.

[133] Remigius, *Commentum*, vol. 2, pp. 268.3–269.4. Remigius offered about three times as many glosses on the rising and setting times as did John the Scot.

the apparent change in solar speed by the changing distance between the Earth and the Sun against a background of equidistant signs of equal arc length.[134]

Carolingian commentaries on this problem of explaining the different lengths of days and nights through the year varied quite a bit. While John the Scot was extremely restrained on this topic,[135] the Anonymous and others prior to Remigius took the opportunity to make a number of points. Not surprisingly, the first version of the Anonymous proposed a diagram; it illustrated the incorrect assumption that the solar orbit and the zodiacal circle both center on the earth (Figure 4.5). Because it might at first sight be assumed to represent correctly the spatial relationships involved, the diagram must have required careful explanation to ensure that novices understood the intent behind the diagram. Predictably, no other ninth-century commentators used this image. However, the proposal by Martianus of a condition contrary to fact stimulated the logical sensibilities of Carolingian scholars, beginning with the Anonymous commentary. The first version glossed the pertinent text as follows; each significant gloss appears in parentheses following the word or clause glossed.

> If all the signs comprise equal amounts of space (proposition), and if, at all times of night and day, six signs must be (assumption) above the earth's horizon, then all days and nights (conclusion) ought to be of equal duration (*marginal gloss*: a true proposition but a false conclusion). (*marginal gloss*: Such syllogisms are rhetorical, because they do not hold.) There is no doubt that six signs are above the earth and that six are hidden, and also that days and nights do differ in their duration. (The latter is here assumed so that the former [conclusion] may be discredited.) For a day at the summer solstice has 14–1/6 hours, and a day at the winter solstice

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[134] NPM 320.6–322.5 (VIII, 846–849); § 846 posed the difficulty with the evidence of different lengths of daylight at different times of year, followed by § 847 with the assertion that observations prove the equality of signs and § 848 with the subsequent evidence of different time intervals spent by the Sun in different zodiacal signs. Finally in §849 he proposed to answer the question by way of an eccentric earth within the solar orbit.

[135] John, *Annotationes*, pp. 176.32–177.8. While John's glosses are all simple definitions or clarifications here, it is noteworthy that his gloss at 177.7 refers to the abbreviation "vv" and expands it to "verbi gratia." Of all the mss. under consideration in our study, only one uses this abbreviation here. Paris 13955, f. 50v margin, writes the abbreviation and "verbi gratia" next to it. This ms. is closely related to BPL 88 and Regin. 1987, but the abbreviation does not occur in those two mss. or in the Vossianus, Besançon 594, BPL 36, or BPL 87. John and the glossator of Paris 13955 may have had access to the same commentary as source.

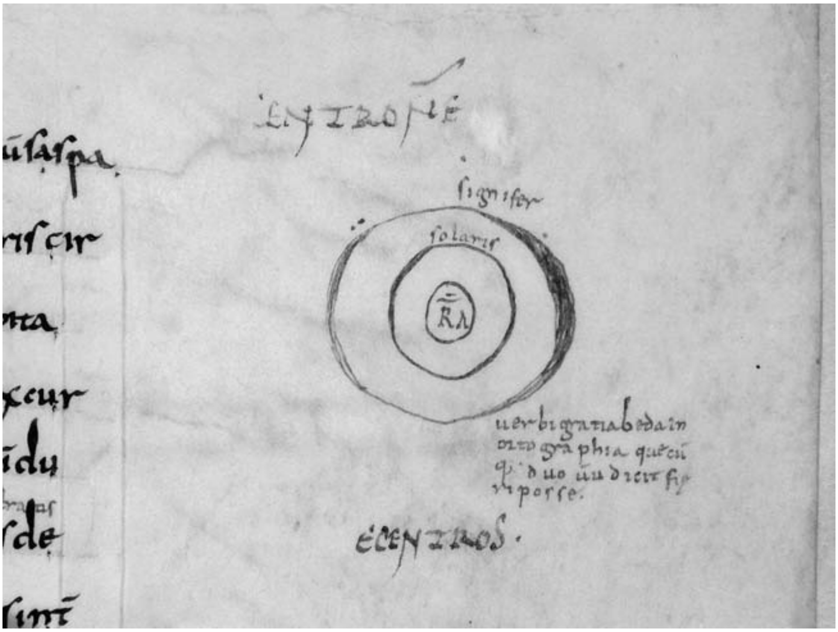

Fig. 4.5. Geocentric Circles for the Solar Orbit and the Zodiacal Circle to Illustrate a False Proposition. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 79r

> has 9–5/6 hours; conversely, winter nights are prolonged, to the length of days at the summer solstice, and summer nights correspond in length to winter days. With such discrepancy (conclusion) in the length of the periods, the natural assumption is that the signs are not to be considered equal. But such a conclusion is refuted by obvious facts (causes) and by our measurements.[136]

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[136] The translation except for the glosses is from Stahl and Johnson, *Martianus Capella*, vol. 2, pp. 329–30. See NPM 320.12–22 (§§ 846–847) for the text. The glossed text from Voss. lat. F.48, f. 78v,15–21, states: "Si spatiis (proponit) aequalibus signa omnia percensentur (numerantur) ac necesse (adsummit) est diebus noctibusque cunctis sena signa supra terras esse, omnes dies noctesque (conclusio) pares esse debuerunt (*marg. gl.* vera propositio sed falsa conclusio). (*marg. gl.* Rethorici sunt isti silogismi quia non habunt igitur.) Sena autem signa superstare non dubium est totidemque delitescere (abscondere), (assumitur quod est posterius ut destruatur quod est primus) dies quoque noctesque variari diversitatibus spatiorum. Nam (scilicet, certum) solstitialis dies habet aequinoctialis mensurae horas xiiii et vi-tantem (id est, sextam partem hore, scilicet, solstitialis), brumalis vero horas viiii et dimidiam ac terciam portionem (scilicet, unius horae). (*marg. gl.* duo su[m]pta) Vicissim brumales noctes solstitialis diei temporibus porriguntur (extenduntur), cuius lucis (scilicet, brumales (*sic*) diei) tempora suscipit nox aestiva. In (conclusio) tanta varietate diversitateque temporum illud profecto colligitur,

This pedagogical concern for logical explication was common, and, where an author proposed questions in terms of assumptions, observations, and necessary conclusions as Martianus did here, Carolingian scholars saw an obligation and an opportunity to dissect the argument for their audience. The second version of the Anonymous offered almost exactly the same glosses as the first version and made two minor corrections in the glosses.[137] Another glossator, from the later ninth century, showed a distinct interest in emphasizing numerical values, converting fractions of hours into unciae, e.g., "dimidiam" equals "vi. uncias," and even claiming to locate himself at a far northern latitude in a gloss that gave the length of daylight at summer solstice as 18 hours. The source of this information may have been Anatolius, Bede, or a calendar, and the latitude of the glossator is uncertain.[138] We also find that this scholar

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signa aequalia non habenda. Cui (scilicet, illorum qui proponunt) conclusioni et rerum (causarum) veritas et nostra regula refragatur (resistit)." I include in parentheses all interlinear glosses and marginal glosses, marking only the marginal glosses as such.

[137] BPL 88, f. 161r. The glossator corrected "brumales" to "brumalis" and "sumta" to "sumpta"; his version of "vera propositio sed falso conclusio" was "vera regula sed falsa conclusio." He emphasized the section by adding the capitalized marginal index, "NOTA. QUID DIERUM SPATIA NOCTIUMQUE DISCERNAT." The glosses in Paris 13955, f. 50r, are closest to these in BPL 88.

[138] BPL 87, f. 123r,22, gloss *ad* solstitialis dies (NPM 320.16): "secundum clima suum loquitur. nam secundum nostrum clima decem et viii horas habet." Ptolemy, *Syntaxis*, II, 6, 25 placed this maximum daylight at 58° N. lat., which is at the northern tip of Scotland, runs just north of Denmark, and touches the northern tip of Gotland in the Baltic Sea. Pliny, NH II, 186–187 referred to the general phenomenon of variation in maximum length of daylight and gave a few examples, including the length of 17 hours "in Britannia." Pliny, NH VI, 211–219, gave maximum lengths of daylight for ten parallels, and the longest he mentioned was the 17-hour daylight "per Hyperboreos et Britanniam" at NH VI, 219. Pliny's information was repeated by Bede, DTR 33, and used in DNR 47, but not extended there to include a day of 18 hours. Pliny also said (II, 219) that "more recent scholars" had added a highest parallel, above Britain and its 17 hours of daylight, running from the Rhyphaean Mountains to the island of Thule, which he placed at six days voyage north of Britain (II, 187) and wrote that at the solstices Thule has either no daylight or no night (IV, 104). In his *Historia ecclesiastica* I, 1 (ed. Plummer, p. 11), Bede gave the maximum length of daylight in Britain—he did not say or imply where in Britain—as 18 hours. He almost certainly drew the data from Anatolius of Laodicea's *De ratione paschali*; see McCarthy and Breen, *Ante-Nicene Christian Pasch*, pp. 52–3, 69–70, 105–11, for text, translation, and detailed explanation of *De ratione paschali* 13. Anatolius applied an old Egyptian tradition of a two-hour increment and decrease per month, giving maximal and minimal values of 18 and 6 hours for the length of daylight, a simple and convenient choice of values, not based on local observation. It is curious that Bede did not use Anatolius's data in his own *De ratione temporum*, if Anatolius was his source. Did Bede later consider Pliny's reports adequate confirmation for this information? It is not likely that Bede made this observation, and he certainly did not calculate it. The glossator of BPL 87 did not make an observation of 18 hours of solstitial daylight, and was not likely located at

barely noted in passing the logical question pursued so diligently by the Anonymous.[139] One further glossator showed little concern for numerical detail and no sign of interest in—perhaps no awareness of—the logical question in the Capellan text, for he appears to have done no more than protest that Martianus's report of the maximum length of daylight at his latitude may have been correct for Africa but not for the glossator's location.[140] When we turn to the glosses of Remigius on the same text, we find that he made extensive use of both versions of the Anonymous and of the glosses in BPL 87 while adding many simple clarifications and synonyms of his own.[141]

In reflecting upon the matter of maximum length of daylight at various latitudes, we must remember that this was not a trivial calculation, since it required spherical geometry. Pliny gave no hint of ability to make such calculations, compiling instead a large number of data from ancient sources. Similarly, Bede collected information from Pliny, rearranging it at times but mentioning no such calculations himself. However, simple linear approximations could be made with the aid of a waterclock. The only mystery in Bede's data is his source for the statement of a length of 18 hours of solstitial daylight in Britain. He may have estimated on the basis of observations in northern Britain. Carolingian scholars had either to gather such information from an ancient (or possibly Byzantine) source or to suppose an approximation on the basis of limited information in a source like Pliny's *Natural History*. They might try approximations using an hourglass or attempt precise observations in conditions that made success very uncertain.

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the latitude for the observation, although he may have come from Britain or Ireland. He may have copied the information from Anatolius, Bede, or a calendar. Notably the gloss uses "clima" rather than "circulus" or "segmentum," the terms found in Pliny and Bede, and may intend a wide band of latitude rather than a particular degree. Precisely the same gloss exists in the commentary of Remigius, *Commentum*, vol. 2, p. 269.25–26. Since we know where Remigius was located, it is clear that he was not recording an actual measurement; he most likely copied the gloss from BPL 87. Clearly Remigius did not understand the local observational significance of the gloss. Should we assume that Remigius found this gloss and BPL 87 at Auxerre? For Britain, at least, these maximum solstitial hours became common by s. XI; see *Aelfwine's Prayerbook*, ed. Günzel, p. 112, #21. For further information on solstitial hours see below, pp. 284–5, nn. 238–239.

[139] The only mention of the logical question appears in the single gloss *ad* signa aequalia non habenda (NPM 320.21): "falsa conclusio" (in BPL 87, f. 123v,2).

[140] BPL 36, f. 109v outer margin, an unkeyed gloss that states, "sicut est in Africa non apud nos." This gloss stands next to the text of NPM 320.14–16, but almost certainly refers to the following sentence that describes the length of solstitial daylight.

[141] Remigius, *Commentum*, vol. 2, pp. 269.5–270.31.

Let us return to the fundamental question posed by Martianus, the varied lengths of the seasons and the eccentricity of the earth to the Sun's orbit in order to explain the phenomenon. We can conclude our survey of the glosses to the text by observing that they are numerous and they attend to grammar and vocabulary almost exclusively, as the text proceeds to describe the path of the Sun through the zodiac in broad strokes, giving a general picture of its passage through each sign in a different length of time.[142]

In his description of the heavens and the stars in the first half of Book VIII, Martianus established for Carolingians an image of the celestial sphere that easily outstripped the creations of both Pliny and Macrobius as a framework for understanding qualitatively the positions and motions of the stars and planets. Assuming a familiarity with the stellar sphere at the level of students who had already studied computus, the commentators on the Capellan *astronomia* could expect their audience to know the names of the zodiacal signs as well as the locations of the zodiacal constellations, the polar stars, and a number of the other constellations.[143] To this basic picture Martianus added reinforcement for the structural elements of the five basic parallels, five great circles, and the risings and settings of constellations. His progress into the relative positions of the earth, the solar orbit, and the circle of signs in order to set the stage to explain the varied lengths of the four seasons took scholars beyond the frameworks provided by computus or Pliny or Macrobius. The planetary astronomy of Martianus would offer Carolingian readers their first approximation of a structure, a set of circular models, to account for the variety of planetary motions—not only for the vagaries of a planet like Mars but also reasoned accounts of phenomena such as the limited elongation of Mercury and Venus from the Sun and the different lengths of the four seasons of the year. The many glosses of the Carolingian commentators, despite occasional errors, on terminology in the *astronomia* made access easier for a new audience and increased its familiarity with astronomy in general. A

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[142] Our focus here is § 849 (NPM 321.9–322.5). For the glosses see Voss. lat. F.48, f. 78v,28–79r,9; BPL 88, f. 161v,2–14; BPL 87, f. 123v,12–22; Paris 13955, f. 50v; Remigius, *Commentum*, vol. 2, pp. 270.32–271.32. John the Scot found little to gloss here, presumably because of the lack of challenging material.

[143] This background knowledge, based on a study of computus, seems assured by the comments of Bede and of Hraban Maur, who wrote of the need to take students out to observe and learn the constellations at night. See Rabanus, *Martyrologium. De computo*, p. 252.3–5 (*De computo*, 40); Hraban composed his computus ca. 820.

modern reader may find tedious or pointless the frequent glosses that provide simple definitions and synonyms for readers, such as *sphaera* = *caelum, ambitus* = *circulus, orbis* = *globus, obliquitas* = *inaequalitas*, and *ecentron* = *extra centrum*. But the familiarity of a Carolingian audience with these and many other terms along with their equivalents made possible a new level of verbal facility on which to build new astronomical understandings.

5. *General Characteristics of Planetary Motion (§§ 850–856)*

Three essential themes dominated the general introduction to planetary motion; first, the distinction of the east-to-west motion of all from the west-to-east motion through the zodiac of each planet at an individual latitude and individual speed; second, the differences between the Sun and the Moon on one hand and the five additional planets on the other; third, the differences between Mercury and Venus, which moved in orbits around the Sun, and the three outer planets, which orbited around the earth. To open the second part of his *astronomia*, Martianus discussed briefly the word 'planet' itself and then presented the names of the five planets other than the Sun and Moon in Latin and transliterated Greek. He used the Latin names much more than the Greek names in his planetary astronomy. From here he launched into the following topics.

1. A general description of the motions of the planets (§§ 850–857)
2. The sizes of the lunar and other orbits (§§ 858–861)
3. The course of the Moon (§§ 862–871)
4. The course of the Sun (§§ 872–878)
5. The other five planets (§§ 879–886)
   The Inner Planets: Mercury (§§ 879–881) and Venus (§§ 882–883)
   The Outer Planets: Mars (§ 884), Jupiter (§ 885), and Saturn (§ 886)
   Visibilities, stations, and retrograde motions of planets (§ 887)

Martianus repeated at the outset a familiar moral from the ancients. The name 'planet' ('planeta') suggests etymologically that these bodies are wanderers. However, he preferred to call them "confusers" ("planontes"), because it is humans rather than the planets that have wandered in their attempts to understand planetary motions, which are definite and orderly. Aratus and Hyginus considered the planetary motions difficult to comprehend but not actually errant, or disorderly, and Martianus agreed. The first version of the Anonymous affirmed this view and included Servius in the group that erroneously claimed the planets are irregular wanderers in the skies.[144] In glossing the Greek names of the five wanderers the Anonymous carefully set down a translation of each to explain its character, whether physical or metaphorical or both. For the first version of the Anonymous they were: Saturn (Phaenon = terrible), Jove (Phaeton = the temperament of light), Mars (Pyrois = fire), Venus (Phosphoros = a wheel or beacon of light), and Mercury (Stilbon = swift flying star).[145]

The general motions of the planets, described by Martianus, were two: first, their revolution in common with the fixed stars once a day from east to west and, second, their individual revolutions from west to east at separate and characteristic speeds. He began his account of these planetary motions with a cosmological justification for the latitudinal motion of planets across the zodiac and for the inclination of the zodiac with all the planetary motions at an angle to the equator. The planets move obliquely so that their motions are not directly contrary to the general east-to-west motion of the celestial sphere, since such directly adverse motions would cause the heavens to crumble. Martianus assumed that only directly contrary motion would endanger the stability of the cosmos.[146] The first version of the Anonymous commentary took this Capellan cosmological statement and converted it into a logical statement, the conclusion of which dissolved the original teleological conception. According to the Anonymous, a part of the whole can not possibly move contrary to the whole, since it will, as part of the whole by definition, move only with the whole. And he continued, reasoning that since the planets are part of the whole cosmos and cannot

144 Aratus, *Phaenomena*, 460; Hyginus, *De astronomia*, p. 136.222–224 (IV, 8); NPM 322.7–10. The Anonymous gloss appears at Voss. lat. F.48, f. 79r,10 (*ad* erroribus [NPM 322.7]: "ut Servius vult et alii").

145 Voss. lat. F.48, f. 79r,12–13 (NPM 322.13–15), followed exactly by Besançon 594, f. 70v. BPL 88, f. 161v, BPL 87, f. 124r, and John, *Annotationes*, p. 177.16–19, are almost the same and differ at a number of points from the Vossianus and Besançon mss. in their translations of the planetary names. Remigius, *Commentum*, vol. 2, p. 272.15–20, collected translations of the planetary names from all the preceding sources. The Greek planetary names were also known to Carolingians from Cicero, *De natura deorum*, II, 52–53.

146 NPM 323.5–7 (VIII, 853): "non tamen adversum mundum [planetae] rigido motu [pergent], sed obliquo per zodiaci defixa moliuntur; alioquin ex contrario partium suarum motu mundus stare non posset."

possibly move against the whole, they must necessarily move obliquely.[147] While the second version of the Anonymous did not preserve this line of argument, John the Scot and BPL 87 did so, offering a modified and more economical form.[148] All these Carolingian commentators focused on the logical formulation of the two motions rather than on the presumed physical problem or the apparently teleological solution, whereby Martianus implied that the deity avoided contradiction and disorder by setting the motions at a significant angle to each other to preserve the stability of the cosmos. Furthermore Martianus as well as these commentators were unable or unwilling to imagine a mechanical solution incorporating two opposed spherical motions at different radial distances and not interacting directly with each other. However, the logical focus of the Carolingians rejected the Capellan implication that the deity could even be confronted by such a cosmological difficulty, arguing instead that the cosmic structure must be logical as the product of a perfectly logical God. We should also recognize that the physical cosmos of the mid-ninth century was dominated by qualities and forces, such as Plinian solar radial forces, and not by geometrical structures, which provided a passive background rather than active concepts for astronomical research. Therefore a Carolingian response to the problem suggested by Martianus would be unlikely at the time of the Anonymous commentary to provide an analysis primarily in geometrical or mechanical terms.

Martianus next set out for assessment a doctrine attributed to "the Peripatetics," that the planets do not move in opposition to the celestial sphere but rather in the same direction, only not quite as swiftly, so

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[147] These outer marginal comments written by the second glossing hand appear in Voss. lat. F.48, f. 79r: "Dicunt Peripatetici quod omne quod suis partibus constat contrariam sui partem abere non potest. Mundi autem partes sunt planete, igitur contrarium cursum ei abere non possunt. Omne quod est aut totum aut pars est. Si totum est, suis partibus constat mundus, autem totum est planete igitur partes mundi sunt, et si nulla pars sua contraria sibi non est, planete igitur contraria mundus motu abere non possunt, obliqui igitur moventur." They do not appear in the other ms. of the first version, Besançon 594, nor do they appear in the two mss. of the second version.

[148] BPL 87, f. 124r outer margin: "Una res contraria sibi esse non potest, quia totus mundus cum suis elementis quasi una res est. Et non habet contrarium in se. Ideoque non recto cursu planete contra mundum currit sed obliquo, ne contrarium in una re sit." John, *Annotationes*, pp. 177.31–178.2: "Una res sibi ipsi non potest esse contraria; una res est mundus et ideo planete non e contrario currunt recto motu sed oblique ne contrarietas in una re sit." Remigius, *Commentum*, vol. 2, p. 273.13–16, repeated the interlinear gloss of BPL 87 here and added a comment composed from the comments we have quoted from BPL 87 and John.

that each planet gradually falls behind the stellar sphere at a fixed rate specific to that planet. He used the two extreme planets, Saturn and the Moon, to illustrate his point. According to this doctrine Saturn moves almost as fast as the celestial sphere while the Moon moves so slowly that it falls back a complete revolution in less than 30 days.[149] However, the statement of the Peripatetic doctrine began with the note that it was only being assumed for the moment, and Martianus promptly returned to the generally accepted view, that the Moon is far swifter than the other planets because of its smaller orbit and that all move in opposition to the celestial sphere with Saturn taking the longest time for one revolution because of the tremendous size of its orbit. Both versions of the Anonymous glossed 'Peripatetics' as "a part of the Platonists," a gloss which received the complementary note by one glossator that Aristotle was the head of the Peripatetic school.[150] However, the initial gloss subordinating the Peripatetics to Platonists received mixed acceptance in later commentaries, being tacitly rejected by John the Scot and adopted and expanded by Remigius.[151]

As Martianus embarked on his description of the actual motions of the planets, he pointed first to the general west-to-east motion of all seven, added the existence of retrograde motions and stations for only five of the planets, not the Sun or the Moon, then asserted that the Sun and the Moon eclipse each other ("vicibus") in turn while no other planet is ever eclipsed. This is, of course, a misstatement on two counts. The Moon can eclipse the Sun, but the Sun never eclipses the Moon. The Anonymous (although only in a later gloss), John the Scot, and Remigius all caught and commented upon this error.[152] However,

[149] NPM 323.7–13 (VIII, 853). John, *Annotationes*, p. 178.4–9, stated more explicitly how this doctrine would have the Moon move.

[150] Voss. lat. F.48, f. 79r,20; BPL 88, f. 162r,8–9; for the gloss "pars Platonicorum." At Voss. lat. F.48, f. 79r outer margin, the second hand in this ms. adds a gloss, "Aristo[te]les princeps fuit perip[at]et[icorum];" this gloss does not appear in Besançon 594 or in the mss. of the second version of the Anonymous.

[151] It does not appear in BPL 87 or in John the Scot, who showed great interest in anything relating to Plato or Platonists in his commentary. We do find the gloss in Paris 13955, f. 50v. In Remigius, *Commentum*, vol. 2, p. 273.19–20, it was expanded to: "Peripathetici enim discipuli Platonis maxime disputant in deambulando," a combination of the Anonymous and John; Remigius then added verbatim John's text regarding the Moon's hypothetical motion according to the Peripatetics; cf. John, *Annotationes*, p. 178.4–9, and Remigius, *Commentum*, vol. 2, p. 273.20–24.

[152] Gloss *ad* vicibus (NPM 323.20). Voss. lat. F.48, f. 79r outer margin (the second glossing hand): "Vicibus. Ideo dixit quia putavit quod eclypsis lunae sol esse, solis item luna. Sed non ita est solis enim eclypsis luna est luna vero obiectio terrae." This gloss

the claim that no other planets ever suffer occultation was passed by in silence by the Anonymous and John, while Remigius glossed this misstatement with an affirmation of the error.[153] It is worth remarking that no glossator contributing to the compilation of the Anonymous nor John the Scot seems to have encountered extant Carolingian records of observations of planetary conjunctions, which should have suggested the real possibility of occultation.[154] At least none of our commentators mentioned this, and Remigius positively ruled it out by agreeing with Martianus.

In his designation of the general motions of the planets, after mentioning eclipses, Martianus turned to the last and perhaps most peculiar with a mention of Venus and Mercury. Unlike the other five planets, which are circumterrestrial, these two do not circle Earth. He then laid down further conditions about the planets before describing how Venus and Mercury do move.[155] The two fundamental conditions were (1) that the earth is eccentric to all the planetary orbits, and (2) that all seven planets make daily changes in their positions and orbits. Regarding the second condition, since each planet rises at a different position each day, Martianus said that we can find each planet traveling a different latitudinal circle, or parallel, around the earth each day, the total number of these circles in a complete orbit being determined by the orbital speed of the planet around the earth. The Sun describes 183 of these day circles from summer to winter solstice and then repeats in reverse the same number of day circles in returning from winter to

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does not appear in the second version of the Anonymous. John, *Annotationes*, p. 178.9–19, elaborates and makes much clearer the point of the Anonymous gloss: "VICIBUS ac si dixisset: Sicut terra aufert lumen solis a luna ut defitiat, ita luna aufert lucem solis a terra ut non appareat sol in quibus partibus terre in die eclypsis solis fit quando luna est in coitu, non quia deficit sol sed quia radii eius propter lunam interpositam non veniunt in quasdam partes terrae. Lunae vero eclypsis fit quando plena est, et illa deficit quia radii solis ad illam non possunt venire propter terram. Luna enim a sole illuminatur." This gloss of John should be separately indexed as 449, 25 in Lutz's edition. Remigius, *Commentum*, vol. 2, p. 274.12–19, repeats John verbatim.

[153] Ibid., p. 274.20–21: "QUINQUE VERO SIDERA NESCIUNT OBUMBRARI id est non patiuntur eclypsin."

[154] Lohrmann, "Alcuins Korrespondenz mit Karl," in *Science in Carolingian Times*, pp. 113–4, reports from three ninth-century mss. of Bede's DTR the conjunction of Saturn and Jupiter in Cancer in the year 770; Lohrmann also mentions the assertion (unacceptable to moderns) by the chronicler known as "Astronomus" in the *Annales regni Francorum* that the planet Mercury crossed the face of the Sun in 807. Such reports, although not strictly of occultations, would seem to indicate the possibility of planetary occultations by Carolingian criteria.

[155] NPM 323.21–22 (VIII, 854).

summer solstice. Because Mars requires two years to complete its orbit around the earth (and through the zodiac), whereas the Sun needs only one year, Mars will travel along twice as many parallels before completing its orbit. Similarly Jupiter will have twelve times as many day circles, and Saturn will have twenty-eight times as many. This rather elaborate description by Martianus received Carolingian glosses that attended primarily to the numbers involved rather than to the spatial arrangement. The first version of the Anonymous simply remarked that a full day circle, number 183, was added for the one-fourth of a day at the end of each year. John the Scot composed a slight expansion of the same point as made by the Anonymous, and apparently misled Remigius into thinking that the basis for the 183 circles was the extra day of the leap year, accumulated every fourth year. Remigius certainly explained the numbers this way and seems to have forgotten that the extra circle, number 366, would be added each year rather than every four years.[156] The second version of the Anonymous glossed only the number for Mars. Above the number of circles he added "366" ("id est, ccclxvi") for the number that Mars would describe in half of its orbit, and a later Carolingian commentary glossed the same word but gave the number of circles transited over a full cycle of Mars.[157] The attention paid here by Remigius to an added circle for leap year is one small testimony to the continued awareness of many Carolingian students of astronomy to calendrical matters and suggests what we might call a computistical, as opposed to geometrical, sensibility in certain astronomical discussions.

[156] NPM 324.4 presents the number as a continuous Roman numeral. Voss. lat. F.48, f. 79v,3 gives it as "CLXXX & III," which fits better with the readings of John and Remigius. At this point the Vossianus shows the Anonymous interlinear gloss: "bis accipere addito quadrante." John, *Annotationes*, p. 178.17–18, reads: "CLXXXIII CIRCULOS Tres ideo dixit propter quadrantem quem accepit pro integro die." Here the "whole day" John mentions is for the annual ¼ day and is represented by the final, 183rd circle. Remigius, *Commentum*, vol. 2, p. 274.31–34, reads: "CLXXX ET TRES CIRCULOS HABERE SOLEM quot habet in ascensu, tot in descensu, id est CLXXXIII in ascensu et totidem in descensu. Tres addidit propter bissextum qui fit ex quadrantibus quarto anno." Remigius has interpreted the number 183 differently than the Anonymous and John but has not changed the practical result of 366 circles per year. Remigius has misunderstood John to have meant the quadrennial accumulation of one full day that makes a leap year.

[157] BPL 88, f. 162v,6. This version of the Anonymous also took care to gloss quantities here as follows: *ad* octies vicies (NPM 324.7–8): "i. xxviii;" *ad* uno signo (NPM 324.14): "i. triginta partibus;" *ad* parte dimidia (NPM 324.15): "i. xv partibus." BPL 87, f. 124v, offered the gloss *ad* duplos circulos (NPM 324.7): "i. dccxxxii;" that is, 732 circles traveled by Mars over one complete orbit.

6. *The Circumsolar Motions of Mercury and Venus (§ 857)*

Returning to his introduction of the peculiar situation of Mercury and Venus, Martianus reported, "Their circles do not enclose the earth in any way, but they travel around the Sun in a wider path" ("...eorum circuli terras omnino non ambiunt, sed circa solem laxiore ambitu circulantur").[158] Where he found this important theoretical statement Martianus never said. What becomes clear in reading further is that he believed it to represent the real paths of these two planets, not just a convenient geometrical pattern that would save the appearances. There are many avenues to explore for meanings and ramifications of this theory of circumsolar Mercury and Venus, but we shall focus here on the exact Capellan texts and their Carolingian glosses, including diagrams.

The *astronomia* of Martianus varied somewhat in its wording for the orbits of Mercury and Venus, so we begin with the text as it appears for the Anonymous commentary.[159] In the translation below we have marked with asterisks the variants found in the Vossianus manuscript, representing the first version of the Anonymous.

> Now although Venus and Mercury display daily risings and settings, nevertheless their circles do not in any way enclose the earth but instead circle around the Sun in a wider path. The center (*centron*) of their singulars* is set in the Sun so that they are sometimes above it, more often inside* it and closer to the earth, and from it Mercury* extends one sign and a half. But when they are above the Sun, Mercury is closer to the earth, when inside the Sun, Venus, inasmuch as the orbit is both limited* and wider.[160]

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[158] NPM 324.11–12 (VIII, 857). For exploration of the early medieval tradition of circumsolar Mercury and Venus according to Martianus Capella, see especially Eastwood, " 'The Chaster Path of Venus'," in idem, *Astronomy and Optics*, ch. 2; idem, "Astronomical Images and Planetary Theory," in idem, *The Revival of Planetary Astronomy*, ch. 7. I limit the current study to details of the Carolingian mss. of Martianus and their glosses.

[159] In *De nuptiis*, VIII, the orbits of Mercury and Venus are described first, together, in section 857 (NPM 324.10–17) and later, separately, in sections 879–883; in the latter place many attributes of their orbits are described. Their circumsolar paths receive most discussion by Carolingian commentators at the initial presentation, where they are thematically linked.

[160] Voss. lat. F.48, f. 79v,7–11. In the following transcription, at each place marked with an asterisk in the translation above, I add in parentheses the preferred choice in the modern edition of Willis (324.10–17) and in brackets Willis's addition to the text as it appears in the Vossianus. "Nam Venus Mercuriusque licet ortus occasusque cotidianos ostendant. Tamen eorum circuli terras omnino non ambiunt, sed circa solem

We want to understand how the Anonymous handled this text, including its divergences from the established modern text. In the glosses we can see immediately some misdirections and lesser difficulties for Carolingian readers. The first comment attempted to explain why these two inner planets circled the Sun rather than the earth. An interlinear gloss said simply that it was because the Sun is larger than the earth, while a marginal comment compared the sizes of the orbits of the other planets to these two and said that the others are larger orbits in all ways except perhaps in one way, since we would say, if we were to use Pliny's data, that the latitude of Venus extends beyond the twelve degrees of the zodiac.[161] The absence or omission of this comment from every other Carolingian commentary at this point indicates that it was considered unhelpful.

Here we have a prime example of what could go wrong in the copying of existing glosses, especially when the scribe was not simply a copyist but also an active glossator and commentator himself. The glosses in many ninth-century commentaries at this point make clear what happened. In the first sentence in the translated text we find, "…Venus and Mercury…circle around the Sun ("solem") in a wider path ("laxiore")." The text from which the first Anonymous copied evidently had the gloss "quia maior solem quam terra mutabili" ("variable, because the Sun is larger than the earth") above the two consecutive words "solem laxiore." The gloss was intended for "laxiore" alone. The Anonymous commentator did not understand that there was one, continuous gloss and separated it into "quia maior solem quam terra" and "mutabili," attaching the first to the word "solem" and the second to the word

laxiore ambitu circulantur. Denique singulorum (circulorum) suorum centron in sole constituant. Ita ut supra ipsum aliquando, intra (infra) plerumque propinquiores terris ferantur. A quo quidem uno signo et parte dimidia Mercurius, [Venus vero XLVI partibus] disparatur, sed cum supra solem sunt, propinquior terris est Mercurius, cum intra solem, Venus, utpote que orbe castioque (vastiore) diffusioreque curvetur."

[161] Voss. lat. F.48, f. 79v outer margin: "Maiori spatio circulorum aliarum enim planetarum circulorum spatium circa terram undique secus amplitudinem ____ arum autem duarum inter terram et celum quod est maioris spatii forsitan igitur hoc de Venere intelligi potest excedit signiferum." Both this and the interlinear comment, "quia maior sol quam terra," are by the second hand in this commentary and do not appear in Besançon 594. In fact, neither the interlinear nor the marginal comment of the Vossianus appears in the mss. of the second version of the Anonymous, nor in BPL 36, BPL 87, or Paris 13955. In John the Scot, *Annotationes*, p. 178.24–25, we find the gloss *ad* laxiore: "id est maiore, vel ideo dicit quia sol maior est quam terra." In Remigius, *Commentum*, vol. 2, p. 275.14–15, *ad* laxiore: "maiore, ampliore, vel digniore. Ideo dicit quia sol maior est quam terra."

"laxiore" as synonym. This misunderstanding led this second glossing hand in the Vossianus to develop the marginal comment we have mentioned that compared the sizes of the orbits of Mercury and Venus to those of the other planets in an elaborate attempt to explain why the two planets circled the Sun rather than the earth, where the original form of the Anonymous (no longer available to us) neither conceived not tried to answer such a question. However, later commentators did not make the same error. Instead, they ignored the word "mutabili" and focused on the "quia maior sol quam terra," which they applied in one form or another to "laxiore" ("wider") in the text of Martianus.[162] With the common result being the interlinear gloss "maiore" ("larger") for "laxiore," these later glosses avoided the error of the Vossianus glossator, but they did adopt the causal emphasis of the phrase "quia maior sol quam terra" ("because the Sun is larger than the earth") and emphasize that therefore the circumsolar planets follow a "maior" ("larger") circle around the Sun. At the same time, these commentators offered no reason why the greater size of the central body, the Sun, should require larger orbits for its satellites.

As we have seen, the first Anonymous version considered 'variable' ("mutabili") rather than 'larger' to be the best sense of the adjective "laxiore" in the text. The first Anonymous apparently read right through the copying error in their Capellan text that presented "singulorum" ("singulars") for "circulorum" ("circles"), understanding immediately what was needed here. A gloss then repeated in slightly different words the main point, that "the Sun is indeed like a center" ("est enim sol quasi centrum"), ensuring that a novice would not mistake this unfamiliar doctrine. Next, a modest difference appeared in the first version's text of "intra" for "infra" in relation to the Sun; "intra" clearly puts the planet inside the Sun with respect to the earth, while "infra" puts the planet 'below' the Sun, which might be ambiguous.

[162] Voss. lat. F.48, f. 79v,9, placed "mutabili" above "laxiore" and subsequently crowded "quia maior sol quam terra" into the inadequate, preceding space above "sol." Besançon 594, f. 71r, carries the same gloss to "laxiore" and none in the preceding space. BPL 36, f. 110v, glossed "laxiore" as "maiore quam sol." BPL 87, f. 124v, BPL 88, f. 162v, and Paris 13955, f. 51r, glossed "laxiore" as "maiore." The comments of John and Remigius appear in our previous note. The replacement of this gloss above the word "laxiore" by all commentators other than the first Anonymous version seems to have followed from a different exemplar of the Anonymous commentary. It gave a clear meaning to "laxiore" and indicated why the relative sizes of the earth and Sun pertained here.

The major difficulty for the Anonymous commentators in this section on the circumsolar planets was handling the topic of the limited elongations of Mercury and Venus from the Sun. The apparent distance that each of the circumsolar planets diverged from the Sun before turning back towards it would determine which planet had the smaller circle around the Sun. The result would support one or another tradition on planetary order. The Anonymous and John the Scot, it turns out, were more successful than Remigius in dealing with the question of bounded elongations.

The text presented the statement that Mercury can extend as far away as one and one half signs from the Sun, a statement which we now know occurred because of an error in the manuscript tradition. But what did our commentators know? They did not consider it obvious that an error had occurred, but this applies only to this place in the *astronomia*. They knew the limits of elongation for both Mercury and Venus from the Sun according to Pliny's *Natural History*, Bede's *The Nature of Things*, and the Seven Book Computus of 812 (in the chapter *De positione et cursu planetarum*). In all these places the composers of the Anonymous commentary could read that Mercury never appears farther than 22° from the Sun and Venus never appears farther than 46° from the Sun.[163] Yet almost all surviving manuscripts of the *astronomia* written before the end of the ninth century preserve without correction or comment the erroneous interval of one and one half signs from the Sun to Mercury at its maximum elongation.[164] Presumably, one reference for correcting an erroneous reading here should have been

[163] Pliny, NH II, 38–39. Bede, DNR, 13. For the Seven Book Computus, see above, p. 104.

[164] In more precise detail, BPL 88, f. 162v,12, has in the original text line the abbreviation "ven" for "Venus," but this has been crossed out and "mer" for "Mercurius" has been written above it by a hand different from and apparently preceding the copying of the interlinear glosses of the Anonymous. Vat. Regin. 1987, f. 128r,12, has a lacuna at this point in the text and a marginal insert with "mercurius." The reading "mercurius" appears in BPL 87, f. 124v,13; Paris 8669, f. 107r,6; and London Harl. 2685, f. 93va,22. Oxford Laud. 118, f. 77v,22 (s. IX ex.) has "mercurius" in the text with underlining (indicating corrigendum) and "venus" added above it by the copyist for the text. In Paris 8670, f. 103v,25 (s. IX m.), a later interlinear gloss reads "venus" above "mercurius" in the text line. Paris 13955, f. 51r,12, has "venus" in the text and thus presents an essentially correct report. The earliest ms. with a text clearly like that reported by the editor Willis (at 324.15) is Bruxelles 9565–9566, f. 173v,1–2 (s. IX 4/4): "...signo et parte dimidia mercurius venusque disparatur." A Reichenau ms., Karlsruhe Aug. LXXIII, f. 93r,36 (s. IX 2/4) has "mercurius" on the text line with underlining and "venus" written above it.

the later discussion by Martianus of each planet's orbit in detail. For Mercury and Venus this occurred at sections 879—883 where, in the modern edition, we can read that Mercury never extends more than 22° away from the Sun, while Venus has a maximum elongation of 46°.[165] Unfortunately, for this portion of Martianus's text almost all the manuscripts we have from the ninth century present the correct elongation for Venus but the wrong elongation, 32°, for Mercury.[166] Our survey of these manuscripts shows that only one early manuscript, apparently not widely known, offered the correct elongation for Mercury at both locations in the text; this is the copy from Reichenau, on the Bodensee. The extant copy next in time with correct readings at both locations in the text is Paris 13955, which contains a textbook of the quadrivium, including our heavily glossed copy of the *astronomia* from the third or fourth quarter of the ninth century with many readings from the Anonymous commentary. This manuscript is later than our two versions of the Anonymous, leaving the glossators for the two versions without any clear guide for the teaching of Martianus on Mercury's maximum elongation. The approach of the Anonymous commentary to this situation was not to reject but to accept the excessively large intervals stated in the available text, one and one half zodiacal signs at one point and 32° at another point, and to proceed to explain what the over-sized interval of 32° meant. The first interval, one and one half signs, was simply passed over by the Anonymous in silence, leaving us with no clear understanding of exactly how the commentators perceived this datum. However, awareness by the first version Anonymous commentators of the correct elongation of Mercury from the Sun appears in a marginal comment on Book I of *De nuptiis*, where they state the interval of 22° unambiguously.[167]

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[165] NPM 333.16 (Mercury), 334.16 (Venus).

[166] We should note here that the Anonymous commentary offers extensive comment at this later location in the text in order to explain how the 32° is possible. This elongation for Mercury is reported by Voss. lat. F.48, f. 81v,13; Besançon 594, f. 73r,16; BPL 88, f. 128r,3 (a lacuna in the text, interlinear gloss of "xxxii"); Vat. Regin. 1987, f. 131r,29; BPL 87, f. 166r, 17–18; Oxford Laud. 118, f. 79v,6; Paris 8669, f. 109v,10–11; Paris 8670, f. 106r,20; London Harl. 2685, f. 95ra,5–6. The early Reichenau ms., Karlsruhe Aug. LXXIII, f. 95v,10, reads "xxii partes," and Paris 13955, f. 53r,12, also has "xxii partes."

[167] Voss. lat. F.48, f. 2v outer margin, in agreement with Besançon 594, f. 1v: "Et tunc quasi mercurius matrem salutat quando cum sole in tauro moratur quia secundum veram astrologiam nunquam longius a sole nisi viginti duabus partibus distat." In another marginal gloss (*ad* apollinis; NPM 5.18), at f. 3r and f. 4r respectively in

John the Scot's reactions to the text in the two locations in Book VIII let us know that he took into account the correct elongations for both Mercury and Venus even though we do not know exactly what text appeared in his copy of *De nuptiis*, since his is a running commentary rather than a glossed text. To the text of *De nuptiis* VIII, 857, John responded, "Now 'a sign and a half' signifies 46° [rather than 45°], because there are also signs in which the Sun remains 32 days."[168] At this point we are not told which planet or planets are involved, but John's use of the interval for Venus's elongation suggests that he had Venus alone in mind or else both circumsolar planets together. Similarly in commenting on VIII, 880, John clearly had a text that assigned Mercury an interval of 32°, but he referred first to an alternative interpretation of this interval that denied it the standard meaning of elongation and then made clear that the elongation of Mercury from the Sun was not more than 22°.[169] When Remigius came to comment on this text assigning 32° to Mercury (VIII, 880), he avoided accounting for the quantity and said simply that it meant one zodiacal sign plus two degrees in the next sign. To this he added a few lines later, ignoring John's correction and without any notice of the problem involved, that 32° is the elongation of Mercury from the Sun.[170] It is surprising

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the two mss., Mercury's elongation "xxii partibus" appears again in the Anonymous. BPL 88, f. 5r outer margin, gives Mercury's elongation as 22° in a comment repeated verbatim by BPL 87, f. 4v upper margin *ad* aberrare (NPM 5.19). John, *Annotationes*, p. 14.30–34, does not say this and reports the limit of 30° (at NPM 5.20) given by the *astrologi*. However, at this point in the other version of his commentary on Book I, found in the Bodleian ms. Auct. T.2.19, f. 6v, John wrote, "Venus elongatur a Sole plus quam spatium unius mensis, id est quadraginta sex partibus; Mercurius vero elongatur a Sole viginti duabus...." See the edition by Jeauneau in *Quatres thèmes*, pp. 91–166, at 114; at pp. 94–5, n. 13, Jeauneau supports the view that the two versions of this commentary represent different selections from one commentary. At least with regard to the two contradictory statements on Mercury's elongation, this view of John's commentary seems insupportable. Remigius, *Commentum*, vol. 1, p. 82.7, used John's elongation of 30°.

[168] John, *Annotationes*, p. 178.28–30: "Nam XLVI partes signum et dimidium significant quia sunt quoque signa in quibus moratur sol XXX duabus partibus." At this point Bern 331, f. 77v,53, has "xxxiii" where Paris 12960, f. 105r,23, has "xxx duobus [dies]"(?), which a different hand has emended to "xxx duabus partibus." The modern editor has preferred the latter, emended text, which means degrees. Bodleian ms. Auct. T.2.19, f. 134r,3–5, is the same as the Paris ms. and has "xxxii-bus partibus." The topic of varying lengths of time spent by the Sun in different signs is treated elsewhere in Martianus's text and by the commentaries.

[169] Ibid., p. 184.28–29. Paris 12960, f. 107r,9–10, has "...nam ibi non elongatus plus quam viginti partibus et secundum alios xxii-bus."

[170] Remigius, *Commentum*, vol. 2, p. 290.5–6, glosses NPM 333.16 (*ms.* xxxii partes),

to find that Remigius, who seems to have had access to a variety of prior Carolingian commentaries as well as to the texts of Pliny and/or Bede regarding this topic, left readers with inadequate instruction on the confused Capellan manuscript teachings about Mercury's elongation from the Sun.

7. *Three Versions of Circumsolar Motion for Mercury and Venus (§ 857)*

If we now return to the Anonymous commentary's attention to the relative paths of Mercury and Venus around the Sun, we find that the elongation of Mercury from the Sun was a prelude to a more obvious problem—one which the commentators could not avoid. Martianus described how each of the two planets stood with respect to the Sun, the earth, and the other planet at two positions, first above the Sun and then between the Sun and the earth. Confusion about the precise spatial relationships, especially in the subsolar positions, was exacerbated by a peculiar, although unchallenged, adjective describing the planetary circles. And a marginal comment, brought over with the rest of the commentary from its prototype, heightened the confusion. To dispel the confusion the Vossianus glossator added diagrams, a solution adopted by almost all the Carolingian manuscripts of the Anonymous commentary.

The last sentence of our translation is the framework for the confusion and for the solutions presented by the Anonymous. We repeat the sentence, "But when they are above the Sun, Mercury is closer to the earth, when inside the Sun, Venus, inasmuch as the orbit is both limited and wider." This sentence appears in the Vossianus with interlinear glosses, one long marginal comment, and three related marginal diagrams.[171] First we give the sentence with glosses, then the marginal comment and the diagrams. "Sed cum supra solem sunt propinquior

restating the quantity. Subsequently Remigius (*Commentum*, vol. 2, p. 290.12–13) glosses NPM 333.19 (*ms*. partium xxxii) thus: "scilicet suarum quibus a sole distat." Also, Remigius, *Commentum*, vol. 1, p. 82.6–7 (NPM 5.20), followed John's gloss at this point in Book I in not questioning the assignment of a thirty-degree elongation of Mercury from the Sun. Remigius ignored the Anonymous here and did not use the alternate version of John's commentary, found in the Bodleian ms. See above, n. 167.

[171] Voss. lat. F.48, f. 79v,11. The marginal comment is keyed to "est mercurius" in the text, and the three diagrams clearly relate to the line of Capellan text by way of the marginal comment.

terris (id est, soli) est mercurius,* cum intra solem venus utpoteque orbe castioque (angustioreque inferius) diffusioreque (superius) curvetur." The glosses, set here in parentheses, show immediately some of the cause of confusion. The gloss to "terris" resets the reference point from earth to Sun and directs the reader to think of Mercury as being closer to the Sun rather than to the earth when the two planets are above the Sun. This creates no difficulty when the two are above the Sun, but the next phrase leads the reader to relate the planets to the Sun again, with Venus closer when they are below the Sun, thus inverting the subsolar order of the planets. We now have the combined subsolar and suprasolar orders of the three bodies from the earth outward as follows: earth—Mercury—Venus—Sun—Mercury—Venus. The result requires intersecting orbits of Mercury and Venus, if we draw circles for their paths around the Sun, and we should wonder why the Anonymous glossed "terris" in this way. The reason was the marginal comment, which was added before the diagrams and presumably before the interlinear glosses, because the marginal comment directed the reader to replace the "terris" with "soli." The diagrams were then invented for the commentary as it appears in the Vossianus.

In addition to the redirecting comment and gloss, the word 'castior,' not accepted by current modern editions, presented a small difficulty for the Carolingian reader, but glossators from the Anonymous onwards consistently interpreted the word as 'more restricted' or 'closer' with regard to the relative position of Venus when between the Sun and the earth.[172] In this set of glosses we can see all interpretations working to support the apparent meaning of the marginal comment that Mercury would be closer to the Sun only when above the Sun. This marginal comment deserves close attention not only for our understanding of the interpretations of Martianus's text but also for clues about the larger framework of knowledge brought to bear upon the text. The marginal comment reads as follows.

> If one wished to show the order of the planets according to Plato, the "terris" ('to the earth') can stay in this sentence. If, in fact, we prefer to assume the order of the planets according to the Pythagoreans and Pliny,

[172] NPM 324.17. (Willis, like Dick, accepted the editorial emendation, 'vastior' for 'castior,' of Kopp in 1836 against all manuscript readings.) For more detail on this ms. reading, see Eastwood, "The Chaster Path," pp. 147–9.

> we can never understand this unless the "terris" is removed so that the sentence is written thus: 'when they are above the Sun, Mercury is closer,' so that '[closer] to the Sun' is understood.[173]

This comment proposed the following doctrinal background. First, that Plato's planetary order was known (Moon—Sun—Mercury—Venus), and that the unglossed and unemended text of Martianus was adequate to describe it. Second, the planetary order of Pliny (Moon—Mercury—Venus—Sun) was the same as that of the Pythagoreans (the same order attributed to "certain Pythagoreans" by Calcidius, *Commentarius*, c. 72), and the comment offered an emendation of Martianus's text to describe the Plinian-Pythagorean order. Third, the comment implies that this Plinian-Pythagorean order is more appropriate in the Capellan text, presumably because Martianus agreed with the latter planetary order. As a result, a glossator might attempt to remove the "terris" from the text, but the more economical and preferred act was to add an interlinear gloss to achieve the same effect. The first Anonymous version glossed the text 'nearer to the earth' with the phrase 'that is, to the Sun.' The second Anonymous version initially glossed 'nearer to the earth' with the phrase 'or the Sun,' and subsequently the Latin 'terris' was crossed out and replaced by 'ei,' which produced the new

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[173] The precise wording of this marginal comment varies among the mss., raising questions about the sequence and lines of affiliation in the Anonymous commentary. The more common text of the comment appears in the second version of the Anonymous and later, reading as follows. "Si secundum platonem ordinem planetarum voluit ostendere in hac sententia terris potest stare. Si vero pytagoricos pliniumque secundum ordinem planetarum velimus assumere, nunquam intelligere poterimus nisi ablatum fuerit terris ut sic sententia scribatur, sed cum supra solem sunt, propinquior mercurius, et subaudiatur soli." For this, see BPL 88, f. 162v outer margin; Regin. lat. 1987, f. 128r inner margin; Paris 13955, f. 51r lower margin. The comment does not appear in any form in BPL 36, BPL 87, Oxford Laud. 118, Paris 8669, or Paris 8670. Voss. lat. F.48, f. 79v outer margin, reads the same except for one verb, one conjunction, and word order: "Si secundum platonem ordinem planetarum voluit ostendere, in hac sententia terris potest stare, si vero secundum pitagoricos pliniumque ordinem planetarum velim assumere, nunquam intellegere poterimus nisi ablatum fuerit terris ut sic sententia scribatur, sed cum supra solem sunt propinquior mercurius est, ut subaudiatur soli." The verb "velim" here was read as "velimus" and the final "ut" as "et" in the second Anonymous version. The second version also placed "secundum" in the position before "ordinem" instead of before "pitagoricos." Besançon 594, f. 71r margin, followed its twin in the Vossianus with the verb "velim," but, curiously, placed the word "secundum" in both locations, before "pitagoricos" and before "ordinem." Finally, because of the verb "poterimus" in the comment, we assume that "velim" is incomplete and should be "velimus," suggesting that BPL 88 may have copied more correctly from the original Anonymous composition than the glossator of the Vossianus at this point.

text, "but when they are above the Sun, Mercury is closer to it...," following exactly the directions of the marginal comment.[174] John the Scot did not bother to reproduce this marginal comment, nor did later ninth-century manuscripts containing major portions of the Anonymous commentary. The overall result is that the marginal comment plus the interlinear glosses in the two versions of the Anonymous commentary produced a broad acceptance of the new meaning of the text and in many cases an acceptance of a revised text as well, replacing the "terris" with "ei" and/or "soli." In a spirit of pedagogical thoroughness, Remigius offered a series of short glosses ensuring that the text at this point would be read in a way requiring intersecting circles for Venus and Mercury around the Sun.[175]

Was the revised text of Martianus sufficiently clear for the commentators of the first two versions of the Anonymous? They seem to have agreed that one or more diagrams would be needed. The most elaborate and intriguing set of diagrams is the trio created for the Vossianus. We can be fairly certain that these three diagrams illustrating the possibilities posed by the text of Martianus plus the marginal comment were original creations of the director of this copy of the commentary. After the marginal comment had been copied into the manuscript by one writer, a second scribe drew immediately below the comment a design of the circles of Venus and Mercury around the Sun as imagined according to the revision of Martianus's text (Figure 4.6). The figure shows two intersecting planetary circles with neither one centered on the Sun. The two circles, roughly drawn, are approximately the same size. The order of the planets outwards is: Mercury—Venus—Sun—Mercury—Venus. The image is labeled 'according to Martianus' by its scribe.

[174] Voss. lat. F.48, f. 79v,11, and Besançon 594, f. 71r,17, *ad* terris: "id est, soli." BPL 88, f. 162v,13: "ei" is inserted by another hand between the interlinear gloss "vel solis" and "terris," which has been crossed out in the line of text. Regin. lat. 1987, f. 128r,12, has a lacuna at this point, with the text provided in the outer margin: "Sed cum supra solem sunt, propinquior est ei [Mercurius]." This was obviously copied from BPL 88 after the final gloss "ei" was inserted. By the time BPL 36 was glossed late in the ninth century, the text line had become "ei" instead of "terris," and the interlinear gloss to "ei" was "id est, soli." BPL 87, f. 124v, has an erasure where "terris" would be, and "id est, soli" is the gloss.

[175] Remigius, *Commentum*, vol. 2, p. 275.23–24, *ad* propinquior est ei mercurius, cum intra solem, venus (NPM 324.16–17): "PROPINQUIOR EST EI scilicet soli, MERCURIUS, CUM INTRA SOLEM scilicet sunt. VENUS scilicet propinquior est soli." See p. 257, n. 185 below for John's sole comment on NPM 324.16–17.

Not satisfied with the clarifying diagram for the glossed, revised text of Martianus, the designer created a distinctive picture of the same planets according to Pliny (Figure 4.7), because he realized that Pliny's text would not support the same diagram that had been drawn for Martianus. The new diagram is labeled as being in accord with Pliny and Pythagoras, and it was placed in the closest location available on the page when it was created, that is, after the other marginal comments had been written. This figure indicates that the designer had detailed knowledge of Pliny's text, although the design itself must have raised eyebrows among the earliest audiences for the figure. It shows both Mercury and Venus as pendant arcs, not complete circles, from the Sun's circle around the earth. Mercury hangs much lower than Venus, and the arc of Venus meets the circle of the Sun on either side at points farther from the Sun than the meeting points of Mercury. That is to say, the two planetary arcs intersect, Mercury comes closer to the earth, and the bounded elongation of Venus from the Sun is notably greater than the elongation of Mercury. An inquiry into Pliny's *Natural History* to discover the origin of such a design as Figure 4.7 leads us to just one place. In discussing Venus and Mercury, Pliny rather obscurely described them as below the Sun, having certain intervals away from the Sun, their paths oscillating back and forth to either side of the Sun, and never crossing the Sun.[176] The designer for the Vossianus diagram has read this text from Pliny in the light of Capellan circumsolarity for Venus and Mercury, including the relative sizes of the planets' elongations from the Sun, and produced two pendant and intersecting arcs as a result. This imagined design was certainly the product of textual research, not theoretical research. We have no information surviving from Roman antiquity that even hints at such a pattern being seriously entertained by any scholar in the ancient world. On the other hand, when we consider the limited understandings of planetary paths by

[176] I give the full passage from Pliny, NH II, 72–73, with emphasis on the words that would most likely have stimulated the Plinian model in Figure 4.7. "…cur Veneris stella numquam longius XLVI partibus, Mercurii XX (*mss*. XXII) ab sole abscedant, *saepe citra eas ad solem reciprocent. Conversas habent utraque apsidas ut infra solem sitae*, tantumque circulis earum subter est quantum superne praedictarum [planetarum], et ideo non possunt abesse amplius, quoniam curvatura apsidum ibi non habet longitudinem maiorem, ergo utrique ratione modum statuunt apsidum suarum margines, ac spatia longitudinis latitudinum evagatione pensant. At enim cur non semper ad quadraginta sex et ad partes viginti (*mss*. viginti duo) perveniunt? Immo vero, sed rationes canonicos fallit. Namque apparet apsidas quoque earum moveri, *quod numquam transeant solem*." Plinius, *Naturalis historia libri XXXVII*, ed. Jan and Mayhoff, vol. 1, pp. 149.25–150.12.

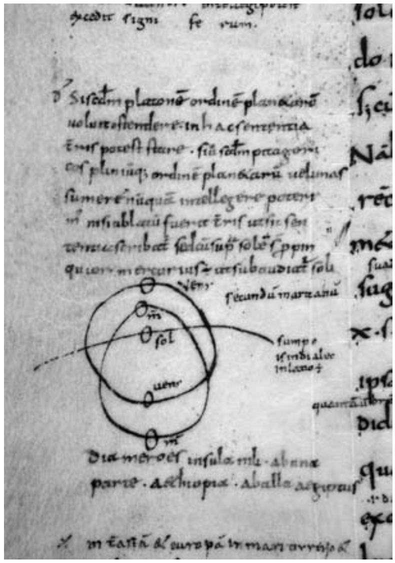

Fig. 4.6. Revised Version of Martianus' Circumsolar Planets. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 79v

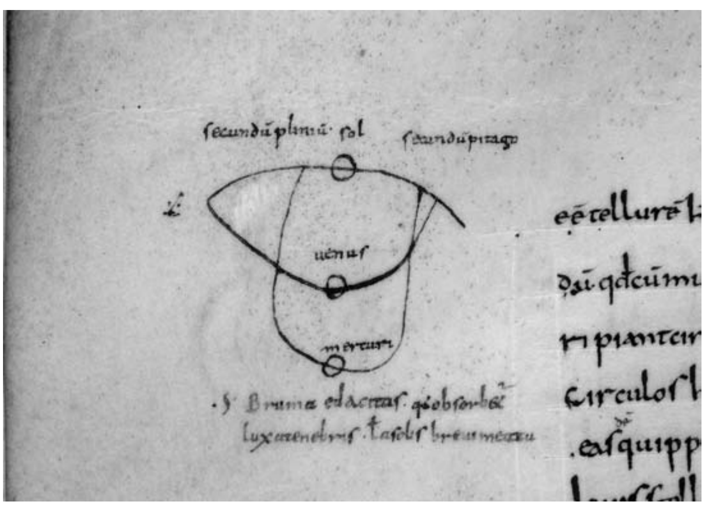

Fig. 4.7. A Plinian Pattern of Circumsolar Planets. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 79v

Carolingian scholars under the influence of computistical doctrines and concerns, we may consider the Plinian image of Figure 4.7 as a serious inquiry by our Anonymous commentator. With the Plinian doctrine of solar radial influence extended by Martianus to explain the restriction of the two inner planets to orbits around the Sun, we can conceive of a Carolingian scholar, unsure of the possible results of the power of solar rays, proposing the design that we find in the Vossianus.

Not yet finished with his creation of clarifying diagrams, the designer produced a figure to represent the pattern of Plato, since this was the first model mentioned in the marginal comment that led to the illustrative diagrams. The image of Plato's order of these inner planets, again subordinated to the Capellan concept of circumsolarity, is in one sense the strangest of all (Figure 4.8). On one hand, it appears to us to be the simplest and easiest to accept, for it shows the two planets Mercury and Venus in more or less concentric circles around but not centered on the Sun. The circles do not intersect, and Mercury is closer than Venus to the Sun. All these attributes tend to please a modern viewer. However, this pattern is far from the planetary order that we find in Plato's *Timaeus* or in Calcidius's commentary on that work, and we are hard put to understand how the image in Figure 4.8 was called Platonic. To reach some understanding, we can begin with the label on the design; it is said to be according to Platonists ("secundum platonicos ista") rather than according to Plato. More important, we need to remember that Macrobius's *Commentary on Scipio's Dream* dealt extensively with the order of the inner planets and set forth as a basis for discussion two opposing orders, that of the Chaldeans and that of the Egyptians. Macrobius explicitly linked Cicero with the Chaldeans and Plato with the Egyptians.

Although Macrobius made no mention of Pliny, the connection between Pliny's planetary order and the Chaldeans emerged before the middle of the ninth century at Corbie in the Paris Compend, a collection of astronomical texts which excerpted Macrobius's account and inserted Pliny's name on the Chaldean side of the debate.[177] Considering the wide awareness of Pliny's teaching on the order of the planets, we should not be surprised that it was associated with the Chaldean order in opposition to that of Plato and the Egyptians. But, when we return to the alternatives of Pliny versus Plato as posed in a

[177] See above, pp. 68–72, for the Paris Compend, contained in Paris 13955; see f. 56v,19, for Pliny.

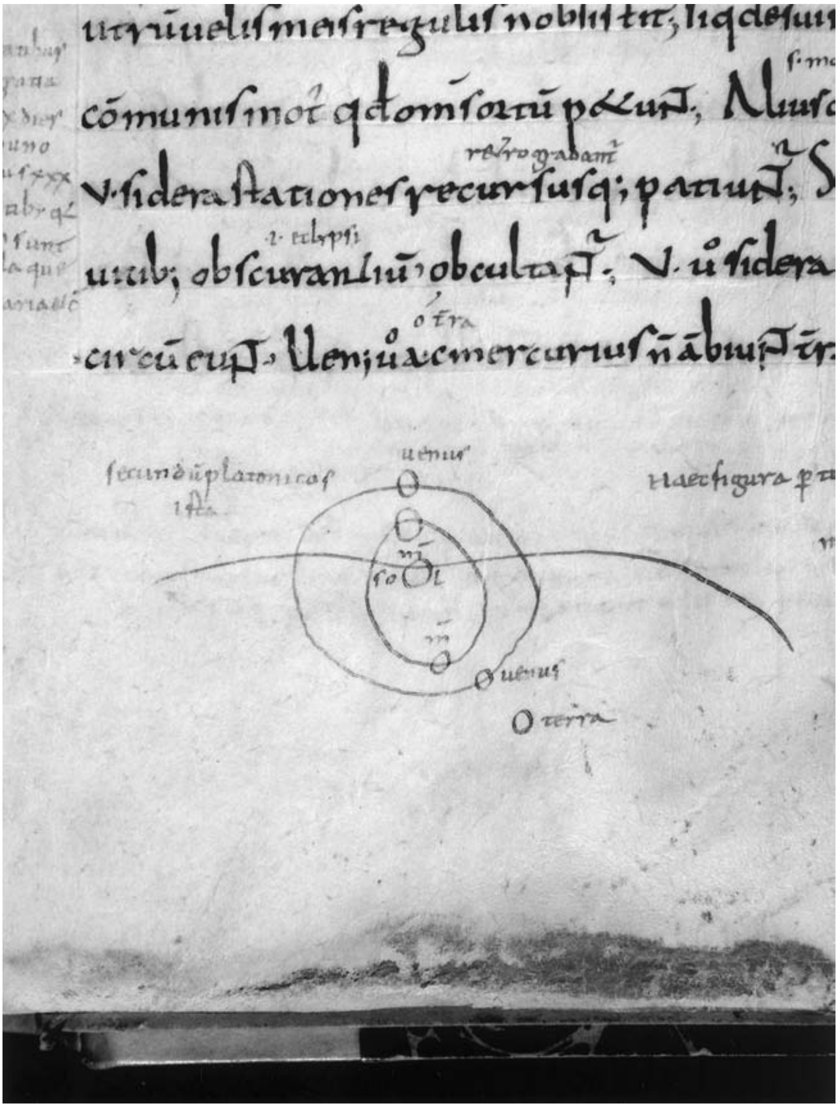

Fig. 4.8. A Platonist Model of Circumsolar Planets. Leiden, Universiteits-bibliotheek, Special Collections, ms. Voss. lat. F.48, f. 79r

circumsolar context by the marginal comment to Martianus's text, we remain surprised at the apparent claims of the commentary. How are we to understand the claim that either of these two ancient authorities proposed orbits around the Sun? In Book I of *De nuptiis*, the second hand in the Vossianus commented in a tantalizing but brief manner that "according to the Platonists Mercury is closest to the Sun."[178] What this rather surely referred to was the Platonic order of planets according to Macrobius, who, as we know, considered Plato's sequence from the earth to be: Moon—Sun—Mercury—Venus—Mars, etc. If we assume that this is what the original Anonymous commentary also understood and then translated Plato's order into a circumsolar pattern to fit Martianus's demand that Mercury and Venus circle around the Sun and not the earth, we would have a figure like that drawn for "Platonists" by the Anonymous.

To complete this story of plausibilities, even if not certainties, we turn again to one section of the Paris Compend and look in some detail at its contents and apparent intentions. As part of its astronomical teaching, this compendium from the second quarter of the ninth century presented a long chapter on "The Order of the Planets," taken from Macrobius, Pliny, and Calcidius. The Macrobius excerpt reproduced the essential parts of the relevant text on the Chaldean (Plinian) and Egyptian (Platonic) orders, and the excerptor wrote nothing at this point to show preference for either of the two sequences. In a series of excerpts from Pliny, the compiler provided information on a number of planetary phenomena, including stations and retrogradations. Finally, the excerpts from Calcidius, which in length constitute the majority of the chapter, made clear that stations and retrogradations, which include the bounded elongations of Mercury and Venus, were appearances rather than reality and that an epicycle showed how such apparent planetary irregularities were really uniformities according to the philosophers ("secundum physicos"), once they were seen as the results of uniform circular motions.[179]

[178] Voss. lat. F.48, f. 5v (ref. NPM 11.16–19): "id est, consilium meum et tuum ex uno fonte venire quia secundum platonicos mercurium sidus proximum est soli, scilicet certum est."

[179] For this chapter on planetary order, see Paris 13955, ff. 56v–59r; the excerpts from CCT are cc. 74, 85, 77–80 in that sequence and appear on ff. 57v–59r. Calcidius's c. 85, regarding an epicyclical explanation of planetary phenomena, is on f. 58r. Following c. 85, the compiling scholar remarked, "Hac ratione diligenti cura considerata invenietur secundum physicos quemadmodum et stare atque procedere etiam et regradari

We have shown so far that the Anonymous commentary on this section of the Capellan text took place in three steps, essentially at the same time. First, the marginal comment introduced Platonic and Plinian orders, implying that both were or could be seen to be circumsolar. Second, interlinear glosses reoriented the position of Mercury in terms of the Sun rather than the earth. Third, diagrams of Platonist, Plinian, and Capellan circumsolar patterns were drawn to clarify the differences between the orders of Plato, Pliny, and Martianus, after they were understood in circumsolar form. Since the text of Martianus made no mention of Plato or Pliny, we may wonder why they should be introduced at all, and the answer here must be that the lengthy discussion by Macrobius of Mercury, Venus, and the Sun in two different fixed orders was well known to students of astronomy, so that the description by Martianus of these three planets required some interaction with the descriptions by Macrobius. And in response to the question why Macrobius's positions of Mercury and Venus in fixed orders should be made variable, that is, both subsolar and suprasolar, our best answer is to assume that the Paris Compend was known by the Anonymous commentators and that it persuaded them to see the Plinian and Platonic orders in a new way.

The compendium resulted from the collecting and excerpting of astronomical texts from Macrobius, Pliny, and Calcidius during the second quarter of the century on the subject of planetary order, with this scholarly effort taking place at one of the prime centers of manuscript production at the time. While we know nothing of the travels of the manuscript of the Compend immediately after its assembly, nor do we have recognizable references to it by contemporaries, the imagination and awareness of the compilers of the work are remarkable.[180]

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stelle putentur cum ille nihil illorum faciant, sed tantum ordinabiliter per circulos suos incedant." While not cited by any mid-ninth century scholar, Calcidius's cc. 108–109 and 112 indicated that some ancient interpreters of Plato proposed circumsolar epicycles for Mercury and Venus. Were these the "Platonists" referred to in the diagram of the Vossianus manuscript?

[180] Regarding the manuscript, Paris 13955, see the following. Ganz, *Corbie*, pp. 152–3; Bischoff, "Hadoardus," p. 53; Corsetti, "Note sur les excerpta," pp. 113–4, 117–8, 127–8; Munk Olsen, *L'Étude*, vol. 1, p. 353 (# B.5); Leonardi, "I Codici," p. 282 (# 171). The full text of the Paris Compend has been edited for publication. The portion of this manuscript that I have used previously and shall return to, the glossed copy of the *astronomia* of Martianus, appears also to have been produced at Corbie late in the ninth century with commentary copied or composed at that time. The other astronomical materials were copied at one time, at mid-century or earlier.

The doctrines contained, especially when used in a textbook to teach astronomy, must have become known and discussed fairly soon after its creation, and they would have become elements of the oral culture of mid-century scholars interested in astronomy and cosmology.

It remains for us to compare the three diagrams as they appeared in the versions of the Anonymous commentary. Figures 4.6–4.8 show respectively the Capellan, Plinian, and Platonist patterns according to the first version of the Anonymous, and this only in the Vossianus, which is the first of two manuscripts. The second manuscript, now in Besançon, displays none of the circumsolar diagrams. When we turn to the second version of the Anonymous, both manuscripts of this version have the Capellan and the Platonic patterns but not the Plinian pattern. Their form of the Platonic arrangement places Venus on the inner circle around the Sun and Mercury on the larger, outer circle with the two circles centered on the Sun (Figure 4.9).[181] Readers of Calcidius's commentary on the *Timaeus* would know that Plato placed Venus closer than Mercury to the Sun, but this Platonic order was a fixed suprasolar order, not a circumsolar pattern.[182] Furthermore the diagram of the Platonic order in the second Anonymous version (BPL 88) was not attributed by the glossator to the Platonists or anyone else; it simply stood as a representative of the Capellan text when read in a certain way. The most probable reason for the inversion of the order of Mercury and Venus in this picture of concentric circles is also the least interesting reason—a mistake in copying from the exemplar. (We should, however, note that this diagram in BPL 88 creates a suprasolar order according to Plato as described by Calcidius and a subsolar order according to Pliny.) BPL 88 and its single, contemporary copy are the only examples we find of Martianus's *astronomia* showing the Platonic pattern with Venus closer than Mercury to the Sun. For the director of copying of the second version of the commentary (BPL 88), the diagrams seem to have been less important than they were for

In a personal communication (20 June 2002), Wesley Stevens informed me of the results of his intensive study of hands, glosses, and markings in the geometrical and astronomical materials in Paris 13955, from which he concluded that the compilation was made between 825 and 840, since an identifiable hand (named IId by Stevens), active at Fulda around the earlier date, copied parts of these texts.

[181] BPL 88, f. 162v margin, the Capellan model with two equal, intersecting circles for Venus and Mercury; on f. 162r margin, the Platonic model. Regin. 1987, ff. 127v (Platonic), 128r (Capellan), copied BPL 88.

[182] CCT 148 (c. 96), gives the Platonic order: Moon-Sun-Venus-Mercury etc.

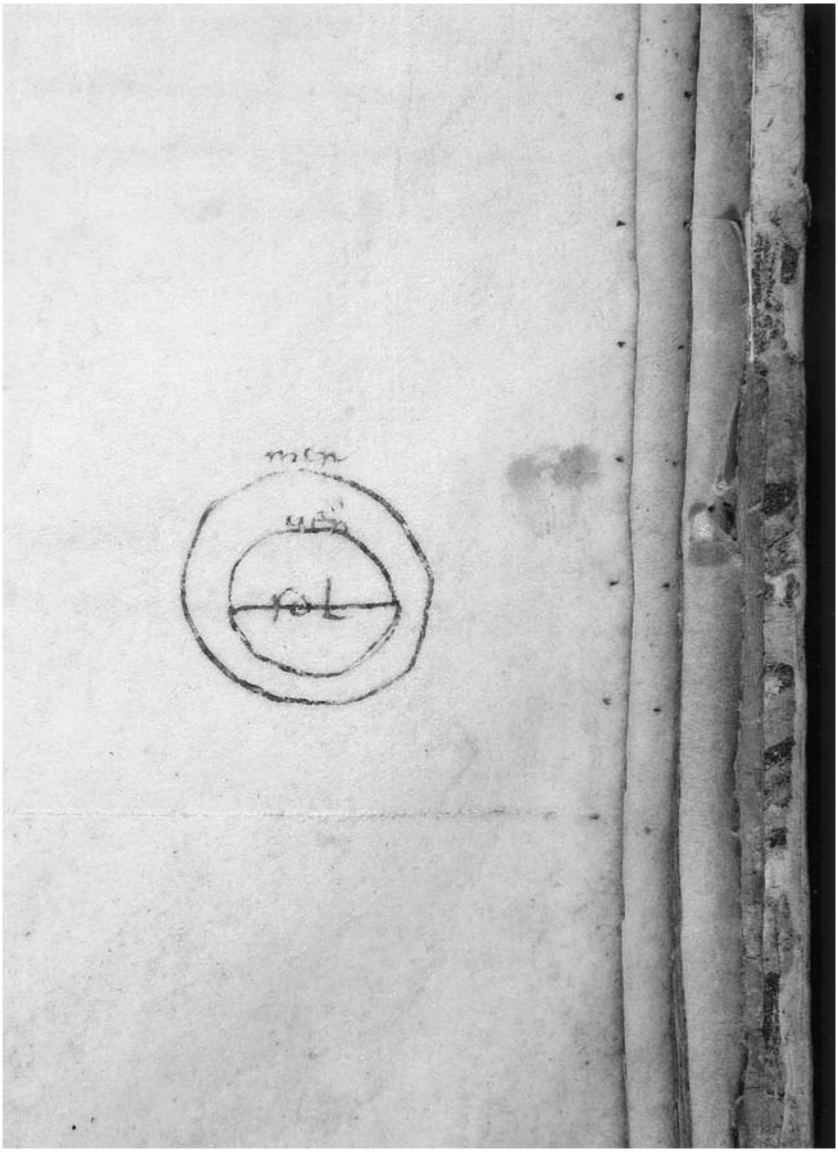

Fig. 4.9. A Platonist Model of Circumsolar Planets. Leiden, Universiteitsbibliotheek, Special Collections, ms. BPL 88, f. 162r

the commentator working on the first version of the Anonymous (the Vossianus manuscript). We should also notice that of all ninth-century diagrams of circumsolar Mercury and Venus for Martianus's *astronomia*, only the Vossianus attatched to the pattern of concentric, or at least non-intersecting, circles the name of Plato or Platonists.[183] This association appears to have been disbelieved, discredited, or disregarded already in the third quarter of the ninth century despite the fact that many glossed manuscripts continued to preserve the marginal comment that referred to a Platonic order based on one way of reading the Capellan text.[184]

In the first version of the Anonymous commentary the creator of the diagrams for the Vossianus manuscript industriously worked out a figure for each of the three authorities involved in a circumsolar arrangement of Mercury and Venus and carefully labeled each diagram with the name of its proposed author. None of the succeeding Carolingian commentaries attached authors' names to the diagrams where they appeared in the margins by the text. Only the Vossianus offered a diagram of the Plinian type; it did not appear in the marginalia of any other Carolingian manuscript. As we have just noted, only three included the Platonist pattern. Four, including the Vossianus, presented the diagram with intersecting circles for the Capellan arrangement beside Martianus's text describing the order of Mercury and Venus. As for the two commentaries best known to moderns, those of John the Scot and Remigius, while neither of these included the marginal comment discussing the Platonic and Plinian orders, their glosses to the text of Martianus pointed out the relative positions of Mercury and Venus in the subsolar and suprasolar portions of their orbits so as to

[183] All other mss. either left the diagram without attribution or attributed it to Bede. Not until the 12th century did another scholar comment on *De nuptiis* Bk 8 and attribute such an image to Plato; see Paris BnF lat. 14754, ff. 182v–191v (Bk 8), f. 188r for the labeled diagram (s. XII¾).

[184] BPL 87, f. 124v has the figure of Capellan intersecting circles (unattributed); the marginal comment does not appear; there is no other circumsolar diagram in the ms. The Capellan diagram appears to have been added with the second set of glosses in order to add greater clarity and understanding to the final lines of § 857. Paris 13955, f. 51r lower margin, has the marginal comment, but no circumsolar diagram appears in the ms. No ninth-century ms. of the *astronomia* other than those we have mentioned has a diagram of circumsolar planets at the pertinent place in the text. That is to say, such diagrams appear only in Voss. lat. F.48, BPL 87, BPL 88, and Vat. Regin. 1987. The distribution of the three types of separate circumsolar diagram in Carolingian and later mss. appears in Eastwood and Graßhoff, *Planetary Diagrams*, pp. 143–4.

make it clear that the two planets would travel on intersecting circles. Neither John nor Remigius referred to the intersection of circles as such or to diagrams at all.[185]

There remains one more aspect of these circumsolar diagrams to discuss here. In four of the Carolingian copies of Martianus Capella's work that carry none of the three diagrams in the margins of the *astronomia*, there appears a set of astronomical diagrams on a separate page at the end of *De nuptiis* (Figure 4.10). This appendix of diagrams, found in BPL 36, Paris 8669, Paris 8671, and Munich 14729, includes the three circumsolar diagrams drawn along a single arc of the Sun's orbit. They appear as alternative interpretations for the paths of Mercury and Venus reported by Martianus at §857 but without giving explanations, because none of these four manuscripts carries the marginal comment naming Pliny and Plato. Two of these manuscripts, Paris 8669 and Munich 14729, show the three versions of circumsolarity without attribution. The other two, BPL 36 and Paris 8671, show the three versions with attributions to Pliny, Martianus, and Bede beside the images, and there is no justification in either manuscript for the attribution to Bede of the pattern originally connected to Plato. Equally notable, it was the designer of the individual circumsolar diagrams in the Vossianus who first brought together a set of ten astronomical diagrams and placed them at the end of *De nuptiis*. In this set he created the combination of the three circumsolar diagrams on a single arc and omitted attributions to authors. In other words, it seems that the creator of the diagrams in the first version of the Anonymous was responsible for many of the individual marginal diagrams in Book 8 and for the appendix of ten diagrams at the end of the work, which include the three circumsolar versions on a single arc. Only those manuscripts that copied none of the marginal diagrams included the appendix at the end, and those manuscripts that copied some of the astronomical diagrams in the margins with the text did not include the appendix at the end. Of course, we must except from either group the Vossianus, which seems to have been the ultimate source of all or

[185] John, *Annotationes*, pp. 178.31–179.1: "ORBE CASTIORE DIFfUSIOREQUE Ideo dixit castiore, id est strictiore circulo, nam strictior est circulus Veneris sub sole, supra vero diffusior, id est amplior; versa vice circulus Mercurii castior est supra solem, diffusior vero sub sole." The alternate version of John's commentary on this passage in Bodleian ms. Auct. T.2.19, ff. 133v,18–134r,10, has the same glosses as Paris 12960 (ed. Lutz, pp. 178.24–179.1). Remigius, *Commentum*, vol. 2, p. 275.24–28, copied John's gloss almost verbatim.

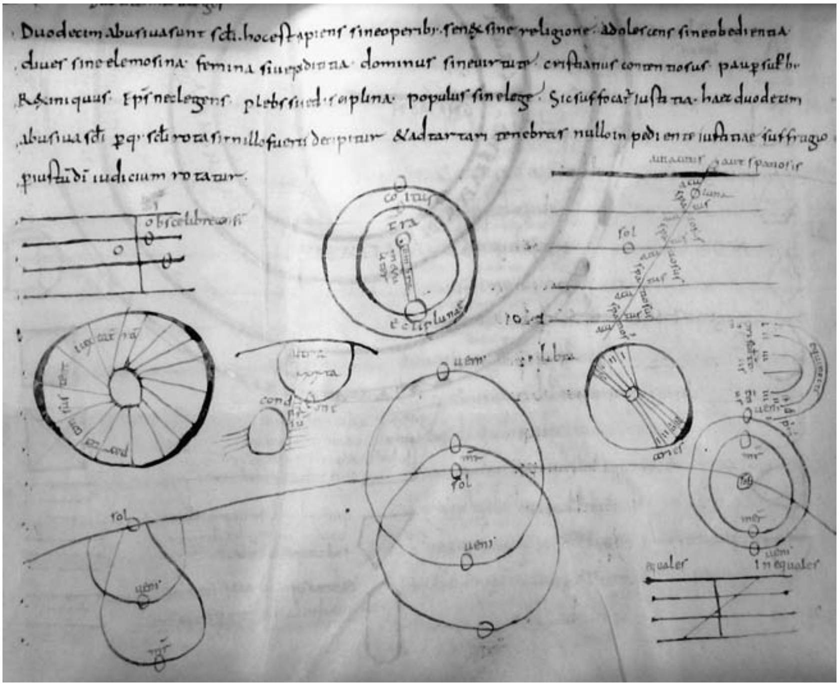

Fig. 4.10. Appendix of Ten Astronomical Diagrams. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat, F.48, f. 92v

most of the astronomical diagrams we find in the Carolingian manuscripts of Martianus Capella's work. To the designer of these novel figures in the Vossianus, they must have seemed a unique and superior way to understand the orderly and continuous motions of the stars and planets. At the same time, the apparent speed with which he invented and drew freehand the many diagrams must have struck other scholars as less than orderly so that it was ultimately the appendix, a separate set of images on a single page, easily assigned to a scribe adept at good instrumental drawing, that not only continued to be copied but evolved as well over the next two centuries.[186]

To answer the question of the source and reason for the attribution of the so-called Platonist diagram to Bede, we point to glosses

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[186] The appendix of diagrams already appears with Remigius's commentary in Paris nal 340 (s. X) on f. 83r, and on f. 94ra,20–26, is the comment of the Anonymous defining the three circumsolar patterns.

and diagrams added to two manuscripts of Bede's DNR and DTR. The earlier example appears in a Bede manuscript of ca. 850 where a diagram of circumsolar Mercury and Venus stands before the opening of Bede's DNR.[187] The later example appears in Berlin Phillipps 1832, a heavily glossed manuscript of Bede's DTR in which Martin of Laon put together glosses over some length of time until ca. 874. In commenting on DTR 8, Martin drew materials from Martianus and Macrobius concerning the paths of Venus and Mercury, combining his excerpts so as to harmonize the Macrobian material with the explicitly circumsolar text from Martianus, and Martin drew a small picture of one, unlabeled, circumsolar planet, intended to represent either of the two mentioned in the comment immediately below the image.[188] While this image does not show two concentric circumsolar planets, it does testify to the use of a circumsolar figure for Venus and Mercury attached to texts from Martianus. Surely by the end of the third quarter of the century the association of Bede with a circumsolar figure had been established and specifically concentric circles were included for the two planets where the Reichenau manuscript was involved. In either case the obvious origin of the circumsolar image was Martianus Capella's *astronomia* with its glosses and diagrams. As awareness of this association widened, the attribution of one of the three versions of circumsolarity to Bede was not difficult. And this association was easily accepted where the tradition of glosses and diagrams for Book 8 excluded any mention of Plato or Platonists in such a connection.[189]

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[187] Karlsruhe LB Aug. CLXVII, f. 16r, upper diagram. On the ms. see Bischoff, "Irische Schreiber," *Mittelalterliche Studien*, vol. 3, pp. 48–9. The diagram and its relationship to Bede's works, found on ff. 18r–46r of this ms., are discussed in Eastwood, "Astronomical Images and Planetary Theory," pp. 12–17. The diagram was first published and connected with Martianus Capella by Charles Jones, "Note on concepts of the inferior planets," pp. 397–9. An accompanying comment on f. 18bis, drawn from Martianus, includes the bounded elongation of Venus in § 857 according to the sole correct early manuscript of *De nuptiis* that survives (n. 164 above): "…denique circulorum suorum centron in sole constituuntur, ita ut supra ipsum aliquando intra plerunque propinquiores terris feruntur, a quo quidem uno signo et parte dimedia Venus disparetur, sed cum supra solem sunt propinquior est terris Mercurius.…" This suggests interaction between precisely the two Reichenau manuscripts concerned.

[188] Berlin Phillipps 1832 (Rose 130), f. 22r lower margin. For the text of DTR 8 with Martin's glosses, see ed. Jones, pp. 301–2. For detailed discussion of Martin's glosses in Phillipps 1832 and esp. on f. 22r, see Contreni, "John Scottus and Bede," pp. 123–7.

[189] For the diagrams of BPL 36, f. 129r, and Paris 8671, f. 84r, attributing the circumsolar images to Pliny, Martianus, and Bede, see Eastwood, "Astronomical Images and Planetary Theory," pp. 12–13.

8. *The Two Great Luminaries: (a) the Moon (§§ 858–871)*

Martianus began his description of the individual planets with the Moon, a celestial body that clearly interested both him and the Carolingian commentators even more than the two planets that circled the Sun.[190] His essential focal points were (1) measuring the lunar orbit using eclipse shadows on the surface of the earth, (2) the phases of the Moon, (3) the nature and strength of the Moon's light, (4) lunar time intervals, and (5) eclipses. Carolingian approaches to these topics reveal a number of ninth-century orientations.

Martianus first calculated the size of the lunar orbit and referred in passing to the measurement of the earth's circumference in his *geometria* (Book 6). He claimed to determine the sizes of the Moon's body and orbit by the lunar shadow on the earth during a solar eclipse, and he gave the following steps as his method for obtaining these data. He used three terrestrial latitudinal bands, known as *climata*, to identify the width of the lunar shadow. The interval between each of the three *climata* he used is one and one-half hours of maximum daylight, at the solstice, more than the previous *clima*. Conditions for a full solar eclipse at Meroe, the southernmost *clima* of the three, produce only a partial solar eclipse at the *clima* of Rhodes, and no eclipse at the next mentioned, the mouth of the Borysthenes (Dnieper, on the Black Sea).[191]

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[190] Having already discussed the positions of Mercury and Venus with respect to the Sun, neither the Anonymous (both versions) nor John the Scot paid attention to Martianus's brief mention here that some scholars place Mercury and Venus immediately beyond the Moon while others place the Sun next after the Moon. Only Remigius made passing reference in a gloss that remains obscure without interpretation. See Remigius, *Commentum*, vol. 2, p. 275.31–32 (NPM 324.19–20; VIII, 858): "ALII CONCERTANT contendant, sicut Plato, non attendentes positionem ipsarum sed ordinem absidarum." Remigius has Plato agreeing with the second group, who placed the Sun's circumterrestrial circle next after the Moon's; here Remigius uses the word 'absis' in one of its many senses according to Pliny. Except for this location he follows Martianus in using the term only with the outer planets; see below, pp. 299–301, for the various meanings of 'absis'. For some sense of proportional interest we can note that the Capellan texts we have discussed on circumsolar Mercury and Venus occupy nine lines in Willis's edition, and the Capellan text on the Moon occupies 122 lines (with a few bits of extraneous material); we can say that Martianus devoted about ten times as much space to the Moon as to circumsolarity.

[191] As Stahl, *Martianus Capella*, vol. 1, p. 191, n. 67, has noted, Cleomedes reported that a total eclipse at the Hellespont was observed as partial at Alexandria. These two locations are only one hour apart in maximum daylight hours and only two of the canonical seven climates apart, whereas Martianus's three points are separated by three climates each. See Cleomedes, *Caelestia (ΜΕΤΕΩΡΑ)*, p. 64 (II.3.15–18). The data surrounding full and partial eclipses, especially as given by Martianus, are less than precise

Without giving the numerical value, he said that the distance in stadia between the latitudes of Rhodes and Meroe was known, allowing him to calculate that the Moon's shadow at the solar eclipse occupied one eighteenth of the earth's circumference. His next step was to find the actual width of the Moon's body. Since the Moon's shadow is cone-shaped and the Moon itself is therefore wider than its shadow on the earth, the extent to which both full and partial eclipse were observed defined the extent of the Moon's body, which creates the shadow. Taking the interval of partial eclipse to one side of the full eclipse and assuming a similar interval on the other side, the width of the Moon would be three times the width of the Moon's shadow on the earth, according to Martianus. The Moon's width was thus three times one eighteenth, or one sixth, of the earth's circumference. This comparison of lunar diameter and terrestrial circumference is, strictly speaking, erroneous. However, Martianus appears to have been making estimates, and his procedure here shows him approximating an arc one-eighteenth of the earth's circumference to one side of the eighteen-sided polygon inscribed within the circumferential circle. He then multiplied this unit by three for the Moon's diameter as a fraction of the earth's circumference.

His subsequent measurement of the lunar orbit in terms of the apparent lunar diameter was carried out in order to find the relative sizes of the lunar orbit and the circumference of the earth and thereby the absolute size of the lunar orbit. This measurement involved a comparison of the amount of water drained from a clepsydra while the Moon's body—its diameter—rose above the horizon with the amount of water drained from a clepsydra during the full rotation of the celestial sphere, marked by the rising of the same fixed star on the two successive nights involved. The result showed the two volumes of water to be as one to six hundred. That is, the Moon's apparent, or angular, diameter was one six-hundredth of its orbital circle. And so he found the size of the Moon's orbit to be one one-hundredth of the earth's circumference.[192]

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in any case. The seven canonical climates (Isidore, *Etymologiae*, III.xlii.4) from south to north are: Meroe (13 hours of daylight), Syene, Alexandria, Rhodes, Hellespont, mid-Pontus, and Borysthenes (16 hours of daylight). At VIII, 876 (NPM 332.2–11) Martianus names eight climates, probably based on Varro: Meroe, Syene, Alexandria, Rhodes, Rome, Hellespont, Borysthenes, and Rhyphaean Mountains.

[192] Stahl, *Martianus Capella*, vol. 1, pp. 191–2, offers a comparable summary of Martianus's procedures for the lunar measurements and comparison with the earth's circumference. As he notes in *Martianus Capella*, vol. 2, p. 335, n. 79, Martianus's text is quite abbreviated according to the modern editions (e.g., NPM 325.6–326.6). Stahl's

The convenient multiples, 3, 6, 18, 100, and 600, argue for approximations on the part of Martianus. This remains likely when we notice that his numbers produce an apparent diameter of the Moon equal to 36´, again a convenient number in angular measurement.

The geometrical approach of Martianus incorporated and produced a set of numerical results. In the Anonymous commentary we find extended attention to the geometrical procedure by only one scribe. The first commentator in the Vossianus, who copied the marginal comment about Platonic and Plinian circumsolar models, was not inclined to say much here, and so we find no marginal comment of note in the Besançon manuscript, which copied almost all the marginal comments by the earlier hand in the Vossianus commentary. When we turn to the second version of the Anonymous, we again find little comment on the geometrical procedure of Martianus. Only the slightly later scribe in the commentary in the Vossianus had much to say about the geometry, including two diagrams, and we find no trace of this scribe's work in the other early hands or manuscripts of the Anonymous commentary.[193] In Figure 4.11 this Vossianus designer produced one of his less helpful images, for it does not explain how to measure the Moon's width and in a confusing diagram mistakenly depicts the lunar diameter as one sixth of the earth's diameter (misrepresenting Martianus). On the other hand, if not clear, the figure would seem to be innovative and interesting, for it removes the earth from the center of the lunar orbit and moves it just beyond the Moon where the two bodies can be immediately compared by visual inspection to discover their relative sizes. But rather than pursue or try to explain such a line of description, other commentators focused on identifying the particulars and clarifying the arithmetical procedures and results.

The first and second Anonymous versions assumed that, when Martianus indicated "the nearby *clima*" ("propinquo climati") where the eclipse was partial, he meant near his own position on the globe, and they glossed 'propinquo' accordingly, while another commenta-

translation follows the expanded account of Martianus's procedure, derived from Remigius, *Commentum*, vol. 2, pp. 277.18–278.7. The text of Martianus's account in Voss. lat. F.48, f.79v,19–29, is the same as Willis's edition. For an account of a parallel measurement see Macrobius, CSS 80.20–84.23 (I.xx.11–31), where the Sun's diameter and orbit are measured, supposedly according to the Egyptians.

[193] This is not to say that this scribe was so late as to have no influence. It was the same scribal hand that collected the set of ten images for the appendix of astronomical diagrams appearing in later ninth-century copies of *De nuptiis* and its commentaries, but his diagrams for the sizes of lunar diameter (Fig. 4.11) and orbit did not find favor.

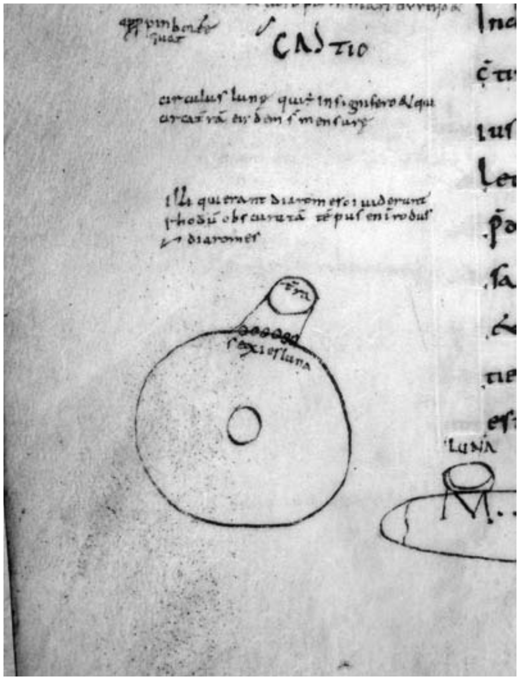

Fig. 4.11. The Moon's Diameter as One-Sixth the Earth's Diameter. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 79v

tor assumed that he meant Alexandria.[194] Both John Scottus and the second commentator in the Vossianus called attention to the position of the *clima* of Rhodes in the sequence of *climata* but reported different numbers.[195] Remigius drew upon John's comment when labeling Rhodes as the fourth climate and then claimed without justification that the amount of the partial eclipse was one fourth.[196]

Where we find the commentators fully agreeing in the discussion of lunar eclipses is in distinguishing three types of shadow, which they called cylindrical, pyramidal, and turbonidal (inverted pyramidal). Two of the three names appear in the first Anonymous, and all three were

[194] NPM 325.7. Voss. lat. F.48, f. 79v,20: "cartagini" (not in Besançon 594); BPL 88, f. 163r,4: "id est, martiano. id est, cartaginiensibus" (also in Paris 13955, f. 51r); unglossed in BPL 87; BPL 36, f. 111r,18: "alexandriae."

[195] John, *Annotationes*, p. 179.6–8; Voss. lat. F.48, f. 79v lower margin. See n. 191 above for the canonical list of climates and those of Martianus (§ 876).

[196] Remigius, *Commentum*, vol. 2, p. 276.26–30.

defined clearly by the second version of the Anonymous as well as John the Scot, who nicely characterized the term 'turbonidal,' or 'tornado-like,' as like a spinning toy used by a child.[197] Although Pliny the Elder had already defined the three kinds of eclipse shadow, his names for the shapes were not all the same. In fact, only '*turbo*' was the same, and it is unclear exactly what influenced the Carolingians to choose their alternatives.[198] Nonetheless, the agreement by the Carolingians on these three names signals the importance of both nomenclature and the subject of eclipses in their teaching.

John Scottus set down the most elaborate calculation from Martianus's numbers for the size of the Moon as follows. "The lunar body at the top of its shadow is as 18 to 6, and from this it is inferred that the Moon covers a sixth part of the earth's circumference, which is 406,010 stadia. A 360th part of this is 1,127$\frac{3}{4}$ stadia, 38 feet, and 3$\frac{1}{3}$ inches; $\frac{1}{18}$ part [of the earth's circumference] is 22,556 stadia and 6 paces."[199] Remigius was not satisfied with John's computation and revised the results to 1,127$\frac{1}{2}$ stadia, 38 paces (190 feet), and 11$\frac{1}{3}$

[197] Voss. lat. F.48, f. 79v,23, *ad* umbra metaliter: "in modum turbonis inversi, id est, pyramidis." BPL 88, f. 163r inner margin: "Tria sunt genera umbrarum. Chilindrides, Pyramides et turbonides. Chilindrides est quando lumen et *corpus* equales sunt. Pyramides quando lumen maius est et corpus minoris. Turbonides quando *lumen minus est et corpus maius*." The emphasized words were corrected and written by a different hand. John, *Annotationes*, p. 179.11–19: "METALITER id est conus unum ubi deorsum versus acuitur umbra. . . . Turbonidis est quando lux minor est quam corpus, tunc enim crescit umbra ultra corpus sicut turbo quo ludunt pueri." BPL 36, f. 111r outer margin: "In omni umbra tria sunt lux, corpus, et locus, et omnis umbra triphario dividitur, aut enim est chilindrides, id est equalis suo corpori, aut turbonides, maior, aut piramides, id est minor." Neither BPL 87 nor Paris 13955 has any such comment. Remigius, *Commentum*, vol. 2, p. 277.1–10, shows signs here of copying a short gloss from BPL 87, f. 125r,5, which glossed 'metaliter' (NPM 325.12) as 'mensuraliter,' and extensively from John the Scot regarding the three shapes of shadow. The trio of shadow names from the Capellan commentary tradition was used in the gloss to Bede's DTR, 7 in Berlin Phillipps 1832, f. 21r,30 (ed. Jones, p. 296.19: *ad* tenebris).

[198] Pliny, NH II, 51 (ed. Mayhoff, v. 1, 142.15–21): ". . . cum sint tres umbrarum figurae . . . si par lumini sit materia quae iaciat, umbram columnae effigie iaci nec habere finem, si vero maior materia quam lumen, turbinis recti, ut sit imum eius angustissimum et simili modo infinita longitudo, si minor materia quam lux, metae existere effigiem in cacuminis finem desinentem talemque cerni umbram deficiente luna." At NH II, 47, Pliny equated the third shape, *meta* with *turbo inversus*. The Carolingian choice of names may have been influenced by Calcidius, CCT 142–3 (c. 90), who wrote of *cylindroides, calathoides*, and *conoides*.

[199] John, *Annotationes*, p. 179.20–24. Here and in the next set of numbers by Remigius I follow the equivalence of 5 feet to a pace and 125 paces per stadium. Martianus gave the number 406,010 stadia, which is strikingly different from his figure 252,000 stadia in the *geometria* (VI, 609; NPM 213.8–10).

inches in the first instance, and 22,556 stadia, 13 paces (65 feet), [4 feet, and 5¹⁄₃ inches] in the second instance.[200] These commentators were much more concerned with numerical accuracy, even in computations that Martianus chose not to carry out, than with explaining his geometrical procedure. When Martianus turned from calculating the length of the Moon's orbit to calculating the lengths of other planetary orbits, the Anonymous, John, and Remigius repeated the procedure at length without noteworthy addition. Martianus's basic assumption for this was simple. The planets, all being made of the same most subtle substance, move at the same linear speed unless we have positive reason to assume otherwise.[201] A further limitation on measurement was the center of planetary revolution. The orbits of Mercury and Venus could not be measured simply by observing their times of revolution and then comparing these with the known length of the Moon's path, since those two planets circle the Sun. Thus Martianus quickly surveyed the circumterrestrial planets and noted that the Sun, requiring 12 times as long as the Moon to circle the earth, must have an orbit 12 times as great, and similarly Mars, Jupiter, and Saturn, with orbital times of 24, 144, and 336 months respectively, will have orbits these many times as great as the Moon's. The understanding of the first Anonymous version here slipped unaccountably, for he proceeded not only to point out that the 24-month orbit of Mars was two times twelve but also to write that this number is to be compared with the earth, when, in fact, Martianus had compared it to the lunar orbit.[202] The first Anonymous then restated 144 as 12 times 12 and 336 as 28 times 12. Finally he repeated in different words the last measurement in this section of the Capellan text, which multiplied the 336 months of Saturn by the 100 representing the size of the lunar orbit relative to the earth in order to get the result 33,600 for the measurement of Saturn's orbit in multiples of the earth's circumference.[203] The second Anonymous version

[200] Remigius, *Commentum*, vol. 2, p. 277.14–17; the numbers and units in brackets have been added by Lutz, the modern editor of the text. The gloss in Oxford Laud. 118, f. 78r,10, gives 22,556 stadia, 17 paces.

[201] The Anonymous affirmed the nature of the planets; Voss. lat. F.48, f. 80r inner margin: "Potest fortasse resisti quod luna velocior sit quam sol, sed redditur quod nullatenus est velocior. Omnia enim corpora celestia subtilissime sunt nature etc." Macrobius, CSS 85.31–86.16 (I.xxi.5–7), using a diagram, described the measurement clearly.

[202] Voss. lat. F.48, f. 80r,2 (NPM 326.9): "bis duo decies. multiplicatus. scilicet, quam terrae." Besançon 594, f. 71v, *ad* invenitur: "scilicet, quam terrae."

[203] Voss. lat. F.48, f. 80r outer margin; Besançon 594, f. 71v outer margin.

quietly corrected the first version's comparison of Mars's orbit to the earth and avoided any extensive repetition of Martianus's numbers in this section.[204] John the Scot, followed verbatim by Remigius, stated clearly, correctly, and economically the matter of lunar orbital length and lunar multiples in calculating other planetary orbits.[205]

Although Pliny had explicitly reminded his readers that a circle's circumference is a multiple of the diameter and 3–1/7,[206] none of our Carolingian commentaries chose to compare the planetary distances producible from Martianus's calculations of orbital lengths with the harmonic planetary intervals listed in the Plinian excerpt in the Seven Book Computus. Discussing these measured values would have reduced the sense of reasoned celestial order, and the different approaches of linear measurement and simple ratios of small whole numbers were not marshaled against each other.

Martianus turned next to the appearances and course of the Moon. Beginning with the lunar phases he described how the Moon's always illuminated hemisphere displays more or less of it to us during its passage around the earth, and he named seven points along this monthly path. At first visible illumination the shape is a crescent and called *mēnoeidēs*, at 90° of its cycle *dichotomos* (half), *amphikurtos* (gibbous) at 135°, and *panselenos* (full) at opposition, or 180°. The final three points are the first three in reverse, proceeding then to invisibility. Carolingian glosses here did not stray much from synonyms, with occasional indulgence in etymologizing. A favored moment came in glossing the name *mēnoeidēs*, which was said to mean either simply "first" (*mene*) or, more substantially, "one" (*monas*) by the first Anonymous version, and part of this was picked up by the second version.[207] However, throughout

[204] BPL 88, f. 163r,18, *ad* invenitur: "scilicet, quam luna." See the same gloss in Paris 13955, f. 51v,10.

[205] John, *Annotationes*, p. 179.26–32. Remigius, *Commentum*, vol. 2, p. 278.3–8. Without apparent influence on other commentaries, the second commenting hand of the first Anonymous worked out the calculations for the lengths of the other orbits in terms of the earth's circumference; see Voss. lat. F.48, f. 80r outer margin.

[206] Pliny, NH II, 87; in II, 86 he said that the diameter of a circle is a little less ("paulo minus") than $\frac{1}{3} + \frac{1}{21}$ of the circumference.

[207] NPM 327.7. Voss. lat. F.48, f. 80r,14: "id est, prima luna ab eo quod est mene vel ab ee (*sic*) quod est monas." The same gloss, with a change of "ee" to "eo," appears in Besançon 594, f. 71v. BPL 88, f. 163v inner margin: "Meneides dicit quasi monoides id est singularis forma, luna enim inter cetera sidera hanc forma cornacula est… (*illegible*)." The number of lunar phases was not always so detailed; the Anonymous commentary to Book 2 referred to either four or five phases; Voss. lat. F.48, f. 17r outer margin (*ad* triformis, NPM 49.21), inner margin (*ad* conversiones, NPM 50.2–3); Besançon 594, f. 14r margin; BPL 88, f. 30r margin.

this discussion of phases and their names no one before John the Scot looked for an opportunity for more far-reaching comment. At the beginning of the section on phases he used the Capellan term *physici* as he had earlier in his comments on the *geometria* of Martianus in order to contrast a false with a true opinion among scholars. The *physici* (natural philosophers) knew and maintained, according to John, that the Moon does not have its own light but has light only from the Sun, while unnamed persons have claimed the opposite, false opinion. He chose this moment to emphasize the importance to him of the natural philosophers, whom he called "the searchers for natural truths" ("naturalis veritatis inquisitores").[208] Remigius, of course, followed suit, though perhaps with less intense conviction.[209]

Where Martianus set down the Greek names of the lunar phases we find that the second Anonymous version produced the only astronomical illustration that does not exist in the first version of the Anonymous. In BPL 88 and in those who copied from it exists a marginal set of seven images in a vertical column to show the seven lunar phases (Figure 4.12).[210] They are neatly labeled, and the designer carefully added the numbers, not mentioned by Martianus, to tell a reader the exact number of days into the cycle that each stage appeared. These images of lunar phases are meant to be direct representations, even if crude, of the Moon's appearances.

In the three manuscripts that carry the representations of the lunar phases at 1, 8, 12, 15, 18, 22, and 29 days, these images offer information pertaining to a distinctive monastic concern, the lunar stages upon which prognoses of impending death could be based. The numbered

[208] John, *Annotationes*, p. 180.6–17, *ad* physicorum (NPM 326.17). Presumably John was commenting on the *quidam philosophi* of Isidore, *Etymologiae*, III.liii.1, who held exactly the opinion that John reported. John also emphasized that the *quidam* are not called *physici* and have no name. Others, such as Macrobius, held that all the planets beyond the Moon had their own light, but Macrobius clearly did not think this of the Moon; see CSS 74.26–30 (I.xix.9).

[209] Remigius, *Commentum*, vol. 2, pp. 278.28–279.6; Remigius also showed at this point (p. 279.6) his continued use of the second version of the Anonymous by copying the distinctive gloss *ad* assertione (NPM 326.17): "documento"; see BPL 88, f. 163v,2, and Regin. 1987, f. 128v, outer marginal insert, for the origin of this gloss in the Anonymous.

[210] The image appears not only in BPL 88, f. 163v, and Vat. Regin. 1987, f. 129r, but also in one other ninth-century ms., Paris 13955, f. 51v. These three mss. are alone among Carolingian mss. of *De nuptiis* with the image of lunar phases. Isidore, *Etymologiae*, III.liv.1–2, listed seven phases, provided an image of them, and said that the phase of half-moon occurs on the seventh and twenty-second days. Isidore's list of phases differs from that of Martianus.

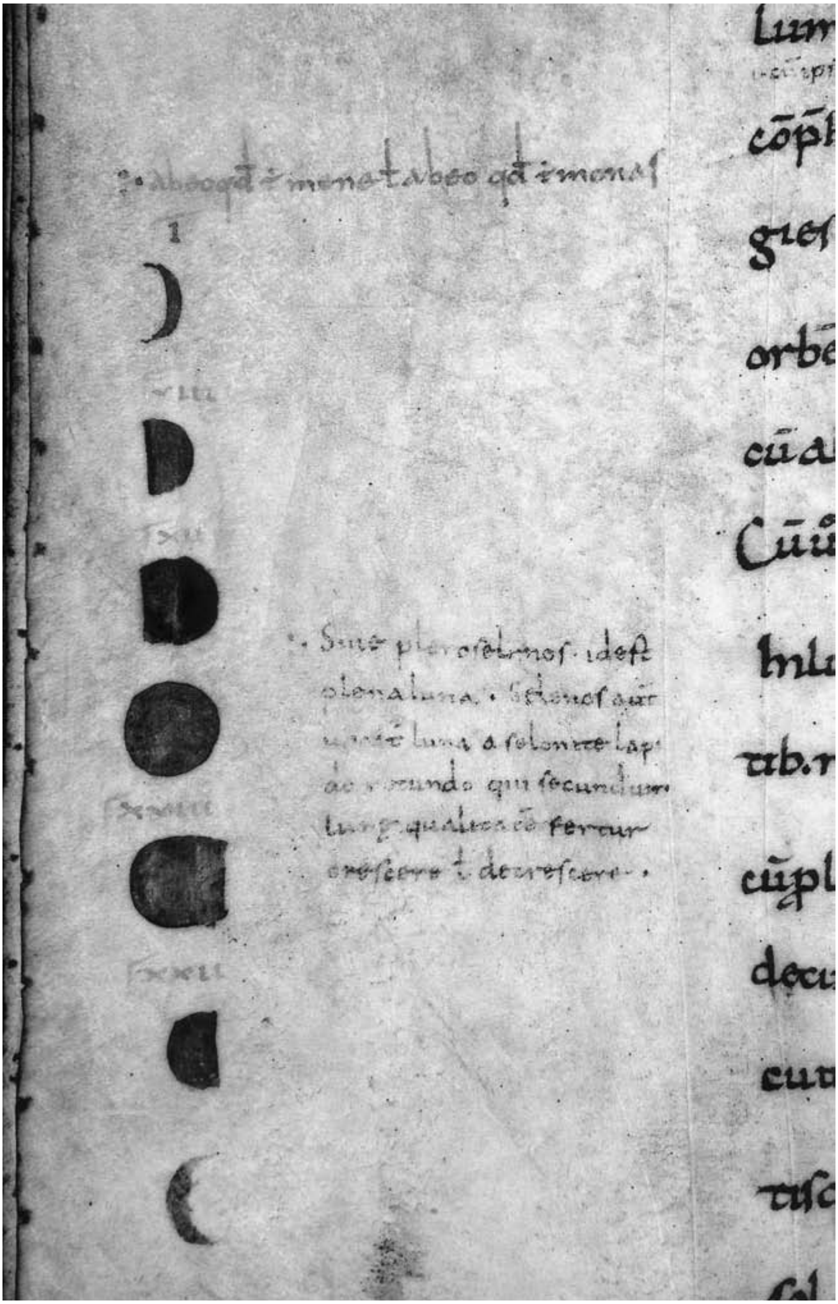

Fig. 4.12. Seven Lunar Phases. Leiden, Universiteitsbibliotheek, Special Collections, ms. BPL 88, f. 163v

day in the lunar cycle on which a monk fell ill was an important tool for predicting the outcome of the ailment. Some computistical collections of the ninth century aided this concern by including prognostic tables entitled *The Sphere of Apuleius* (or *Pythagoras*) which foretold the outcome of disease on a numerological basis that used a number less than 30 (the remainder after division by 30), derived from numerical values for the letters of the person's name, and tied that number to the corresponding day of the lunar cycle with a tabular outcome for each day of the moon. Another prognostic device was the set of Egyptian days, unpropitious days for undertaking any new activity and for many medical events. Two Egyptian days per month were indicated in calendars and could be readily associated with specific lunar phases using the numbered images in the second Anonymous version.[211] Along with other lunar calendrical calculations, the Egyptian days and *The Sphere of Apuleius* found use in Carolingian ecclesiastical preparations for the moment of death. The ninth century saw an elaborate development in the West of preparatory and ritual care for the dying and the dead among the clergy, secular and regular, as well as nobles who from the 860s onward assumed the monastic habit when they believed death to be approaching, in anticipation of benefiting from these new rites.[212] Both computus and astronomy aided this religious development, which

[211] On Egyptian days see Thorndike, *Magic and Experimental Science* vol. 1, pp. 685–6 (with inaccuracies). A convenient edited calendar with Egyptian Days marked (D') is *Aelfwine's Prayerbook*, pp. 91–102. A good example of the sphere of life and death (*Sphere of Apuleius*) appears in Cologne 83(II), f. 218v (s. IXin.).

[212] This is not to say that these lunar intervals were defined solely for this purpose; the interval from the 15th to the 22nd day, for example, was mentioned by Bede, DTR 28, quoting from Vitruvius, as the best time of the month to fell trees for timbers. The three mss. of *De nuptiis* that have the pictured lunar phases with lunar day numbers are BPL 88, f. 163v; Vat. Regin. 1987, f. 129r; Paris 13955, f. 51v. Regarding the ritual development see Paxton, *Christianizing Death*, chs. 3–5. On the associated medical prognostications, see idem, "*Signa mortifera.*" For information on *The Sphere of Apuleius* and its uses down to the eleventh century, see Juste, "Comput et divination," in *Abbon de Fleury*, pp. 107–14. Regarding clerical collections of prognostic texts, especially in the Anglo-Saxon world, see Liuzza, "Anglo-Saxon prognostics," pp. 198–203, where a variety of prognostications for the days of the moon are described, including ninth-century examples in London BL Harl. 3017, ff. 58r–60r (ca. 862). Thorndike, *Magic and Experimental Science*, vol. 1, p. 676, refers to a ninth-century computus (Paris nal 1616, ff. 14) that includes a sphere of Pythagoras, a lunare, a text on Egyptian days, and wind omina; the lunare is edited in Svenberg, *Lunaria*, pp. 23–9. At the same time, the opposition of some churchmen to the use of lunar days for planning activities intensified; see Filotas, *Pagan Survivals*, pp. 138–9.

probably motivated the commentators of the second version of the Anonymous to add their lunar-phase diagram.

For some of our commentators it was important to remark upon the difference in the heat and strength of light reflected from the Moon compared to sunlight hitting the earth directly. Such a remark arose from the simple perception that light reflected at full moon remained weaker than the light striking the earth from the Sun. Both John and Remigius cast the argument as a contrast between light that came to the earth after reflection from the Moon and light that came to the earth and was reflected by the earth. (They may have had in mind a situation such as the reflection of sunlight from sand or a light-colored roadway.) Both referred to the greater distance traveled by light reflected to us from the Moon compared to that traveled by sunlight reflected directly by the earth's surface, and they concluded that the shorter distance in the second case is the cause of the heat of summertime.[213] This reason for the heat of direct sunlight on the earth as compared to moonlight was quite different from, if not opposed to, the reason given by Macrobius and found in the second Anonymous. He and one other commentator considered the rays reflected by the Moon to be essentially without heat and as a result to give a less sharp light than rays directly from the Sun.[214] Although Martianus raised no such issue here, the language of some commentators implied a notion of purer,

[213] John, *Annotationes*, p. 180.29–33. The text here is curious, and the modern editor has emended it, perhaps incorrectly. I follow Paris 12960, f. 106r,3 (variants in Bern 331 in parentheses) in the following reading, with one addition, of John's comment: "Nam radii solis repercutiuntur a lunari corpore et non veniunt [recte] per noctem ad terram, et flebiliores (Bern 331, f. 78r,32: lebiliores *pro* labiliores) quam radii solis repercutiuntur a terra. longius enim a nobis est luna quam terra, et ideo quia in terra sumus, plus ardemus in aestivo tempore." Remigius, *Commentum*, vol. 2, pp. 279.33 – 280.5, seems to have understood John and wrote, "Nam radii solis repercutiuntur a lunari corpore et non veniunt per noctem ad terram. Blandiores [sunt] quam radii solis qui repercutiuntur a terra. Longius enim a nobis est luna quam terra et ideo quia in terra sumus plus ardemus in aestivo tempore. Quidam dicunt LUCUBLANDIORES (for Martianus's "lucubrandiores" at NPM 327.3) id est quam radii solis, quia sine calore sunt atque ob hoc non ita acutam habent lucem sicut solis radii."

[214] The 'quidam' in the last sentence of Remigius, n. 213 above, fits exactly the text and gloss of BPL 88, f. 163v,8, and Vat. Regin. 1987, f. 129r,2, *ad* lucublandiores: "id est, lucis, blandiores. non enim ita acutam habent lucem sicut solis radii." Also, BPL 36, f. 111v outer margin, has a keyed gloss *ad* lucubrandiores: "minores, id est, sine calore." Remigius evidently copied his final clause from the second Anonymous and probably adopted the phrase "sine calore" from BPL 36. Behind these comments on the Capellan text lies the account of Macrobius, CSS 75.7–22 (I.xix.12–13), that makes the body of the moon absorb the heat projected as part of sunlight and reflect only light and no heat to the earth.

unheated sunlight when reflected from the Moon than when reflected from the grosser elements of the earth, but John and Remigius spoke only of stronger and weaker rays on the basis of distance traveled.

Martianus set forth the various numbers for lunar intervals such as the sidereal (27⅔ days) and synodic (29½ days) periods along with the lunar year (12 synodic months) and others. On these numbers different commentaries spent more or less time clarifying, exemplifying, or restating the numbers, including symbols, and their meanings. An especially interesting example is the length of the sidereal month, for which Martianus may well have intended 27⅓ days, but Carolingian readers were not in agreement.[215] The Anonymous gave the special symbol for the fraction ⅔ its verbal equivalent ("bisse") as well as restating with a numeral the number of hours of daylight it involved, "id est viii horis" (8 hours). John the Scot elaborated further, giving the number of equinoctial daylight hours, 8 out of 12, that were intended, producing 27 days and 8 hours as the length of a sidereal month. At the same time he noted that some persons held that the fractional symbol meant ⅓. In this case, John wrote, the fraction should be applied to a 24-hour day, giving again the result of 8 hours for the fraction of a day and 27⅓ days as the length of a sidereal month. Putting somewhat finer points on the same set of statements, Remigius offered the same commentary on this matter.[216] The apparent temerity of the commentators in changing Martianus's value of the sidereal month vanishes when we realize that they were following other weighty authorities, that is, Pliny, Macrobius, and Bede, to name only the most obvious, and were being diplomatic in not contradicting Martianus directly.[217] In general, each of the three major commentaries was more elaborate than its predecessor in such discussions, John the Scot more detailed than the Anonymous and Remigius more detailed than John. A significant amount of basic, precise information about the Moon and its passage

[215] The critical edition here reads "xxii et bisse," noting that the fraction exists as a symbol similar to a "Z" in most mss., including the Vossianus; NPM 327.17. Stahl, *Martianus Capella*, vol. 1, p. 193, reads this as ⅔ of a 24-hour day and repeats it in his translation (vol. 2, p. 336) of *De nuptiis*.

[216] BPL 88, f. 163v,19; cf. Voss. lat. F.48, f. 80r,20, and marginal gloss: "id est, tertia parte unius diei." John, *Annotationes*, p. 181.20–26. Remigius, *Commentum*, vol. 2, p. 281.13–20. For the symbol and its value see Bede, DTR 4 (ed. Jones, p. 279.11).

[217] The value of 27⅓ days for a sidereal month appears in Pliny, NH II, 44; Macrobius, CSS 27.14–18 (I.vi.50); and Bede, DTR 8 (ed. Jones, p. 302.56–57).

through time intervals and the spaces of the zodiacal signs was covered here by Martianus (§§ 864–868) and the commentaries.

When Martianus turned to the course of the Moon through the zodiac he not only reminded readers that the lunar latitude covered the full twelve degrees of the zodiac but also retailed a tradition as old as Eudoxus that the Sun departs from the plane of the ecliptic by one half a degree to the north and to the south but only in the sign of Libra.[218] He then proceeded to the increasing temporal cycles in which the Moon is involved—a 235-lunation interval, a 55-year interval, and a Great Year, for which he gives no length. To these numbers our Carolingian commentators readily added clarifications and definitions, all in familiar calendrical terms. Martianus defined the first cycle as a return of the Moon to the same month, the same longitude, and the same latitude, which should be a cycle of the lunar nodes, but he then shifted to the term of the Metonic calendrical cycle, which is 235 lunar months, or 19 years (with intercalated months). This latter cycle was very familiar to early medieval scholars as a computistical interval, and the commentators immediately saw all three intervals as calendrical units. The 55-year term defined the time for the Moon to return to the same place on the same day of the year under the same fixed stars. And the Great Year, which Macrobius had defined as 15,000 years and Cicero had given as 12,954 years, was left without precision by Martianus, but the Carolingians gave it the computistical perfection of 532 years (19 × 28) rather than one of the Great Year intervals they could easily find in Macrobius, Servius, Solinus, the Seven Book Computus, or even Bede.[219]

[218] Stahl, *Martianus Capella*, vol. 1, p. 193, n. 74, mentions the repetition of this datum by compilers. Pliny, NH II, 67, listed the Sun's latitude of one degree to the ecliptic; Theon of Smyrna, *Astronomia* 38 (ed. Hiller, p. 194), placed the Sun at a latitude of one half a degree to the ecliptic. Martianus's remark about the Sun in Libra was made the subject of a special diagram in the appendix of the first Anonymous version; see below, p. 402, Fig. 6.12.

[219] Cf. p. 65, n. 66; pp. 88–89. See Servius, *In Vergilii Aeneidos libros*, vol. 3, p. 284; Solinus, *Collectanea*, p. 33.13. Bede, DTR 36 (ed. Jones, p. 397.43–44) reported a 600–year Great Year from Josephus. Pliny, NH II, 40, mentioned but did not define or give the length of a Great Year. 532 years was the value of the Great Year according to the first Anonymous in Voss. lat. F.48, f. 80v,10. The gloss of the second Anonymous in BPL 88, f. 164r,21, gave, curiously, 533 years, which was repeated in Vat. Regin. 1987, f. 129v,20; Paris 13955, f. 52r, also repeated this gloss. John, *Annotationes*, p. 182.24–30, gave an explanation of the basis as well as the value 532 years. Remigius, *Commentum*, vol. 2, pp. 283.29–284.3, followed John almost verbatim, then added more at 284.11–13, suggesting the influence of a source like the comment to Bede, DTR 6,

Eclipses of the Sun and Moon would seem to us to have held great interest for Carolingian scholars, but the direct discussion of this topic by Martianus (§§ 869–871) drew very limited glossing, most of which attended to translations of Greek terms along with synonyms and referents of pronouns. There had, of course, already been coverage of shadows in lunar and solar eclipses earlier in the *astronomia*, and Martianus did not offer enough precision here to stimulate much further commentary.[220] He labeled eclipses and approximations on the basis of the direction of approach of the Moon, and one of his primary concerns seems to have been the introduction into the descriptions of the Greek terms for these different eclipse approaches and approximations. The glosses are fullest where the Greek required Latin equivalents. Martianus identified the time of possible solar eclipse as the time of new moon and the time of possible lunar eclipse as the time of full moon, adding to this only (1) the already available knowledge that the lunar latitude could prevent the Moon from being on the ecliptic at the right time for an eclipse and (2) the recognized rule that eclipses can not be closer together than six months.[221]

The most notable addition by the Anonymous was an image of a lunar eclipse, found only in the first version of the Anonymous (Figure 4.13).[222] Martianus carefully used his newly minted word 'metaliter' in each of the two locations where he described solar and lunar eclipses, ensuring that this term would be considered appropriate for either sort of eclipse.[223] The designer of the lunar eclipse diagram in Figure 4.13 did not include the unusual word and paid attention only to the opposition of Sun and Moon, the designation of 'luna xv' to position the Moon longitudinally, and a truly symbolical shadow between the

in Berlin Phillipps 1832, f. 21r outer margin (ed. Jones, p. 295.101, *ad* circuli), which referred to the positions of the Sun and Moon at Creation and the divinely established concord of planetary cycles. The commentator on Bede wrote, "Naturaliter enim in primo signo ubi sol et luna fuit creata, id est in Ariete, est inicium et finis mensium et annorum, et ibi cursus omnium planetarum disligatur, id est ad unam concordiam venit, ibique omnes circuli finiuntur."

[220] See above, p. 264, nn. 197–198, regarding solar eclipses at § 859.

[221] See the relatively brief glosses to these eclipse descriptions by John, *Annotationes*, p. 183.2–18, and Remigius, *Commentum*, vol. 2, pp. 284.14–285.30.

[222] Voss. lat. F.48, f. 80v; Besançon 594, f. 72r. The Besançon ms. copied faithfully, including the error we describe below. This eclipse diagram differs in various ways from that found in the appendix of diagrams.

[223] NPM 325.12 (VIII, 859), 329.15 (VIII, 870), for solar and lunar eclipses respectively.

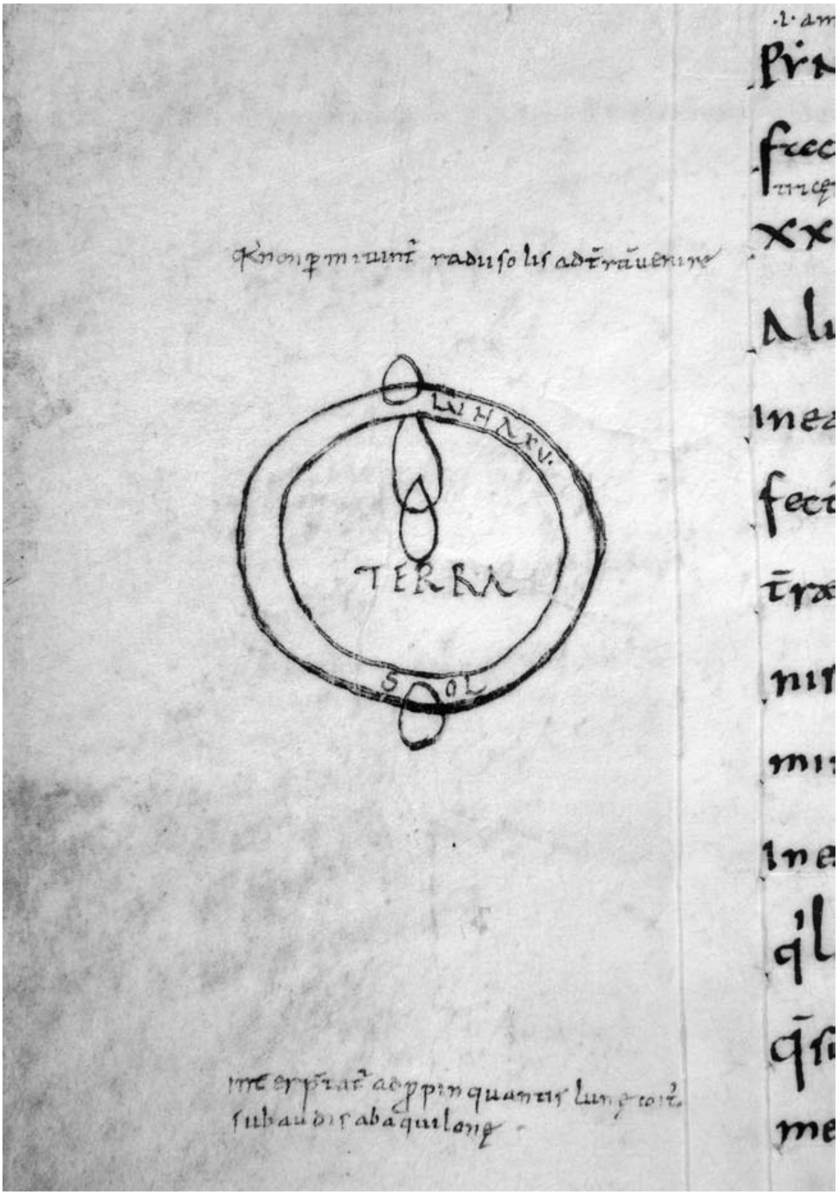

Fig. 4.13. A Lunar Eclipse. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 80v

earth and the Moon. This depicted shadow did not even approximate any of the three shapes so carefully noted in the commentaries to the previous, solar eclipse passage. Furthermore the two bodies, Sun and Moon, were placed on the same circle rather than on separate orbital circles. With such limitations, this eclipse diagram did not gain enough favor to be copied into any subsequent commentaries. On the other hand, in the lunar eclipse illustration that appeared in the appendix at the end of the Vossianus we find the term 'metaliter' inscribed beside a cylindrical shadow image, suggesting that the designer had decided to change emphasis and focus more on the shadow than on the obvious positions of the three bodies in an eclipse. Also, he changed the placement of the Sun and Moon to their separate orbital circles for the appendix diagram, although the solar body is not labeled there.[224] Thus in the appendix diagram the topic of shadows became more important than repetition of the well-known—even obvious—positions of the two circling bodies in an eclipse. In accord with this, the Moon that is placed in conjunction with the Sun in the appendix diagram, appropriate for a solar eclipse, has a smaller circle for its body than the circle of the Sun's body just above it so that we can imagine the lunar body in this diagram projecting a pyramidal shadow onto the earth in a solar eclipse. However, the cylindrical shadow cast by a smaller earth towards a larger lunar body in the diagram does not suggest the correct explanation of a lunar eclipse. Further improvements could obviously have been made in the eclipse diagram. Even so, the transitions in the character of the eclipse diagram of the Anonymous show us examples of reconsiderations that accompanied a commentary as it was completed in preparation for use.

9. *The Two Great Luminaries: (b) the Sun (§§ 872–878)*

For inclusion in his Collectaneum Hadoard of Corbie selected one part of *De nuptiis*, and this was the unit (§§ 872–878) devoted to the Sun.[225] Hadoard's interest in the section would seem to have been cosmological and cosmographical, with special attention to the reasons for the

[224] The lunar eclipse diagram in the appendix of the Vossianus (Fig. 4.10) is reproduced individually in Eastwood and Graßhoff, *Planetary Diagrams*, p. 127.
[225] See above, p. 76, n. 97.

different lengths of the seasons and the orderly progression of the changing lengths of daylight. The courses of the Moon and the Sun provide the two fundamental cycles of time, with the Sun establishing the seasons and the daily lengths of light and darkness, which vary with the time of year and terrestrial latitude. The Sun's motion is dual, and Martianus reminded readers of the daily movement in concert with the stars from east to west combined with the proper motion of the Sun at an oblique angle contrary to the stellar sphere. He then proceeded in relatively straight-forward fashion to describe the most familiar and important changes in the Sun's apparent motion and the results. First, it has a regular succession of rising and setting points on the horizon each day from summer solstice to winter solstice and back again. Second, because the earth is not at the center of the Sun's annual orbit, the Sun travels from our spring equinox to fall equinox in a different number of days (185⅓ according to the manuscripts; 185¼ when emended) than from the fall equinox to spring equinox (180 days), leading to four seasons of diverse lengths. Third, for the northern hemisphere we know the changing length of daylight and nighttime at fixed intervals through the year for all latitudes, especially for eight well-known locations. The commentaries on this section dealing with the Sun do not refer back to earlier discussion of the same themes, most notably §§ 846–849, where the first Anonymous made numerous comments on the maximum and minimum lengths of daylight, nor do the commentators repeat information they had provided earlier.[226] Thus the authors of this commentary must have assumed that readers, whether students or otherwise, would proceed through the full commentary in order to know the glosses and comments on any topic. Lacking any index or adequate marginal indices, it could serve well as an encyclopedic source for the study of astronomy only after the user had first read the *astronomia* completely and then returned to passages desired.

The first version of the Anonymous glossed the text of this section on the Sun rather extensively, and both hands in the Vossianus manuscript offered marginal comments, the second hand much more than the first. As they had done earlier the Anonymous writers tagged the doctrine of solar motion in combination with, rather than against, the cosmic rotation as Peripatetic ("secundum peripartеticus"(*sic*)), and

[226] See above, pp. 226–30, for discussion of the lengths of daylight at different latitudes.

the second Vossianus hand commented that Martianus wrote in a manner suggesting that the Sun could be seen as not fitting the needs of humans. The same writer encouraged his readers to mix grammar and arithmetic when he remarked that when Martianus described the day circles of the Sun, 183 for each half of the year, this was synecdochic, for the 366th circle represented only part rather than a whole day.[227] Passing on to the subject of the unequal seasons of the year, which Martianus did not treat quite explicitly, since he gave only two halves of the year rather than the four seasons, the first Anonymous offered an extremely interesting diagram (Figure 4.14), albeit unsuccessful, to explain the four seasons.[228] Martianus gave the following account.

> We must not overlook the fact that although the two hemispheres are of equal dimensions—one from the equator to the north pole, the other from the equator to the south pole—and although, as I have mentioned, the signs on either side [of the equator] are equal, the sun nevertheless courses through them in unequal periods. It completes its upper course, towards the summer tropic, in $185\frac{1}{4}$ (*ms.* $\frac{1}{3}$) days, and its lower course, towards the winter tropic, in 180 days. The obvious cause of the discrepancy is that, as I have said, the earth is eccentric to the sun's orbit, which is more elevated in the upper hemisphere and draws closer to the earth in the lower. There is no doubt that the sun courses over its shorter curve more swiftly and over its more extended curve more slowly.[229]

Interlinear glosses in the first Anonymous version carefully pointed out that, for the semi-circle of the zodiac including summer solstice and the sign of Cancer, the Sun required $185\frac{1}{3}$ or $185\frac{1}{4}$ days, and, for the semi-circle including winter solstice and the sign of Capricorn, the Sun needed only 180 days. The greatest concern of the glossator was to identify clearly the zodiacal arcs for the two intervals. He also inserted the gloss 'or one fourth' ("vel quadrante") above the fraction 'one third of a day' ("triente diei") after 185 and emphasized that the Sun passed faster ("citius transcurrit sol ad inferiora") through the six signs in the semi-circle ending at Libra. However, in reading the last sentence of

[227] For these two marginal comments see Voss. lat. F.48, f. 80v: "ideo dixit nam quasi dixisset nam sol non convenit mortales;" and f. 81r: "sinecdoichos dixit ut pro vi horis quod in partem numerum dividere non potuit." The figure of speech, synecdoche, has a part represent the whole or the whole stand for a part.

[228] This diagram appears in both mss. of the first version, Voss. lat. F.48, f. 81r, and Besançon 594, f. 72v, but in no other ms. of *De nuptiis*, either Carolingian or later.

[229] Stahl, *Martianus Capella*, vol. 2, p. 339 (§ 873); NPM 330.22–331.8. I have modified Stahl's translation.

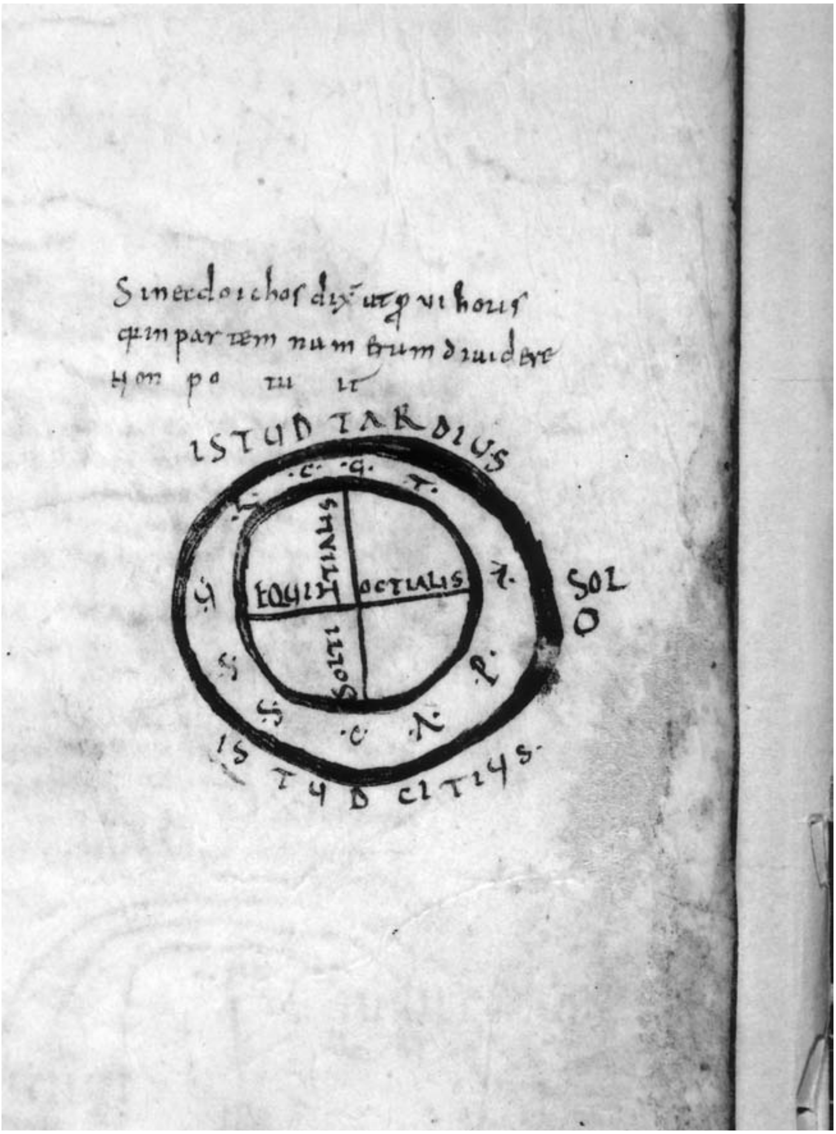

Fig. 4.14. Explanation of the Different Lengths of the Seasons. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 81r

the Capellan text quoted above, the glossator of the Vossianus slipped and mistook the solar circle for the zodiacal circle. Where Martianus said, "The Sun courses over its shorter curve more swiftly and over its extended curve more slowly" ("[solem] citius transcurrere breviorem sinum tardiusque diffusum"), the glossator became confused and glossed the word 'sinum,' intended to mean the Sun's curve, as 'the arc of the zodiac' ("curvatura signiferi"). The sentence, read in terms of this confused gloss, then seemed to say, "The Sun courses over the shorter arc of the zodiac more swiftly and over its larger curve more slowly." To this confusion the accompanying marginal diagram (Figure 4.14) added its own difficulties.[230]

The larger historical and conceptual frameworks for the diagram for the seasons will be discussed in our next chapter, but here we need to analyze it at least enough to understand the likely intentions of its designer. Figure 4.14 presents the following content. Of two circles, one of which surrounds the other, the inner circle is the circle of signs with the earth understood to be at its center, at the intersection of the two perpendicular diameters within. These two diameters are labeled and represent the celestial equator ("equinoctialis") and the north-south line connecting the two points of solstice ("soltitialis" (*sic*)). Surrounding this inner circle are eleven initial letters for the names of the eleven constellations—omitting Libra, seen as the tail of Scorpio—that comprise the zodiac. These initials proceed from "A" for "Aries" at the right end of the equator to "V" for "Virgo" just above the left end of the equator, giving six constellations in the upper semi-circle, and then from "S" for "Scorpio" around through "P" for "Pisces" on the lower semi-circle, which gives six signs but only five constellations in the lower semicircle. The omission of Libra from the constellations of the zodiac, an accepted form, we have seen earlier in Martianus's *astronomia*, and the designer of this diagram seems to be following that usage. The use of eleven rather than twelve divisions of the zodiac tells us that no exact subdivision of the zodiacal circle beyond the two parts was intended; the image is simply that of two unequal parts. The outer circle of the two is the circle of the solar orbit. It has the word "sol" as well as a small circle below the word to represent the body of the Sun, both of

[230] A very full discussion of Carolingian perceptions and explanations of the lengths of the four seasons appears in the next chapter, on Calcidius's *Timaeus* commentary. The glosses in the first Anonymous version mentioned in this paragraph are from Voss. lat. F.48, f. 81r,6–12.

which are at or near the zero point of Aries, where the Sun rises above the horizon for twelve hours of daylight at vernal equinox. The solar circle is not only larger than the zodiacal circle, contained within, but also has a center separate from the center of the zodiac. Because the diagram is drawn freehand, we cannot determine precisely the center of the solar circle, but it appears to be somewhat below the center of the zodiacal circle, in accord with the quoted Capellan text in the doctrine that the earth is eccentric to the solar circle. Finally, we have two phrases written along the solar circle, labeling the upper and the lower semi-circles of the diagram. Above appears the phrase 'this one more slowly' ("istud tardius"); below appears the phrase 'this one more swiftly' ("istud citius"). This is the total content of the diagram.

Exactly what does this diagram tell us? Assuming the knowledge of a modern for the moment, we can see that the diagram was not meant to convey much detailed information, since, for example, the individual constellations of the zodiac are not spaced regularly around the inner circle, although the designer seems to have paid attention to the need to keep half of the signs above and half below the equator. And because the solar circle is outside the zodiacal circle, rather than vice versa, we can see immediately that the usual conventions for representing the inequality of the four seasons cannot be readily used. At the same time, this also tells us that the designer was not familiar with such conventions. The primary concerns of the designer seem to have been to show what Martianus claimed, to wit, that the inequality of the two parts of the Sun's motion, from fall equinox to spring equinox and from spring equinox to fall equinox, is due to the eccentricity of the earth within the solar circle. Perhaps the great mystery in the diagram is the orientation of the solar circle with respect to the zodiacal circle. As the image appears to us now, the slowest point of solar motion, according to the phrases about relative speeds, should be near summer solstice (top of the diagram), when the Sun enters Cancer, and the swiftest point near Capricorn, where winter solstice occurs (bottom of the diagram). This fits rather well with the information of other sources, such as Calcidius, for the lengths of the seasons. However, the geometry of this diagram in the first Anonymous version shows a longer solar arc from Libra to Aries and a shorter solar arc from Aries to Libra, thus requiring the Sun, which travels its own circle at a constant speed, to spend more time traversing the solar arc from Libra to Aries than that from Aries to Libra. But this is quite the opposite of the phrases that label slower and swifter arcs! The geometry contradicts the verbal description. For a simple, qualitatively adequate diagram, the designer should have centered the inner, zodiacal circle below the center of the solar circle, thus locating the longer solar arc around the upper semi-circle of the zodiac, but he did not do this. What he did was to produce in his diagram each of the elements given by Martianus. Most especially, the designer included the eccentricity of the earth in the solar circle and the proper labels for slower and swifter arcs of solar motion, and he placed these labels more or less correctly in relation to the zodiac. But the designer did not have a Euclidean geometrical view and simply ignored the need for a correlation of the geometrically eccentric earth with the arcs of greater and lesser speed of the Sun. He included all these elements separately but not in a geometrically related way. Here we find the limits of the Anonymous commentators and presumably of many other scholars before and at mid-century in comprehending, or at least in imagining, the spatial relativity found in the usual plane geometry for representing the apparent changing speed of the Sun through the zodiac during the year. Or, to put it differently, the Anonymous commentary offered a diagram for the lengths of the seasons that included separately all the elements of a qualitatively correct explanation but in an incorrect combination, and the designer did not understand that it was an incorrect image.

Martianus concluded his discussion of the seasons by reviewing the zodiacal signs corresponding to each season, primarily the turning points of Aries, Cancer, Libra, and Capricorn, which mark respectively the beginnings of spring, summer, autumn, and winter for the northern hemisphere. On the contrary, he said, the antipodes have the seasons in opposition to us, although with the same turning points; Aries brings autumn, Cancer winter, Libra spring, and Capricorn ushers in summer. This is the only place in the *astronomia* where Martianus mentions the antipodes, although he discussed them much more fully in his *geometria* where Carolingians commented extensively. The first and second versions of the Anonymous offered almost no glosses or comments here, nor did a number of other commentaries, their only concern at this point being to emphasize not the opposition of winter and summer at the same time but rather the similarity of climate at the equinoxes.[231] The commentators, particularly Remigius, seem to

[231] For full discussion of glosses in Book 6 regarding the antipodes see above, pp. 200–202. Here in Book 8, Voss. lat. F.48, f. 81r,16–18, glossed only the final phrase

have been untroubled by referring to persons at the antipodes as well as in our (European) region and wrote about the climate for "us and them" ("nobis et illis").

The varying lengths of daylight at different terrestrial latitudes as well as different times of year was the aspect of solar motion that occupied most of the Capellan text on the Sun and consumed most of the Carolingian commentators' attention. Martianus began with the general picture that at any northern latitude the days become longer and the nights shorter between vernal equinox and the summer solstice in Cancer, while the opposite happens between autumnal equinox and winter solstice in Capricorn. Thus far the Anonymous simply paraphrased certain points and added a few synonyms. But when the Capellan text proceeded to enumerate eight *climata* and their locations, the glossators became more active. Martianus's eight climates were an expansion of the traditional seven as we have already noted above, but on this point the first hand in the Vossianus remarked not only that there are eight climates on each side of the equator but also that Pliny said there are twelve. And in conjunction with this comment the second hand glossing the manuscript wrote that "moderns" have added four zones, making a total of twelve.[232] At only one point in defining the geographical locations of the climates did the first Anonymous seem to slip, glossing "Gallias" with "scilicet, Peloponessi" when Gaul was meant, and this error received a quick marginal revision with a paraphrase of the opening of Caesar's *Gallic War*, naming the three parts

"aequinoctia utrique parti temperiem" with "et nocti (*pro* nostri) et antipodius" (nothing in Besançon 594). Nothing appeared in BPL 88 or Vat. Regin. 1987, nor in Paris 13955 or BPL 36. John the Scot followed the Vossianus in noting that at the equinoxes the antipodes have temperate seasons just as we do; *Annotationes*, p. 183.23–24. The same point was noted with elaboration in BPL 87, f. 127r,9, *ad* temperiem: "facit sed econtrario quia vernum in illis est autumnus et noster autumnus illorum est ver;" which was picked up by Remigius, *Commentum*, vol. 2, p. 287.22–25, along with additions of his own: "SOL TENENS AEQUINOCTIA scilicet in Ariete et in Libra. UTRIQUE PARTI id est superis et inferis, id est nobis et illis, AEQUINOCTIA faciunt temperatum tempus vel TEMPERIEM. CANCER scilicet facit, sed e contrario, quia ver nostrum illis est autumnus, et noster autumnus illis est ver."

[232] Voss. lat. F.48, f. 81r (Hand 1) outer margin *ad* viii (NPM 332.2): "climata viii superius, viii inferius, unum a fronte uno, alterum ab altero. Plinius xii dicit." At f. 81r,22, (Hand 2) *ad* climata viii: "plagae, sed moderni addiderunt iiii ut sint xii." The reference to eight climates is to Martianus; for Pliny, see NH VI, 211–218, where he gave seven parallels (not named *climata* by Pliny), after which he added five more (NH VI, 219–220). The "moderni" of Hand 2 was probably based on NH VI, 219–220, as well, since Pliny wrote of the seven parallels established by "the ancients" and then of five parallels added by "the most diligent followers."

of Gaul and the rivers on their boundaries.[233] John the Scot paid no attention to the geographical vocabulary, reserving his comments for discussion of the numerical details of daylight hours at the different climates. Remigius, on the other hand, made brief comment on almost all the place names in this paragraph (§ 876).[234]

The maximum and minimum numbers of hours of daylight at the different *climata* drew a great amount of glossing, showing concern for details of counting, calculation, and numerical vocabulary.[235] At the first mention of this topic (VIII, 846) Martianus had included precise fractions of an hour for maximum and minimum lengths of daylight at his own latitude. Here Martianus began (VIII, 876) with a less precise pair of numbers, nine hours for the minimum, at winter solstice, and fourteen hours for the maximum. The Anonymous in both versions let this pass, as these glossators had dealt earlier with the more detailed presentation. John the Scot seems to have been the earliest to comment on Martianus's pair of numbers. He simply remarked correctly that Martianus did not include the fractional portions. Remigius copied John's remark and added, from the Capellan text, that the numbers vary with different nations, by which he meant different places, or latitudes.[236] Martianus's numbers for the maximum and minimum hours of daylight at each of his eight *climata* are as follows.[237]

Finally, Martianus reported that at each location the change in length of daylight follows the same pattern over the six months between solstices; $1/12$ part of the change occurs in the first month, $1/6$ part in the second month, $1/4$ part in the third month, $1/4$ part in the fourth, $1/6$ part in the fifth, and $1/12$ in the sixth month. The Anonymous as

[233] Voss. lat. F.48, f. 81r outer margin (NPM 332.7): "Tres sunt galliae, prima a pyrineis usque a (*sic*) garonna. Secunda a garonna usque ad sequanna (*sic*) et matronam. Tertia usque ad rhenum. Sed prima vocatur aquitania, secunda celtica, tertia belgica." See Julius Caesar, *De Bello Gallico*, I,1,2, ed. du Pontet, p. 1.3–5.

[234] Remigius, *Commentum*, vol. 2, p. 288.4–17.

[235] Extended glossing and commentary on this topic occurred at its first mention by Martianus (§ 846); see above, pp. 226–30.

[236] NPM 331.25–332.1. John, *Annotationes*, p. 183.26–27; Remigius, *Commentum*, vol. 2, pp. 287.34–288.2. John, *Annotationes*, p. 184.2–4, made the same point again, here repeating the full number with fraction, $9+ 1/2+1/3$, given in *De nuptiis* VIII, 846, to complete the minimum number of hours for Rhodes in the text here (VIII, 877); he also noted that Martianus eliminated fractions at some other points in this section. Remigius, *Commentum*, vol. 2, p. 288.24–28, said much the same as John but elaborated for greater completeness.

[237] NPM 332.12–333.2 (VIII, 877). Stahl, *Martianus Capella*, vol. 1, pp. 196–8, with comments.

Clima	*Longest Daylight (Hours)*	*Shortest Daylight (Hours)*
Meroe	13	11
Syene	14	10
Alexandria	14	10
Rhodes	14	9
Rome	15	9
Hellespont	15	8
Borysthenes	16	8
Rhypheans	16	8

well as John Scottus and Remigius chose to exemplify these fractions with an extreme *clima* in which the minimum daylight is six hours and the maximum eighteen, providing the sequence of six monthly increments from January to June as 1 hour, 2 hours, 3 hours, 3 hours, 2 hours, 1 hour.

The progression in added and subtracted hours per month was as important as the lengths of the longest day and night. The example of a *clima* with extremes of six and eighteen hours was arbitrarily chosen for the sake of simplicity in the work of Anatolius (d. ca. 282), a bishop of Laodicea, but appears to have been understood as an observation by many or most Carolingians. It was not newly discovered at this time. It was suggested by Pliny and used explicitly by Bede in his *Ecclesiastical History of the English People*, and it also appeared in the *horologium* of Willibrord and in early ninth-century computistical manuscripts, including the compilation in the Three Book Computus of 818.[238] However, prior to the Anonymous commentary, every Carolingian example of

[238] Obrist, "The Astronomical Sundial," at pp. 83–8, 96–101, argues for Willibrord's *horologium* as the source for references in Carolingian calendars to a summer solstice with 18 hours of daylight. Obrist offers further evidence in support of such early sources in her "La representation carolingienne du zodiaque," p. 31 (f. 19v in the Basel F.III.15a). Scholars also refer for 18 hours of solstitial daylight to McCulloh, "Martyrologium excarpsatum," in *Saints, scholars and heroes*, vol. 2, p. 215 (19 June); the ms. reading in Vienna 387, f. 12r, is "DIES HORAS XVI. NOX VI.," which McCulloh corrects to "DIES HORAS XVIII…;" there is no entry for winter solstice (f. 15v), and there is no entry for summer solstice in the comparable calendar of the Munich ms. Unlocalized, the hours 18 and 6 appear in the Three Book Computus of 818 in Munich 210, ff. 136r (see the solstitial radii of the figure) and 161v,24, in a calendrical table above the date 19 December. Further information on these hours appears below, n. 239, and the sources in Bede, Anatolius, and earlier are above at pp. 229–30, n. 138.

this pair of extreme values, six and eighteen hours, either presented the values without further remark or stated a constant increase in hours, as we find in the proposed reconstruction of the Lorsch calendar of 789, in which the increase in hours between solstices is two hours every month rather than the graduated values given by Martianus and supported by the Anonymous and John the Scot. The comment by the first Anonymous on the Capellan text points to this disagreement with the earlier computistical materials without mentioning them explicitly.[239]

The first Anonymous version saw fit to create a diagram to illustrate this extreme geographical location (Figure 4.15). It presents three, roughly drawn concentric semi-circles, with each endpoint labeled "primus," "secundus," etc. to "sextus," for the six months between the solstices and then gives Roman numerals for the number of hours added in each of these months according to the text. At the middle of the semi-circles is a line labeled "aequi" for "aequinoctium" to indicate that the greatest rate of increase occurs at equinox, where the zodiac crosses the equator and is at its maximum angle of incidence with the parallels of latitude, just as Martianus said in pointing out that the

[239] Borst, *Kalenderreform*, in his reconstruction of a Lorsch calendar of 789 (pp. 254–98), reveals the following: at p. 196 Borst admits that the Calendar of Nivelles und Rheinau, which Borst uses, is confused and undependable on hours of daylight; at pp. 181–2, 275, 297, it is clear that the Computus Graecorum, based on an early Irish computus, uses maximal hours of 15 and 9 hours, not 18 and 6; finally, even accepting the use of 18 and 6 hours in the Lorsch reconstruction, we find that the progress per month was 2 hours every month between solstices, just as in Anatolius's *De ratione paschali*, which contradicts the more acceptable, geometrically based data and rationale of Martianus Capella at VIII, 877. Another example of the fixed two-hour change per month with clear implication that 6 and 18 hours are the extremes appears in the Monte Cassino arts ms., Paris 7530, ff. 277r–280r (ca. 797); on the ms. see Holtz, "Le Parisinus Latinus 7530, synthèse des arts libéraux." Followed by John, the first Anonymous saw and corrected the error of the fixed two-hour change per month. For the Anonymous see Voss. lat. F.48, f. 81v,5–6 (NPM 333.3–6), and outer marginal comment: "Ut verbi gratia in climate ___ (?), dies minima habet vi horas, longissimus xviii adduntur; ergo xii hore in estate longo diei que addito, id est, xii, dividenda est, cuius duodecima pars unum est; in prima ergo mense una hora crescit." This marginal comment was added to the Vossianus as part of a second stage of glossing, the first of which did not include the numerical values. The two stages of interlinear glossing appear as such in the second version; see BPL 88, f. 166r,7–9, and Vat. Regin. 1987, f. 131r,16–19. Neither the diagram nor the marginal comment of the Vossianus appears either in Besançon 594, f. 73r, or in the second Anonymous version. BPL 87, f. 127v, and BPL 36, f. 113v, include essentially the same glossing as is found in the second Anonymous version. John, *Annotationes*, p. 184.15–21, added only greater clarity to what appeared in the Anonymous; John also referred to solstitial hours of 18 and 6 at 139.34–140.16 (VI, 597; at NPM 209.17). Remigius, *Commentum*, vol. 2, p. 289.7–18, added more details but nothing new or unexpected.

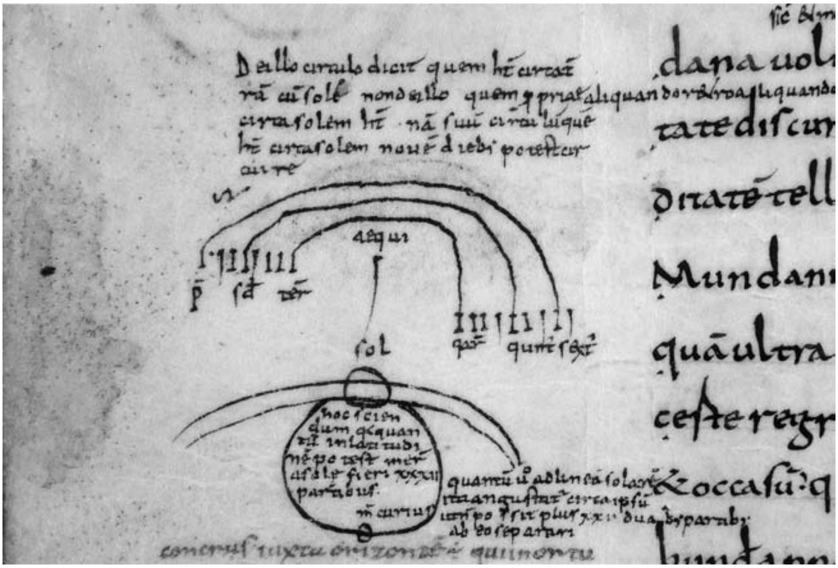

Fig. 4.15. Six Increments of Daylight Hours Between the Solstices. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 81v

zodiac is at its minimum angle when it reaches the tropics of Cancer and Capricorn, where the solstices occur.[240]

The diagram is misleading. In order to represent unambiguously the six hourly increments the designer should have labeled consecutively six endpoints, including that of the "aequi" midline, with ordinals from "primus" to "sextus." There should also be an unlabeled line to the left of the line labeled "primus," because a beginning point (one of the two solstices) is needed. He should then have placed the number of hours for each interval in the opening before, or prior to, the ordinal indicating the month in which the hour(s) were added or subtracted. This corrected design would show seven endpoints with the middle one, labeled "aequi," also being labeled "tertius." There would then be an unbroken sequence of numbered endpoints from first to sixth and an unbroken list of numbers, ascending from one to three and descending from three to one in the succession of six spaces between the numbered lines. The misleading diagram received modification

240 NPM 333.6–7 (VIII, 878).

when it was selected by the designer for inclusion in the appendix (see Figure 4.10).[241] There the designer changed the numbering of the six monthly endpoints to emphasize the equilibrium and the equinox, using the ordinals "first," "second," and "third" on each side for the three monthly endpoints leading to the central equinoctial line. This revision put more visual emphasis on the equinox as the point of maximum increase or decrease in daylight and as the point of equilibrium between solstices. It showed clearly the succession of regularly increasing and decreasing increments of daylight or darkness per month. The new diagram eliminated the most evident weakness of the prior version by carefully placing the numerals for the monthly change in number of added or subtracted hours precisely at the tips of the six monthly endpoints. Unfortunately, the designer did not remove a more fundamental limitation, which was the failure to make the point of equinox one of the monthly endpoints where a change in the addition or subtraction of daylight hours occurs. And finally, the designer did not include, or at least label, the two solstices as the first and last endpoints, which is necessary for the diagram to represent unambiguously the Capellan pattern of temporal change between the solstices. As it now stands, the diagram can only represent what Martianus intended if one understands each of the six endpoints of semi-circles as the midpoint of a monthly interval, thus allowing the equinox midline to mark the end of one monthly interval and the beginning of another. While such an interpretation is quite acceptable, it is hardly the only one likely to be made by an uninstructed reader. Perhaps, then, we have discovered the expectation by the designer of this modified diagram that it would normally be interpreted by a teacher for a student audience. And so we must assume that the diagrammatic emphasis on a non-uniform increase and decrease in daylight between the solstices became the primary concern of the designer and that the full, correct understanding of all elements of the diagram by students would always require the guidance of an informed scholar. The importance of this diagram in contradicting a potentially widespread assumption that the increments of daylight or darkness are the same for every month between solstices

[241] Voss. lat. F.48, f. 92v, for the appendix diagrams. The "equinoctium" diagram appears immediately above the diagram for concentric circumsolar Mercury and Venus. An enlarged image with notably incomplete description and text appears in Eastwood and Graßhoff, *Planetary Diagrams*, pp. 124–5.

seems to have been sufficient reason for the diagram to remain in the appendix as it was copied by later scholars.

10. *The Two Inner Planets: Mercury and Venus Again (§§ 879–883)*

The phenomena of the Moon and the Sun fit with and helped students to understand the basic celestial order of spheres and circles, especially the sphericity of the earth, the centrality of the earth in the stellar sphere, and the eccentricity of the earth in the solar circle. Further, the specific circular motions and observation conditions required for such events as eclipses and changing hours of daylight enhanced the understanding of this celestial order. But the phenomena of the other five planets were curious without adding much to the coherent picture of a network of interrelationships of the earth, stars, Sun, and Moon. The five other planets did, however, pose problems for explanation, especially the limited elongation of Mercury and Venus from the Sun and the regular retrograde motions of all five planets. Martianus had dealt with the bounded elongation of Mercury and Venus earlier in Book 8,[242] and here he paid attention to the variety of their phenomena, of which solar elongation was only one part. Once again Mercury and Venus received the most attention among the five planets. Mars received little discussion of its varied and difficult apparent motions. Jupiter and Saturn were given only the briefest descriptions. What we find here in the Capellan descriptions of the five planets is the sense of relationship among them. There are certain noteworthy phenomena that are common to all, certain appearances restricted to the two inner planets, Mercury and Venus, and certain appearances common to the three outer planets, Mars, Jupiter, and Saturn.

Martianus opened his descriptions of the five planets by emphasizing the special importance of Mercury and Venus because of their circumsolar orbits. He proceeded to spend more space on these two planets than on the three outer planets. Like Venus, Mercury's longitudinal motion is one of epicyclic circles ("circulos epicyclos") around the Sun. In explanation Martianus said that rather than moving around the earth directly, the planet "in a certain manner circles to the side"

[242] At VIII, 857; see pp. 238–59 above.

of the earth ("de latere quodammodo circumduci").[243] Mercury, being so close to the Sun, needed greater attention than any other planet, for it is frequently obscured by the Sun's light and so can be seen only for short intervals of time. In its accompaniment with the Sun Mercury completes a passage around the earth in just under a year. Remaining within 22° of the Sun, the planet courses around that body more often than once a year and can be seen at times ahead of it and at times behind it, so that before sunrise Mercury may appear in the sky in the east and after sunset it may be seen in the sky in the west. In both these situations the planet will appear only when it is far enough from the Sun, which in turn must be located below the horizon for the planet to be visible, and the time interval will usually be short because of its return towards the Sun after reaching the maximum elongation of 22°. What we call Mercury's risings occur, first, in the evening when each night Mercury gets farther from the Sun and sets later after sunset until it begins to move in retrograde. Then it moves closer to the Sun and sets earlier each night until it is obscured by the Sun and can not be seen. Shortly thereafter its morning rising occurs, and it begins to rise earlier before sunrise until its direct motion resumes. After its direct resumes it begins to move closer to the Sun and rises later each morning until it is obscured by the Sun. Obviously Mercury never rises or sets in opposition to the Sun.[244] Martianus added more data, such as the planet's latitude of 8°, and the need for a twenty-degree interval between Mercury and the Sun for the planet to be at full brilliance. He also said, rather unhelpfully, that Mercury may move as far from the Sun as a full sign plus a small part of another sign, although we never see the planet at so great an elongation.

The Carolingian commentators had already discussed Mercury's motions a great deal when commenting on the circumsolar planets. This time the Capellan text presented more appearances as well as the epicycles of Mercury and Venus, and heavy glossing ensued on

[243] At NPM 324.12–13 (§ 857) Martianus said clearly that the centers of motion of Mercury and Venus were in the Sun's body, but he did not use the term 'epicycle.' Here in § 879 (NPM 333.11–13) he used "epicycles" to name their orbits but gave an imprecise and awkward definition of the term. While Martianus certainly understood the two planets to orbit in circles around the Sun, it is unclear how precisely he understood the term 'epicycle.'

[244] NPM 333.8–334.11 (VIII, 879–881). I have tried to clarify the Capellan account of Mercury and have simplified it slightly. Aaboe, *Episodes*, pp. 11–12, describes the synodic cycle of an inner planet.

the part of the Anonymous and Remigius, but not John the Scot. The difference here seems to have been the amount of clarification of vocabulary, a concern that interested John much less than the others. At the point where Martianus began to describe Mercury, the first Anonymous version placed the fourth of its capitalized marginal indices, "DE CURSU PLANETARUM," to highlight an especially important subject.[245] Among the interlinear glosses of the Anonymous we find (a) 'epicyclic' ("epicyclos") glossed as "supercircular, since they [the circles] are above the earth, not [circling directly] around the earth, whether above or below." Further on, the Anonymous glossed (b) the 'diverse [epicyclic] circles' of Mercury as "narrower and more open [circles], because it does not [always] have the same approach [to the Sun] but makes now a small circle, now a large one." This description in the glosses of diverse elongations of Mercury derives from the text plus added diagrams and not from observations. These glosses reveal, first, a desire to account for the appearances and, second, an apparent imprecision in the conceptual grasp of epicycles. The same sensibility emerges in a gloss to the next sentence where Martianus described (c) the planet as "orbiting in diverse shapes," and the Anonymous responded with the glosses, "different shapes/images," and "Sometimes it orbits directly, sometimes obliquely, sometimes across the zodiac."[246] Again we find a focus on the phenomenal rather than the theoretical in both text and gloss, but the absence of any appeal to a simple, generic model of epicycles in order to help in explaining the appearances strongly suggests an uncertainty, possibly apprehension, in the use of the term 'epicycle.' Other commentaries do not suggest a different situation. Martianus himself uses the term only one time in his *astronomia*.

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[245] Voss. lat. F.48, f. 81v. The first three majuscule marginal indices of the first Anonymous are (1) "DE DIVERSITATE ORTUS OCCASUSQUE SIGNORUM" at f. 78v, (2) "DE MAGNITUDINE CIRCULORUM PLANETARUM" at f. 80r, and (3) "DE LATITUDINE CIRCULORUM PLANETARUM" at f. 80v; similar marginal indices appear for Venus, Mars, Jupiter, and Saturn on ff. 81v–82r. The same index markings appear in Besançon 594 at (1) f. 70r, (2) f. 71v, (3) f. 72r, and (4) f. 73r, as well as the planetary indices on f. 73r–v.

[246] This set of closely placed and related glosses can be found in Voss. lat. F.48, f. 81v, at lines 10, (a) *ad* epicyclos (NPM 333.11): "id est, supercirculares quoniam supra terram sunt, non circa terram sive inferius sive in superius sint;" 12, (b) *ad* diversis circulis (NPM 333.15): "id est, angustioribus et latioribus quia non aequaliter accessionem habet, sed nunc facit parvum circulum nunc magnum;" 14, (c) *ad* diversis schematibus variatur (NPM 333.17–18): "variis figuris;" "aliquando currit recte aliquando oblique aliquando per signiferum." John, *Annotationes*, p. 184.24, glossed "epicyclos" simply "id est circulos superpendentes;" he glossed none of the other words at these three points addressed by the Anonymous.

From a modern perspective one of the more interesting aspects of the Capellan theory of epicycles is its limited utility. Martianus applied epicycles only to Mercury and Venus to describe their circles around the Sun. Although he recognized retrograde motion as an attribute of every planet other than the Moon and Sun, he saw no need to introduce additional circles, that is, epicycles, to account for retrogradation. Where we think of an epicycle as a geometrical and kinematical tool, Martianus seems to have considered it a peculiar descriptive term used by his sources for the inner planets, with no special explanatory power. The essential difference between Plinian and Capellan planetary theory is the assignment of Mercury and Venus to circumsolar orbits. Martianus simply modified Pliny's dynamical theory to introduce epicycles for the two inner planets. His discussion of the five planets and their motions was heavily influenced by Pliny's planetary theory, explaining planetary motions on the basis of the dynamics of solar rays that moved the planets along eccentric circles, which Pliny called apsides, and within specified limits of latitude and longitudinal progress similar to Pliny's. At the very end of Book 8 Martianus wrote,

> The effective ray of the Sun brings about the changes in path and altitude and the causes of station, retrogradation, and forward motion of all the aforementioned [planets]. Upon striking them, such a ray lifts them up or presses them down or makes them deviate in latitude or move in retrograde.[247]

This closing statement about the dynamics of solar rays followed Plinian theory. One of many points for comparison from Pliny's text is an account of retrograde motion of the outer planets where he said,

> ...in their first stations...the planets begin to go backward. The reason for this should be emphasized. When they are struck...by a triangular ray of the Sun [at 120°], they are prevented from following their direct path and are raised up [directly away from us] by the fiery force [of the ray so that they appear to us to stop].[248]

What Martianus appears to have done with the Plinian solar force was to conceive the limits of elongation of planets from the Sun in

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[247] NPM 337.1–4 plus text reported in apparatus. See below, pp. 302–3, n. 266, for the full text in Voss. lat. F.48.

[248] Pliny, NH II, 69 (ed. Jan and Mayhoff, vol. 1, p. 149.4–9): "...in stationibus vero primis...incipiant...stellae retroire. Cuius rei ratio privatim reddenda est. Percussae in...triangulo solis radio inhibentur rectum agere cursum, et ignea vi levantur in sublime."

relation to their distance from the Sun. The outer planets were far enough from the Sun so that they could circle around the earth, the true center of the cosmos, even though the power of the Sun's rays caused them to stop, regress, and then resume their direct, or west-to-east, motion. And the solar effects were much greater on Mars than on Jupiter and Saturn, as Mars was much closer than the other two to the Sun. The inner planets, however, were so close to the Sun that they could not escape the Sun's grasp and were held by the Sun within the limits that we call their elongations. Whereas Pliny conceived the motions of these two planets to be like oscillations along arcs moving in tandem with the Sun, Martianus thought of the motions as small circles moving with the Sun within the limits of elongation. That is, the Sun kept the two planets moving around itself in circles rather than along with itself in oscillating arcs. These two alternative interpretations, Plinian and Capellan, of the bounded elongations of Mercury and Venus were, in fact, also proposed by late ancient commentators on Plato's *Timaeus*, and Calcidius's commentary mentioned the two views, which were probably known to Martianus.[249] The difference between Calcidius's and Martianus's understandings is that Calcidius considered the circle, an epicycle, a sufficient explanation of the bounded elongation, making the concept of some force, or *vis*, completely superfluous. For Martianus the epicycle was a peculiar kind of circle that resulted from a force, the force of the Sun. It was solar radial force, not epicycles, that explained the bounded elongations for Martianus. He seems to have imagined that the solar force transformed the Plinian oscillating motions of the inner planets into closed circles around the Sun, binding them within the visual angles of 22° (or 23°) and 46° from the Sun, assigned respectively to Mercury and Venus by both Pliny and Martianus. The outer planets could not be bound in this way because of their greater distances from the Sun, thus limiting the effects of its radial force on them.The anomalies of Mars, Jupiter, and Saturn remained effects within circumterrestrial orbits, which the Sun was unable to refocus on itself.

Returning now to the epicycle of Mercury as described by Martianus, we encounter a manuscript corruption that produced a significant interpretive move by the Anonymous and other Carolingian commentators.

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[249] CCT, cc. 109, 112, offered the alternative interpretations of a *vis* and a *circulus* to explain the motions of the inner planets.

As we noticed previously, when first discussing the circumsolar planets (above, Section 6), virtually all early copies of the *astronomia* held that Mercury could appear up to 32° ("numquam ultra xxxii partes") away from the Sun, where Martianus described this planet individually.[250] Rather than change this reading of Martianus's text, the Anonymous and subsequent Carolingian scholars glossed it to add a new and ill-defined path, or position, of the planet Mercury. The first version of the Anonymous even created a diagram for it (Figure 4.16), and the diagram survived as one of the standard Appendix diagrams for the *astronomia*. Notably the first Anonymous glossed the Capellan phrase "diversis schematibus" with "variis figuris," an alternative with intriguing possibilities. This Anonymous gloss allows us to consider the position of the glossator as an inquirer and arbiter, ready to offer different diagrams, or images (*figurae*), to account for the text of Martianus. This line of modern interpretation of the Anonymous diagram of the anomalous 32° for Mercury's interval from the Sun leads to the possibility that the Anonymous understood fully what the proper bounded elongation of Mercury should be—it had been stated clearly by Pliny—and that the first Anonymous treated the text of Martianus simply as an oddity to be explained away. His diagram easily bears this kind of interpretation. On the other hand, no Carolingian respondent to the Capellan text said that the 32° was simply erroneous, and no one tried to explain that it meant something other than 32°. The Carolingian problematic was one of finding the way to accept both the authoritative elongation of 22° and the special Capellan interval of 32°, and the diagram of the first Anonymous version was the most successful attempt. Inspected carefully, it shows us exactly what the various commentators said about the 32°, whether they adopted the diagram itself or not. Thus the responses by Carolingian commentaries suggest three conclusions. First, Martianus had sufficient authority that ninth-century scholars were loath to change a manuscript reading on a point as significant as this, where the Capellan theory of the inner planets was novel and widely respected. Second, the theory of Mercury according to Martianus was not completely clear, and glossators thus had further reason to be cautious about modifying the text. Third, the commentaries on Capellan astronomy honored the text but also explained it in a way that fit

[250] NPM 333.16 (VIII, 880). Voss. lat. F.48, f. 81v,12–13, carries this common corruption of the text.

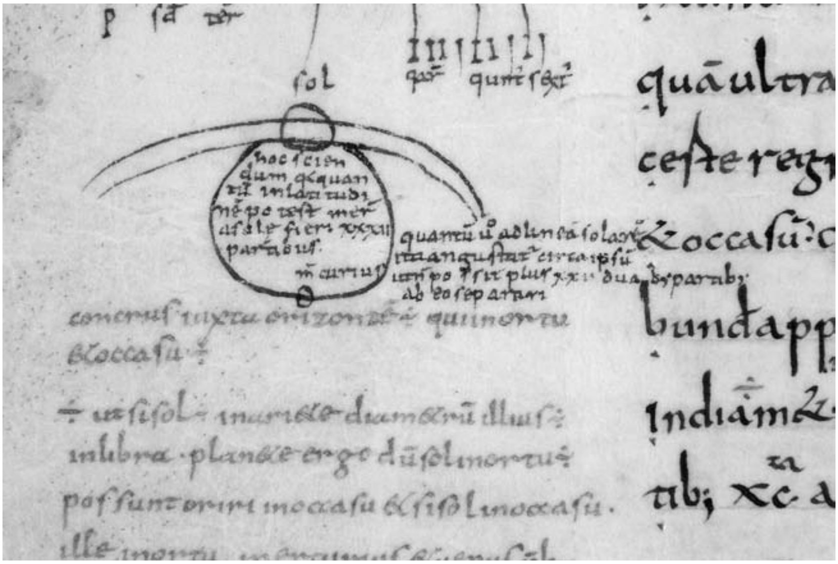

Fig. 4.16. Elongation of Mercury from the Sun at 32° "sub sole." Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 81v

with the information they had from Pliny and Bede about Mercury's bounded elongation. The first Anonymous glossed 'xxxii partes' with "sub sole" ("below the Sun") and added the marginal comment, "with respect to the solar path, [this 32°] is narrowed around the Sun so that it [Mercury] can not be separated more than 22° from the Sun." The second Anonymous simply concurred in general, offering less elaboration. John the Scot followed the first Anonymous while restating the explanation more clearly. Other commentaries from the later ninth century did not always take any notice of the curious, extended elongation of Mercury. Finally, Remigius seems to have understood but to have assembled prior comments that both explained and ignored the problem, thereby encouraging some ambiguity.[251]

How should we understand what the Carolingian glossators understood by the 32–degree elongation of Mercury "below the Sun"? Despite other possible interpretations, the one that best fits the Carolingian outlook is deceptively simple. We begin by recalling that Mercury traveled on a circle, a special kind of circle called an epicycle. Rather than consider models for Mercury's motion that would explain the 32° interval between it and the Sun satisfactorily to us, we should look more carefully for an explanation that readily explained such a motion to Carolingians satisfactorily. As the first Anonymous version said, the figures (*figurae*) we draw to represent this may vary, with the circle of Mercury being here small and there large. And as John the Scot said in making explicit the intent of the Anonymous, the elongation of Mercury from the Sun along the Sun's linear path can not exceed 22°, but Mercury's circle may expand to an angular interval of 32°

[251] The relevant text for these glosses is NPM 333.14–16: "Sed idem Stilbon, licet Solem ex diversis circulis continetur, ab eo tamen numquam ultra xxii (*ms.* xxxii) partes poterit aberrare nec duobus signis absistere." The interlinear gloss and marginal comment of the first Anonymous appear at Voss. lat. F.48, f. 81v outer margin, beside the diagram for the longer comment; f. 81v,13, for the gloss *ad* xxxii: "sub sole." BPL 88, f. 166r, *ad* aberrare: "et hoc sub sole intellige." John, *Annotationes*, p. 184.27–29: "ULTRA XXXII PARTES istum numerum sub sole intellige non ante solem vel post solem in longitudine signiferi, nam ibi non elongatus plus quam viginti partibus et secundum alios viginti duabus." BPL 87, f. 127v, *ad* aberrare: "sub sole intelligendum est." BPL 36, f. 114r, *ad* xxxii partes: "ante et retro." Oxford Laud. 118, f. 79v,9, *ad* partium liberatur (NPM 333.19–20): "id est, xxxii." Remigius, *Commentum*, vol. 2, p. 289.30–34, follows John the Scot's comment precisely, but at 290.5–6 Remigius simply reaffirms the "xxxii partes" as a given, and again at 290.12–13 he does much the same. It would require a scholar already familiar with the problem and the tradition to lead a novice through Remigius's comments on the matter. Perhaps he relished the pedagogical opportunity he had created.

below the Sun, that is, on the plane on which we always see Mercury's motion anyway but between the solar circle and the earth rather than on the solar circle.[252]

Here we encounter another intriguing and revealing fact about the approach of the designer of the figures in the Vossianus and of the Appendix diagrams added at the end of *De nuptiis*. According to a modern outlook, the designer of the diagrams did not consider visual perspective in his graphical presentation of Mercury's circular orbit. Looking again at the images of this planet's path (Figures 4.6, 4.10, 4.16) and keeping in mind all the stipulations in the Capellan descriptions of its path as elaborated by the Anonymous and confirmed by John the Scot, we can see that an observer on the earth with a Euclidean visual perspective would report a greater elongation from the Sun for Mercury than for Venus in the diagrams of circumsolar planets in Figures 4.6 and 4.10. The 32-degree expansion of Mercury's circle lies between the circle of the Sun and the earth, not along the Sun's circle, and the designer of the diagram did not intend to present this expansion as the planet's elongation from the Sun. A sense of visual perspective from an earth-bound reference point was irrelevant. Considered as an image on a drawing board, the figure could be modified to represent greater and smaller expansions of the planet's path at intersections with the solar circle and between the solar circle and the earth. The placement of Mercury's circle is extreme in Figure 4.16 and was revised by the designer for the "ultra xxxta" diagram in the Appendix (Figure 4.10) in order to show only that segment of the orbit presenting the infra-solar 32°. What we realize is that the diagram is quite unperspectival or even anti-perspectival, for it shows the elongation of Mercury to be less than that of Venus in only one way. Along the solar circle we see that the circle of Mercury cuts the solar circle at points closer to the Sun than the intersections of Venus with the solar circle. We might call this a conceptual perspective, but it is not a visual perspective, unless, perhaps, we imagine ourselves observing from some unspecified point more or less perpendicular to the plane of the ecliptic and looking down (or up) at the paths of the circumsolar planets. One solution to this difficulty would have been to extend the orbit of Mercury in the

[252] Voss. lat. F.48, f. 81v,12 *ad* diversis circulis (NPM 333.15): "id est, angustioribus et latioribus quia non aequaliter accessionem habet sed nunc facit parvum circulum nunc magnum." For John the Scot, I have here interpreted rather straightforwardly his comment above, n. 251, from *Annotationes*, p. 184.27–29.

opposite direction ("supra solem"), projecting much farther beyond the Sun (and beyond Venus's orbit) than towards us and thereby making our earth-bound view of Mercury's path more in accord with the specified angles of bounded elongation for both Venus and Mercury. Unfortunately, such a solution would also reverse the order of the inner planets, making Venus closer to the earth than Mercury in both the infra-solar and supra-solar positions, directly contrary to the dominant traditions and Martianus's text. We do not know whether or not the designer of the Vossianus diagrams considered this perspectival solution, but he clearly did not adopt it.

The subject of visual perspective was explicitly recognized in one of the diagrams of the Appendix, the so-called *partes angustantur* diagram, which can be seen as a rota with many spokes, or radii, in Figure 4.10 on the left side of the page.[253] This diagram illustrated the Capellan text that stated the apparent increase in size, or angular arc, of an object approaching an observer at the center of a circular framework. We may suppose that the problem of representing relative sizes of multiple objects at different distances within a radial visual framework was not well comprehended by Carolingians, although they saw the need for perspective regarding a variation in the distance to one individual object. The Anonymous and John Scottus (and Remigius?) understood that the widest portion of Mercury's circle between the solar circle and the earth was wider than the portion of the planet's circle intersecting the Sun's path. It is not so clear to us what they understood about the view from the earth of the complete path of Mercury with respect to the Sun. The difficulties in modern comprehension of the Carolingian representation of a complex situation like the orbits of Mercury and Venus quickly bring to the surface the differences in the two graphical formats. The Carolingian format for this image is closer to something like an engineer's drawing in orthographic projection than it is to any kind of artistic visual perspective.

Venus received somewhat less coverage than Mercury by Martianus, and this trend accelerated with his treatment of the three outer planets. Here we learn rather quickly that among the planets he gave priority to the circumsolar planets, which leads us to recognize that the author's primary focus was on the Moon and the Sun and their effects. Martianus gave more space in his text to Mercury than to Mars, Jupiter, and

[253] See below, p. 402, Fig. 6.13.

Saturn combined. He described Venus's appearances in some detail (§§ 882–883), associating study of the planet with Pythagoras as Pliny had also done. Venus takes anywhere from about eleven months to more than a year to complete its orbit, depending on whether it is in retrograde or not. As an evening star its rising does not last for more than 20 days,[254] while as a morning star it may appear as long as four months. For the latitude and elongation of Venus, Martianus diverged somewhat from Pliny and followed another source like Calcidius, giving the latitude as 12°, not 14°, and using 46° (from Pliny) as a maximum visible elongation as well as 50° (from Calcidius) as an interval that Venus may depart from the body of the Sun. Venus also has the ability like the Moon to cast shadows (well before sunrise) on the earth. Martianus did not use "epicycle" in this separate account of Venus.

The first Anonymous commentator immediately picked up and pointed out the divergence from Pliny regarding Venus's latitude and explained the different values for elongation by glossing 50° as "where it [the orbit] is wider" ("ubi diffusior est") and 46° as "its appearance along the solar orbit" ("in linea solari velut appareat"); here the Anonymous used the same approach as he had previously with the two different elongations of Mercury. The second Anonymous version, however, avoided the differences, making no remark about planetary latitude and glossing only the lesser, Plinian value for elongation in order to emphasize it as the more meaningful.[255] John the Scot distinguished between the two values for elongation by labeling the larger value as one "below the Sun, before or behind [the longitudinal motion of the Sun]" ("sub sole ante vel retro") while clearly identifying the lesser value

[254] Stahl, *Martianus Capella*, vol. 1, p. 199, n. 94, remarks that Venus remains visible much longer after sunset than Martianus stated. Stahl writes that maximum brilliance of Venus occurs about 36 days before and after inferior conjunction, which includes an unstated number of days of invisibility while in proximity to the Sun. Stahl and Johnson, *Martianus Capella*, vol. 2, p. 343, offer a translation (§ 883) that states 20 days of total evening visibility, which seems not to be what Martianus intended. Notably, none of our Carolingian scholars commented on this point with the exception of Remigius, who specified that the 20 days were the rising time only; see Remigius, *Commentum*, vol. 2, p. 292.4 (NPM 335.7): "IN VESPERTINO VERO scilicet ortu, NUMQUAM XX DIEBUS scilicet continuatim." Stahl seems to have misjudged the meaning.

[255] Voss. lat. F.48, f. 81v,26–27, for the two glosses on elongation; the comment on Pliny's value for latitude is in the outer margin, written by the first hand of the Anonymous: "Plinius dicit quod duas partes excedit, unam supra et aliam infra, videlicet xiiii.". For the second Anonymous version, see BPL 88, f. 166v, *ad* aberrare (NPM 334.16): "id est, longe esse, scilicet, a sole."

as the actual elongation of Venus.[256] Here John's comment about the 50-degree interval followed again the reasoning of the first Anonymous and the widespread agreement on Mercury's 32-degree interval "sub sole." John had only one other comment to make about the Capellan text on Venus; he added that the variations in its motion were caused by the Sun. By contrast, Remigius wrote at length about Venus and virtually buried John's comment about the 50-degree interval in a large wave of details, essentially synonyms and definitions.[257]

11. *The Three Outer Planets: Mars, Jupiter, and Saturn (§§ 884–887)*

The planet Mars exhibits significant variation in its movements. It travels its two-year orbit at an inclination of 5° to the ecliptic. Because of its closeness to the Sun, Mars feels the force of solar rays at a position of 90° from the Sun. Thus Mars has a first station, unlike the other upper planets, at quadrature and a second station at the same angle on the other side of the Sun. In agreement with Pliny, Martianus placed the apogee (*altitudo*) of Mars in the sign of Leo and the planetary exaltation (*absis sublimis*), or point of maximum physical influence on the earth, at the twenty-ninth degree of Capricorn.

On the modest amount of detail given by Martianus the Anonymous made little comment except for the newly introduced term 'absis' and its meanings. Martianus evidently wished to avoid using the word 'absis' for both apogee and exaltation as Pliny had done and so used 'altitudo' for apogee and 'absis' only for exaltation. However, the first Anonymous was intent on introducing Pliny's vocabulary to make clear to readers how the terms of Martianus and Pliny should be compared. Leaving 'altitudo' without a gloss, the Anonymous glossed the first Capellan use of 'absis' (meaning "apogee") simply as 'circulus' ("circle") to show

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[256] John, *Annotationes*, p. 185.3–4: "L MOMENTIS hoc dicit sub sole ante vel retro, nam tunc elongatur XLVI partibus." The gloss in BPL 36, f. 114r, *ad* discedens (NPM 334.16): "subtus," seems to have derived from John. BPL 87 and Paris 13955 offered nothing significant on the text regarding elongation.

John, *Annotationes*, p. 185.1–2, also said about Venus, "...non semper aequalem cursum tenet propter radios solis."

[257] Remigius, *Commentum*, vol. 2, pp. 291.14–292.7; the gloss on MOMENTIS (not L MOMENTIS) is at 291.21.

that the apogee is indicated on the orbital circle of Mars, around an eccentric earth, at the farthest point from the earth. He then glossed the very specific use of 'absis' for the planetary exaltation to show that this was only one of three uses of the term, and this brief gloss was more fully explained by a marginal comment that gave the full Plinian use of 'absis' in its various meanings. While Pliny's terminology was not distinctive enough, his explanations made it clear what meanings he had in mind. He noted that the Greek term 'ἁψίδας' (*apsidas*) had the general meaning 'circulus' in Latin, while the term 'absis altissima' referred to the apogee, or far point from the earth, and another use of 'absis altissima' was its application to planetary *sublimitates*, or astrological exaltations, which occur under different zodiacal signs than the apogees. The Anonymous followed these different uses with an abbreviated paraphrase of Pliny's text, which he rather clearly had at hand.[258]

The second Anonymous version chose to make similar points with more interlinear glosses than the first version but without the marginal comment, yet it seems that his glosses, like the marginal comment of the first version, would require a reader to get further assistance, either from Pliny's text or from a more experienced scholar. Thus the second version's gloss to the term for apsis, 'absidem,' simply said "circulum altiorem" ("higher circle") and his gloss on 'altitudo' ("apogee") said only "absis," all of which, one might imagine, could be a bit confusing. And this glossator became confused himself at one point regarding Mars when he glossed 'the two superior [planets]' as "that is, Mercury and Venus," apparently corrected with a gloss by the first Anonymous specifically naming Jupiter and Saturn.[259] When John the Scot glossed the section on Mars he did not refer to this disagreement over the

[258] Pliny, NH II, 63–65. The first hand of the commentary (Voss. lat. F.48, f. 82r) wrote in the outer margin: "[1] Absida grecum est latine circulus et dicitur absida generalis, id est, singularum planetarum circulus. [2] Est et absida specialis, nam ubi se planetarum meatus longe a terra erigit, altissime abside nomen accepit. E contrario vero ubi terre propinquat humillima vocatur absida. [3] Absis autem est ubi planetae altitudines suas descensionesque in aliis signis mutant."

[259] Regarding NPM 335.13 ("absidem"), 335.14 ("altitudo"), and 335.11 ("cum duobus super positis"). The last of these appears to have caused a response from the first Anonymous, since it is hard to believe that the second Anonymous, who glossed here with "cum mercurio et venere," would have first seen and then contradicted the first Anonymous at this point, who glossed the phrase with "cum iove et saturno." For the three glosses in the second Anonymous version see BPL 88, f. 167r,7–9, and Regin. 1987, f. 132r,6–9. The first Anonymous response is at Voss. lat. F.48, f. 82r,6, *ad* cum duobus super positis: "cum iove et saturno." BPL 87, f. 128r, followed the second Anonymous on this last point. BPL 36 and Paris 13955 did not gloss this phrase.

identity of "the two superior" planets, and he followed and restated the Plinian sense of the terms for apogee and station. He also restated Martianus's description of Mars's first and second stations. Remigius entered the fray over "the two superior" planets and chose to endorse the interpretation of the second Anonymous, explaining that the Capellan reference was to the two planets next above the Moon and ignoring the continuing text of Martianus that clearly grouped Mars with "two superior" planets that had risings, settings, stations, and retrogradations in common with Mars. Such a description could only refer to Jupiter and Saturn, given all the differences Martianus emphasized between the inner and the outer planets, and we can only assume that Remigius reached for a justification without considering the full meaning of the text here. For the planet Mars Remigius copied the brief comments of John and most of the glosses in both versions of the Anonymous.[260]

With the planets Jupiter and Saturn Martianus reduced his descriptions considerably, the commentaries doing likewise, although he did offer some noteworthy closing discussion of the outer planets as a group. He described Jupiter as a healthful influence, gave its orbital period of twelve years, its latitude of 5°, its apogee in the sign of Virgo, and its exaltation at 15° in Cancer. In glossing the Capellan text the first Anonymous gave simple clarifications, including a gloss on the healthful influence of Jupiter, inserting 'temperate' ("temperata") above 'healthful' ("salutaris") that would remind any reader familiar with the standard texts of the day of Macrobian discussion (and others) of the characteristic astrological influence of each of the planets.[261] The second Anonymous passed this opportunity but did disagree with the first version regarding the description of planetary exaltation.[262] On all this, John the Scot and Remigius chose to say little or nothing.[263]

For Saturn Martianus again stayed with the most basic information. As the outermost planet it takes almost thirty years for its revolution,

[260] John, *Annotationes*, p. 185.5–11. Remigius, *Commentum*, vol. 2, pp. 292.8–293.4 on Mars; he explained the meaning of "two superior" planets at 292.12–13 and copied the marginal elaboration on "absis" from the first Anonymous at 292.29–34.

[261] For Macrobius and planetary effects see above, pp. 66–7, 85–6.

[262] NPM 336.1–5 (§ 885). Voss. lat. F.48, f. 82r,10 *ad* salutaris: "temperata." This gloss appears also in BPL 87, f. 128r,23, and Paris 13955, f. 53v,9. Voss. lat. F.48, f. 82r,12 *ad* absis (NPM 336.4): "descensus"; BPL 88, f. 167r,16: "id est, excelsior ascensus eius."

[263] John said nothing at all. Remigius was uncharacteristically taciturn, but he followed the second Anonymous in his gloss on 'absis;' see Remigius, *Commentum*, vol. 2, p. 293.3–4: "Absis vero, id est circulus eius, sive excelsior ascensus eius."

has its apogee in Scorpio and its exaltation at 20° of Libra. The latitude of Saturn is 3° or as little as 2°. To this brief description the first Anonymous version added very little, being contented with the more precise amount of twenty eight years for the planet's period and noting that Pliny preferred 2° as this planet's latitude. The second version of the Anonymous had less to say and simply clarified a few words. John offered no gloss except to specify that Saturn's orbit required twenty nine years, a point which Remigius repeated along with a small number of synonyms as glosses.[264]

The ending of Martianus's *astronomia* seems to have been lost, but the text as found in the Vossianus and many other manuscripts probably includes all the astronomical information the author intended. Beyond the brief description of Saturn, we find an account of the three outer planets as a group, which forms a satisfactory closing. As Stahl has noted, the text follows Pliny and other ancient authorities in the numerical details of periods, latitudes, risings, and settings for the outer planets.[265] Considering Mars, Jupiter, and Saturn together, Martianus remarked that they become visible beyond 12° from the Sun, whether at morning rising or setting. We can also see each of these planets rise in the east, in opposition to the Sun as it sets in the west, and this evening rising is called 'acronical.' The occultations, or last visibilities, of these planets occur as they lose their own brilliance to the rays of the approaching Sun. The outer planets have morning stations at 120° from the Sun, evening risings at opposition to the Sun, and evening stations at 120° on the other side of the Sun. Martianus concluded with a brief, perhaps truncated, paean to the power of the Sun's rays to cause the various planetary phenomena.

> The powerful effect of the Sun's rays is responsible for the anomalies in the orbits of all the aforementioned planets and for their stations, retrogradations, and progressions. The rays strike the planets, causing them to rise aloft or to be depressed, or to deviate in latitude or to retrograde.[266]

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[264] NPM 336.6–10 (§ 886). Voss. lat. F.48, f. 82r,14 *ad* modico minus: "paulo minus, id est, xxviii;" in the same line, *ad* duabus partibus: "secundum Plinium." John, *Annotationes*, p. 185.12: "MODICO MINUS paulo minus tot partibus, id est xii;" I take this to mean 12° less than the planet travels in 30 years, giving Saturn a period of about 29 years. See Remigius, *Commentum*, vol. 2, p. 293: "MODICO MINUS una pars, id est paulo minus." Does Remigius mean one year less?

[265] Stahl, *Martianus Capella*, vol. 1, pp. 199–201, nn. 95–101; idem, vol. 1, pp. 343–4, nn. 101–107.

[266] Stahl and Johnson, *Martianus Capella*, vol. 2, p. 344. This solar dynamic force,

In this closing the Carolingian commentators found no further novelty to explain and restricted themselves to brief glosses with synonyms and alternative phrases. The first Anonymous version offered about a dozen of these; the second Anonymous likewise although glossing different words in many cases. John the Scot had already finished his glossing. Remigius alone found a long list of terms to gloss, with insertions and synonyms and alternatives, making his commentary on the close of the *astronomia* a virtual dictionary of every substantive term in this brief text.[267]

12. *Conclusions*

We moderns make our own emphases when we read and comment on medieval commentaries. Thus my commentary in this chapter allots much space to the topics of epicycles and the circumsolar orbits of Mercury and Venus. The first Anonymous was already doing this in his expansion of Capella's treatment of Mercury, Venus, and the Sun with his addition of glosses, extensive commentary, and three diagrams in the margins. This was the only occasion the commentator took to create models (his three diagrams), because the Capellan text seemed imprecise and in need of such exploratory hypothesizing. The Anonymous commentary also shows us the potential elasticity of the term 'epicycle' on the basis of Martianus Capella's text in the absence of a prescribed geometrical definition with a diagram and applications.

This study of the content of the Capellan book on astronomy and its commentaries has focused almost wholly on the discussions of doctrine, not the glosses on the letter of Martianus's text, except where the meanings of astronomical terms required discussion beyond a simple clarification or synonym. In order to discuss relationships among the Carolingian commentaries on the *astronomia* of Martianus we shall

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as we have pointed out above, has Stoic backgrounds and is fundamental in Pliny's account of planetary motions. NPM 337.1–4 gives the abbreviated form of the text's ending with the added line in the apparatus. Voss. lat. F.48, f. 82r,23–25, has the longer ending (given here without correction): "Sed cursus diversitates altitudinisque causas consistendi retrogradiendique atque incedendi omnibus supradictis inportat radius solis adfulgens qui eas percutiens aut hi sublime attollit aut in profundum deprimit aut in latitudinem declinare aut retrogradari facit."

[267] Voss. lat. F.48, f. 82r,16–25; BPL 88, f. 167v,1–16. Remigius, *Commentum*, vol. 2, p. 293.12–35.

continue with the simple grouping of manuscripts used so far in this chapter. While we do not assume that it was the original Anonymous commentary, the version in the Vossianus manuscript at Leiden, which is evidently the earliest surviving copy or form of the Anonymous, has received the label of 'first' version of the Anonymous along with the closely related copy in the Besançon manuscript. The somewhat later manuscript, from the old public library collection at Leiden (BPL), labeled BPL 88, was based on the same archetype as the Vossianus but also appears to have interacted directly with the Vossianus as a separate commentary, indicating that the two existed together for at least a brief time. BPL 88 has an essentially exact copy in the Vatican manuscript Reginensis lat. 1987, and we use these two to represent what we call the 'second' version of the Anonymous commentary. The first version, at least in the Vossianus, was completed before 850. The second version of the Anonymous (the copy in BPL 88) appears to have been completed just after 850 and to have been known by John the Scot. A number of ninth-century commentaries on the work of Martianus Capella made use of one or both versions of the Anonymous. We have included references to such uses in two other manuscripts at Leiden, two in the Bibliothèque nationale de France, and one in Oxford, but these are simply indices of widespread familiarity with the Anonymous in the Carolingian world. The commentaries of John the Scot and Remigius of Auxerre have been our primary points for comparison.

Because of an absence of detailed and extensive study of the Anonymous commentary on the *De nuptiis*, it has generally been assumed that John the Scot was a relatively independent and creative commentator and that Remigius copied much but not all from John's commentary. The material we have provided from and about the Anonymous, at least for astronomy, allows us to see clearly that John's originality was more in his occasional reformulations of content from the Anonymous and in his greater clarity of presentation. Similarly Remigius's commentary derived a large amount of material from the Anonymous in its various forms and lines of descent as well as from John's commentary.[268] On the basis of our study of the *astronomia* commentaries, it is clear that the Anonymous in its two versions was a

[268] Comparison of the Anonymous with the commentaries of John and Remigius makes it necessary to revise the assessments of the latter pair in McCluskey, *Astronomies and Cultures*, pp. 158–62, where the absence of the Anonymous makes it impossible to assess the ninth-century Capellan tradition adequately.

crucial source for both John and Remigius. The second version of the Anonymous offered innovations or views not found in the first version only four times according to our study, making the first version by far the most influential commentary until that of Remigius at the end of the ninth century. An initial survey of some thirty eight topics treated in the three commentaries on Capellan astronomy shows that John the Scot followed or depended on the Anonymous commentary (usually the first version) twenty times and introduced notable innovations about six times; for the other twelve topics John either said nothing or offered modest alternatives.[269] Partly through his use of John's commentary and partly through direct use of one or another version (or descendant) of the Anonymous, Remigius made very extensive use of the Anonymous. Looking back at the Carolingian study of Martianus's textbook, these three commentaries have equal importance for us in understanding the level of astronomical knowledge and the concerns of scholars studying and teaching the astronomy of Martianus Capella.

Compared to the first version, the second Anonymous version was more selective in the amount of commentary produced and focused more on the effect of its commentary on readers. Among the thirty eight topics we have used for comparison there are fourteen points, in addition to the four locations for innovation, where the second version differed from the first, almost always by omitting a gloss or comment.[270] The four innovations made by the second Anonymous include one modest emphasis of Martianus's text to the effect that light reflected

[269] John's use of the Anonymous commentary was extensive and at times quite imitative. At NPM 302.11, the gloss *ad* Timaei by John, *Annotationes*, 165.17–18, reads: "Timeus dicitur quidam homo cui scripsit Plato librum qui vocatur *Timeus*." This did not appear in the first Anonymous and came directly from the second Anonymous, BPL 88, f. 153r inner margin: "Timeus fuit quidam ad quem Plato librum scripsit quem appellavit Tymeum licet quidam dicant a Greco ethimologiam sumptam quod est Tyme et interpretatur anima. Ibi enim Plato de anima disputavit." Notably, John did not adopt the latter part of this gloss. But seeing that he agreed that Timaeus was the person to whom Plato wrote the dialogue, we are entitled to ask whether he had read carefully or fully either the *Timaeus* or Calcidius's commentary by the time he wrote his commentary on *De nuptiis*. Certainly we should not accept the notion that this gloss in the *Annotationes* was not copied by John Scottus simply because it was erroneous; cf. Marenbon, "Platonism—A Doxographic Approach," pp. 74–5. I have addressed provisionally the problem of John's knowledge of Plato, at least regarding astronomy, in "Johannes Scottus and Astronomy," pp. 309–11.

[270] Only three of the thirteen points do not fit this characterization. Of the three, one is a small addition, one a correction of fact, and one an error by the second Anonymous version.

to the earth by the Moon is a milder light than rays from the Sun.[271] The others were more substantial. One was the addition of the set of images for seven lunar phases with the lunar day number for each image (Figure 4.12). And were we to broaden our framework to include Books 1–2, we would encounter the conversion of a long comment of the first Anonymous by the second Anonymous into a nice set of four labeled images to convey four harmonic proportions and their arithmetical names.[272] Another innovation was the restriction to two of the alternative patterns for circumsolar planets. The second Anonymous used only concentric circles and intersecting circles as patterns for the orbits of Mercury and Venus around the Sun; the commentator also reversed the order of the two planets with respect to the Sun, placing Venus on the inner circle in the pattern of concentrics. Finally, the second Anonymous introduced a remarkable alternative interpretation of the term 'antipodes.'[273] This commentator chose to define the antipodes of Europeans as a region and population on the opposite side of the northern hemisphere rather than diametrically opposed and therefore in the southern hemisphere. Since Pliny, Macrobius, and Martianus Capella had all discussed antipodes, and Isidore and Bede had dealt severely with the notion of human inhabitants at the antipodes, the second Anonymous can hardly have erred carelessly. And we have noted that John the Scot noticed and explained what the second Anonymous commentator did in this regard. He seems to have been determined to offer a way to allow inhabited antipodes without offending against the reasons of Augustine, Isidore, and Bede. In other words, human habitation was acceptable for the commentator of the second Anonymous version only in the northern hemisphere, where persons would have access to the Christian message of salvation. At the same time, the second Anonymous did not try to dismiss the antoecians, another population located below the equator and mentioned by Martianus. When compared to the first Anonymous commentator, the second Anonymous seems oriented towards avoiding controversy, perhaps for a younger audience or for a more conservative overseer of the teaching curriculum.

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[271] See above, p. 270, n. 214, for glosses on NPM 327.3.

[272] BPL 88, ff. 5v–6r inner margins, for the four figures of harmonic/arithmetical proportions. BPL 88, f. 4v inner margin, also added a new and interesting comment (*ad* endelichiae) not even suggested in the Vossianus, indicating an expanded use of Calcidius at mid-century.

[273] See above, pp. 201–2, nn. 77–78, for the relevant comments by the second Anonymous and John the Scot.

Although we have limited evidence, we find the second version of the Anonymous quite solicitous for more moderate, less speculative—even less inquisitive—positions than the first version. In the use of diagrams the second Anonymous did not try to represent the different lengths of the seasons, omitted the most inventive of the three circumsolar planetary designs (the Plinian), and added a thoroughly unsurprising and very useful picture of seven phases of the Moon. A number of the topics that the second version chose not to discuss were taken up by both the first version and John Scottus, and these are finer points of concern that the second Anonymous appears to have found either unimportant or too subtle for his anticipated audience. Examples are the correction of Martianus's misstatement that the Sun and the Moon eclipse each other, the avoidance of conflict over the precise data for the latitude and the elongation of Venus according to Pliny as opposed to Martianus, and the unwillingness to engage in reinterpreting Martianus's statement that the obliquity of the zodiac to the equator was required to maintain the physical integrity of the cosmos. On the other hand, the second version was relentless in working to expand the vocabulary of its audience.[274] The second Anonymous was an intelligent reader and commentator, ready to make the occasional completion or correction needed when it was obvious, and committed to a view of astronomy as a corroborative body of knowledge clarifying the sense of order in God's creation.

John Scottus, who may now appear to us less original in his glosses and comments on Martianus's *astronomia*, easily remains the Carolingian scholar with the clearest and most economical commentary. He began his commentary on Book 8 with the simple statement, "This art is called *astrologia* or *astronomia*." To this he immediately added a brief but highly pertinent distinction between *astrologia* and *astronomia*. The former he called the "ratio astrorum" ("reason, or nature, of the stars"), and the latter he called the "lex astrorum" ("specific order of the stars"). We know *astrologia*, for example, in knowing which zodiacal constellations are rising and which are setting. To know *astronomia*, on the other hand, is to know which signs rise vertically and which obliquely, and this knowledge is not according to the nature of things but according to the

[274] Furthermore the second Anonymous commentary on the first half of Book 8 shows a nice attention to the different ways an audience will receive glosses opening with .i. (id est), .s. (scilicet), or no opener; the different intended intonations of these gloss groupings when read aloud are apparent.

observer's position on the earth. For one positioned at the very middle of the world there is no oblique zodiac; for us, who live on the surface of the terrestrial globe outside the path of the zodiac (or the ecliptic plane), the zodiac is oblique, because we see it as being to the south below us.[275] Here John began with a familiar phrasing from Isidore in distinguishing astronomy from astrology and then turned in a different direction, using the same names, focusing instead on an *astrologia* akin to theoretical astronomy and an *astronomia* attentive to observation and the mathematical manipulation of data. However, John did not introduce in this opening statement about *astrologia* and *astronomia* his third interest, *fisica*, which he invoked at points in his commentary on Capellan cosmology in Book 8. *Fisica* was John's source for the fundamental physical truth about nature, the natural philosophy that lay behind *astrologia* and at times reoriented and corrected it. While we have only a few examples of the debate between *astrologia* and *fisica* in his *Annotationes*, John is the only one of our commentators—except for Remigius, who copied from John—that dealt openly with the adequacy of astronomical theory.[276] And even John treated matters of theory, of natural philosophy, and of the purposes for studying astronomy only occasionally and in part, not as themes requiring any overarching statements and explanations. These were not proper elements of the Carolingian commentaries. At the same time John could assume that readers were aware of his meaning and therefore the general background of *fisica*, because the terms were already used as if requiring no explanation by the first Anonymous version in comments on Book 1 regarding Mercury's elongation from the Sun.[277]

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[275] John, *Annotationes*, p. 165.2–9.

[276] The examples to which we have referred previously are found in *Annotationes*, pp. 171.15–172.7, 180.6–17. These are used and discussed at pp. 209–11 above.

[277] See Voss. lat. F.48, f. 3r outer margin, where the elongation is emphasized with no less than three separate comments: (1) "Tangit fisicam quia numquam mercurius aberrant a sole xxii partibus nec uno mense abest a sole;" (2) "…veram astrologiam tangit quia numquam mercurius elongatur a sole nisi xxii partibus…;" (3) an exact repetition of the first of these comments at a more conspicuous point in the margin. However, the first Anonymous did not distinguish the meanings of *fisica* and *astrologia* here and conflated them. John took pains to make the distinction between them—and not in reaction to this particular use by the Anonymous. If we wish to pursue this *fisica*, we shall find it first in the ancient tripartition of philosophy into *phisica-aethica-logica*, regarding which see D'Alverny, "La Sagesse et ses sept filles," p. 249. Among its various graphic representations are Bern cod. 336, f. 8r (s. IX½), following a fragment of Alcuin's *De dialectica*, and the detailed scheme in Bern cod. B56, f. 183v (s. X–XI), attached to an earlier copy of *De nuptiis* with Remigius's commentary. The latter ms.

What did the commentaries contribute to the Carolingian study of astronomy? In one sense they were completely bound by the limits established by the text receiving gloss and commentary. But as we have seen, the commentaries did all of the following. First and most obviously, a commentary on a text like Martianus's astronomy identified that text as an important source for study—as an authoritative and useful survey in the case of Martianus. Second, as commentaries, going beyond the normal concern of glosses to elucidate the letter of the text, the works of the Anonymous and successors elaborated astronomical doctrine. Examples abound, and some that spring to mind are (1) the elaboration of the four elements and the celestial aether into a theory that put terrestrial actions in opposition to celestial actions, (2) the introduction of external doctrine to extend what appears in the commented text, such as the development of three different patterns of circumsolar planetary motion along with the assignment of each pattern to an authoritative name (Martianus, Pliny, Plato), and (3) importing data to extend patterns already provided in the text in order to show more fully the consistency and the precise content of the phenomenon, such as the maximum lengths of night and daylight at an expanded range of *climata* in the northern hemisphere. And finally, through focus on certain topics in Martianus's text the commentaries identified questions for further exploration. Questions raised and clearly remaining open to further investigation included inquiries into the meaning and use of epicycles and a graphical explanation of the seasons of the year.

The use of diagrams in astronomical texts studied by Carolingians was not new, but the diagrams of the first Anonymous offered a new prospect for contemporaries. We have seen in previous chapters the innovation of content in traditional diagrams, such as the insertion by Dungal of the Plinian (also Chaldean) order of the planets into Macrobius's configuration intended to show the Platonic order. We have also seen the invention of new diagrams to illustrate doctrine in traditional texts, such as the four diagrams, designed perhaps under Adalhard of Corbie (ca. 810), to represent four astronomical excerpts from Pliny's *Natural History*. In all these examples we see the results of

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scheme shows *phisica* subdivided into *arithmetica, astronomia, astrologia, mechanica, medicina, geometrica,* and *musica*. Thus we find *astronomia* and *astrologia* on the same hierarchical level along with five other mathematical-scientific disciplines. On this subdivision, which also predated the Carolingian period, see Bischoff, "Eine verschollene Einteilung," *Mittelalterliche Studien*, vol. 1, pp. 273–88.

designs produced only after careful and authoritative consideration; the diagrams were instrumentally drawn, and they remained relatively stable in subsequent copies of the texts concerned.

In the diagrams appearing in the first Anonymous we are able to observe an evolution that actually extends beyond the Vossianus manuscript to other manuscripts following the Anonymous and to subsequent generations of scholars and scriptoria using the *astronomia* of Martianus Capella. In the Vossianus the diagrams evidently originated with the scribe we have designated the second hand in the process of commentary, and he may have been copying images set down on an abacus or a waxed tablet. Comparison of the Vossianus diagrams with the diagrams for the same topics in the other manuscript of the first Anonymous version, the Besançon manuscript, reveals that the images in the Vossianus were not considered authoritative and had no status beyond that of potentially useful additions to the commentary. The Besançon copy used the same marginal diagram for eclipses, and, except for the fact that it was more neatly drawn, the copy is exactly the same as the Vossianus original. On the other hand, the Besançon copy of the Vossianus diagram for the different lengths of the seasons took great liberties with the original in assuming that it was simply an imprecise rendering of concentric circles and made the zodiacal and solar circles perfectly concentric.[278] At the same time the Besançon copy nicely corrected the spelling of one word, retained all the labeling of the original, and crowded the initials for the zodiacal signs into groups that were spatially less representative than the original. In short, the copy made the diagram neater and less representative by eliminating the eccentricity of the earth within the solar circle. The lack of any traditional authority for the diagram along with the obviously freehand character of the Vossianus drawing must have encouraged the Besançon copyist to clean up what he took to be a messy attempt, *une tentative* as some moderns would have it, in the case of the diagram of the seasons, while preserving faithfully the eclipse diagram as found in the Vossianus.

The status of each of the marginal diagrams in the Vossianus was hardly more than that of a sketch. Like a sketch each diagram was a

[278] Voss. lat. F.48, ff. 80v (eclipses), 81r (seasons); Besançon 594, f. 72r (eclipses), 72v (seasons). Figs. 4.13–4.14 show the Vossianus figures. See below, Fig. 5.6, for the Besançon image for the seasons.

rough-and-ready aid to concretize a verbal description. Geometrical analyses and demonstrations were extremely rare in Carolingian astronomy, and diagrams were used mostly for descriptive purposes. As such they held a more tenuous place but could also be applied to a text more quickly than images requiring a careful and elaborately worded account. Thus the figures in the Vossianus were swiftly created and, as we have seen, often failed to clarify sufficiently to inspire acceptance and adoption in another commentary. At the same time these diagrams show us the reception by one scholar of the text and his perception of a way to represent topics in the text. Furthermore the existence of such diagrams in a widely consulted manuscript must have inspired readers to copy, perhaps to vary or improve, possibly even to hypothesize about, what they saw when they experimented with these diagrams on their own dust boards, waxed tablets, or whiteboards. Through such diagrams the designer could propose models and alternatives for the text, for example, the model of Capellan circumsolar planets and the alternatives of Pliny and Plato. And finally, the creator of these diagrams has given us occasional insight into his understandings and perhaps the understandings of his contemporaries, for example his intriguing diagram to explain the lengths of the seasons of the year, which allows us to see the limits of his conceptualization of relative spaces, which were shared by the copyist who reproduced it in another manuscript. While many of the marginal sketches in the Anonymous commentary fell by the wayside, we have noted the assembly, preservation, and virtual canonization of an appendix of ten diagrams from the work of the designer of diagrams in the Anonymous. The appendix appeared in the first version of the Anonymous and was redone with more care, primarily by using instruments to draw circles, circular arcs, and straight lines for presentation in a number of other ninth-century copies of *De nuptiis* and by the early tenth century in copies of the commentary by Remigius of Auxerre. Here we can observe the evolution of the diagrams from sketches in the Anonymous to accepted authority by the tenth century and beyond.[279]

[279] The appendix of diagrams appears in Paris nal 340, f. 83r (s. X), a copy of Remigius's commentary. For eleventh-century use and development of diagrams in the appendix, see Eastwood, "Invention and Reform in Latin Planetary Astronomy."

CHAPTER FIVE

USING CALCIDIUS'S *COMMENTARIUS* IN CAROLINGIAN ASTRONOMY

The fourth-century commentary by Calcidius on Plato's *Timaeus* offered far more astronomy than the works we have studied in previous chapters, yet Calcidian astronomy found no audience before the second quarter of the ninth century, and there is no direct evidence of critical study of the manuscripts of his translation and commentary until the last quarter of the century.[1] Our earliest witness to the use of Calcidius comes in an excerpt in a theological collection from the circle of Alcuin. Here some four lines from the commentary were adapted as a summary of the harmonious order of God's creation, especially its material components.[2] Previously accepted evidence that the *Commentarius* was at the court of Charlemagne has been seriously questioned, although there remain reasons to believe that a complete manuscript of Calcidius's translation of the *Timaeus* with his commentary existed at the Aachen court ca. 800.[3] The library catalogue of Reichenau on Lake Constance

[1] The standard critical edition is Waszink, *Timaeus a Calcidio translatus commentarioque instructus* (CCT hereafter); the second edition differs primarily in the addition of eleven pages to the introduction of the first edition. For introduction to the commentary and extensive bibliography, see Gersh, *Middle Platonism*, vol. 2, pp. 421–92. Additional information about Calcidius, his correspondent Osius, and the manuscripts appears in Dutton, "Medieval Approaches." Waszink, *Studien zum Timaioskommentar*, vol. 1, is of limited use for Calcidius's astronomy, since it omits the basic astronomy of cc. 65–91 and treats only cc. 92–97, 108–112, and 114–118 among the astronomical-cosmological sections. On the translations by both Cicero and Calcidius and the latter's commentary in the Carolingian era see Somfai, "Transmission and Reception." Suggestions for the wider awareness of the *Timaeus* and Calcidius's commentary in the ninth century appear in McKitterick, "Knowledge of Plato's *Timaeus*."

[2] CCT 305.21–306.2 (c. 304). The full *capitulum* in which this excerpt appears is printed in Marenbon, *From the Circle of Alcuin*, p. 167, item C; it is followed in the collection by a glossarial note on terms in the excerpt. The complete collection of excerpts, known as the "Dicta Candidi," whose author has been identified as Wizo, a student of Alcuin, is described by Ineichen-Eder, "Theologisches und philosophisches Lehrmaterial;" Calcidius is mentioned at pp. 193, 196 (# 14), 199.

[3] Bischoff, *Manuscripts and Libraries*, pp. 29, 64, 139, used the distinctive script to date Paris 2164 at s. IX in. as one in a group copied in northeastern France. This dating has been cast in doubt by Huglo, "Trois livres manuscrits," pp. 278–82, whose codicological study gives Paris 2164 a date of s. X¾. However, because of the script,

recorded a copy of *Kalchidius in Thymeum Platonis* sometime after 842 during the ninth century.[4]

1. *The Paris Compend: the Earliest Use of Calcidius for Astronomy*

While knowledge and some use of Calcidius's work may go back to the court of Charlemagne and the teaching of Alcuin, it seems clear that use of the *Commentarius* for astronomy did not begin until much later, apparently during the second quarter of the century. And for astronomy it was the commentary rather than the *Timaeus* that deserved and found use among Carolingian scholars. Ninth-century references to Plato could as often be to Calcidius's commentary as to the *Timaeus*, and other sources such as Macrobius's commentary on the *Somnium Scipionis* gave many ideas and doctrines under the name of Plato.[5] Calcidius included in his commentary a long string of paragraphs (cc. 56–118) on astronomy and cosmology that carried out his goal of demonstrating the rationality of Plato's physical macrocosm in more contemporary (Middle Platonist and Aristotelian) terms.[6]

Our first significant excerpts from Calcidian astronomy appear anonymously in the text we have called the Paris Compend, probably brought together during the 830s and by 840, which contains texts of some length from Macrobius and Pliny as well as Calcidius.[7] The

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Huglo proposes that Paris 2164 is an exact copy of a model brought to Fleury sometime after 816 by Helisachar, a friend of Alcuin and later chancellor for Louis the Pious and abbot of Saint Aubin at Angers.

[4] *Mittelalterliche Bibliothekskataloge Deutschlands und der Schweiz*, vol. 1, p. 266.

[5] Dutton, "Medieval Approaches," p. 193, supports the notion that the two could be confused, offering a nice example from Eriugena's *Periphyseon*. We should notice that Macrobius named the *Timaeus* ten times and Plato at least 32 times in his commentary.

[6] See Appendix for a list of these numbered sections with their contents.

[7] I base the dating of the Paris Compend in part on the following: Leonardi, "I Codici" (1960), pp. 443–4 (nr. 171) with bibliography; Bischoff, "Hadoard," *Mittelalterliche Studien*, vol. 1, pp. 58–9; Corsetti, "Note sur les excerpta," pp. 113, 114 n. 7, 127 n. 7. These sources, with Corsetti depending on personal notices from Bischoff, would tend to place Paris 13955 overall in the third quarter of the century. In addition, Bischoff seems to have been correct in regarding the folia with the glossed copy of Capella's astronomy as an insertion in the ms. towards the end of the century. An earlier copy of Capella, possibly with all nine books, may have been used as a reference before this copy of Book VIII alone was made available. However, more detailed study of the hands in the manuscript by Wesley Stevens in 1993 and later produced the identification of one copyist involved in the astronomical excerpts in Paris 13955 as the

manuscript was in the library at Corbie at mid-century, and parts of it, including the Compend, seem likely to have been brought together before Hadoard's influence as librarian. Hadoard's interest in the text of Martianus Capella is witnessed by his participation in some of the glossing of the ninth-century Corbie copy of *De nuptiis* in the Paris ms. lat. 8670 as well as his inclusion of a section from the Capellan *astronomia* in his Collectaneum.[8] The Compend does not include any text from Martianus Capella, because in the manuscript this compendium follows a complete, glossed copy of Book 8 of *De nuptiis* and functions as a further commentary, or set of chapters, on three especially important areas of concern in the Capellan *astronomia*.[9] These areas of concern are (1) the eleven circles of the celestial sphere, (2) epicycles, especially as a rationalization of the apparently non-uniform motions of the five planets exhibiting stations and retrograde motion, and the eccentric circle as a means of explaining the non-uniform lengths of the seasons, and (3) the variations in planetary risings and settings.

The first chapter in the Compend, *De caelestibus circulis* ("On the Celestial Circles"), offers a simplified and corrected version of Macrobius's description of the same ten circles as can be found in *De nuptiis* VIII, 817–837, with the meridian added by Macrobius as an eleventh circle.[10] Comparison with the Capellan text shows us that the Compend has a much simpler initial description of the circles of the celestial globe. The compiler took the text of Macrobius and made a number of tactical omissions such as the historical account of earlier notions about

same hand that Stevens identified as scribe IId in "Fulda Scribes at Work," pp. 294, 299–300, et passim; this Fulda scribe worked on Paris 13955 by ca. 840, although we do not know where (personal communication from Wesley Stevens, June 2002). This pushes the production of the Paris Compend back at least one decade before Bischoff's dating. The added glossed copy of Capella's astronomy may have replaced an earlier, unglossed copy.

[8] For the ms., see Leonardi, "I Codici," p. 437, nr. 161, and Ganz, *Corbie*, p. 152. For an important note on the Anonymous commentary in this ms., see Contreni, "Three Carolingian Texts," p. 808. See above, p. 76, n. 97, for Hadoard's excerpt from Capella's *astronomia*.

[9] For the Paris Compend, see above, pp. 252–4; also pp. 68–72. An earlier published account of the Compend is Eastwood, *Revival of Planetary Astronomy*, ch. 10, pp. 172–8. I have prepared for separate publication a study with transcribed texts of Paris 13955, ff. 46v–56v, which contain a glossed commentary on *De nuptiis* VIII, an Aratea (inc: "Duo sunt extremi vertices. . . ."), and the Paris Compend.

[10] The first chapter of the Compend is found at Paris 13955, ff. 56r,8–56v,19. The excerpt from Macrobius covers CSS 61.7–63.24 (I.xv.2–17) with selected paraphrases and four omissions by the excerptor.

the Milky Way (I.xv.4–6), along with the widely approved correction of Macrobius's intersections of the zodiac and the Milky Way. Macrobius had said (at I.xii.1) these intersections were in Capricorn and Cancer, and the excerptor for the Paris Compend wrote into his excerpt, "Now it [the Milky Way] intersects the zodiac in Gemini and in Sagittarius, and there are ten other circles, one of which is this zodiac, which we call *signifer* in Latin."[11] At the end of the simplified Macrobian account of eleven celestial circles, the Compend uses a transitional sentence to introduce the planets and then shifts to an excerpt from Calcidius that discusses the differences between fixed stars and planets, pointing out that some motions are common to both groups.[12]

The second chapter of the Paris Compend, *De ordine planetarum* ("On the ordering of the planets"), begins with Macrobius's well-known order of the planets, comparing the orders of the Chaldeans and the Egyptians, and proceeds to selections from Pliny, followed by an excerpt from Calcidius that is the longest part of the chapter.[13] By beginning the chapter with the Macrobian passage on the Egyptian versus the Chaldean systems, the compiler begins with an example of the need for principles of order, since different sequences of the planets have been supposed. Macrobius provided a beginning in this direction by accepting the priority of observation when there is no conflict with theoretical reason but preferring theoretical reason in a case of conflict. The next set of excerpts in this chapter of the Compend, from Pliny, deal with the planets separately and in sub-groups, discussing absides, exaltations, and latitudes as well as solar radial forces. The Calcidian sections follow with detailed, frequently geometrical, descriptions of the planetary motions, including epicyclic and eccentric patterns. More importantly, the texts from Calcidius present first epicycles, then eccentrics, as the geometrical reasonings that show there is an order of uniform circular motions among the planets despite the appearances of irregularity.

[11] Paris 13955, f. 56r: "Nam in geminis ac sagittario zodiacum intersecat X autem alii circulis quorum unus est ipse zodiacus quem latine signiferum vocamus." This insertion follows the text of I.xv.7, fits in where I.xv.8 has been omitted, and is followed by I.xv.9–10, after which the next major omission occurs.

[12] CCT 116.1–14 (c. 69, partial).

[13] The sources here are Macrobius, *Commentarii*, I.xix.2–13; Pliny, NH II, 45–46, 58–61, 63–67; Calcidius, *Commentarius*, cc. 74, 85, 77–80; presented in the sequence given here.

The opening text from Macrobius has very few omissions and inserts only one fact. The compiler adds the name of Pliny to those of Cicero, Archimedes, and the Chaldeans, setting their planetary order over against that of Plato and the Egyptians. The addition of Pliny's name indicates that by the time of the compilation the order found in the Macrobian diagram (Figure 2.5) is recognized as Pliny's planetary order, apparently placed in Macrobius's text by Dungal.[14] Furthermore the presence of Pliny's name here in the Compend may have contributed to the long marginal comment in the Anonymous commentary to Capella regarding the possible circumsolar patterns for Mercury and Venus; that comment opposed Plato directly to Pliny. The topic of the order of the planets from the earth to the stellar sphere could be called one of the astronomical questions of the day in the first half of the ninth century, because Macrobius simply presented two fixed orders and chose what he took to be Plato's order in preference to that of the Chaldeans. Pliny, while agreeing with the Chaldeans and being supported by early medieval authors like Isidore and Bede, gave no argument to prove the superiority of his order. Only with the spread of Martianus Capella's doctrine of circumsolar Mercury and Venus was there the beginning of a reconciliation between the two opposed views on the sub-solar versus the supra-solar locations of Mercury and Venus, and it was Capella's astronomy that seems to have occasioned the Paris Compend as a basic yet theoretical introduction to planetary astronomy.

The second chapter of the Compend provided Carolingians with their first useful account of an epicyclic planetary orbit, something not to be found in Capella's text.[15] Before the alternatives for ordering the two inner planets could be shown to have a single resolution, the concept of the epicycle had to be adequately defined and explained, tasks that Calcidius performed for scholars of the ninth-century. But the Calcidian account was preceded by a set of excerpts from Pliny, describing the stations, retrogradations, absides, and latitudes of the planets along with Pliny's specific causal explanations of these phenomena. And what the discerning reader, especially when led by a knowledgeable teacher, would learn from the subsequent Calcidius excerpt was that epicycles and eccentrics, with their modifications, were alternative

[14] The diagrams with description, discussion, and text appear in Eastwood and Graßhoff, *Planetary Diagrams*, pp. 49–55. For Dungal's part in this diagram's planetary order see above, pp. 43–52.

[15] See above, pp. 291–2, for the actual limitations of his use of 'epicycle.'

conceptual tools explaining geometrically all these appearances that Pliny accounted for physically.

These excerpts from Calcidius offered a truly geometrical basis for the claim that the appearances of irregularity in celestial motions are not real irregularities but the results of combinations of uniform circular motions. The reality is a fully ordered, regular set of circular motions. Asserting this fact is the burden of the first paragraph, in which Calcidius remarked that the apparent stations and retrograde motions of five planets are observed only because we view them against the background of the zodiac, a part of the outer stellar sphere.[16] The compiler turned immediately to Calcidius's description of a generic epicycle (c. 85) and copied the full text describing a lettered diagram.[17] The diagram was not copied into the manuscript, nor was a space left for its inclusion later. We should also notice that no other astronomical diagram appears in the Paris Compend, although it includes Pliny's accounts of the apsides and latitudes of the planets, diagrams for which were well known in northern France by the time of this compilation. Given the apparent pedagogical purpose of the Compend, we should expect diagrams to accompany the Plinian and Calcidian excerpts, and indeed they may well have been present—presented on separate tablets or boards.[18] The text that survives would have been set forth at the same time that the points on a separate, enlarged form of the diagram were noted for the students. We may even imagine that the complete production of the diagram with labeled points was intended as a subsequent project, or challenge, to students, who would be expected to follow and recreate on their waxed tablets the diagram solely from the instructions by Calcidius; at the very least, they would have been expected to copy it from the demonstration board.[19] We provide here a version of this diagram (Figure 5.1) for modern readers. Within the excerpt, following the first use of 'epicyclus,' we find the only addition

[16] Paris 13955, ff. 57v–58r: CCT 122.3–123.3 (c. 74). I refer to the sections of Calcidius's text using the paragraph numbers in modern editions for convenience.

[17] Paris 13955, f. 58r: CCT 136.7–137.13 (c. 85). Description and translation of this text of Calcidius appear in Eastwood and Graßhoff, *Planetary Diagrams*, pp. 87–90.

[18] Netz, *Shaping of Deduction*, pp. 13–16, describes the materials for ancient Greek geometrical diagrams and (pp. 58–67) "contexts for the emergence of the lettered diagram." The Carolingian situation was quite different from the emergence of ancient Greek geometrical diagrams, but there are some parallels.

[19] Eastwood and Graßhoff, *Planetary Diagrams*, pp. 110–11, lists 43 examples of this diagram in manuscripts of Calcidius, and others are known.

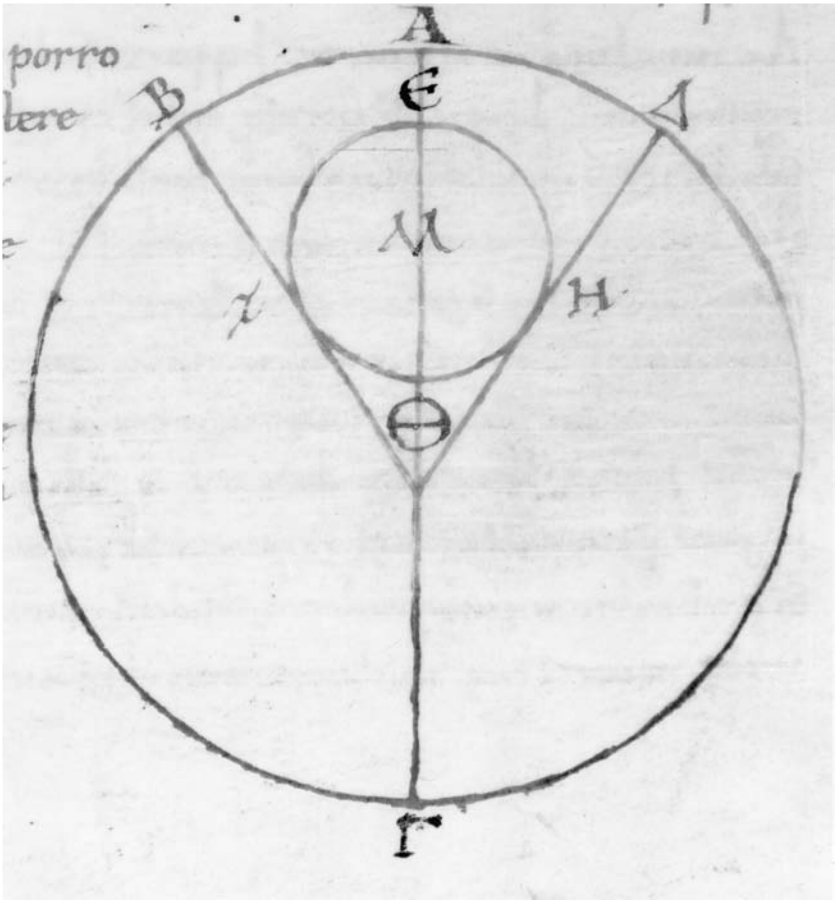

Fig. 5.1. Calcidius's Generic Epicycle. Brussels, Bibliothèque royale de Belgique, ms. 9625-9626, f. 31r

to this paragraph of Calcidius. Recalling pointedly Martianus Capella's characterization of an epicycle, the compiler inserted, "A circle set apart from the earth is called an epicycle. It does not expand towards nor does it enclose the earth."[20] After copying Calcidius's full description of an epicycle, identifying where in the diagram the stations and retrogradations would occur, the compiler added his own instructive comment that, according to the *physici*, we have now learned that the appearances of station and retrogradation are not real, for these are the orderly effects of circular motions.[21]

This chapter of the Paris Compend closes with a copy of Calcidius's cc. 77–80, which included both a description and a full explanation, with diagrams, of the different lengths of the four seasons of the year on the basis of a solar eccentric. The phenomenon, we should remember, was inadequately dealt with by the Anonymous commentary on Capella's astronomy, which attempted a diagram to explain the lengths of the seasons.[22] In paragraph 77 from Calcidius we read that the sun, moon, and five other planets participate in a variety of changes, unlike the fixed stars, but these inconstancies are not as they seem to us. In fact, there is no inconstancy in divine acts. The planetary circles continue in an equal and regular progress, but our perception of this motion against the background of the zodiac gives them the appearance of irregularity and shifting motion. The next paragraph (c. 78) sets forth instructions for a simple diagram, again not produced for students, of the four quarters of the zodiac corresponding to the four seasons with the exact number of days in each season written in the proper quadrant. (Figure 5.2) The compiler dropped one sentence from this paragraph of Calcidius, because it referred to the divinity of the stars, which would raise unnecessary comments or questions in a ninth-century monastic school. The diagram is a descriptive and not an explanatory one, simply setting up clearly the appearances that need to be explained.[23] Finally, with a transcription of most of cc. 79–80,

[20] "Epicyclus autem dicitur circulus a terra separatus. Nec ei imminens id est qui intra se terram non continet." The compiler's sentence imitates Capella: "… circulos epicyclos…id est non intra ambitum proprium rotunditatem telluris includere, sed de latere quodammodo circumduci." (NPM 333.11–13)

[21] Paris 13955, f. 58r: "Hac ratione diligenti cura considerata invenietur secundum physicos quemadmodum et stare atque procedere etiam et regradari stelle putentur cum ille nihil illorum faciant, sed tantum ordinabiliter per circulos suos incedant."

[22] See above, pp. 277–81, and Fig. 4.14.

[23] CCT 125.15–127.15 (c. 78); the sentence omitted can be found at p. 127.11–12. An

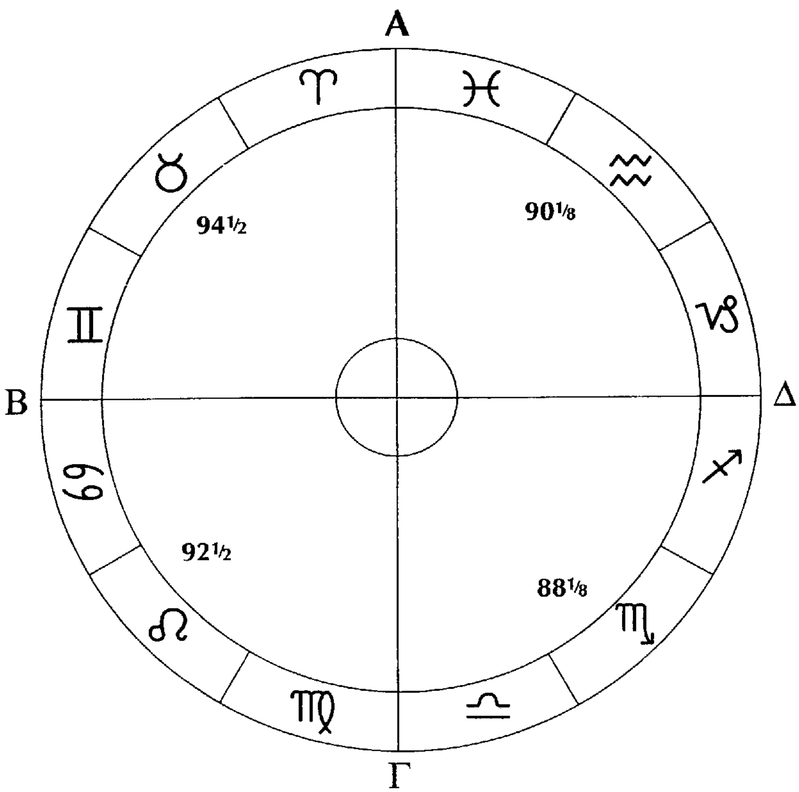

Fig. 5.2. Modern Reconstruction of Calcidius' Description of the Lengths of the Seasons

the compiler transcribed both Calcidius's critique of the diagram for c. 78 (Figure 5.2), since it required that the Sun's motion be inconstant, and a complete description of the diagram needed to explain qualitatively and in detail how a constant motion of the Sun on its circle will seem to be faster and slower along different arcs when seen from the earth, positioned eccentric to the sun's path and at the very center of the zodiac (and the stellar sphere), against which the solar motion is observed (Figure 5.3).[24] This remarkable set of excerpts from Calcidius to explain geometrically the different lengths of the seasons was apparently intended to supplant the sort of unsuccessful attempt found in the Anonymous commentary on Capella's *astronomia*. It appears, however, that the compiler of these texts in the Paris Compend had set too high a standard in expecting that the text could at that time be a sufficient basis for producing correct diagrams from Calcidius's account. Thus it was not disseminated for wider use, since no diagrams accompanied the text. Our more detailed study below of the earliest surviving diagrams from manuscripts of the *Commentarius* will show a variety of problems initially faced by the Carolingian scholars who used and at times adjusted these diagrams.

The third chapter of the Paris Compend, "On the Various Rising and Setting of the Planets" (*De vario ortu et occasu planetarum*), presents rather concisely the rising and setting phenomena from Calcidius (cc. 71, 70) and Pliny (NH II, 74–77). The reversal of the two Calcidian paragraphs helps greatly by dealing initially with the different meanings of risings and settings of planets and stars before discussing the risings of the upper planets separately from Mercury and Venus. However, the Plinian text that follows has many errors, presumably from a poor exemplar, making this portion of the chapter difficult to use, despite a number of corrections and one lengthy addition by the compiler of the Compend. Yet this chapter on risings and settings of the planets was clearly intended to serve the function of summarizing succinctly the description of planetary phenomena, primarily risings and settings. The Plinian excerpt treats in detail the stations, risings, and settings of Venus and Mercury, emphasizing the differences between the sub-solar

abbreviation of the text, limited to the description of the diagram, with translation and diagram, appears in Eastwood and Graßhoff, *Planetary Diagrams*, pp. 73–5 (Fig. 4.1).

[24] Figure 5.3 is a modern product of Calcidius's instructions in c. 80. Versions from the eleventh century are reproduced in Eastwood and Graßhoff, *Planetary Diagrams*, pp. 76–8, with text and translation of cc. 79–80 on pp. 79–82.

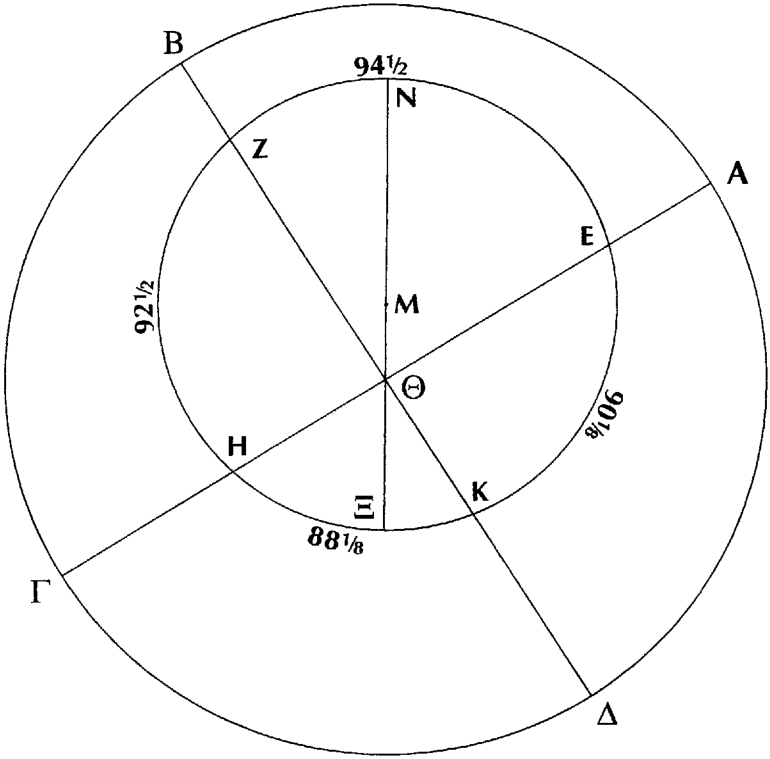

Fig. 5.3. Modern Reconstruction of Calcidius's Explanation of the Lengths of the Seasons

and supra-solar planets, and describes very briefly the phenomena of the upper planets. In this way the compiler paralleled, simplified, and clarified the treatment given to the planets in the final sections of Martianus Capella's astronomy.

2. *Mid-Century Appearance of Calcidius: John the Scot*

The Paris Compend was apparently copied at Corbie, remained in its library, and was used and glossed by various hands including Hadoard's in the third quarter of the ninth century. This was not the only source for uses of Calcidius's *Commentarius* in the 850s as the commentaries of the Anonymous and John Scottus Eriugena on the *De nuptiis* of Martianus Capella testify. The second version of the Anonymous (in Leiden BPL 88) introduced a marginal comment in the first of the two mythological books of *De nuptiis* at the point where the god Mercury in his search for a suitable bride wanted to ask for the hand of Psyche, the daughter of Entelechia and the Sun. While any good Carolingian scholar could recognize that Psyche was the soul, the figure of Entelechia required definition. The second Anonymous offered a set of definitions according to Calcidius ("perfecta aetas"), Aristotle ("absoluta perfectio"), Plato ("anima mundi"), and Greek etymology ("endos lechia id est intima aetas").[25] We should look at the source of this information and the variant recorded by John the Scot. In discussing the Aristotelian view of the soul, Calcidius provided the definition, "Hanc ergo speciem [id est animam] qua formantur singula generaliter Aristoteles entelechiam, id est absolutam perfectionem, vocat."[26] For the second Anonymous this was simply Aristotle's definition. Whether John made use of the Anonymous we do not know, but it is clear that the Anonymous did not use John's version. For John it was an opportunity to expand in a direction of his own choosing, which he did with the help of phrases

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[25] NPM 4.11 (I, 7) for the Capellan text. BPL 88, f. 4v inner margin, for the second Anonymous: "Endelichia secundum Calcidium perfecta aetas, secundum Aristotelem absoluta perfectio interpretatur. Plato tamen dicit endelichiam animam mundi esse et dicta endelichia quasi endos lichia, id est intima aetas." The hand for this comment is not the main gloss hand and may be a somewhat later ninth-century writer. The comment was copied verbatim in BPL 87, f. 3v outer margin. No such comment exists in the first version of the Anonymous.

[26] CCT 236.5–7 (c. 222).

in the Platonist response to Aristotle's views (Calcidius cc. 125–126).[27] John then proceeded to identify Martianus as a Platonist regarding the nature of the soul.

John's penchant for active and adventurous interpretation appears again in his comment on *De nuptiis*, I, 16, where Martianus had Virtue and the god Mercury cross the seven celestial rivers of the Destinies. These rivers could easily be interpreted as the seven planets, which John did, but he then went much further and, referring to Calcidius's commentary, claimed that Plato had placed the Sun at the center of all the planets and suggested that Martianus as a Platonist put all the planets but one in orbits around the Sun.

> Not without reason is it asked how Virtue with Mercury are said to cross the circles of the planets while seeking Apollo, and to have found him beyond all the planets, and, having found him, those three—I mean Apollo, Mercury, and Virtue—to have crossed again the same circles in order to ask the advice of Jupiter; but regarding this it should be said that the circles of those other planets are around (*circa*) the Sun and place their center (*centrum*) in it as Calcidius describes in the commentary upon the *Timaeus* of Plato. Since Plato himself places the center of all the planets in the Sun, then they should be whole (*integri*) both below (*infra*) the Sun and above (*supra*) the Sun. No wonder that this same Martianus, being a thorough-going Platonist concerning the location of the planets, should explain these teachings in detail. And thus it was necessary for Virtue and Mercury to cross the circles of planets twice, first until they are below the Sun, secondly, together with Apollo, until they are above the Sun. Nor indeed do the Platonists maintain that a circle (*circulum*) of Saturn, of Jupiter, of Mars, and also of the Moon goes around (*ambire*) the Earth but that only *Saturn* (my emphasis) goes around the Earth. Indeed it was possible to think according to the opinion of other philosophers that they were able to cross the circle of Venus and of Mercury twice, since they

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[27] Jeauneau gives his view on John the Scot's approach to the term 'entelechia,' which John glossed in both the Paris and the Oxford mss., more succinctly in the latter. See Jeauneau, *Quatre thèmes*, 110–11, n. 25. For John's comment in the Paris ms. see *Annotationes*, p. 10.16–24: "ENTELECHIA ut Calcidius in expositione *Timei* Platonis exponit perfecta aetas interpretatur. Aetas quippe adulta ‘ηλικία a Grecis dicitur. Entelechia vero quasi εντος ‘ηλικία, hoc est intima aetas. Generalem quippe mundi animam Entelechiam Plato nominat, ex qua speciales animae sive rationabiles sint sive racione carentes in singulas mundani corporis partes sole administrante, vel potius procreante, procedunt ut Platonici perhibent. Quorum sectam Martianus sequitur asserens Psichen, hoc est animam, Entelechie ac Solis esse filiam." For the modified form in the Oxford ms. comment, see *Glosae Martiani*, ed. Jeauneau, in *Quatre thèmes*, p. 110: "Endelechia vocatur perfecta aetas, eliche aetas generalis. Ideo autem dicitur anima esse filia Solis, quae gr(ece) vocatur NYC, quia dum anima ad perfectam aetatem pervenerit endelechia vocatur. Perfecta igitur anima a claritate scientiae dicitur."

are both below and above the Sun. Not finding Apollo on the Earth nor in the regions of the lower air, which is located between the Earth and the Moon, how were they able to discover any other circle first except the lunar circle? And if so, not unless they crossed only three circles below the Sun, to wit those of the Moon, Mercury, and Venus. And so, if circles of planets according to Platonic teaching are complete and unitary (*integri*) both below and above the Sun, what prevents concluding that they are crossed twice?[28]

Taken at apparent value, this passage contains the following astronomical content. (1) At least some planets, according to Calcidius, circle the Sun as center. (2) All the planets circle the Sun as center, according to Plato. (3) According to the Platonists a listed group of planets—Saturn, Jupiter, Mars, and the Moon—do not circle the Earth; only one of them, Saturn, does so. (4) The circles of the planets Mercury and Venus are both below and above the Sun, according to some philosophers. These four sentences simplify without misrepresenting John's astronomical comment. A further simplification, accepted by most moderns who have interpreted this text, holds that John, regardless of errors he may have made in reaching his conclusion, taught here that the Sun is the center of the orbits not only of Venus and Mercury but also of Mars and Jupiter.[29]

[28] NPM 8.22–25. John, *Annotationes*, p. 22.20–23.6: "CUM VIRTUTE MERCURIUS Non inmerito queritur qua ratione Virtus cum Mercurio planetarum circulos quaerentes Apollinem transcendere dicuntur, eumque ultra omnes planetas invenire et iterum reperto Apolline, illos tres Apollinem dico, Mercurium et Virtutem eosdem circulos consultum Iovis flagitantes transvolasse, sed ad hoc dicendum [est] ceterarum planetarum circulos circa solem esse, ac per hoc centrum suum in ipso ponere sicut Calcidius in expositione *Timei* Platonis exponit. Ipse siquidem Plato planetarum omnium centrum in sole ponit, ita est ut sub sole integri et supra solem. Quid itaque mirum si iste Martianus dum sit omnino Platonicus de situ planetarum documenta edisserit? Ac per hoc bis necesse erat Virtuti cum Mercurio planetarum circulos transire, primum quidem dum sunt infra solem, secundo vero adiuncto ipso Apolline dum sunt supra. Non enim Platonici circulum Saturni Iovis Martis nec non et lune ambire terram sed solummodo [Saturnum] terram ambire perhibebant. Poterat enim intelligi iuxta aliorum philosophorum opinionem bis circulum Veneris ac Mercurius potuisse transire, quoniam et infra solem sunt et supra. Non invenientes vero Apollinem in terra neque in tractibus inferioris aeris qui inter terram lunamque est constitutus, quomodo alium nisi lunarem circulum primum potuerant invenire? Et si ita est, non nisi tres tantum modo circulos, lunarem scilicet Mercurialem Veneriumque, infra solem transierunt. Itaque si planetarum circuli et infra integri secundum Platonicam doctrinam et supra solem sint, quid impedit bis eos transcendi posse existimari?"

[29] Jeauneau, the editor of Eriugena's *Periphyseon Liber Tertius*, p. 113, note to lines 3272–6 (698A), refers to this passage of the *Annotationes*, agrees with the interpretation that four planets are made to circle the Sun, and lists other moderns who support this view.

What are the astronomical consequences of the doctrines in these four sentences? The first and the last of the four raise no problem, the first being imprecise and the last holding only to the circumsolarity of Mercury and Venus, a notion supported by observations and well known through Martianus's *De nuptiis*. The second sentence, proposing that all the planets circle the Sun as center, presents the following observational contradictions. It is not true, and ninth-century observers knew it was not true, that Mars and Jupiter never shine in the sky in the middle of the night, yet the view that these planets circle the Sun and so move with it to the opposite side of the Earth from us at night would require them to be below our horizon for most of the night. The third sentence offers a remarkable contradiction to what is observed. According to "Platonists" only Saturn circles the Earth, while the other planets, including the Moon, do not circle the Earth. If John had taught such a view, he would have endured great derision from his contemporaries, since it means that the Moon can never be seen in the middle of the night, that we could never see a full Moon on the eastern horizon at sunset, nor could we ever see the sequence of lunar phases every month that we do, in fact, see. Given such clearly erroneous observational requirements, which do not demand much effort to disprove factually, we should wonder why John's text here has been interpreted so single-mindedly to involve a broad heliocentrism.

There are also errors of scholarship in John's comment, if we hold to the modern view that he intended to expand heliocentric motion to four planets. Plato did not consider the Sun to be at the center of the circular orbits of all (or most) of the planets. Calcidius did not attribute such a teaching to Plato. Nor did Martianus make any planets other than Mercury and Venus circumsolar, and John obviously knew this, since he was commenting on the *De nuptiis*, and Book 8, the astronomical book, stated the Capellan view explicitly.[30] In addition, in the Oxford manuscript of his commentary on Book 1 of *De nuptiis* John stated very clearly that Martianus, listed as a "Platonist" in the Paris manuscript, made the three supra-solar planets circle the Earth rather than the Sun.[31] If John actually intended to credit Plato with the heliocentric

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[30] Furthermore, in his comment on *De nuptiis* I, 27–28 (Willis 13.1–7), John, *Annotationes*, pp. 30.22–31.7, placed the planets in the Plinian order, following Martianus here.

[31] *Glosae Martiani*, ed. Jeauneau, 114.21–24 (*ad* menstrua praecursione, NPM 5.20): "…Venus vero et Mercurius non ambiunt terram sicut tres planetae quae sunt supra Solem, sed circa Solem habent circulos."

doctrine that appears to be in the Paris manuscript, he has fabricated that doctrine from unknown sources. It did not appear in either version of the Anonymous commentary on *De nuptiis*.[32] John did not insert it anywhere in his commentary on the *astronomia* of Martianus.[33] It was not made part of the alternative version of John's commentary on Book 1 in the Oxford manuscript.[34] In fact, the only reason to pay much attention at all to this comment by John is the appearance of an apparently identical view in his *Periphyseon* a decade or more later. There he supposedly stated that Mercury, Venus, Mars, and Jupiter all circle the Sun as center of their orbits.[35] The context and details of that *Periphyseon* statement require careful investigation, and I have done so in a separate study.[36] Here we can restrict our attention to John's claim that Calcidius authorized a certain doctrine.

The Paris manuscript of John's commentary contains many inaccuracies, a number of which Lutz identified in the introduction to her edition.[37] Although she raised no question about the comment upon *De nuptiis* I, 16, where John ostensibly introduced heliocentrism, an obvious inaccuracy appears there and is revealed in the edition. In the sentence, "Non enim Platonici circulum Saturni Iovis Martis nec non et lune ambire terram sed solummodo [Saturnum] terram ambire perhi-

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[32] The text (NPM 8.25) on which John commented is at Leiden Voss. lat. F.48, f. 4v,13 (first Anonymous version) and BPL 88, f. 7r,16 (second version) with no comment at all equivalent to John's.

[33] See above, Ch. 4; a careful survey of John's commentary on Book 8 in the three mss. in Bern, Oxford, and Paris reveals no such doctrine there.

[34] *Glosae Martiani*, ed. Jeauneau, pp. 130–2, where aspects of the same Capellan text are glossed with no suggestion of the heliocentrism apparent in Paris 12960 as edited by Lutz.

[35] Eriugena, *Periphyseon Liber Tertius* 112.3257–113.3277 (697C–698A).

[36] Eastwood, "Johannes Scottus and Astronomy." One of the points maintained by modern supporters of the view that John must have meant that all the planets but Saturn circle the Sun is John's use of the word 'circa' to describe the positions of the supposedly circumsolar planets. Jeauneau (*Periphyseon* ed., p. 113n.) refers to a number of older studies supporting this view and discounts my studies of Macrobius and Calcidius intended to update and correct the older, Duhemian view. As for John's meaning when using the word 'circa,' he clearly used it in two ways, at times to mean 'around' as in 'around a center,' and at other times to mean 'near' in a spatial sense. John's use of the latter meaning, disregarded or disputed by the Duhemian modernists, appears clearly in *Annotationes*, 171.36 *ad* intercapedines (NPM 309.6; VIII, 814), where 'circa terram' appears and, in the name of good sense, can only mean 'near the earth' in this example. In *Periphyseon* 3275 (III, 698A), I claim that the only sensible reading of 'circa solem' is 'near the Sun,' not 'around the Sun.'

[37] *Annotationes*, pp. xxviii–xxx.

bebant," there is an erasure or corruption between the words, "Martis" and "nec non."[38] At the same time, the next line shows smooth copying without extra space or corruption in the wording, "sed solummodo terram ambire perhibebant," to which the editor has added "Saturnum" to create sense out of nonsense.[39] Lutz added the word 'Saturnum,' it seems clear, in an attempt to bring this passage into accord with the apparent heliocentric doctrine in the *Periphyseon*, which was written a decade or more later. The scribe may well have omitted a word here or may even have had an erroneous exemplar. But what word—was it more than one word?—was omitted? We already know that allowing the Moon to be a planet that does not circle the Earth would lead to the prediction of remarkable regular observations that never occur. Therefore Lutz's choice of 'Saturnum,' made to accommodate a text not even composed at the time of John's *Annotationes*, in order to fill the omission is unsuitable. Among the four named planets at this point, we should choose the Moon and place 'lunam' where Lutz inserted 'Saturnum.' Needless to say, this leaves the three planets Saturn, Jupiter, and Mars, as bodies that do not, according to John's Platonists, circle the Earth. And this doctrine, still astronomically problematical, does not accord with the details of the heliocentric doctrine attributed to John in the *Periphyseon*, since all moderns who agree on such an interpretation also agree that in the latter text Saturn is explicitly excluded from the heliocentric group and is considered geocentric, while the Moon is not mentioned at all.

We should return to our quest for Carolingian uses of Calcidius with the recognition that John simply did not find this doctrine of heliocentric planets attributed to Plato (or anyone else) in Calcidius's commentary. We do not know his source. But we can certainly imagine Remigius of Auxerre, who used much of John's commentary along with much from other commentaries in his own on *De nuptiis*, paging through his copy of Calcidius to find this view stated by John and concluding that it was incorrect and not to be propagated. Just as we have found in our study of the Carolingian commentaries on the *astronomia* of Martianus, Remigius selected from a wide set of sources, chose with some independence, and could readily exclude something in John's *Annotationes*

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[38] Paris 12960, f. 56r,18. I have used a microfilm copy to determine this fact.

[39] For these two points in the sentence in question, see *Annotationes* 22.33–34; it is also above at p. 326, n. 28.

because it was either false or useless for his purposes.[40] Nor did any other commentator on Book 1 of *De nuptiis* repeat such a doctrine of heliocentric planets. It could not be found in Plato, in Calcidius, or any other source.

What Calcidius did teach about planetary orders is rather clear. At *Commentarius* c. 70 he reviewed the observational differences between the inner and outer planets, noting that Mars, Jupiter, and Saturn travel slower and are commonly seen in opposition to the Sun whereas Venus and Mercury are always seen close to the Sun ("circa solem semper videntur"), Mercury never more than 20° from the Sun and Venus about 50°.[41] This text, without attribution to Calcidius, could also be found in the Paris Compend, where the elongation of Mercury from the Sun is given as 22°.[42] Significantly Calcidius's choice of words includes the phrase 'circa solem' with the unambiguous meaning 'near the Sun' and not '[circling] around the Sun.' When we observe Mercury and Venus within certain intervals of distance from the Sun, we always observe these planets at some angular distance either preceding or following the Sun, at sunrise and sunset, and not on circular orbits around the Sun. Such circular orbits are theoretical and can not be observed from the Earth. Since the Calcidian statement is observational, the word 'circa' does not refer to circular orbits. Subsequently in his commentary (c. 72) he reported the Pythagorean ascending order of the planets, Moon—Mercury—Venus—Sun—Mars—Jupiter—Saturn, characterizing Saturn as the neighbor of the outer sphere of fixed stars and conceiving the Sun to be at the middle and like the heart of the planetary order ("inter planetas sol medius locatus cordis"). In the next paragraph (c. 73) Calcidius remarked on the disagreement among authorities about the planetary order and then pointed out that Plato had the Moon in the first circle around the Earth and the Sun in the second ("Plato etiam in hoc ipso Timaeo primam altitudinem a terra

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[40] We can find Remigius's view of Plato's planetary order in his comment on *De nuptiis* VIII, 858 (NPM 324.19–20): "post cuius [lunae] orbem alii Mercurium Veneremque, alii ipsius circulum Solis esse concertant;" Remigius, *Commentum*, vol. 2, p. 275.31–32: "ALII CONCERTANT contendant, sicut Plato, non attendentes positionem ipsarum sed ordinem absidarum." Here the 'alii' glossed is the second in the text quoted from Martianus, telling us that Plato should be understood as placing the Sun's circle next after the Moon's circle, since *absis* = *circulus* here. (Both Pliny and Martianus gave occasion for this use of 'absis.')

[41] CCT 118.2–13.

[42] Paris 13955, f. 59v.

usque ad lunarem circulum, secundam usque ad solem . . . dimensus est"). Somewhat later (cc. 99–100) Calcidius explained in detail that the Sun, like a living heart, is in a sense in the middle of the cosmos but not in the middle of the corporeal cosmos, which is the position of the Earth; the Sun's place is in the midst ("mediotullio") of the living parts of the heavens. Thus Calcidius clearly stated that Plato's physical ordering of the planets requires the Sun to be next after the Moon, although he also explained that the vital, or spiritual, order of things puts the Sun, as the heart, in the middle.[43] Consistently in these paragraphs Calcidius made it clear that Plato located the Sun in the second planetary circle out from the Earth, with only the Moon closer to the Earth. The Sun's centrality among the planets was, according to Calcidius, only as the heart in a living being, not as the geometrical center of circular orbits.

If we survey the whole range of astronomical patterns devised or suggested through the Carolingian era and its immediate aftermath, we find one that seems visually approximate to John the Scot's apparent heliocentrism, although we do not propose that this was John's precise meaning nor do we assume that John's view in the *Annotationes* inspired this image. Early in the eleventh century there appeared as an illustration of Martianus Capella's planetary theory a geocentric diagram with the Earth so extremely eccentric that all the planets except the Moon and the Sun appear to be circling the Sun rather than the Earth (Figure 5.4).[44] We offer this image from a later time as a reminder that

[43] The Pythagorean order and the Pythagorean doctrine of the Sun as middle and heart of the planetary world appears at CCT 119.12–18 (c. 72). Plato's placement of the Sun in the second circle is at CCT 121.6–8 (c. 73). Calcidius's further account of the Sun as the heart of the world appears at CCT 151.4–152.2 (cc. 99–100). The central importance of the Sun was also explained by Macrobius, CSS 79.16–17 (I.xx.6), where he promoted the equation of *mens mundi* and *cor celi* with *sol*; he did not cite Plato. Macrobius also followed Cicero in describing the Sun as mind, moderator, and director of the world; see CSS 78.25–26 (I.xx.1), 78.32–79.16 (I.xx.3–5). Referring to Macrobius, the Anonymous commentary on *De nuptiis* II, 193 (*ad* trina, NPM 53.8), repeated the equation, *Apollo = mens mundi = dux mundi*; see marginal glosses at Voss. lat. F.48, f. 17v, and BPL 88, f. 31v. Pliny, NH II, 12–13 (ed. Mayhoff, I, 131.18–23), also retold this Stoic theme: "Eorum [septem siderum] medius sol fertur, amplissima magnitudine ac potestate nec temporum modo terrarumque, sed siderum etiam ipsorum caelique rector. Hunc esse mundi totius animum ac planius mentem, hunc principale naturae regimen ac numen credere decet opera aestimantes."

[44] Florence San Marco 190, f. 102r (s. XI in). A brief description as well as a Renaissance copy of this image appear in Eastwood and Graßhoff, *Planetary Diagrams*, pp. 139–40, with other copies and versions listed on p. 143. For the ms. see Leonardi, "I Codici," pp. 47–8 (nr. 60).

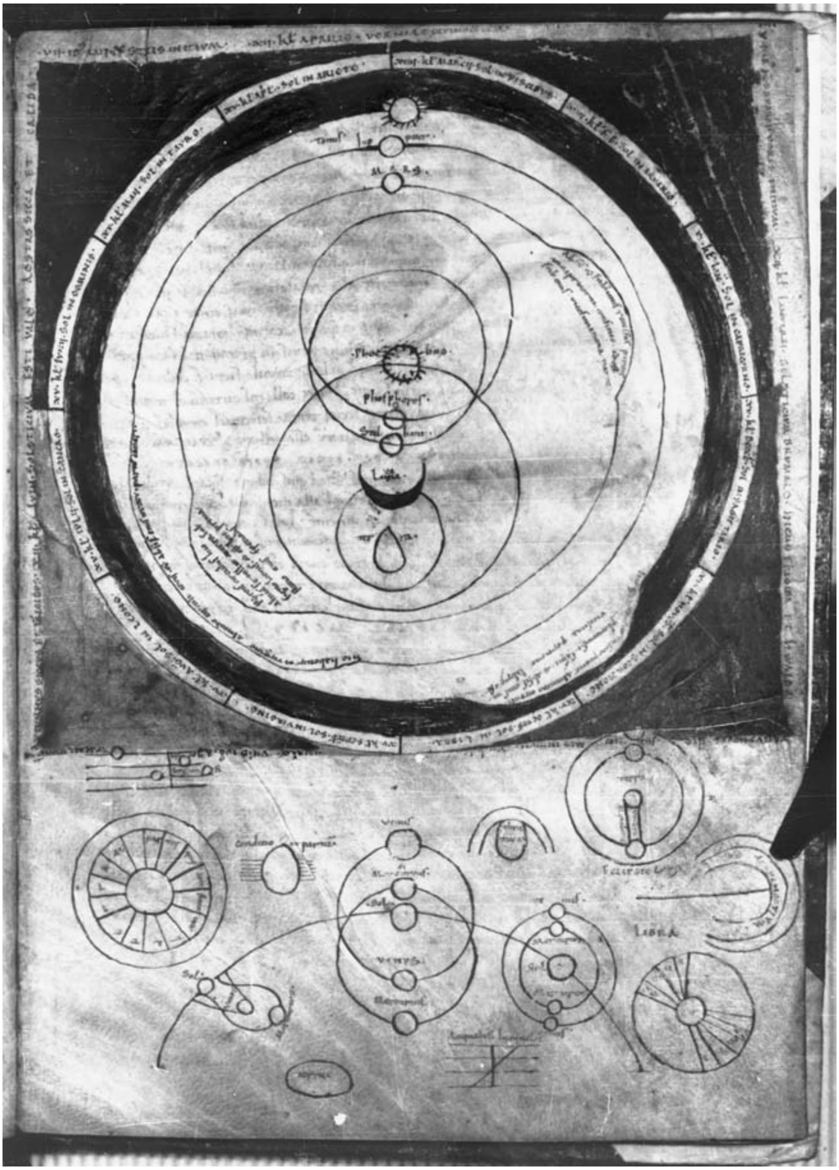

Fig. 5.4. Capellan Planetary Theory. Florence, Biblioteca Medicea Laurenziana ms. Laur. San Marco 190, f. 102r. Su concessione del Ministero per i Beni e le Attività Culturali. E' vietata ogni ulteriore riprodizione con qualsiasi mezzo.

a thoroughly geocentric cosmology can lie behind John's comment in the *Annotationes*. The image in Figure 5.4, which is a Capellan model of planetary motion, not a diagram drawn to scale, does indeed glorify the Sun and place it in the middle of planetary orbits that have the Sun more or less as their momentary spatial center, yet the planetary circles other than Mercury and Venus enclose the Earth and clearly have the fixed eccentric Earth rather than the moving Sun as their cosmic center and anchor.[45] To understand this image correctly we must realize that the Sun orbits the Earth annually while each of the outer planets orbits the eccentric Earth, not the Sun, at the appropriate orbital speed for the planet concerned. The image of Figure 5.4 is a deception insofar as it may suggest heliocentric rather than geocentric orbits for the outer planets.

3. *Explaining the Lengths of the Four Seasons: the Viewpoint of Computus*

In the second half of the ninth century Calcidius's *Timaeus* commentary offered new insight into observations and calculations of the lengths of the seasons of the year, superceding what Carolingians found in Bede's DTR and the works of Macrobius and Martianus. There was more than one approach to understanding the lengths of the seasons, and the different perceptions of the elements of this question expose rather nicely a variety of concerns and abilities of Carolingian scholars who studied the problem. Two distinct conceptual frameworks involved were the temporal and the spatial. The temporal framework was basic to the discipline of computus and was tied both to the divine creation of the world according to the Book of Genesis and to the establishment of the date of Easter each year. The age of the world since the creation, the exact time of the calendar year at which the vernal equinox occurred (at the creation and at the present time), and the manipulation of the various rules for locating Easter Sunday after the equinox—all these temporal considerations were seen in numerical terms and discussed as numerical intervals in units of time by computists. The spatial framework, basic to Hellenistic astronomy, involved considerations of time as well as space but was expressed primarily in

[45] A copy and fuller discussion of the content of Fig. 5.4 appear in Eastwood, "Invention and Reform," pp. 272–4.

spatial units and concepts such as angles, arcs, radii, and lengths of line segments. The astronomical source that presented the Hellenistic framework most clearly to Carolingians was Calcidius's *Commentarius*. Carolingian negotiations of the pathway from computus to Calcidius in studying the lengths of the seasons offer us the chance to observe closely the variations in Carolingian perception of the framework of astronomy as well as the different Carolingian attempts to handle the problem of explaining the seasons.

The lengths of the four seasons were well known to scholars of the eighth and early ninth centuries, as the topic came within the purview of computus and was fully discussed in this context. Assuming that Bede's DTR, composed in 725, was the most common Carolingian source for authoritative information on computistical matters, we learn that Bede, like other computists, defined the seasons primarily in temporal terms. While the determination of the vernal equinox was of prime importance as the foundation for finding the date of Easter, the other three turning points, the autumnal equinox and the solstices, were not so crucial. Yet Bede provided more information than many scholars required.

In DTR 6, Bede identified the vernal equinox with the fourth day of Creation and the fourth degree of the sign of Aries, when the Sun was actually created, according to Genesis, on the twelfth of the calends of April.[46] As he progressed, in Chapter 16, Bede gave to each zodiacal sign an equal interval of time, 30 days plus 10½ hours, rather than an equal number of degrees.[47] In Chapter 30,[48] where he addressed equinoxes and solstices as his only concerns, he reported Pliny's placement of the four turning points at the eighth degree, respectively, of the signs Aries, Cancer, Libra, and Capricorn, beginning with the spring equinox, and without comment or definition as regards the time intervals involved. Bede then quoted from a Pseudo-Hippocratean source that gave the beginnings of the seasons as the eighth of the calends of the months January, April, July, and October. Following this he noted that such traditional dating, respected by many Christian as well as non-

[46] Bede, DTR 6, ed. Jones, pp. 290–5.

[47] Ibid., pp. 333–7. Helperic of Auxerre (s. IX ex.), *De computo*, 31 (PL 137, col. 42B), continued the use of this average time of Bede.

[48] Bede, DTR 30, ed. Jones, pp. 371–6. In the calendar Bede used with DTR, he marked the beginning of each season and gave the number of days it contained; see Meyvaert, "Discovering the Calendar (*Annalis libellus*)," pp. 47–58.

Christian writers, needed to be revised after careful consideration of the rules established at Nicaea in 325 and by Bishop Anatolius. Bede concluded DTR 30 with the assignment of the four turning points to the twelfth of the calends of the four months of January, April, July, and October, again a purely calendrical definition of the equinoxes and solstices. Finally, in Chapter 35 Bede presented a variety of social customs regarding the intervals of the seasons, always in temporal terms.[49]

The careful study of DTR for an understanding of the seasons produces a strong sense of balance. Although the four turning points did, in fact, result in the different intervals of 91, 92, 92, and 90 days, beginning with the spring equinox, their variations appeared almost accidental, each being consistently associated with the twelfth of the calends of a month by Bede. His one account of zodiacal signs in correlation with temporal intervals referred to twelve signs, each of which the Sun traversed in the same amount of time. Any variation in the length of one season compared with another season had no explanation, only an authoritative definition in terms of a calendrical time interval. In the computus of Rabanus Maurus (A.D. 820) this sense of four equal intervals gained further emphasis when Hraban added to his reiteration of Bede's basic account a recalculation of the seasonal intervals to produce four exactly equal lengths of 91 days plus 7½ hours.[50]

From a classical Greek astronomical point of view Bede's account of the seasons either obscured or denied the varying speed of the Sun, and even the appearance of a varying speed of the Sun, as the cause

[49] Bede, DTR 35, ed. Jones, pp. 391–5.

[50] Rabanus, *Martyrologium; De computo*, pp. 244 (ch. 34. De quattuor vicissitudinibus temporum), 265 (ch. 53: De solstitiis et aequinoctiis). Isidore of Seville, *Etymologiae* V, xxxiv, while less precise than Rabanus, placed the four turning points at the eighth of the calends of the first, fourth, seventh, and tenth months; Isidore also said that the two equinoxes divide the year into equal parts. Current at the time of Rabanus's computus was a very different set of seasonal intervals, drawn from Pliny, NH XVIII, 220–221, which defined the lengths, beginning at spring equinox, as 94½, 92½, 88⅛, and 90⅛. Only three of these intervals were explicitly given, the interval from summer solstice to fall equinox having to be calculated. This information appeared not only in the full text of Pliny, known in the early ninth century, but also in the Carolingian excerpt of these sections of Pliny with further material under the title *De temporum mutatione* in the Three Book Computus, II, 7, surviving in the two mss. Vienna 387, f. 124v, and Munich 210, f. 124r–v. Each of these preserves the incorrect number 89⅛ for the interval from fall equinox to winter solstice. Neither ms. has any gloss calculating the length of the fourth seasonal interval. This divergent list of seasonal intervals, so different from Bede's and Rabanus's, received no comment and no use. Pliny's seasonal lengths were the same as those given later by Calcidius.

for the inequality of the seasonal time intervals. Given this lack of awareness of an apparent change in the Sun's speed through the year, the reader of Bede's DTR would simply find nothing about the lengths of seasons that needed any reasoned explanation. On the contrary, the dates and intervals of seasonal beginnings were no more than arbitrary customs, made to fit more or less with four astronomical events that Bede conceived as discrete points in time that could be connected to four corresponding discrete points on the zodiac. Between these discrete points, even when zodiacally defined, there was only uniformity, whether in the flow of time or in the motion of the Sun.

4. *Macrobius and Martianus Capella on the Four Seasons*

The treatments of the lengths of the seasons in the writings of Macrobius and Martianus Capella, widely available in the ninth century, offer illuminating bases for our comparison with Calcidius, whose explanation provided, in terms of mature Hellenistic theory, the most satisfying account available to the Carolingians. In his *Commentary on Cicero's Somnium Scipionis*, Macrobius was more inclined to discuss measurement in dealing with the structure of the cosmos than when dealing with its operations.[51] He described the movements of the planets, and especially the Sun, primarily in terms of attributes in order to give a qualitative picture of the cosmos and its workings.[52] The Sun is the controller of the world, keeping the planets in their ordered relationships.[53] Macrobius never placed the Sun on a circle around an eccentric earth. His canonical diagram for the seven planets and the zodiac assumed the earth as central and the solar and zodiacal circles as concentric.[54] All early medieval copies of this diagram preserved concentricity. At

[51] For example, in his description of the measurement of both the Sun's size and the size of the solar orbit; see CSS 80.8–84.23 (I.xx.9–31).

[52] Like Macrobius in this regard, Isidore of Seville had focused upon qualitative aspects and physical attributes of the Sun and the seasons. See Isidore, *Traité de la nature*, pp. 199–205, where the attributes of the seasons occupy all but five lines of text that briefly list the numbers of days in the seasons. On the different presentations in the Middle Ages of Isidore's diagram for the seasons and a discussion of related physical doctrines, see Obrist, "Le diagramme isidorien des saisons," a very useful article although certain judgments seem excessive.

[53] Macrobius, CSS 79.14–16 (I.xx.5): "Ita solis vis et potestas motus reliquorum luminum constituta dimensione moderatur."

[54] CSS 84.29–86.16 (I.xxi.1–7); see above, Figs. 2.2–2.5, at pp. 38, 44–5.

least once he specified that the earth is central within the solar circle.[55] And in his discussion of the four seasons Macrobius focused on the balance and order of the cycle. Saying nothing about the number of days in any season, he emphasized equalities and mentioned explicitly only the qualities of the four seasons.[56] Continuity and balance were his utmost concern. Cosmic symmetry prevailed over astronomical measurement in Macrobius's commentary.

Martianus Capella's astronomy, as we have seen in the previous chapter, did introduce the seasons in a quantitative context.[57] Capella pointed out more than once that, while the earth is central in the great circle of the zodiac, it is eccentric to the solar circle.[58] This fact allowed him to remark that the Sun moves through the zodiac at different speeds in different parts. The maximum solar speed of 28 days per sign he placed in Sagittarius, decreasing to a minimum speed of 32 days in Gemini, then increasing to complete the cycle. However, while noting the variation in speeds when he described the four seasons, Capella subsequently presented two (approximate) halves of the year, between the two equinoxes, rather than the four separate seasons.[59] He reported the number of days from fall equinox to spring equinox as 180 and the number of days from spring equinox back to fall equinox as 185⅓.[60] The earth's eccentricity in the solar circle was the reason given for this inequality.

When we look at the Anonymous commentary to Capella's astronomy, we find the results of what must have been discussion and different understandings by the two scholar-copyists in the two (distinctively different) manuscripts that represent the first version of the Anonymous. The Vossianus (Voss.lat. F.48), whose glossed diagram for the lengths of the seasons we have previously described and analyzed in detail (Figure 4.14; here Figure 5.5), mislabeled and may have misunderstood the effect of an eccentric earth as the observation point for recording the Sun's travels through the zodiac. The other manuscript of the Anonymous first version, Besançon 594, preserved all the verbal elements of the

[55] CSS 82.25–26 (I.xx.22): "Terra autem in medio caelestis circuli per quem sol currit ut centron locata est."

[56] CSS 29.1–14 (I.vi.57–59).

[57] Above, p. 278, Fig. 4.14.

[58] NPM 321.1–322.5 (VIII, 848–849), 323.23–25 (VIII, 855).

[59] NPM 330.22–331.8 (VIII, 873).

[60] NPM 331.4 (VIII, 873): the editor prefers the reading of the fraction as ⅓ rather than ¼ here, and the manuscripts split rather evenly on this matter.

Vossianus diagram for the lengths of the parts of the year but then joined these words with a diagram (Figure 5.6) that made the solar and zodiacal circles concentric. This apparent conservatism seems best understood through the view that diagrams of the heavens should illustrate the balance and order of the celestial world. Notably, the director of the Besançon copy of the first Anonymous version chose for Book 8 only those astronomical diagrams that were, or seemed intended to be, thoroughly symmetrical.[61] His adaptation of the diagram found in the Vossianus, especially given the impossibility of understanding that diagram as an adequate explanation of Martianus's words, makes sense in this way. The circular paths show only the facts, that is, the circularity of paths and their contents, such as zodiacal constellations, while the apparent variations in speed, a temporal concern (wherein our visual perception is deceived), are described only in the verbal labels. This scholar of the Besançon copy (Figure 5.6) seems to have been unaware that the eccentric geometrical arrangement would explain something. Figure 5.5 showed us a scholar struggling, albeit unsuccessfully, with the meaning of Martianus's account. Figure 5.6 shows us a Carolingian scholar with a more conservative view of what astronomical diagrams can accomplish.

There were Carolingian scholars who made special note of the differences between Capella's account and Bede's. One example appears in a manuscript containing both Bede's DNR and his DTR, apparently copied at Laon's cathedral school during the third quarter of the ninth century, along with very extensive glosses added to these texts. The manuscript was owned and used by Martin of Laon for some years before his death in 875.[62] The gloss for DNR shows us a prior compilation from multiple sources, probably made around mid-century. Commenting on Chapter 17 of DNR, an anonymous marginal gloss elaborated on Bede's mention of an average length of solar time in each

[61] Unlike any other Carolingian manuscript of Capella's astronomy with diagrams, Besançon 594 selected for copying the following three diagrams: (1) eclipses, (2) the similarity of alternating angles along a diagonal that cuts a set of parallels, and (3) the concentric version of the diagram for lengths of parts of the year. Other possible choices can be seen above, Ch. 4, Figures from Voss. lat. F.48 and BPL 88.

[62] Berlin Phillipps 1832 (Rose 130), ff. 1r–9r (DNR), 16r–54v (DTR). For discussion of the glosses see Lipp, "The Carolingian Commentaries on Bede," pp. 46–99. See also Contreni, "John Scottus and Bede," pp. 116–23. The glosses for DNR and DTR in this ms. appear in ed. Jones, vol. 123A, p. 185, and vol. 123B, pp. 257–61, regarding the origin and copying of the glosses.

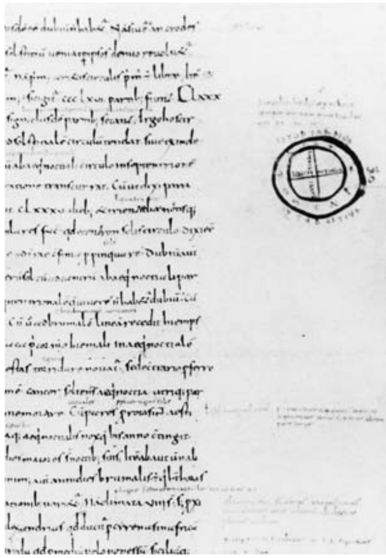

Fig. 5.5. Carolingian Diagram for the Capellan Explanation of the Lengths of the Seasons. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 81r

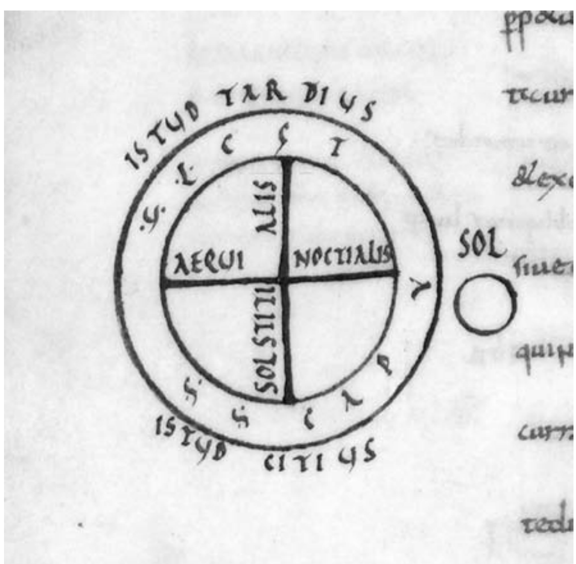

Fig. 5.6. Carolingian Diagram for the Capellan Explanation of the Lengths of the Seasons. Besançon, Bibliothèque municipale ms. 594, f. 72v

sign through the year by applying Capella's information that the solar time intervals varied from a maximum of thirty two days in Gemini to a minimum of twenty eight in Sagittarius. The time interval of thirty days plus ten and one-half hours, the gloss explained, was not the length of the Sun's stay in any particular sign but simply an average, or one-twelfth of the full year.[63] At DTR 30, where Bede dealt directly with the solstices and equinoxes, Martin, a teacher at the cathedral school of Laon, picked up the topic where the DNR gloss ended and added a cause for the changes in length.[64] He referred directly to Capella's explanation for the variation in solar speed through the zodiac, noting that when farther from the earth the Sun moved more slowly through the signs and faster when it was closer to the earth.[65] Martin wanted to identify the reason why the Sun traveled through the zodiac at varying speed, and he emphasized the natural cause found in the eccentricity of the earth with respect to the Sun's circle.

The reception and formulation of Capella's argument by these two ninth-century scholars, commenting on Bede, reveals no effect of the much fuller explanation by Calcidius. In the Vossianus manuscript (Voss. lat. F.48, f. 81r) the marginal diagram (Figure 5.5) added by the first Anonymous version accumulated all the elements of the situation indicated by Martianus except for the lengths of the two different intervals of the year, 180 and 185¼ days. This diagram thus deemphasized precise quantities and focused on the two different seasonal intervals, one longer ("slower") and one shorter ("faster"). On one hand, the designer of this diagram included the crucial element needed for a geometrical explanation, a zodiacal circle with a solar circle eccentric to it. On the other hand, the errors in the diagram (from a Calcidian point of view and from ours as well) are so great that the diagram would seem to have been useless or misleading for teaching. Furthermore the designer of the diagram appears to have reasoned from an absolutist, or non-geometrical, point of view, like our previously mentioned computist viewpoint. The designer apparently supposed that the Sun moves a greater distance in the 'half' of the zodiac in which it moves fastest. He

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[63] Bede, DNR 17, ed. Jones, pp. 208–10, esp. 209 gl. ad lin. 18; Berlin Phillipps 1832, f. 5r, right margin, gl. "B". See above, n. 58, for the source in Martianus Capella.

[64] Contreni, "John Scottus and Bede," pp. 124–5, 128, for Martin and the use of Martianus.

[65] Bede, DTR 30, ed. Jones, p. 372, marg. gl. ad lin. 15; Phillipps 1832, f. 34v, bottom left margin. Martin's source here for the eccentricity of the earth in the solar circle was either *De nuptiis* VIII, 849 or 873; the vocabulary is closer to 849 (NPM 321.11–17).

treated the appearance of greater speed as a physical reality. Therefore he made the longer arc, from autumnal equinox to vernal equinox, the faster (*citius*) arc in the diagram. What the designer was unable to do was to explain geometrically the appearance of the Sun varying its speed in different parts of its annual path. If the Anonymous commentator was able to repeat the Capellan statement that the eccentricity of the earth to the Sun's circle caused the appearance of different lengths of seasonal (solar) intervals, he was no more able to present that cause diagrammatically than Martin of Laon.

Our inquiry into the teaching of Martianus Capella on the seasons and Carolingian understanding of that teaching has produced mixed results. Some Carolingian scholars certainly took note of the topic in Capella's text, and we have at least two diagrams (5.5 and 5.6) to indicate a sense of the need for visualization. But beyond the intention to produce a diagram of the topic, these Carolingian efforts are difficult to understand. The earlier of the two scholars used a model with an eccentric but did so in a way that seems self-contradictory. The later scholar chose to modify the earlier design but gave no explanation, distinguished from simple description, of the phenomena at all. Both scholars apparently understood the account of Capella in a way that did not involve geometrical reasoning about the observation of uniform circular motion from an interior eccentric point. They were not aware of the spatial reasoning employed in viewing motion from within one circular framework against another circular frame of reference. These two Carolingian diagrams of the mid-ninth century are compilations, that is, assemblages of the design elements specified in the text but without a reasoned geometrical relationship among the parts. Yet we might consider that we have found here a readiness for the explanation that Calcidius's diagrams would provide. Mid-century commentators on Martianus Capella had been alerted to the essence of that explanation, and at least one of them thought he could provide a visual realization.

5. *Carolingian Knowledge of Calcidius's Account; Details of the Approach*

When Carolingian readers discovered Calcidius's account of the lengths of the seasons, they could immediately see its relevance to an important computistical matter. However, the introduction of an explanation was something quite new, and the explanation of an appearance that was not part of computus nor of computistical imagination was difficult to absorb. Computus provided arithmetical calculations for identifying the precise dates of events, preeminently Easter Sunday. Calcidius had nothing to say about Easter and little to say about the details of calendars but a great deal to say about the different lengths of the seasons and the geometrical reason for these various lengths. To proceed from Bede's work to that of Calcidius required a large shift in conceptual framework, from time to space and from discrete numbers to curvilinear and angular entities. Furthermore, the computistical framework, if quantitative, was numerically descriptive, while the Calcidian astronomical framework, if qualitative, was geometrically causal. Finally, the computistical approach was mensurational, and the Calcidian approach was perspectival.

The ninth-century copies of Calcidius's translation and commentary that have survived are fewer than those of the tenth century and far fewer than those of the eleventh century, when the commentary, at least, seems to have enjoyed its greatest readership.[66] Nonetheless we have good evidence of wider study of Calcidius's work in the ninth century than the two surviving complete copies suggest. Although the path of entry of the translation and commentary into the Carolingian empire is unknown, we do know that a copy was present at Reims in the later ninth century and used there for further copying into the manuscript of Valenciennes 293.[67] Early in the century the work was probably available at Charlemagne's court library. From such a manuscript, at the royal court or in a north French scriptorium, were made two copies, that in the ninth century Lyon 324 and its twin, the vanished exemplar of Paris 2164 from the later tenth century.[68] At least one other northern French, or possibly southwest German, scriptorium had an exemplar for copying during the second quarter of the ninth century. Such a manuscript was the source for the extended astronomical excerpts (the Paris Compend) included in Paris 13955, a mid-century

[66] CCT, pp. cvii–cxxxi, clxxxvii, for mss. known to the editor. Southern, *Platonism and the School of Chartres*, p. 14, gives a distribution of *Timaeus* mss. for 50–year intervals from 900 on. Dutton, "Material Remains," p. 205, gives a distribution of mss. of both the *Timaeus* and the commentary by half century, using intervals 775–825, etc. Somfai, "Transmission and Reception," pp. 33–43, discusses the availability of both the Ciceronian and Calcidian translations as well as Calcidius's commentary; see p. 38 for mss.

[67] McKitterick, "Knowledge of Plato's *Timaeus*."

[68] Huglo, "Trois livres manuscrits," pp. 278–82.

or earlier compilation for study of the mathematical disciplines. Among those copies now surviving, the Valenciennes manuscript, produced at Reims cathedral, owned by Hucbald of Saint Amand and bequeathed by him to that monastery's library ca. 930, is the most important for our exploration of ninth-century discussions of the inequality of the lengths of the four seasons of the year.

Calcidius's account of the seasons, occupying three paragraphs (cc. 78–80) in Waszink's edition, describes fully the facts and their interpretation by way of geometrical astronomy.[69] Two diagrams were prescribed by Calcidius, one for the observed facts of the situation and one for the geometrical interpretation. Across the Carolingian manuscripts of the ninth and tenth centuries, we can see immediately the stability of the first diagram and the variability of the second. Why did this variability occur in the early extant manuscripts? There is no reason to suppose error on the part of Calcidius's original diagram. We do not know the tradition of the diagrams prior to the ninth century, as there are no survivals. We are left, then, to estimate whether or not the exemplar, or exemplars, which lay behind the surviving ninth-century copies had a correct diagram for the geometrical interpretation of the different lengths of the seasons.[70]

We should look next at these earliest surviving manuscript evidences for determining Carolingian perceptions of Calcidius's teaching. Valenciennes 293 (Figure 5.7) from the later ninth century gives us a witness to a prior, no longer extant diagram that may have been correct. We find a different ninth-century understanding in two very similar diagrams explaining the seasons in Lyons 324 and Paris 2164 (Figure 5.8), which are definitely erroneous in Calcidian terms. The excerpts in the quadrivial compendium of Paris 13955 have no accompanying diagrams. No fully correct diagram for this astronomical question appears in the manuscripts of Calcidius before the eleventh century, although the figure in Valenciennes comes close.[71] Two manuscripts of the tenth century, Bruxelles 9625–26 (Figure 5.9) and Bamberg Class.

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[69] CCT 127.11–130.16. The diagrams in Waszink's edition are copies of those in one tenth-century manuscript.

[70] We identify below in the detailed study of each manuscript diagram the folio of the relevant diagram.

[71] The earliest known correct medieval diagram, a scholar's reconstruction, appears in a ms. written at the priory of the Augustinian canons of Maria Magdalena at Frankenthal in der Pfalz, Vienna 443, f. 174v (s. XI^1), which is reproduced in Eastwood, "Invention and Reform," 297, Fig. 6 (upper right diagram of four).

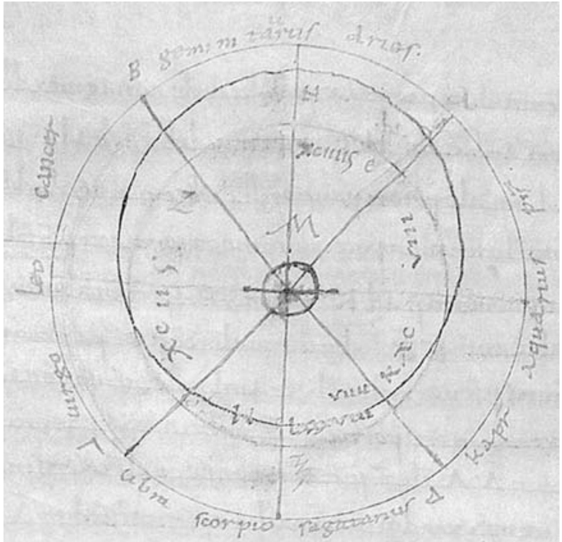

Fig. 5.7. Calcidius's Explanation of the Lengths of the Seasons. Valenciennes, Bibliothèque municipale ms. 293, f. 48v

Fig. 5.8. Calcidius's Explanation of the Lengths of the Seasons. Paris, cliché Bibliothèque nationale de France, ms. lat. 2164, f. 37v

18 (Figure 5.10), while not correct, raise important questions about the ways in which the diagrams to explain the seasons were composed. In addition we find interesting and divergent approaches in Paris 10195 (Figure 5.11), a late tenth-century manuscript from the abbey school of Echternach, and in the computus of Abbo of Fleury, Berlin Phillipps 1833 (Figure 5.12), which included excerpts with diagrams from Calcidius. Knowing the approaches of Bede, Macrobius, and Martianus Capella, we must ask how the Carolingians understood the astronomical problem as presented by Calcidius. We begin with Calcidius.

A basic observation in Greek astronomy (and earlier) was the variation in the number of days from vernal equinox to summer solstice and in each of the subsequent quadrants of the annual solar circle. None of these four intervals was equal to each other, although the difference was always a small number of days. Calcidius recorded this fact and gave two diagrams for it as well. In an initial, circular diagram of three concentric circles (see Figure 5.2), delineating an outer band for the twelve signs of the zodiac and an inner band for the four seasons, he gave the numbers of days for the seasonal lengths. He first pointed out that the diagram was divided by two diameters, one vertical and the other horizontal, into four equal spaces; that is, each quadrant held three signs and represented one season. He then inscribed within the inner band of each quadrant the number of days in the respective season, which was identifiable by the names of the signs contained in the outer band of that quadrant. Beginning with the vernal equinox, at the top of the diagram, and proceeding counter-clockwise, the four intervals he gave were $94\frac{1}{2}$, $92\frac{1}{2}$, $88\frac{1}{8}$, and $90\frac{1}{8}$. The total, of course, was $365\frac{1}{4}$ days. These intervals showed much greater numerical variation in seasonal lengths than Bede had allowed as we have seen. The diagram presented directly the coincidence of four equal spaces of the zodiac with the four unequal times of the seasons—what we might choose to call the result of the varying speed of the Sun. However, this was not the choice of Calcidius or of Greek mathematical astronomy. The diagram of this data simply set in a geometrical perspective a situation that needed explanation.

Since a basic postulate of the Greek astronomy used by Calcidius was the uniform circular motion of all celestial bodies, which we can also recognize as an application of the philosophical doctrine of the constancy of the celestial realm, he then prescribed a second diagram (see Figure 5.3) to show how the Sun actually moved uniformly on its circle, although it appeared to change in speed and actually produce

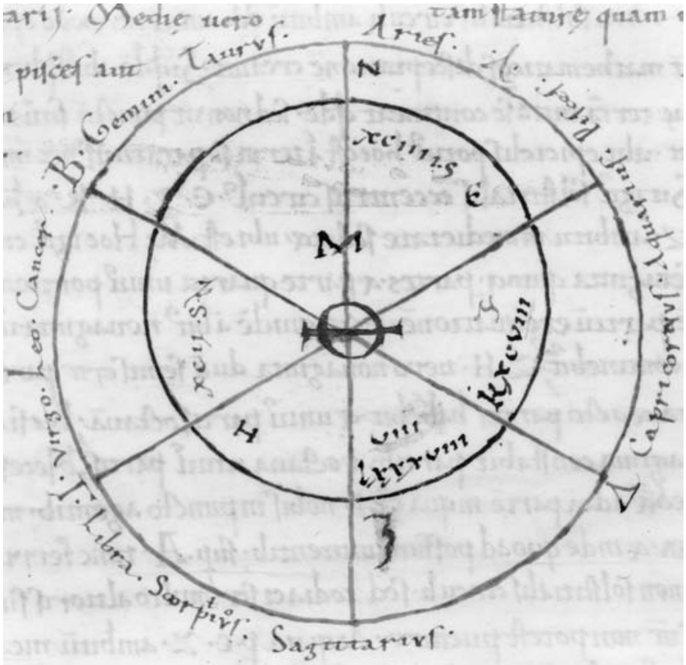

Fig. 5.9. Calcidius's Explanation of the Lengths of the Seasons. Brussels, Bibliothèque royale de Belgique ms. 9625–9626, f. 29v

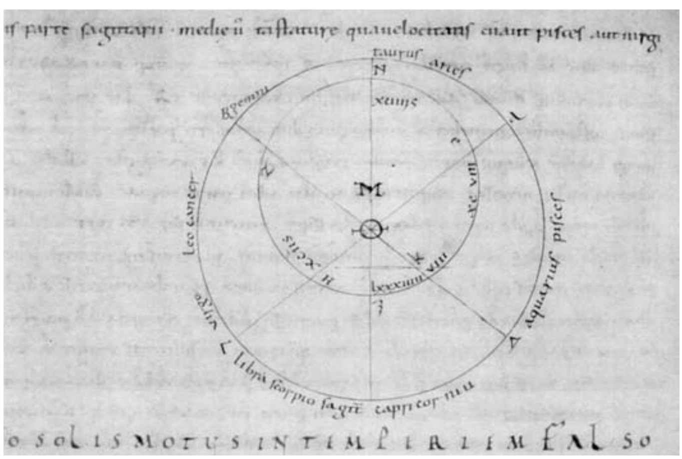

Fig. 5.10. Calcidius's Explanation of the Lengths of the Seasons. Bamberg, Staatsbibliothek ms. Class. 18 (olim M.V.15), f. 35v

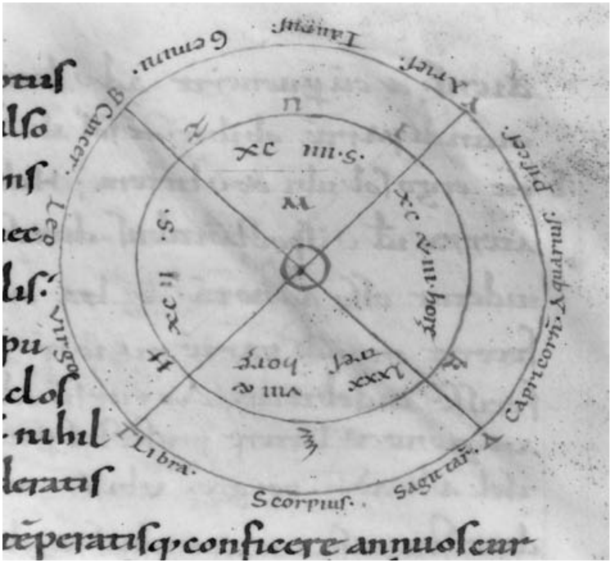

Fig. 5.11. Calcidius's Explanation of the Lengths of the Seasons. Paris, cliché Bibliothèque nationale de France, ms. lat. 10195, f. 99r

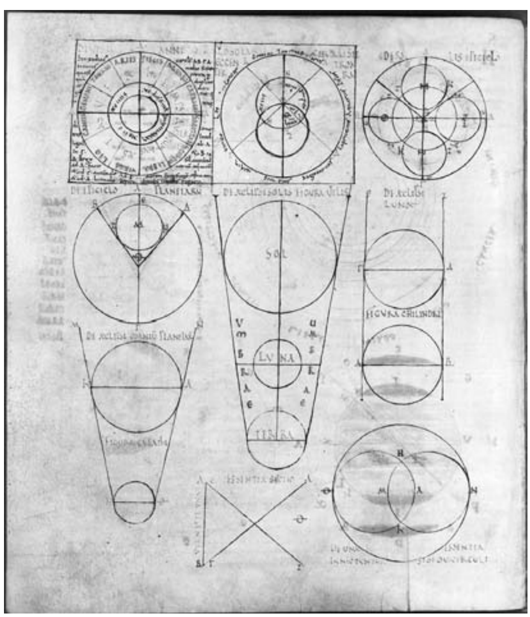

Fig. 5.12. Calcidius's Explanation of the Lengths of the Seasons. Berlin, Staatsbibliothek zu Berlin—Preußischer Kulturbesitz, Handschriftenabteilung ms. Phillipps 1833, f. 36v

the different lengths of the seasons. In the second diagram a circle replaced the somewhat indefinite band containing the four time intervals for the four seasons, and this circle appeared as an eccentric circle. Representing the solar orbit, this circle held the four time intervals previously inscribed in the four quadrants of the zodiac that were created by two perpendicular diameters of the zodiacal circle. The eccentric circle showed the position of the Sun's orbit relative to the zodiacal circle and to the observer on the central earth. The earth remained at the center of the cosmos and of the zodiac. This is reemphasized by the intersection of the two perpendicular diameters at the earth in the center. The earth is also within the eccentric circle of the Sun's path but not at its center. Finally, there is one diameter of the eccentric solar circle which coincides with a third diameter of the zodiacal circle that indicates the two points of maximum and minimum apparent speed of the Sun. The text of Calcidius's explanation of seasonal lengths runs as follows.

> c. 78. Yet it cannot be that, contrary to the aforesaid nature in divinity, they [the planets] do or experience anything disordered (*inordinatum*). Whence it seems that both the Sun and the other planets (*stellas*), while moving uniformly and in good order along their own circle, appear to us, observers on the earth, to move along ΑΒΓΔ, which is not the solar but the zodiacal circle.
>
> c. 79. Wherefore the Sun moves, not along this zodiacal circle but along another, solar circle, which is exclusively its own. If, in fact, the center (*punctum*) of each circle were in Θ, we would discover by the same reasoning (*ratione*) the divisions of the solar circle like the zodiac into the same partitions and inequalities, and in the same way the Sun would travel the four equal parts of the circle ΑΒΓΔ, some in more days, others in fewer days. But if this reasoning has showed that men have falsely supposed what is against the nature of the stars, surely it will be clear that the center of this circle (*globi*) along which the Sun is moved is not in Θ. Therefore the circle of the Sun will either contain Θ, but not as its center (*punctum vel medietatem*), or pass through that same Θ, or completely exclude it in every sense. And indeed it is impossible for the Sun to pass through Θ, for earthly things would burn up from the powers of the Sun, and, with the body (*globo*) of the Sun always above us, there would be constant day and never night, for the Sun would never set. And so it remains that Θ should be either within or outside of the Sun's circle; either assumption will be shown to have good reason. Indeed this situation [of the two alternatives] created a disagreement among the astronomers (*mathematicos*) so that, whereas some claimed that the planets are moved on eccentric circles (*sphaeris*), which encircle the earth but not as their center, others preferred epicycles, which are circles (*globis*) [fully] separate from the earth and not near it.

c. 80. Let there be then the eccentric solar circle EZHK, having its center in the middle (*in medietate*) of the arc EZ, at M as can be seen. With this circle divided into 365¼ days (*partes*), of this sum the arc (*ambitus*) EZ contains 94½ days (*portionibus*), ZH[72] is 92½ days (*partium*), HK has 88⅛ days, and the remaining arc KE consists of 90⅛ days. And so when the Sun reaches that point (*partem*) marked by E, it is necessary that we, being on the earth at the centerpoint of the world, and looking from there, insofar as we are able, towards A, then it [the Sun] seems to be there [at A], although that place is not at the solar circle but at the distance of the much higher zodiac, to which our visual power cannot [fully] reach. And thus as [the Sun] moves uniformly along the arc EZ, which is larger than each of the other three arcs, so that in necessarily more days (*diebus*) completing a longer arc it will reach Z, it will seem to have reached B. And after traversing the arc AB, it [the Sun] will be thought to have gone through exactly one-fourth of the zodiacal circle in more days, as the reason of uniform motion requires, and, again, traversing uniformly the arc ZH of its [solar] circle, the second magnitude, in 92½ days—this same arc is composed of just so many days (*partium*)—when it [the Sun] will arrive at H, it will appear to us to have reached Γ. And having traveled through the [zodiacal] arc ΒΓ, equal to the previous one, in fewer days, in the same way illuminating the smallest [solar] arc HK, so that in 88⅛ days, where in just this number of days it will travel and arrive at K, from the position of Θ it will seem to observers to be at Δ, and it will be judged to have covered the equal [zodiacal] arc ΓΔ in this remaining smaller number of days. And in continuation of the same misunderstanding, with the arc KE traveled in 90⅛ days and [the Sun] represented [in the diagram] distinctly at E, the annual orbit being completed, it [the Sun] is considered to have traveled the arc ΔA, which is equal to those others [of the zodiac], in an unequal time interval, nor is it represented [to our vision] in E as the completion of its circle but in A, the height of the farther, zodiacal circle. But if the two centers of the two circles, that is the larger zodiacal circle and the smaller eccentric solar circle, are conjoined and make [the line] MΘ and then extend beyond as the line NΞ, since the center of the circle EZHK is M and Θ is the center of circle ΑΒΓΔ, the lines NM and MΞ are equal. Accordingly line NM is greater than ΞΘ, and so much more therefore is NΘ than ΘΞ. Thus when the Sun passes through N, farther from the earth at Θ, it will appear smaller to us at a distance and likewise slower, which will occur at about 5½ degrees (or days) (*partem*) into Gemini. And then when it passes through Ξ close to the earth, it will be judged larger and swifter to viewers, which then occurs at 5½ degrees (or days) into Sagittarius. The midpoints in both size and speed will be when it passes through either Pisces or Virgo.[73]

72 Waszink's edition (CCT 128.14) incorrectly reads EH here.

73 This translation of the long text from Calcidius's commentary appears in Eastwood and Graßhoff, *Planetary Diagrams*, pp. 80–2.

In this second diagram Calcidius has shown readers one of the fundamental tools of Greek mathematical astronomy, the eccentric, for explaining apparent non-uniform motion. At the same time, he has not placed the solar circle at the exact position required by calculations based upon the precise lengths of the four time intervals. Instead he has exaggerated the eccentricity in order to make obvious the effect of using this tool. Calcidius thus provided his audience with a qualitative rather than a quantitative model of the solar motion, explaining how the inequality of the seasons occurred but not attempting to show how to calculate the exact lengths of the seasons. These lengths were simply given. What was explained was the fact of inequality but not the amounts of inequality. It is equally important to recognize that Calcidius chose a spatial, or perspectival, rather a numerical explanation of the different lengths of seasons. The two diagrams provided by Calcidius show clearly both the facts of seasonal inequality and a qualitative model for understanding how a uniform circular motion of the Sun can produce the perceived non-uniform motion. A modern reader can readily see in Figure 5.3 that the Sun moving uniformly around circle EZHK will appear to take much longer to pass through the 90° arc AB of the zodiacal circle than through the 90° arc ΓΔ of the zodiacal circle and thus appear to vary in speed, because the viewer is on the earth at Θ rather than at the center of solar motion. Carolingian readers did not readily recognize this perspective, and their diagrams reveal to us their difficulties.

6. *The Diagrams in the Manuscripts and the Approach in Valenciennes 293*

The early manuscripts of Calcidius's commentary with diagrams are limited in number but informative. We shall look primarily at seven of these Calcidian texts, dating from the ninth to the opening of the eleventh century. Only after this long interval did full understanding of the text, witnessed by a correct diagram of the eccentric model, emerge. We list here the manuscripts with two folio numbers. On the first folio appears the diagram corresponding to our Figure 5.2, giving the data, or description, of the four seasons. On the second folio is the diagram corresponding to our Figure 5.3, giving the explanation for the differences in the lengths of the four seasons.

Val: Valenciennes, Bibliothèque municipale, ms. lat. 293, ff. 47r, 48v (s. IX^2).
Ly: Lyon, Bibliothèque municipale, ms. lat. 324, ff. 31v, 32v (s. IX).
Pa1: Paris, Bibliothèque nationale de France, ms. lat. 2164, ff. 37r, 37v (s. X¾).
Bru: Bruxelles, Bibliothèque royale, ms. lat. 9625–9626, ff. 28v, 29v (s. X).
Bam: Bamberg, Staatsbibliothek, ms. Class. 18 (*olim* M.V.15), ff. 34v, 35v (s. X^2).
Pa2: Paris, Bibliothèque nationale de France, ms. lat. 10195, ff. 98v, 99r (ca. 1000).
Ber: Berlin, Staatsbibliothek zu Berlin, ms. lat. Phillipps 1833, f. 36v (ca. 1004).

We begin our study of these manuscripts by identifying five elements that we need to observe in the diagrams. These critical elements are the following and can be observed in Figures 5.2 and 5.3. The five elements do not, however, exhaust the properties required for the diagrams to be correct.

(a) Maintaining the two diameters of the zodiacal circle perpendicular to each other.
(b) Listing exactly three zodiacal signs in each section isolated by the diameters.
(c) Coordinating each set of three signs with the appropriate number of days for that season.
(d) Replacing the inner band for the four lengths of season with a distinct concentric circle and then moving it to an eccentric position.
(e) Creating for the eccentric circle a diameter which passes through the earth's center and is distinct from the two perpendicular diameters of the zodiacal circle.

The first three elements pertain to both diagrams, the last two to the second diagram only. As we proceed to examine the diagrams in each of the seven manuscripts, it will be important for us to consider both the possible reasons for error and the likely effects of the errors on the understanding by Carolingian scholars of the argument provided by Calcidius.

Val shows two stages in the drawing of each of the diagrams. Significant error occurs in the first stage of each and is corrected wholly or partly in the second stage. Beginning with the vernal equinox, conventionally equated with the beginning of the sign of Aries, the first season has 94½ days, normally located in the upper left quadrant of the first diagram (see Figure 5.2). *Val* placed this number of days in the upper left quadrant but initially inscribed in the outer band the three names for the opposite season: Libra, Scorpius, and Sagittarius. A correcting hand of the early eleventh century has rewritten the circle of signs outside the outer circle in order to correlate the proper signs with each of the seasons.[74] The original error would seem to indicate gross inattention by the scribe concerned. However, we should notice that the same scribe has set correct trios of signs with their numbers of days in the second diagram (Figure 5.7). Why did he change? It is remarkable that *Val* is the only surviving manuscript before the twelfth century that contains this error in the first diagram. We may assume that the exemplar used for *Val* had the same error, although this is uncertain. We should then assume that the exemplar showed the correct correlation of signs and seasonal time intervals in the second diagram and that *Val* simply followed its exemplar. This presumably economical assumption of direct copying of both diagrams is acceptable but not entirely satisfying, for it requires the exemplar to have been flagrantly wrong in one case and rather carefully and precisely correct in another case. That is, all other early manuscripts avoided the error of *Val* in the first diagram, but many embraced the error avoided by *Val* in the second diagram, the error of having more or less than three signs associated with a seasonal time interval.

In the second diagram *Val* shows us a very slight change in the angle between the two diameters. Are they meant to be perpendicular to each other or not? We can not be sure. And so the second and third and perhaps the first of the five critical elements are present here. What is also clear is the failure of the original scribe to define the inner circle and relocate it to an eccentric position. We see the result of a correcting

[74] The date of this correcting hand in the manuscript and its relationship to other hands in the gloss on the manuscript are two separate questions. Somfai, "Transmission and Reception," p. 222, n. 21, claims that this correcting hand is the same as that which entered two marginal glosses on ff. 41v and 42v. I do not agree with the identification. She dates the marginal glossing hands as late 11th or 12th century. This dating appears correct for the glosses but inappropriate for the correcting hand of the diagram on f. 47r, which appears to be late 10th to early 11th century.

hand that partially eradicated the original, concentric inner circle and drew a new, eccentric circle. This correction corresponds to our fourth element. The fifth element, drawing a new zodiacal diameter through the center of the inner, solar circle, is included.

What are we to think about the correction to the diagram, shifting the solar circle from a concentric to an eccentric position? Was it made immediately, in order to follow the exemplar? Was the partly removed, erroneous circle a correct copy of the exemplar, meaning that the correcting and presumably later hand had encountered another, better exemplar and chosen to exploit it? Various corrections to *Val*'s text on the different lengths of the seasons occurred in the ninth or early tenth century.[75] Whereas the original scribe of *Val* seems either to have been careless or to have had a poor exemplar, an early corrector with a similar hand, by the late ninth or early tenth century, inserted between the lines on folio 47 verso a comment that shows heightened sensitivity to the choice among possible circles for the Sun's path, according to Calcidius, and to the exclusion of the epicyclical choice.[76] This comment was made by the same scribal hand that corrected errors here in the explanation of the seasons. It shows understanding of the text as well as care in correcting the words of the text. This hand of ca. 900 is surely the best candidate for the corrector of the diagram explaining the lengths of the seasons. The correcting hand had a good understanding of the account of Calcidius in making comments and corrections.

Recent study has argued convincingly for the Reims origin of *Val*, with transfer at some point to the possession of Hucbald of Saint Amand, who in turn bequeathed the book to that monastery at his death in 930.[77] With the added stipulation that *Bru* was copied from *Val*, or another

[75] There are strong reasons to accept that *Bru* was copied from *Val*. Both McKitterick, "Knowledge of Plato," p. 92, and Somfai, "Transmission and Reception," pp. 68 and 88, agree on this. Below I mention corrections in *Bru* that must already have been made in *Val* before *Bru* was copied. Thus we date the corrections to *Val*'s text on the seasons.

[76] Valenciennes 293, f. 47v,5 *ad* monstrabitur (CCT 128.6): "id est aut Θ intra solstitialis circuli ambitum esse aut extra modo epicicli." It is important to notice that exactly this wording was added to the text of *Bru*. That is, what was added as a gloss to *Val* became part of the established text in *Bru*. This addition does not appear as either gloss or addition to the text in *Bam, Ly, Pal*, or *Pa2*, which assures the dependence of *Bru* upon *Val* (or a common exemplar or intermediary) for this statement. Waszink's apparatus notes the appearance of part or all of the text of this gloss in later manuscript copies.

[77] McKitterick, "Knowledge of Plato's *Timaeus*," pp. 90, 93–4.

text like it, at Reims, we ought to ask where these few corrections to *Val*'s text came from, since other corrections had not been made when *Bru* was copied from it. This limited set of corrections and glossing show an interest in and understanding of Calcidius's explanation by ca. 900. Their presence also suggests that a third copy of Calcidius, in addition to *Val* and its exemplar (unless the latter was at Reims only on loan), existed at Reims by the end of the ninth century. The third copy could have provided the better text for the corrections made in *Val*'s explanation of the seasons and carried on into the text of *Bru*. The only question remaining is whether or not Hucbald, the owner of *Val* by the early tenth century and probably during his time at Reims in the late ninth century,[78] had anything to do with these corrections. At this point we can not answer the question.

In the remaining six manuscripts in the early group identified above, the diagrams for the seasons can be categorized in more than one way. Aside from minor and apparently insignificant variations, the first, descriptive diagram for the seasons is the same in all six. Each example holds to the first three of our five elements for correct diagrams, and these three prescriptions are all that apply to the initial diagram, which presents only the data of the seasonal lengths, not the explanation. The significant variations in these six manuscripts all occur in the second, explanatory diagram. If we follow the most obvious visual divergence in defining our categories, we can distinguish between the three explanatory diagrams that contain one inner circle (Group 1: *Bru, Bam, Pa2*) and the three that contain two inner circles (Group 2: *Ly, Pa1, Ber*). This is indeed a striking difference.

7. *Group 1 Diagrams: Corruptions or Misunderstandings in the Manuscript Tradition*

All Group 1 diagrams (5.9, 5.10, 5.11) come from the tenth century. What are their characteristics for explaining the lengths of the seasons? Only one of the three, *Pa2*, preserves the two diameters perpendicular to each other (Figure 5.11). Only one of the three, *Pa2*, distributes the four time intervals correctly, with three signs for each interval and with the correct three signs for each interval. This might lead us to consider

[78] Ibid., pp. 93–4.

Pa2 as a hopeful example of adequate understanding of the diagram. In fact, there is every reason to believe that the second diagram in *Pa2* was an innovation in the scriptorium and not a faithful copy of an exemplar. However, this diagram does not show a good understanding of the explanation in Calcidius's text, but either a dissenting or else a deeply confused view of how to represent that explanation. Innovation it was, but not better understanding. What *Pa2* shows in the second diagram is geometrically exactly the same as the first diagram. In *Pa2* both diagrams, description and explanation, show no more than the correlation of four different time intervals with four equal spaces, that is, the given data for the variations in the four seasons. What has the Echternach scribe, or some other intramural source, conceived for this diagram? We have only two hints from the diagram itself. The supposedly explanatory diagram in *Pa2* omits the vertical diameter added by the scribes for *Bru* and *Bam*, the other examples in Group 1, and also added in all examples of Group 2. This third diameter clearly belonged in the diagram according to the text, but its inclusion in *Bru* (Figure 5.9) and *Bam* (Figure 5.10) accompanied a remarkable distortion of the correct design.

At some point in the tradition of diagrams leading to these two, last-mentioned manuscripts one or more scribes supposed that the three diameters should create spaces that are symmetrical around the vertical axis, either dividing the zodiacal circle into six equal parts or producing at least a bilateral symmetry. Both *Bru* and *Bam* show the results of this misreading, and consequently a further error in each. In these two cases we see the four time intervals distributed in a way that appeared in the large majority of the diagrams for explaining the seasons before the twelfth century. With the vertical diameter as a reference line, this distribution placed three of the numbers, giving the lengths of three of the seasons, on the right side and only one number on the left side. In fact, we can determine that the largest and smallest numbers, $94\frac{1}{2}$ and $88\frac{1}{8}$, should be in opposite quadrants (as in the prior diagram in each pair) and straddle the inserted, third diameter, which should pass through these two quadrants, ΑΘΒ and ΓΘΔ. But almost all scribes insisted on placing each number wholly within one of the sections defined by the three diameters. This may well have been due to their exemplars, but it also came from a tendency to associate one number with one section for reasons of visual neatness when the full explanation had not been worked out by or for the scribe. And finally, with the disorder in placing the numbers, the disorder in locating zodiacal signs came easily. Which signs should be associated with which of the six divisions? As the sizes of the six partitions shifted from copy to copy, the spaces for writing the names of the signs changed, and the results we see in *Bru* and *Bam* occurred. In *Bru* (Figure 5.9), depending on how we read the sector for the number 94½ (uppermost on right side), there are either two or four signs in this sector, not three. The same diagram also gives a maximum of two signs to another seasonal time interval and either three or five to another.[79] All in all, a grand confusion. Similar confusion, with different distribution of the names of signs, occurs in *Bam* (Figure 5.10).

Any attempt to interpret what appears as error or confusion is a difficult process. Although the explanatory diagrams in *Bru* and *Bam* appear to us simply to err, one potential comparison with another tradition of astronomical diagrams of the tenth century must be considered for the light it may shed here. In the diagrams illustrating the Plinian excerpts about planetary absides and planetary latitudes there emerged a strong emphasis on visual symmetry, especially in a group of at least nine absidal diagrams produced mostly in southern Germany during the tenth century (Figure 5.13).[80] What these absidal diagrams reveal are all the following intentions: the omission of six of the twelve signs of the zodiac from the diagram, a willingness to reorder the remaining six zodiacal signs, and the use of circles of the same size for the different planets. Immediately we must recognize that, given the informational purpose of these diagrams, the three modifications listed do not disturb the purpose. The same absidal data (apogees but not perigees) were presented unambiguously in the new sort of diagram, modified to show visual symmetry. And in a few rectangular latitude diagrams in some of the same manuscripts of the tenth century we find not only the emphasis on visual symmetry but also the distortion of information to satisfy the apparent desire for such a visual impression (Figure 5.14).[81] In these unusual Plinian latitude diagrams of the tenth century, we observe a tendency that is not unlike the symmetrical sexpartite division of the zodiacal circle for the diagrams of the seasons in *Bru* and

[79] It will not do to point out that Fig. 5.9 places three names of signs between the letters A and B, because this implies that the other end of the diameter marked by the letter Γ (lower left) has no significance.

[80] See above, p. 138. Regarding the nine absidal diagrams of the tenth century, see Eastwood, *Astronomy and Optics*, ch. 6, p. 268, n. 17, for the mss.

[81] Ibid., ch. 6, pp. 273–4.

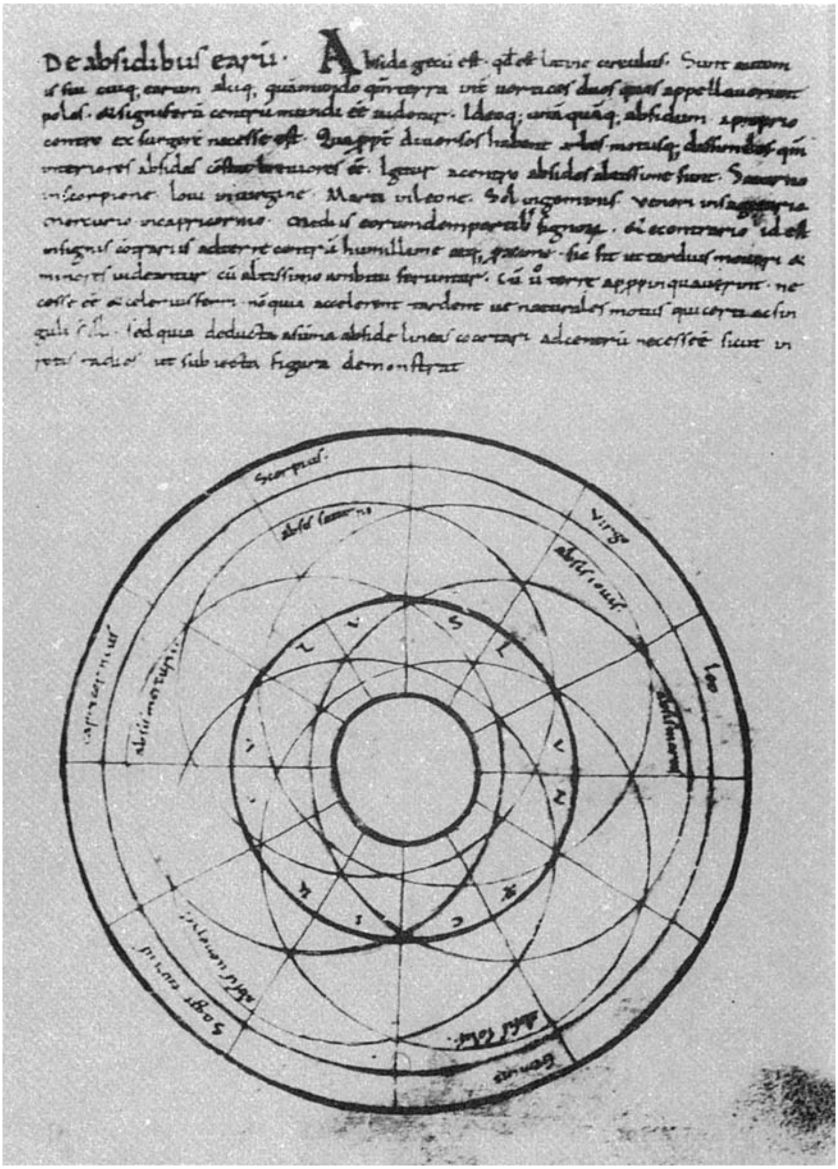

Fig. 5.13. Plinian Diagram for Planetary Absides using a Reordered Zodiac. Madrid, Bibliotheca nacional de España ms. lat. 9605, f. 12r

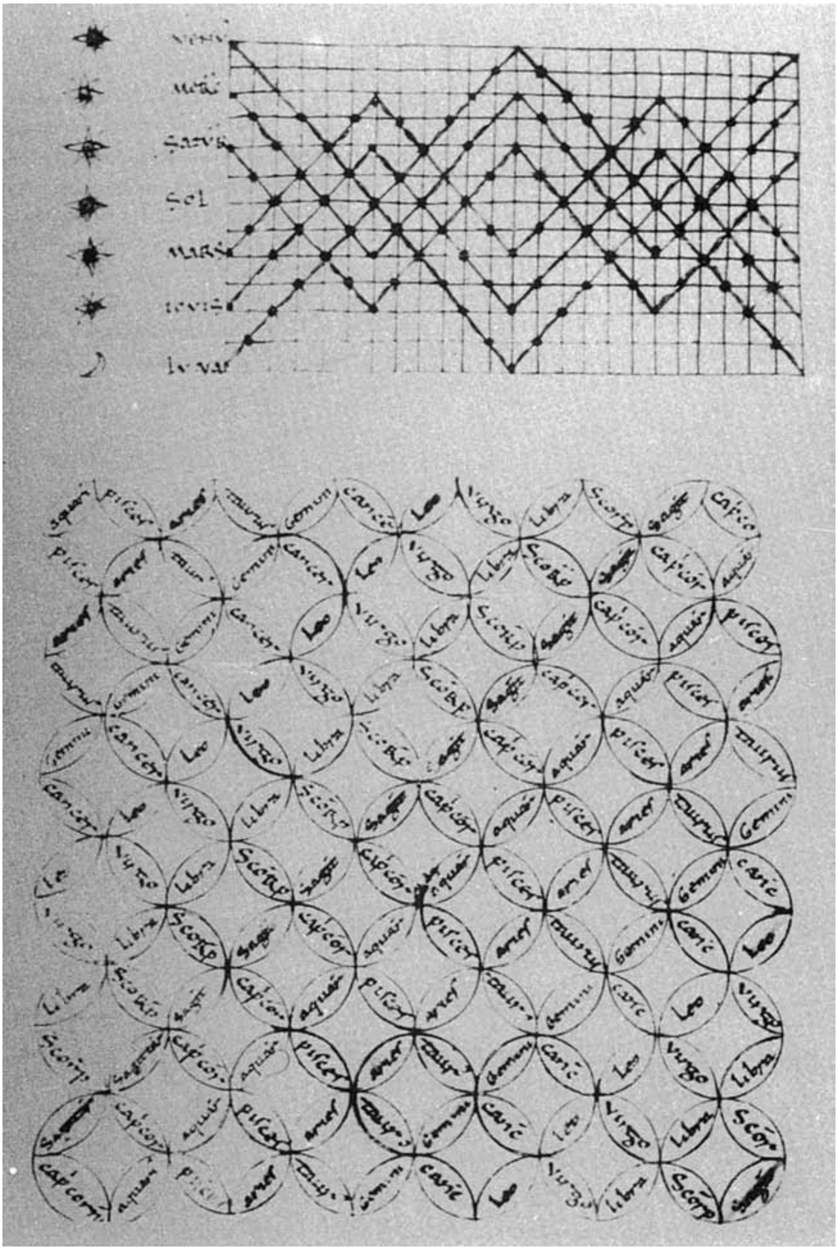

Fig. 5.14. Plinian Diagram for Planetary Latitudes using a Rectangular Grid for the Zodiac. Madrid, Bibliotheca nacional de España ms. lat. 9605, f. 12v

Bam. In other words, we must keep in mind that, if the scholar-scribes associated with these two manuscripts and their diagrams had not yet learned the geometrical reasoning of Calcidius's explanation of the seasons, then the angles between the intersecting diameters and the distribution of zodiacal arcs would not have appeared to these scribes to be critical for the diagram. Simply including an eccentric circle and all the diameters with their proper alphabetical labels, as well as the four numbers for the lengths of the seasons, would have completed the diagram. The presence of all the diagrammatic elements was clear to such scribes. The geometrical relationships of these elements was not fully understood, and so their precise positions were not as important as a neat and symmetrical image. Such a conclusion can be drawn from the arrangement of parts of the two diagrams concerned in *Bru* and *Bam* when they are compared with the contemporary Plinian diagrams for planetary latitudes. This conclusion is, however, tentative and stands as one possible interpretation, pending further discoveries among planetary diagrams in the manuscripts. One strike against this interpretation is the asymmetrical distribution of zodiacal names around the outer circle, although this does not disturb the visual symmetry of the diagram itself.

Bru and *Bam* may simply have copied from their exemplars. If a conscious attempt at visual symmetry did not dictate their diagrams for the seasons, we would like to say that *Pa2* (Figure 5.11) seems to have recognized the thorough confusion in these other two in Group 1. Whether we follow strictly the sexpartite distribution of signs, or we attempt to coordinate the four time intervals with four sets of three signs named above the designated sectors of the diagram, we can find no satisfactory way for any diagram presented by Group 1 to represent properly the text of Calcidius in explaining the seasons' lengths. Therefore *Pa2* may perhaps be accorded credit for apparently returning to a version of the first diagram, retaining a correct association of four equal quadrants of the zodiac with four unequal seasonal time intervals. Yet even here *Pa2* holds some mysteries. Did the innovator of this diagram assume that no more than the change in orientation of the image, with the two perpendicular diameters rotated clockwise about forty five degrees, would somehow explain the variations in the lengths of the seasons? And what should a reader suppose about the significance of the three letters M, N, and Ξ in *Pa2*, when these added letters, which are given their meaning in the account of Calcidius, have no meaning in the diagram of *Pa2*? Perhaps we have given the copyist for this diagram more credit than we should. He may have copied an exemplar no longer extant. Or he may have innovated and assumed, after all, that he was providing here something quite different than the first diagram, which had simply presented the data. If so, he was quite mistaken in this assumption. It is, then, possible that in recognition of confusion in the tradition, he abandoned the pattern available to him in one manuscript and determined to return to a simple presentation of the data without explanation.

Once more, as with the other two members of Group 1 diagrams, we may need to consider the possibility that *Pa2* has a diagram of assembly, that is, the result of assembling one by one the specified attributes of the Calcidian diagram for explanation, paying special attention to discrete items like numbers and letters of the alphabet, but, because of failure to comprehend the geometrical reasoning of Calcidius, omitting the eccentricity of the circle of the Sun within the zodiacal circle. This hypothesized production by way of assembly of individual elements would help explain certain peculiarities of different diagrams, as it proposes that a scribe need not have any comprehension of the overall geometrical reasoning but need only bring together those specific parts he understands. And if a scribe has copied faithfully from an exemplar, we need only move our hypothesis about the scribe's mode of assembly back to the earlier diagram in the exemplar. Our assumptions can still hold for the faithful copier as well. The result of all this, nonetheless, is that in Group 1 all diagrams fail to explain the different lengths of the seasons. Two are geometrically corrupt and confusing; the intent and therefore the full meaning of the third is unclear, but in any case unsuccessful.

It is tempting to dismiss the members of Group 1 as nothing more than failures, but we must register a caution. One of the errors in *Bru* and *Bam* is so basic that it would seem to cry out for correction, and yet none occurred. This error appears in the placement of the twelve zodiacal signs. From early in the ninth century, in a standard diagram found in the *Commentary on Scipio's Dream* by Macrobius and in diagrams accompanying the Plinian excerpt for planetary absides, the ordered circle of signs was copied and learned.[82] More especially the diametrical

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[82] Figure 5.13 here shows a reordered zodiac in a distinctive form of absidal diagram. Prior to and concurrent with this diagram there were far more absidal diagrams that used the normal, correct order of signs. In the canonical Macrobian diagram of the planets surrounded by the circle of signs, the correct sequence of twelve signs, of equal

opposition of certain pairs of signs was widely recognized, for example, between the solstices in Capricorn and Cancer and the equinoxes in Aries and Libra. In Calcidius's text itself, as in normal Plinian absidal diagrams, there appears the opposition of the signs Gemini and Sagittarius, the locations of the solar apogee and perigee.

How can we reconcile the common knowledge of this astronomical pattern with the apparent disregard for it in these two diagrams in *Bru* and *Bam*? Indeed, the first of the two diagrams on our topic in each manuscript contains the standard zodiacal pattern with its diametrical oppositions. Yet in the second diagram, supposedly in support of the explanation of the seasons, *Bru* sets Aries opposite Sagittarius and Aquarius opposite Virgo, while *Bam* places Taurus opposite Sagittarius and Gemini apparently opposite Capricorn; none of these arrangements is correct. Once again we refer to the unusual, reordered Plinian absidal diagrams of the tenth century (Figure 5.13) and notice that in such a configuration the correct diametrical oppositions of signs are not observed. But if this comparison is not sufficient to explain the disorder of signs in the Calcidian diagrams, we must inquire what this distortion of the zodiacal pattern means. One solution—radical but possible—is that the scribes were, in fact, simply reproducing corrupt exemplars and that these exemplars were understood as corrupt by scholars using the texts in the ninth and tenth centuries. Such scholars, our hypothesis would claim, simply redrew the diagrams more correctly on wax tablets for themselves and for any students they had. Even if such an assumption seems extreme, we need not expect that scholars using such diagrams accepted what they saw. The obvious distortion of the zodiac in these diagrams is an error that persons with an interest in astronomy and with any kind of prior background in the discipline would have recognized. Errors in prior diagrams need not have commanded acceptance from readers who were aware of the errors. The error of unequal distribution of the names of signs was not included in *Pa2*, the sole diagram in Group 1 to place them correctly. Unfortunately this diagram did not add the element of eccentricity for the inner, solar circle.

size and with three per quadrant, was unfailingly observed in the manuscript copies from the ninth century forward.

8. *Group 2 Diagrams: The Construction of an Alternative View*

So far we have given the explanation according to Calcidius's text and reviewed the cause of perceived changes in seasonal lengths according to our reconstruction of the original diagram for the text (Figure 5.3). Next we found that the first of two groups of Carolingian manuscript diagrams, produced in the tenth century, failed to represent this causal explanation properly or adequately and may well signal incomprehension. However, the situation may as well signal the practical acceptance of a corrupt image in the manuscript tradition and the consequent construction of a more adequate diagram apart from the manuscript text. Finally, the situation in Group 1 may indicate an unexpected third alternative, the presentation within an image of as many distinct elements of the Calcidian explanation as were understood by the scholar-scribe together with incomprehension of the geometrical relationship of the parts of the diagram, thus making acceptable to the scribe some rearrangements of parts of the diagram in the interest of greater symmetry.

Turning to the second group, Group 2, of the manuscript diagrams (Figures 5.8, 5.12) we find a different situation. The members of this group also fail to offer a correct diagram for the account in Calcidius's text, but there is good evidence for a reasoned and divergent interpretation of the variation in the lengths of the seasons according to the Group 2 diagrams. The most obvious difference between the Group 2 and the Group 1 images is the second circle inside the encompassing zodiac of Group 2 (Figure 5.8). This lower, second inner circle is quite peculiar, especially because it has no identifying markers assigned to it. That is, none of the four lengths of seasons applies to any of its sections, nor does any of the alphabetical letters used in Calcidius's description define any of its arcs or the whole of it. It is a second circle without apparent function. It is also remarkable that the second circle has a radius exactly the same as that of the prescribed solar circle and a center located on the same diameter of the zodiac as carries the center of the solar circle. It is therefore not simply a second circle; it is a second solar circle.

Why does Group 2 add a second solar circle within the zodiacal circle? The answer is in Calcidius's text. In the second half of the short paragraph number 79, there are three options for the circle of the Sun with respect to the point Θ. Calcidius locates Θ within, along, or outside the circle of the Sun. The third possibility, which makes the solar circle an epicycle, is set aside for later consideration. The first option is the circle EZHK in the diagram. The middle choice, placing the earth, Θ, along the Sun's path, is the unlabeled, second inner circle. We can see that Θ is not precisely along this second solar circle. In fact, the point M is either upon or very close to the second circle in each member of Group 2. This placement may represent a slippage in the location of the second solar circle, a gradual erroneous repositioning of the circle from an intersection with Θ to an intersection with M. Yet the location we now find for the second solar circle seems to have been intended, recording the passage of the Sun very close to the earth, as stated in Calcidius's text, so that it burns the earth through its proximity but does not collide with the earth, since the text makes no mention of collision. In either case, the second circle in the diagram derives from Calcidius's account. Was this second circle original in the image? We have no good reason to think so. Even so, some medieval scholar found it instructive to add this circle mentioned in the text. And its presence indicates no necessary lack of comprehension of the diagram and its relationship to the text.

If the second inner circle creates no difficulty for understanding the explanation of the seasons, the location of the two lines intersecting at M, the center of the solar circle, certainly does cause a problem. In our reconstructed figure (Figure 5.3) and in the diagrams of Group 1 as well, these two lines are diameters of the zodiacal circle and must intersect at its center Θ. Strictly speaking, these lines in Group 2 have become chords, since they no longer bisect the encompassing circle and so cease to be diameters. To compound the errors, *Pa1* and *Ly*, though not *Ber*, do not subdivide the signs of the zodiac to give three signs to each of the arcs AB, BΓ, ΓΔ, and ΔA. Instead these two members of Group 2 place four signs in ΓΔ and two signs in ΔA, with three in each of the other two arcs, while only *Ber* (Figure 5.12) distributes three signs to each of the four quadrants of the zodiac. Here it would seem highly unlikely that a medieval scholar could comprehend the explanation of the seasons through the diagrams in Group 2.

There is, however, a noteworthy symmetry in the Group 2 diagram, the symmetry in the divisions of the solar circle. Group 2 appears to have refocused attention upon the text's emphasis on the constant, unchanged speed of the Sun as it proceeds around its circle EZHK. Clearly Group 2 does not present the explanation as Calcidius intended it. If we consider *Ber* (Figure 5.12) to represent best the model for this group of diagrams, from which *Ly* and *Pa1*, textual and diagrammatic twins, diverge in their aberrant placing of signs, then Group 2 has its own rationale, which can be understood. *Ber*, the best manuscript of Abbo of Fleury's computus (ca. 1004),[83] has peculiarities that distinguish it from the other members of Group 2 and give us sharper insights into the understandings behind the diagram to explain the lengths of the seasons. This manuscript does not contain the full text of Calcidius's commentary but has instead a number of well selected excerpts and diagrams from Calcidius to illustrate important astronomical topics as a complement to standard computistical themes. The verbal excerpt on the seasons displays no uncertainty about the meaning of the text on the solar eccentric to explain the seasonal lengths. The diagrams for both the description and the explanation of the variations in length stand side by side, emphasizing the shift from one approach to the other (Figure 5.12). For an early eleventh-century viewer there can have been no evading this shift in diagrams and in approach. The two diagrams have a common intermediate border and are remarkably different. The Calcidius diagrams in *Ber* were taken directly from *Pa1*, which was produced in the Fleury scriptorium during the third or fourth quarter of the tenth century, before or contemporary with Abbo's presence there.[84] It is therefore useful to look not only at the two relevant diagrams in *Ber* but also at the exemplar in *Pa1* as well (Figure 5.8).

The explanatory diagrams in the two manuscripts, each containing two inner circles, one of which is the inner eccentric circle assigned to and labeled for the Sun's orbit, are noticeably different. As we have already said, the Abbonian copy (5.12) reorients the two lines intersecting at the center of the solar circle to make them perpendicular to each other. Less immediately apparent but still clear is the repositioning of the names of the zodiacal signs in *Ber* (5.12), compared to *Pa1* (5.8), so that three names are in each zodiacal quadrant as defined by the two perpendiculars. There is also a finer correction made in the

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[83] Berlin Phillipps 1833 (Rose 138) is described by Rose, *Die lateinischen Handschriften der königlichen Bibliothek*, vol. 1, pp. 308–15. Van de Vyver, "Les oeuvres inédites d'Abbon," pp. 150–4, describes Abbo's computus. Recently there has been much study of Abbo's work; see Obrist, ed., *Abbon de Fleury*, pp. 239–40 for mss. of Abbo's computus, 245–54 for bibliography.

[84] Huglo, "Trois livres," for the origin of *Pa1*. Also, idem, "D'Helisachar à Abbon," pp. 216–20, on Calcidius at Fleury. The direct descent of the diagrams in *Ber* from *Pa1* is clear on the basis of a survey of all the possible (extant) mss. See the locations of the Calcidian solar eccentric diagrams in Eastwood and Graßhoff, *Planetary Diagrams*, pp. 112–14 (diagrams), 98–106 (mss.).

Abbonian version, the reintroduction of the fraction of $^1/_8$ of a day (or three hours) at the end of each number in quadrants ΑΜΔ and ΔΜΓ. Having made these corrections to the pattern provided by the exemplar in *Pa1, Ber* added titles to each diagram adapted from its exemplar. For the diagram (not shown here) to the left of Figure 5.12, describing the seasons (in principle the same as Figure 5.2), we read the title "Divisiones anni," which points to the temporal divisions, or seasonal lengths, inscribed around the inner band in four equal spaces, each a quadrant of the zodiac. For the diagram on the right (5.12), intended to explain how the lengths differ, we read the label "quod solaris circuli sit eccentron terra" ("that the earth is an excenter of the solar circle"). While the excerpt from the text of Calcidius presents completely and correctly his explanation, this title indicated a restricted focus, which is only part of the diagram and not its fundamental purpose according to the text. Taking a cue from the label, a viewer could easily think that eccentricity is the central topic, although the topic is actually the variation of the seasons. And if we assume that a scholar reading the excerpt and following its progress through the elements of the diagram was quite aware of the actual topic, we should still recognize that for the reader the most remarkable element of the diagram, according to its label, was the eccentricity of the solar circle. This was not a novel piece of information, being part of the planetary doctrines of Pliny the Elder and Martianus Capella, well known for two centuries by Abbo's time. But it was an element that distinguished planetary astronomy from stellar astronomy, and the prior diagram in this pair concerning the seasons showed only concentric circles. The label of the second diagram therefore, rather like a marginal rubric to a text, directed the reader to the most obvious new element introduced in order to pass from a description to an explanation.

So far, it would seem, we should be expecting to find an explanatory diagram more in accord with Calcidius's intentions. While this is not the case, we can see in *Ber* (Figure 5.12) an intriguing perspective on the meaning of the text and the diagram in Group 2. The positions of the Sun and earth are clear. The locations of the zodiacal and solar circles are clear. The intersection point of the two perpendiculars is neatly placed at the center of the solar circle. The four labeled arcs of the zodiac that are marked off by these perpendiculars are clearly of different lengths (though ΒΓ and ΔΑ are equal). We therefore find that, as the Sun moves uniformly on its circle, it appears to move through the zodiac on corresponding arcs. The solar arc ΕΖ corresponds to the shortest zodiacal arc AB, and the solar arc HK corresponds to the longest zodiacal arc ΓΔ. These are all distances, spatial intervals. But we also see the names of zodiacal signs, which are well known to be equal in length around the zodiacal circle, distributed three to each zodiacal arc, when these arcs are not equal in length. Furthermore, when we note the temporal intervals associated with each arc, we find equal arcs of the solar circle given different times. We also find the longest zodiacal arc assigned the shortest temporal interval and the shortest zodiacal arc assigned the longest temporal interval. What is the meaning of this diagram?

Any mature scholar in Abbo's circle at Fleury presumably knew that an explanation for the phenomenon of changing seasonal lengths required making uniformities appear to be non-uniform. In fact, we should also assume this general understanding for the original designer of the Group 2 diagram in the ninth century. What remain to be clarified are the precise details of this presentation of appearances. Knowing the Calcidian approach ourselves, we want the diagram to locate the intersection of perpendiculars at the center of the zodiacal circle, on the earth at Θ. But, of course, this has not happened. Instead the diagram requires the viewer to read its content as discrete parts and to recombine them mentally, not in a Calcidian geometrical way, but as a combination of arithmetical and geometrical elements. What the image shows is that two perpendiculars, the extended perpendicular diameters of the eccentric solar circle, will, despite having equal angles separating them, cut unequal arcs from a circle that is not centered at the intersection point of these perpendiculars. Calcidius used this knowledge in a different way than the Group 2 diagram. This diagram used it to show unequal zodiacal arcs cut with equal solar arcs. But those equal solar arcs were labeled with unequal times, so their significance was ambiguous unless defined arbitrarily to eliminate ambiguity. This is what the reader and interpreter of Group 2 had to do, if any was able, in order to make sense of the diagram. When one reads the diagram by combining the inscribed numbers with the arcs of the drawing, one can observe the following facts. First, the Sun appears to travel most slowly through the arc AB, which requires 94½ days in accord with Calcidius's description. Second, the Sun appears to travel most rapidly through arc ΓΔ, which requires only 88⅛ days. The two remaining arcs, BΓ and ΔA, have intermediate numbers of days, 92½ and 90⅛, and are intermediate in their lengths.

Certainly this visual model presented the basic facts and also the most fundamental philosophical point of the astronomical argument. That point was the constancy of the celestial motions. At the same time, the fundamental technical point recognized and presented was the eccentricity of the earth within the solar circle, which was in turn thereby eccentric in the zodiacal circle. The new model, *Ber* (Figure 5.12), preserved the uniformity of solar speed and laid out the zodiacal signs to show that each equal interval in the Sun's circle was projected onto the zodiac so as to create the appearance of changing speed, due to the variations in numbers of days taken to pass from one seasonal turning point to the next and so on through the year. Two very clear limitations are (1) the construction of this new model from a non-relativist solar viewpoint rather than from the relativist earthbound view, which was Calcidius's position, and (2) the shrinkage or expansion of different zodiacal signs along the circle ΑΒΓΔ in Group 2, ignoring the intention of Calcidius to give a clearly geometrical argument in accounting for the variations in the lengths of the seasons.

The new model proposed in Group 2 is primarily a computistical diagram. It ignores the geometrical perspective of Calcidius's demonstration, which shows the various lengths to be the result of the relative positions of the central earth and the separate center of the solar circle. It presents the names of the zodiacal signs and assumes the readers' knowledge that the signs are twelve equal parts of the zodiac, but the image does not represent or use this knowledge visually or geometrically. The model depends on the presence of zodiacal names rather than simply on the structure of the diagram. Only by acting as a computist, noticing the number of days for each of the four solar arcs and reasoning arithmetically by comparing the numbers of days, is the viewer able to make sense out of the Group 2 diagram. The designer of this image did not fully comprehend the geometrical astronomical model of Calcidius. The designer did, however, recognize the philosophical point that the heavens move uniformly, even though an observer sees non-uniform motion. The designer also understood that an eccentric solar circle was needed to explain the non-uniform motion—this point, of course, had already been perceived and repeated by Carolingian students of Martianus Capella's astronomy. What our Group 2 designer did not appreciate was the nature of the geometrical argument.

We might wonder whether geometrical demonstration, as opposed to geometrical techniques for the calculation of measurements, had any meaning for the ninth-century inventor of this design in Group 2. He was committed to the presentation of facts. The facts presented in this image to explain the lengths of the seasons are the uniform motion of the Sun and the course of this motion along an eccentric circle. The facts have geometrical definition in the diagram, but there is no geometrical argument. The Group 2 diagram presents the outlook of a scholar who is between the purely arithmetical view of the seasons found in the older, computistical texts, like Bede's DTR, and the newer geometrical view of Calcidius, which, while essentially qualitative, offers a classical geometrical argument about visual perception of motion as a relativistic experience of spatial frameworks. The designer of the Group 2 image valued numbers and names. They could be placed on a diagram with an earth-centered zodiac and an eccentric solar circle, but their meanings derive little that is new from this arrangement. Their significant meanings remain their names and their absolute numerical values. The Group 2 model shows us a distinctive rationale, understood by at least one group of Carolingian scholars. That rationale was arithmetical and computistical and was actively imposed upon Calcidius's text, replacing the diagram described by that text.

If the diagram to explain the seasons in Group 2 was made to replace the design of Calcidius, when might this replacement have occurred? Looking at the other early diagrams in our study, those in *Val* and in Group 1, we can see that a more correct Calcidian form was known in ninth-century France and that some exemplars existed with improperly oriented diameters in their diagrams. Of the Group 2 diagrams, those in *Ly* and *Pa1* are identical, reinforcing what we already know about the two manuscripts—that their texts are sisters, the tenth-century text of *Pa1* having as exemplar the ninth-century manuscript that was the twin of *Ly*. The diagram in question, then, is a creation from the ninth-century and plausibly from the earlier part of the century. In this milieu, as the Plinian diagrams for planetary absides show us, there was a goodly amount of Roman planetary doctrine imported into computus and believed to serve the interests of its reformed study in the early decades of the ninth century. Conversely, an approach to Calcidian astronomy that imported a computist's perspective should not surprise us.

In trying to place the seasons diagram of Group 2 chronologically, we can take account of one peculiarity in the text. Of all the extant early manuscripts of Calcidius's commentary, only *Ly* and *Pa1* show extensive confusion in copying the Greek letters in the textual description of this diagram. There are confusions of Θ with E, Ξ with Z, and Δ with A. They are more extensive in *Ly* than in *Pa1* and more thoroughly corrected in the later manuscript, *Pa1*, than in the earlier. These confusions do not continue in the succeeding texts of *capitulum* 81 and beyond in these two manuscripts of the commentary. Nor are these confusions reflected in the lettering of the seasons diagrams themselves in these two manuscripts. The image of Group 2 may have been created to accompany either an earlier ancestral manuscript of *Ly* (and *Pa1*) or another copy lacking these confusions in Greek lettering. It remains the case that the design dates most likely from the early ninth century.

9. *A Final Look at the Diagram in the Valenciennes Manuscript*

Among the Carolingian understandings of the variations in the lengths of the seasons we have found a spectrum. The conservative, computistical outlook strongly colored the model of the Calcidian Group 2 diagrams. Two scholars commenting by way of diagrams upon Martianus Capella's astronomy did not disagree with the computistical outlook but revealed additionally an interesting scholarly procedure. They represented the phenomenon diagrammatically by assembling the separate attributes that were given by Capella's text. The assemblage did not provide a geometrical argument or even a reasoned construction; it provided only separate elements. Likewise the alternative in Calcidian Group 1 diagrams seems to have compiled, or assembled, elements of an explanation without showing an awareness of the nature of geometrical argument, which Calcidius's diagram depended upon. In addition, two of the Group 1 diagrams showed a tendency to reorient the diameters to obtain a more symmetrical appearance of the elements of the image. The alternative in *Val* (Figure 5.7) in its corrected form (see Section 5 above) followed and came closest of any of our examples to accurately presenting the explanation in Calcidius's text. *Val* suggests the ability of some scholars in late Carolingian times to understand and to appreciate the geometrical approach of Calcidius and to recognize the difference between a geometrical construction and a simple presentation of data. This comprehension is suggested by the correction of various and many errors of the original scribe. The original scribe wrote in a very readable but rather swift hand, omitting a few words and miscopying many, reading "intra" for "littera" and "etceteras" for "eccentris," among others mistakes. The correcting hand not only found these unusual errors but also simplified the meaning of the text at one point with a gloss to help anyone struggling with the explanation of Calcidius, when it offered three hypothetical locations for the position of the earth with respect to the solar circle.[85]

The inserted gloss shows good understanding by the correcting scholar who also repositioned and enlarged the solar circle EZHK in the second diagram to make it eccentric rather than concentric. We would like to assume that he further recognized the need for the two diameters, ΑΓ and ΒΔ, of the zodiacal circle to be precisely perpendicular, but he did not attempt to change the drawing for fear of introducing confusion. However, the lack of just such further correction to the diagram does obscure the proper visual appearance of EZ as the largest arc of the four in the solar circle. The image also seems to show four zodiacal arcs of different lengths, even though these arcs contain three signs each. Calcidius's geometrical argument is no longer visible, although it may still be argued in this diagram on the basis of verbal definitions of the lines, points, and arcs used in the construction. Even so, in strictly visual terms the demonstration is lost in the figure in *Val*. A scholar with the presumed awareness of the corrector of this manuscript could always redraw the diagram on a waxed tablet with the further geometrical clarity needed to explain it adequately to students. But as it now stands, the diagram must be carefully thought through, noticing, first, the equality by definition of the four zodiacal arcs and, second, the proper proportions of the four unequal arcs of the solar circle. These elements must be reasoned out; they can not be seen directly. The purpose of the image may have been recognizable to a scholar with an advanced understanding of astronomy in the ninth or tenth century, but it would have been obscure to an inexperienced student.

Val bears witness to sophisticated insight into the use of eccentric models for astronomical explanation in the tenth century. Other diagrams, as well as texts, of the ninth and tenth centuries for explaining the lengths of the seasons show us understandings all the way from the simplest computistical view of four equal seasons through a spectrum of different mixtures of the arithmetical descriptive view and the geometrical perspectival view. The strength of the computistical outlook and its various reformulations of the Hellenistic explanation provided

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[85] See above, p. 353, n. 76, for this interlinear gloss.

by Calcidius are the most important characteristics to notice in the Carolingian ways of seeing the lengths of the four seasons. Given the close connection between the computistical view of the seasons and Christian historical and liturgical concerns, the Carolingian scholarly attempts to understand Calcidius's account of the seasons are intriguing. We can find some readers simply failing to comprehend (or simply rejecting), some trying to carry over their computistical vocabulary to the Hellenistic framework, some imagining that they are correcting the account of Calcidius, and a few scholars apparently understanding the Calcidian explanation in the Hellenistic terms in which it was composed. We should not focus too much upon the ability of the small group of scholars who followed Calcidius's account fully. The broad range of views tells us that different understandings developed, were taught to students, and probably evolved variously within individual schools over the latter half of the ninth century and beyond. This openness and diversity of development in understanding how to explain the lengths of the seasons is our most important insight into the Carolingian approaches to this astronomical question.

10. *Calcidius and Carolingian Astronomy*

The astronomy of Calcidius represented a goal rather than an achievement for Carolingian scholars. The Paris Compend bears witness to an awareness in the mid-ninth century of the utility of the *Commentarius* for studying the heavens, but its initial function in this regard seems to have been limited mostly to clarifying the nature and working of the epicycle beyond the incomplete account of Martianus Capella. Calcidius's use of the eccentric model for the lengths of the four seasons provided a challenge which most students seem to have been unable to meet before the eleventh century, although the possibilities for revising and improving the extant manuscript diagrams by new designs on waxed tablets should not be ignored. The Calcidian epicyclical model (with diagram) for the limited elongation of Mercury and Venus from the Sun received no notable investigation, glossing, or correction (which was needed) by Carolingians and would have to wait until the eleventh century for discussion or improvement.[86] What our lengthy exploration

[86] A categorization of the forms and a chronology of the emergence of these forms

of the eccentric model for explaining the seasons has shown us is the deep and abiding effect of the computistical outlook on astronomy. Certainly some Carolingians, for example, commentators on Capella's account of the changing lengths of daylight between the solstices, saw the limitations of the computistical approach to one or another topic, but a complete overthrow of the computistical viewpoint was not yet on their horizon. The longevity of diagrams by assembly for explaining the seasons shows us that point. What we may see in the use of Calcidius for astronomy is a very common Carolingian attitude towards all the Roman works that were revived and mined for their data, models, and approaches. Calcidius's commentary was used for one or another distinct item of information or text or diagram. It was not used by the Carolingians for a larger prospect on astronomy or cosmology or philosophy. What we find in Carolingian astronomical studies is the name of Plato invoked for quite specific purposes, for example, as an authority on planetary order, rather than as the founder of a distinctive cosmology or astronomy.[87] Both John Marenbon and Anna Somfai argue persuasively that Platonism or any larger coherent view was drawn from Calcidius's translation and commentary only after the Carolingian era, in the eleventh to twelfth centuries.[88] The Carolingians used Calcidius and the other Roman sources piecemeal for their applicability to distinctively contemporary concerns—theological, philosophical, cosmological, or astronomical. They sought answers that would satisfy their search for a more complete order in the movements of the heavens.

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in the manuscript diagrams for cc. 110–112 (the bounded elongation of Venus) appear in Eastwood, "Heraclides and Heliocentrism," pp. 242–53.

[87] A Platonic or Platonist order of the planets appears in Macrobius's *Commentary*, and the ninth-century commentaries—certainly those of the Anonymous, John the Scot, and Remigius—on Capella's astronomy refer to Platonist patterns either for all the planets or at least for the inner planets.

[88] Marenbon, "Platonism—A Doxographic Approach," pp. 67–89; idem, *Aristotelian Logic, Platonism, and the Context*, Ch. 1, pp. 10–11. Somfai, "The Eleventh-Century Shift," pp. 1–21.

CHAPTER SIX

CAROLINGIAN DIAGRAMS FOR ASTRONOMY AND COSMOLOGY

The preceding four chapters set out progressively more technical diagrams of astronomical arrangements and motions, leading from Macrobius's planetary order and arrangement of planets in their zodiacal houses to the Plinian designs for four characteristics of the seven planets and their paths, then to the revealing sketches of the Anonymous commentary on Martianus Capella for phenomena such as the changing speed of the Sun between solstices and finally to the qualitative epicycles and eccentrics of Calcidius.[1] Our approach to all the diagrams introduced in this book will continue to be primarily literal and technical, because the nature of scholarly understanding of astronomy (and of cosmology) in the ninth century is usually best revealed through technical analysis. However, important insights into scientific diagrams can be gained through other approaches. At the opposite end of the spectrum from ours are the symbolical interpretations of Bianca Kühnel.[2] She has found a dominance of circular and cross-shaped orders in Carolingian schemata and diagrams that deal with time, revealing intersections of cosmology, chronology, and eschatological concerns. More recently she has surveyed a number of Carolingian diagrams, mostly cosmological, to show the cross as a virtually omnipresent motif, in detail or in layout (or both) of the diagrams.[3] If some of her claims regarding scientific diagrams seem unduly universalizing or occasionally excessive, her approach remains a welcome

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[1] In this chapter I assume the reader's familiarity with the diagrams already discussed in Chapters 1–5. I do not propose to summarize the contents of all the diagrams discussed in the preceding chapters.

[2] See for example Kühnel, *The End of Time*, ch. 2 ("Computistics and Astronomy in Early Medieval Europe"), ch. 3 ("Illuminated Science—Illuminated Faith: Carolingian Diagrams"). An interesting comparison to Kühnel's book can be made with a recent interpretive work on medieval castles, which have traditionally been treated simply as military structures without attention to their influence on cultural concepts, e.g., urban, spiritual, imperial, treated with much insight by Wheatley, *The Idea of the Castle*.

[3] Kühnel, "Carolingian Diagrams," pp. 359–89.

reminder that Christian symbols were so familiar to the literate culture of Carolingian Europe that it must have seemed quite natural, perhaps a simple matter of good order, to employ patterns of the cross in all sorts of descriptive cosmological designs. Not as far afield as Kühnel's analyses from ours are the interpretations of Barbara Obrist, who has written widely on the iconography of early medieval cosmology and computus.[4] A vigorous focus on the significance of certain linear forms, such as the circle and its elaborations, is only part of her interest.[5] She has argued especially for the use of diagrams as evidence of the direct passage of ancient scientific doctrines into early medieval Europe.[6] Here we sometimes find reason to differ with Obrist, simply because our detailed analyses propose Carolingian understandings that are not the same as suggested by her interpretations.

1. *Where and Why Were Diagrams Used?*

Carolingians found two of the four Roman texts we have studied, the works of Macrobius and Calcidius, fully illustrated with cosmological and astronomical images. Pliny and Martianus Capella prescribed no diagrams, and, as far as we know, the earliest astronomical illustrations for their works were created by Carolingian scholars.[7] There were three physical locations for diagrams.

Diagrams were used in the textual space when the authors of the verbal texts prescribed them. We find this in the cases of Macrobius and Calcidius; the diagrams for the excerpts from Pliny are a special case and also appear in the text space, because the diagrams seem to have been intended by the Carolingian excerptors as integral parts of the texts as soon as the excerpts were identified. Diagrams not explicitly mentioned or described by Macrobius and Calcidius appeared in the

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[4] Obrist, *La cosmologie médiévale*, vol. 1, and "Les tables et figures abboniennes," in *Abbon de Fleury*, pp. 141–235.

[5] See her "Wind Diagrams," used in part above, pp. 159–67.

[6] See for example her "The Astronomical Sundial in Saint Willibrord's Calendar;" I discuss an important theme of this article, above, pp. 284–5.

[7] Full lists of the planetary diagrams in surviving manuscripts of these four works are in Eastwood and Graßhoff, *Planetary Diagrams*; see the catalogue of manuscripts and the catalogue of diagrams in each of the chapters for Macrobius, Pliny, Martianus Capella, and Calcidius.

margins rather than in the textual space, and such images for these two authors are later than the ninth century. Marginal diagrams were common in Carolingian copies of Martianus Capella's astronomy, which prescribed no diagrams, and we have described these marginalia as sketches—clearly less authoritative and probably afterthoughts to the verbal glosses and commentary on the text. However, the creators and copiers of these marginal diagrams seem to have intended them to have the same status as verbal glosses and comments. Some diagrams simply restated a point in the text clearly; some elaborated on the text to add precision beyond what was evident in the words of the text; and some diagrams were integral to the marginal comments and added precision to both the comment and the Capellan text, such as the diagrams and marginal comment identifying different patterns of circumsolar motion for Mercury and Venus. Beyond the textual space and the textual margins, a third position exists for Capellan diagrams, that is, the end of the complete text. We have seen the emergence of a relatively standard set of astronomical diagrams as an appendix that appeared after the text of the final book of *De nuptiis*, on music, already at mid-century. These appendix diagrams, widely separated from the *astronomia* (Book 8), were linked to their proper locations in Book 8 by brief phrases written on the diagrams that came from the narrative text of Capella and functioned rather like endnotes in a modern book. Such a group of end-diagrams, an appendix, held a more permanent status than the marginal diagrams, for we have discovered much variety in the choice of marginal images for different copies of Capella's astronomy while Carolingian copies of the appendix of astronomical diagrams attempted to preserve the earliest known version (the Vossianus manuscript) unchanged.

In addition to the physical location of a diagram in a manuscript, we also consider here why a diagram appears in a specific place in the text. And subordinate to this we address the question of why a new diagram may replace a traditional one. In Macrobius's *Commentary* the first canonical diagram encountered by ninth-century readers introduces us immediately to a peculiarity of prescribed diagrams, viz., that the diagram may present a different set of data than required by the accompanying verbal instructions. When Macrobius laid out the pattern of the seven planets in their zodiacal houses and in ascending planetary order from the central earth, he opened the description saying, "Since our eyes often open the way to the understanding of a problem, it would be well to draw a diagram."[8] He then described and labeled with letters the circles, points, and radii needed for a diagram like that in Figure 2.10 (both diurnal and nocturnal houses of the planets); Figures 2.3 and 2.4 follow the layout for the diurnal but not the nocturnal houses. However, among the 152 examples of the diagram for this text there are only 52 that present the planets according to the positioning in distinct signs, or houses, while the large majority places all the planets under one sign. Of the 152 there are 54 examples that reproduce the Plinian order of the planets rather than the order explicitly set forth by Macrobius.[9]

Modern commentators on this situation might be tempted to propose that the divergences from the description in the text are simple corruptions in the diagrams, but such is clearly not the case. Instead we are confronted with the following facts. The framework for the diagram faithfully follows the Macrobian text in virtually every one of the 152 cases. The alternative, Plinian order appears in exactly the appropriate sequence of planets, not in some other, disordered form, in the 54 examples listed. And finally, the Plinian order is the dominant—indeed virtually the only planetary order—found in Macrobius manuscripts of the ninth and tenth centuries. So when we ask, 'Where and why were diagrams used?,' we find that the Carolingian answer was a subtle modification of the answer given by Macrobius. He obviously thought that the first place he needed a diagram was in his account of the planetary positions according to the Egyptians (and Plato), where his image defined at once the order, the relative speeds, and the zodiacal houses of the seven planets. Carolingian scholars seem to have followed by preference the scheme originating with Dungal, as we have argued in Chapter 2, Section 4, who ignored—or, more likely, removed—the topic of zodiacal houses for the planets and provided only the relative speeds and order of the planets as well as reversing Macrobius's statement of the order of the inner planets. Macrobius, as we know, argued in favor of the Egyptian (Platonic) against the Chaldean (Plinian) order.[10] In other words, the first canonical Macrobian diagram was deemed inappropriate according to ninth-century concerns, and

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[8] CSS 85.12–13 (I.xxi.3); "Et quia facilior ad intellectum per oculos via est, id quod sermo descripsit visus adsignet." Stahl trans., p. 175.

[9] These numbers are provided from the data in Eastwood and Graßhoff, *Planetary Diagrams*, pp. 68–71.

[10] Here we summarize conclusions reached above, pp. 36–52.

Macrobius's instructions were contradicted on two important points, the sequence of the planets between the earth and the fixed stars and the location of individual planets under definite zodiacal signs to identify certain astrological characteristics. The planetary sequence was changed, and the connection of planet to sign was destroyed, since the new, Carolingian design (Figures 2.2, 2.5) placed all seven planets under one sign (Aries). If we ask our question anew, we can say that the Carolingian scholars responsible for this altered form of the first Macrobian diagram determined to use a diagram (1) to replace a less preferred planetary order with another, more authoritative order and (2) to resist the inculcation of students with diagrammatic elements of astrology. The second of these two choices is intriguing, because there was no evident attempt to suppress the text having the same information. The presentation of this information in a diagram was opposed, as if to say that the diagram might suggest or enable some kind of astrological or divinatory practice while the verbal account would not. With the ninth-century revision of this Macrobian diagram we find that a diagram could be used to reinterpret a text at one point and to countervail the text at another—an active ideological undertaking that is surely a surprise for modern readers expecting scientific diagrams to represent faithfully and clearly the contents of the texts they accompany. By the late tenth century a scholar added a series of marginal glosses to the text where Macrobius discussed the orders of the Egyptians and the Chaldeans, and the scholar reported that the Egyptians had the more correct order on the basis of better reasoning rather than better observation.[11] The rapid spread from the eleventh century onward of the diagram faithfully representing the Macrobian text is a nice example of the complementarity of a concern to present the text adequately in order to gain greater control of its uses and a notable increase in the search for and collection of astrological materials.[12]

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[11] In Oxford Auct. T.2.27, f. 28r, (s. X ex) a contemporary scribe wrote a large index gloss "De discernendo ordine sperarum," then below it wrote "sententia Egyptiorum," below which he indicated "item aliqua sententia" (the Chaldean order) without attribution, and finally wrote "item sententia" (Egyptian order) beside the line containing "Perspicatior tamen observatio veriorem ordinem deprehendit" (CSS 74.21–22; I.xix.8), glossing "perspicatior" with "mente quam oculo." This glossator saw Macrobius's preference for the Egyptian order contrary to the alternative, yet Dungal's preference remained in this ms. at f. 32r, where a hybrid Macrobian diagram appears with the Plinian/Chaldean order under Aries.

[12] Among the many studies of the growing European interest in astrology from the eleventh century, see Burnett, "King Ptolemy and Alhandreus;" idem, "Advertising the

How far can we take this approach, that is, the assumption that divergence from the author's instructions for a diagram may be an act of intentional revision? The diagrams in Macrobius's text surely did not always show so adversarial a view as seen in the Carolingian revision of the zodiacal configuration. It remains reasonable to assume that cases of corruption most often arose from apparent inability to understand the purpose of a diagram or at least an inability to present a specific diagram properly. This seems to have happened widely in copies of Macrobius's rain diagram (Figures 2.6 and 2.9), to a limited extent in the diagram for terrestrial and celestial correspondences (Figure 2.8), and infrequently in the diagram for the five climatic zones (Figure 2.7). Errors by Carolingian scribes in the last two of these three diagrams seem most clearly to have been due to no more than carelessness or manual ineptitude.

With regard to the rain diagram, we have previously argued that its picturing of a negative rather than a positive assertion led to scribal confusion and that many scholars and scribes tended to imagine and tried to depict the correct image of falling rain rather than the pattern that Macrobius described as a ridiculous and absurd result of an incorrect assumption about the proper direction of "falling down." It seems easy to agree that a diagram should appear with the relevant Macrobian argument, but the resulting range of incorrect images for the rain diagram suggests that Carolingians might have done well to omit an image here![13] In fact, the variety of rainfall diagrams in the early manuscripts derived from more than one response. Careful reading of Macrobius's description of his diagram for the rainfall argument shows that he had this image in mind as part of the proof, not as an afterthought, for he presented its details incompletely in the written description as follows.

New Science," pp. 147–57; and David Juste, "Comput et divination chez Abbon," in *Abbon de Fleury*, pp. 95–127.

[13] A review of the discussion of some of these figures by Murdoch, *Album of Science*, pp. 282–3, with seven different examples of diagrams leaves the reader with the traditional conclusion. More recently, Obrist, *La cosmologie médiévale*, vol. 1, p. 183 and Figs. 65–67, has not advanced the discussion further. One clue to a more nuanced view is Murdoch's mention that two opposed diagrams, the negative and positive views of rainfall, appear on facing pages of the same manuscript; Murdoch saw these as "the result of the scribe's indecisiveness," (p. 283) but we can as easily see them as the result of the scribe's presentation of *two* positions, first Macrobius's argument against the absurd view, next the implied image of the correct view.

> Let a circle represent the earth (*terrae sphaera*); upon it inscribe the letters ABCD. About this draw another circle with the letters EFGLM inscribed, representing the belt of the atmosphere (*aeris orbis*). Divide both circles by drawing a line from E to L. The upper section will be the one we inhabit, the lower the one beneath us. If it were not true that all weights are drawn towards the earth, then the earth would receive a very small portion of the rainfall, that which falls from A to C. The atmosphere between F and E and G and L would send its moisture into the air and sky. Furthermore, the rain from the lower half of the celestial sphere would have to continue on into the outer regions, unknown to our world, as we see from the diagram. To refute this notion would not befit a sober treatise; it is so absurd that it collapses without discussion.[14]

Stahl's translation is slightly different than Macrobius's original but preserves the sense of the text. The reader encounters immediately two concentric circles, representing the spheres of earth and air, with alphabetical labels that are never explicitly located in spatial terms. The diagram is truly a part of the text, which refers by the labels to parts of the diagram that a neophyte reader (or scribe) could hardly be expected to locate securely without the complete labeled diagram before his eyes. Macrobius's description, then, is not really a set of instructions for drawing the image. The description should be considered as a verbalized figure, best read aloud to a student by a teacher informed of the meaning of the figure and pointing to its parts while reading.[15]

Having in mind the above interpretation of Macrobius's diagram, we can better comprehend what we find in the Carolingian manuscript copies. We can find a largely correct copy in a manuscript of the mid-ninth century or later from Corbie, although its placement of

[14] Macrobius, *Commentary*, trans. Stahl, pp. 183–4. CSS 93.14–26 (I.xxii.11–13): "Esto enim terrae sphaera cui ascripta sunt ABCD, circa hanc sit aeris orbis cui ascripta sunt EFGLM, et utrumque orbem id est terrae et aeris dividat linea ducta ab E usque ad L: erit superior ista quam possidemus et illa sub pedibus. Nisi ergo caderet omne pondus in terram, parvam nimis imbrium partem terra susciperet ab A usque ad C, latera vero aeris, id est ab F usque ad E et a G usque ad L, umorem suum in aerem caelumque deicerent, de inferiore autem caeli hemisphaerio pluvia in exteriora et ideo naturae ignota deflueret sicut ostendit subiecta descriptio. Sed hoc vel refellere dedignatur sermo sobrius, quod sic absurdum est ut sine argumentorum patrocinio subruatur."

[15] A nice example of difficulties arising from an attempt to use the text as instructions for drawing the diagram without oral guidance (or a correct model) occurred in St. Gall 65[1], p. 94 (s. X), where the scribe inscribed a square in the outer, aerial circle and placed F and G at the two upper corners of the square. Because he made the terrestrial circle too small and did not inscribe it immediately within the square, the vertical lines of rainfall from the points F and G do not run tangent to the circle for the earth and pass a significant distance from either side.

the letters F and G is inaccurate, suggesting a possible misunderstanding of the precise details of Macrobius's argument. It seems certain that this Corbie copy of the rain diagram had an identical—perhaps even fully correct—model in its exemplar (Figure 6.1).[16] We can also find copies that are incorrect and incomplete around the middle of the century.[17]

However, we may ask whether or not some Carolingian scholars responsible for incorrect rain diagrams were intentionally revising the pattern in order to show the correct pattern of rain "falling down" from the heavens, in agreement with Macrobius's basic doctrine and contrary to the point of the explicitly absurd argument that Macrobius chose to describe by a diagram? This line of interpretation would explain the choice for what we can call a positive, or actual, rather than a negative rainfall diagram and may also tend to explain the variety of positive versions, since no authoritative, Macrobian pattern had ever existed for a positive diagram. A positive rainfall diagram could readily take one of two forms. One would fill the whole space between the outer, aerial circle and the inner, terrestrial circle with vertical lines and omit any vertical lines for rainfall below the outer circle, assuming that rain falling from the aerial sphere to the center should follow vertical lines from both lower and upper hemispheres to the equatorial line (Figure 6.2).[18] The other version would fill the outer space with lines oriented more or less radially to show rain falling towards the center (Figure 6.3).[19] Conjoining this interpretation of a revised rain diagram with that of the revised zodiacal configuration makes it difficult to continue

[16] The Corbie ms. diagram, Paris nal 454, f. 56r, is also used by Eastwood, "Medieval Science Illustrated," p. 193, and Obrist, *La cosmologie médiévale*, vol. 1, Fig. 66. A more correct example appears in Zürich Car. C.122, f. 21r (s. X²–XI¹).

[17] The diagram added by either Lupus of Ferrières or Heiric of Auxerre to Paris 6370, f. 68r, places F and G more accurately, but the basic design of four concentric circles is both incorrect and confusing because of the placement of the superfluous labels 'orbis aeris' and 'spera terrae' along with the prescribed letters ABCD. Bern 347, f. 11v (s. IX¾), apparently copied the rain diagram from Paris 6370 and omitted the superfluous labels. The image in Paris 6370 is reproduced by Obrist, *La cosmologie médiévale*, vol. 1, Fig. 65.

[18] The diagram in Paris 16677, f. 41v (s. IX), was at Fleury by the tenth century. The diagram is also used by Eastwood, "Medieval Science Illustrated," p. 192, and Obrist, *Cosmologie*, vol. 1, Fig. 67.

[19] The diagram in Bruxelles 10146, f. 85r (s. IX ex–X in), has all alphabetical labels carefully and properly placed. A later example, from London Eg 2976, f. 50r (s. XII m), less carefully labeled, appears in Murdoch, *Album of Science*, p. 283 (upper left figure).

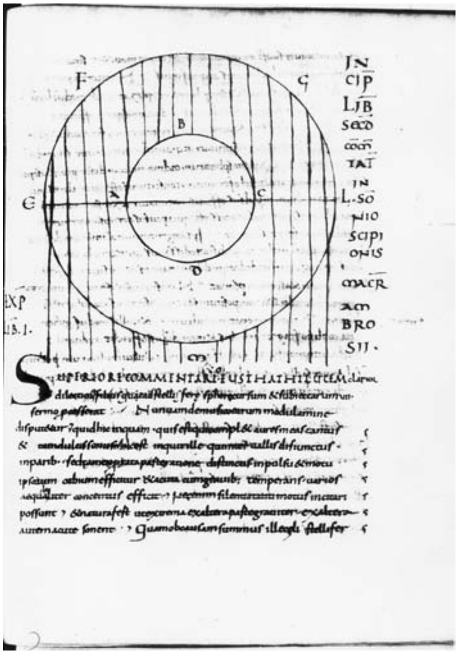

Fig. 6.1. Macrobius's Rain Diagram. Paris, cliché Bibliothèque nationale de France, ms. nal 454, f. 56r

to assume that Carolingian astronomical and cosmological diagrams were always genuine attempts to reproduce the canonical forms and that divergences were simply acts of carelessness or ineptitude or misapprehensions due to faulty models. Instead we may now begin to consider an unexpected answer to the question, 'Where and why were diagrams used?' That answer would be that diagrams were used not only where the author indicated the need for a diagram but also where one or more Carolingian scholars found it desirable to improve the understanding of the text by changing the diagram. Obviously there remain so many cases where corruption is evident, in the source or in the copy or in both, that we see no reason to claim that changed diagrams have always sprung from thoughtful intentions. Nonetheless, the assumption that thoughtful scholars never tried to do more than copy diagrams faithfully seems eminently questionable as well.

Turning to the diagrams added to the astronomical excerpts from Pliny's *Natural History*, our inquiry about where to use diagrams does not involve the author of the text. Pliny the Elder did not suggest or imply diagrams for any of the four excerpted texts, yet diagrams for

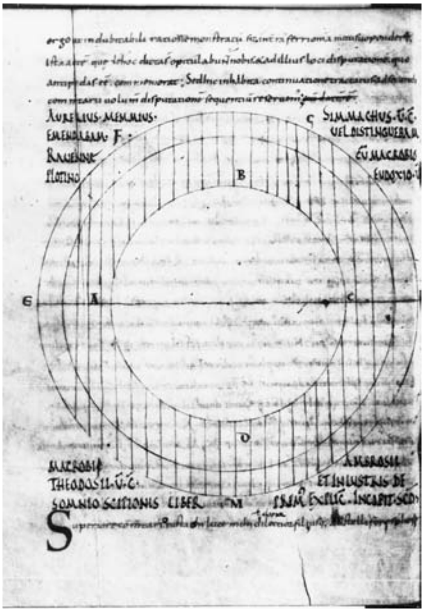

Fig. 6.2. An Alternative Rain Diagram. Paris, cliché Bibliothèque nationale de France, ms. lat. 16677, f. 41v

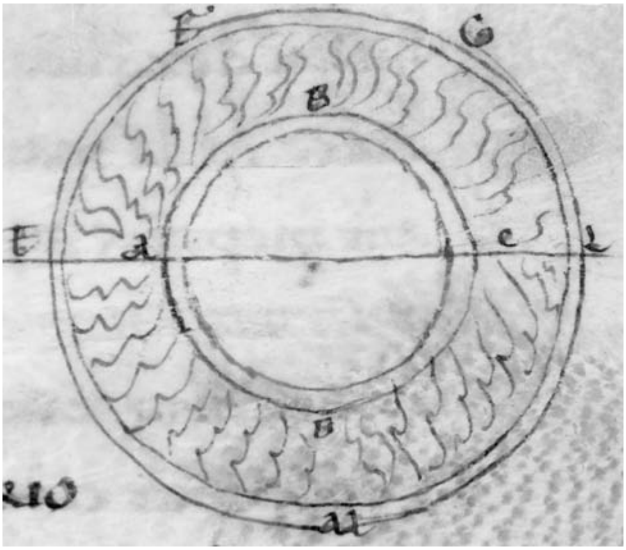

Fig. 6.3. A Further Version of a Rain Diagram. Brussels, Bibliothèque royale de Belgique ms. 10146, f. 85r

planetary order, intervals, apsides, and latitudes appeared with some of the earliest surviving manuscripts of these texts (Figures 3.1–3.4, 3.6) and with many later copies. Unlike the two Macrobian diagrams just discussed, the Plinian images raise no question of a Carolingian concern to disguise or alter any part of Pliny's text. With the Plinian excerpts we have a single diagram in the textual space and directly attached to each separate text with the diagram focused on a single attribute of the planets, although the excerpts describe more. No directions are given for the construction of any of these diagrams. The first excerpt describes the orbital time as well as position for each planet with much more information for the Sun, Moon, and the two inner planets. The diagram simply draws the planetary order from this compilation. The second excerpt is the briefest and closest to its diagram in content. The text begins with a short account of metrical distances between planets, then lists the interplanetary intervals in terms of whole tones and semi-tones, which is the content of the diagram. The third and fourth Plinian diagrams represent short, compact accounts of planetary apsides and latitudes contained in much longer excerpts that present extensive information on risings and settings, stations and retrogradations, occultations, solar radial forces, and more. The texts of the excerpts are not identical to Pliny's original, as there are very modest clarifications and simplifications as well as omissions introduced by the medieval excerptors. This apparently pedagogical orientation continued in the diagrams in their attention to single attributes of the planets. Whereas a rota in Isidore of Seville's DNR acted as a mnemonic carrying a great deal of inscribed information, each of the Plinian diagrams, also circular in their initial forms, had little other than the planetary names and depended on the linear elements of the diagram to convey the intended characteristics of the planets. So, for example, the apsidal diagram had the twelve equal signs of the zodiacal band and only planetary names on the circles within the band; the excessively eccentric planetary circles and the obvious locations of their apogees told the rest of the story. In contrast to the primarily verbal narrative of an Isidorean rota, the Plinian diagrams emphasized spatial and linear depiction of data.

Turning to the question 'where are diagrams located?' for these Carolingian diagrams that were newly created for the Plinian excerpts, it is reasonable to claim that the diagrams were produced at the same time the excerpts were made. The process seems to have been, first, to identify fundamental properties of the planets that should be taught, second, to locate the sections of Pliny's work that listed or described these properties, third, to make the excerpts with the inclusion of important surrounding text that should also be taught, and, fourth, to produce the diagrams for the fundamental properties that were identified at the beginning. One of the four excerpts has a clause added at the end in reference to the relevant diagram. This happened with the apsides excerpt, because in this excerpt the part of the text listing the diagramed characteristic came at the very end, and so the clause 'as the figure below shows' ('ut subiecta figura demonstrat') could be easily added to Pliny's text. Thus the location of each diagram was determined by (1) the prior identification of a fundamental planetary trait and (2) the physical termination of each excerpt, where the diagram was drawn in the textual space to signify an essential element of the excerpted text.

One more way to approach the question of 'where and why' diagrams are placed is under the rubric of invention. Only a moment's reflection is needed to recognize that invention occurred in at least one of the diagrams in each of our four Roman authors. The Macrobian diagram for planetary order within the zodiacal configuration was an innovation within a preexisting image—an invention, even if only in the central part of the design. The four Plinian astronomical diagrams were all inventions with respect to the excerpted texts of Pliny, and the latter pair, for apsides and latitudes, does not seem to have any demonstrable roots in Roman or other ancient sources. We know very well that the Capellan astronomical diagrams were inventions for the text by a Carolingian scholar or group of scholars working on the Anonymous commentary. The selection of ten such diagrams for an appendix was one further invention with regard to the text of *De nuptiis*. And, although important innovations in the diagrams of Calcidius's *Commentarius* came about only in the eleventh century, we know that the text with its diagrams was a subject of study and inquiry before the mid-ninth century. Carolingians were struggling to master the text and its diagrams; they did not show a slavish attachment to the diagrams inherited from previous centuries. Invention in astronomical diagrams was not unusual in the ninth-century investigations of their Roman sources.

2. *Which Diagrams Are Stable?*

The stability of diagrams depends upon a number of conditions, some of which we discuss in the previous section. When one or more scholars decide that a diagram conveys incorrect or undesirable information, a revision may occur for reasons peculiar to the preference of the scholar who controls the copying of the diagram. In such a case the fidelity of the diagram to its text or to its exemplar is of secondary importance as we have seen with the Macrobian planetary configuration. The determination of Dungal, discussed in Chapter Two, to modify the planetary order supported by Macrobius and also, apparently, to avoid the Macrobian depiction of planets in their diurnal and nocturnal houses resulted in the creation of the diagram we recognize as Dungal's (Figures 2.2 and 2.5). How this version of the Macrobian diagram became the form universally adopted in the Carolingian world remains uncertain, but the distribution of his letter to Charlemagne with the diagram as an addition would seem to be the best answer. A similar question of stability pertains to the Macrobian rainfall diagram, although here we have only a reasonable, or plausible, cause for the appearance of what amount to versions of Macrobius's diagram that directly oppose his negative argument and its depiction. We have no certain cause, and we also have clearly erroneous copies with no likely cause beyond the incomprehension of copyists. The reasons for the revisions, or instability, in the Macrobian diagrams for planetary order and for the direction of rainfall did not come from an inadequacy of either diagram to represent its text, nor were such revisions made in order to represent better the verbal text as it would be seen by a competent and unbiased reader. We have encountered, in other words, special reasons for these examples of diagrammatic instability.

More general reasons for stability or instability of a diagram should now be considered. Stability implies concurrent satisfaction; it may or may not indicate comprehension. Instability is the more difficult condition to explain, but there are some obvious explanations. Among these is the decision to replace completely a diagram by another one intended to present exactly the same information in a manner that is easier to copy or to comprehend. This was the case with the four Plinian diagrams, each of which we found in an earlier and a later form. The later forms of the diagrams for planetary order and intervals did not use orbital circles, thus certainly abbreviating the work of the scribe and probably the time required for student comprehension. The later forms of apsidal diagram reduced the time needed by a student to find the connection of planet and sign of apogee. The later, rectangular grid for latitudes was arguably simpler for scribes and quite certainly easier for students learning planetary latitudes. We can notice in passing that these changes—apparently advances—in the pedagogical diagrams for the Plinian astronomical excerpts did not favor circular shapes and showed a primary preference for simplicity, abandoning circularity quickly (long before the end of the ninth century) in three cases, continuing to use it only in the apsidal diagrams where it was necessary. The later forms of the Plinian astronomical diagrams exhibited remarkable stability through the Carolingian era and beyond. Their modifications in later centuries were matters of convenience or aesthetics, most evident in the amazing variety of grid patterns and transverse planetary lines in latitude diagrams. Withal, the basic linear structures and the information conveyed remained instantly recognizable.

A common cause of instability in the tradition of a diagram was the omission of a prescribed diagram in a text, such as the rainfall diagram in Macrobius's *Commentary*. It seems clear that this diagram was omitted in the copy of the work that Lupus of Ferrières owned and had illustrated. The manuscript probably originated at Tours around the year 820.[20] Lupus made corrections to it at mid-century and assured that the omitted diagram was inserted in the space left open at the time the text was copied. Evidently no useful model was available for copying, and the result was an incomplete and incorrect effort (Figure 6.4). This incorrect diagram in turn became the exemplar for at least one further copy and probably influenced others showing at least one attribute in common, the use of four rather than two concentric circles.[21] While we expect that the omission of a canonical diagram would most often lead to errors in attempts to replace or reconstruct the diagram, such an omission could also lead to improvement by way of reconstruction. We have no example to offer from the Carolingian history of the astronomical diagrams, but a noteworthy example occurred in the early eleventh century with the diagram of Calcidius for the bounded elongation of Venus as an epicycle. A long history of corruption of images brought

[20] On the manuscript, Paris 6370, and Lupus, see Gariépy, "Lupus of Ferrières," pp. 103–4; Barker-Benfield, "Macrobius," pp. 226–7.

[21] The immediate copy of Paris 6370 was made in Bern 347; see above, p. 380, n. 17, on the image. On the text and image in Bern 347 and their uses, see above, pp. 72–6, 133.

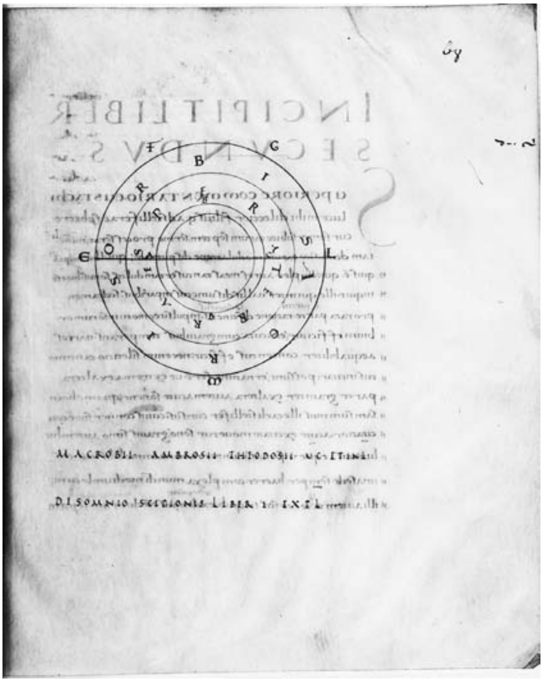

Fig. 6.4. Lupus of Ferrières' Copy of the Rain Diagram. Paris, cliché Bibliothèque nationale de France, ms. lat. 6370, f. 68r

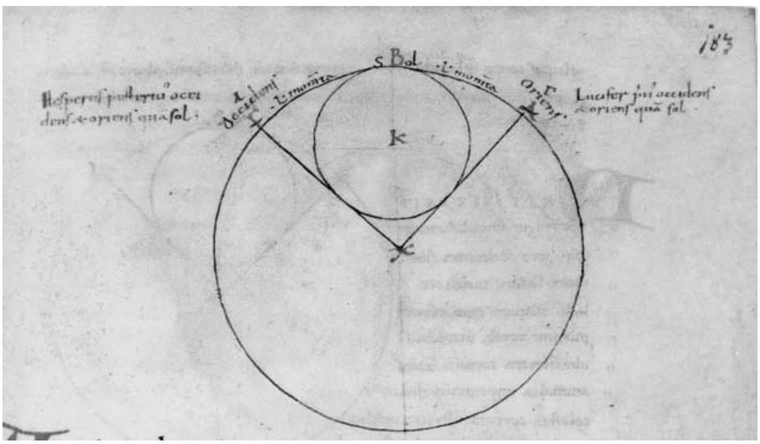

Fig. 6.5. Eleventh-Century Reconstruction of the Diagram for the Epicyclical Model of the Bounded Elongation of Venus according to Calcidius. Vienna, Österreichische Nationalbibliothek, Bildarchiv, cod. 443, f. 183r

a useless version of this diagram into the Carolingian world, and the interruption of the corrupt tradition in one strain of manuscripts led to a reconstruction soon after 1000 in order to fill an empty space (Figure 6.5). The reconstruction was essentially what Calcidius seems to have intended in order to illuminate his account of the epicyclical pattern for Venus's motion.[22]

Among the large number of astronomical diagrams in Calcidius's work we can find various examples of stability and instability. One of the more stable diagrams was the generic epicycle (Figure 6.6), if we allow for examples that failed to have the radii on either side of the epicycle actually touch the epicycle.[23] The ease with which this diagram escaped the distortions that occurred to the similar diagram for the epicycle of Venus in Calcidius's work is difficult to account for. The best explanation currently seems to be that Calcidius's text for the generic epicycle speaks of a diagram with an "epicycle," but the epicycle of Venus is described simply as a circle in the angle between two radii and never referred to as an "epicycle."[24]

Another aspect of diagram stability is the development of two stable branches in the tradition of an image. Again Calcidius is our source for such a pattern of diagrams. At the end of the astronomical-cosmological part of his *Commentarius*, Calcidius described in detail the motion of Venus in retrograde. By far the more common diagram (at least thirty one manuscript examples) for Venus in retrograde shows the planet moving clockwise within the zodiacal band and then proceeding into a tightly coiled path under two or three signs (Figure 6.7). However, a

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[22] The reconstructed diagram (Fig. 6.5) was evidently inserted into an empty space after the exemplar for the text was no longer available; the reconstruction is also used by Eastwood and Graßhoff, "Planetary Diagrams—Descriptions, Models, Theories," p. 204. Full discussion of the corrupt and correct examples of this planetary model in the mss. appears in Eastwood, "Heraclides and Heliocentrism," p. 242 (Fig. 6, the diagram in Vienna 443), 246–51; reprinted in Eastwood, *Revival of Planetary Astronomy*, ch. 9. A characteristic example of the corrupt diagrams can be seen in Waszink's edition of Calcidius's *Commentarius* at p. 158 (left diagram), taken from Bruxelles 9625–9626 (s. X), which happens to be the same form appearing in other early (late Carolingian) copies of Calcidius, such as Valenciennes 293, Lyon 324, and Paris 2164.

[23] An example of the model with non-tangent radii appears in Eastwood and Graßhoff, *Planetary Diagrams*, p. 88, from the eleventh century (Leiden BPL 64). Three examples with tangent radii (from the 10th, 11th, and 15th centuries) are reproduced in Eastwood and Graßhoff, "Planetary Diagrams—Descriptions, Models, Theories," p. 201.

[24] See Eastwood and Graßhoff, *Planetary Diagrams*, pp. 87–90 (generic epicycle), 91–4 (epicycle of Venus).

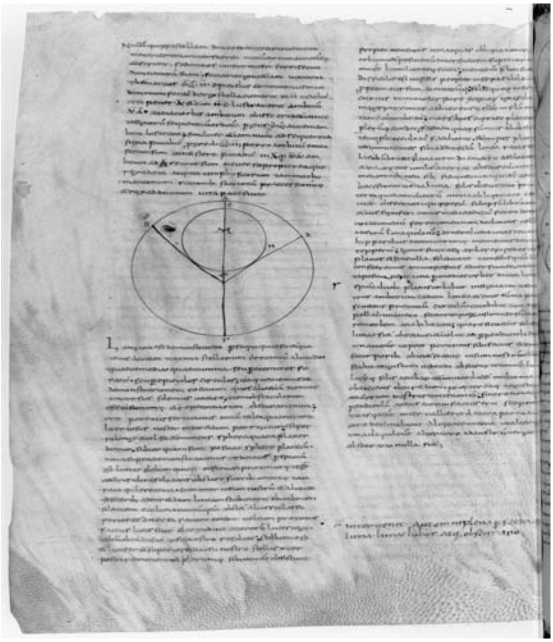

Fig. 6.6. Calcidius's Generic Epicycle. Paris, cliché Bibliothèque nationale de France, ms. lat. 2164, f. 38v

very different, alternative image, three schematic acanthus coils, exists in seven manuscripts (Figure 6.8). Both forms appeared in the earliest extant manuscripts, Valenciennes 293 (Venus within the zodiac) and Lyon 324 (three acanthus coils), and they continued independently. The acanthus form derived from the text of Plato quoted by Calcidius, which referred to *acanthus* coils, while Calcidius's commentary equated this expression with a "spiral" and proceeded to describe its path in more detail. The two different diagrams represent two distinct scribal inspirations, one the external and very familiar acanthus leaf schema, the other the description by Calcidius of the astronomical design.[25] The acanthus tradition lasted through the eleventh century and disappeared.

[25] See Eastwood and Graßhoff, *Planetary Diagrams*, pp. 94–7, for the text and an example of each type of diagram for retrograde Venus. The acanthus design had use outside astronomy, and it was familiar in the early Middle Ages as a Mediterranean motif with Roman connections; see Nees, *Early Medieval Art*, pp. 77–8. This spiral design was not considered a barbarian motif, and we should not be surprised to find it imported into an astronomy text by the ninth century when the acanthus is mentioned by name.

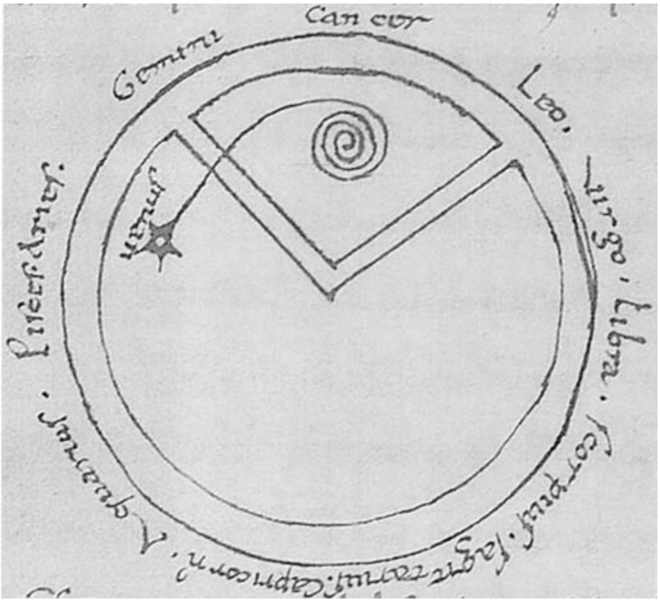

Fig. 6.7. Venus in Retrograde—Zodiacal Version. Valenciennes, Bibliothèque municipale ms. 293, f. 62r

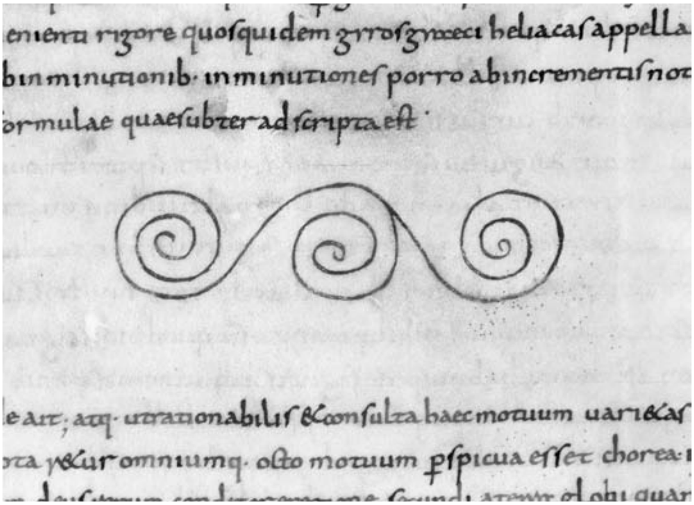

Fig. 6.8. Venus in Retrograde—Acanthus Version. Lyon, Bibliothèque municipale ms. 324, f. 44r

The tradition with a spiral inside the zodiacal band, obviously preferred by Calcidius, continued throughout the Middle Ages.

Some diagrams became stable after an initial period of instability. Our discussion in Chapter Four of the appendix diagrams for Martianus Capella after their creation in the development of the Anonymous commentary offers an excellent example. The set of ten diagrams collected as an appendix around mid-century for the first version of the Anonymous (Figure 4.10) was expanded in the third quarter of the century to eleven diagrams by addition of a distorted version of one of the initial ten. The addition was retained, and the set of eleven received acceptance as a standard appendix through the tenth century (Figure 6.9). The appendix appeared occasionally thereafter in Capellan manuscripts through the fifteenth century, always with at least nine of the original ten diagrams preserved.[26]

Satisfaction with a diagram that was incorrect, commonly with one prescribed by the text, was the apparent condition explaining the stability of a large number of Carolingian astronomical and cosmological designs. In this category, as already explained, we can include the intentionally modified Macrobian diagrams as well as corrupted diagrams in the manuscripts of Calcidius. The variety of forms for the Macrobian diagrams of the five climatic zones (Figure 2.7) and of celestial and terrestrial correspondences (Figure 2.8) shows that corruptions in these were not stable; many copyists, when faced with corrupt exemplars, were able to return to the correct forms of these straight-forward diagrams, usually by comparing exemplars. On the other hand, corruptions in Calcidian astronomical diagrams required an understanding of the qualitative geometry involved, and this could not be gained by comparing exemplars. Hence we have seen difficulties and a very slow development in Carolingian (and subsequent) abilities to improve corrupted Calcidian diagrams for the explanation of the

[26] The original appendix (Fig. 4.10) appeared in Leiden Voss. lat. F.48, f. 92v. The distorted form of the Aries-Libra diagram as a new, unlabeled image in Paris 8669, f. 122r, then joined the appendix to make a total of eleven in Paris 8671, f. 84r, and Leiden BPL 36, f. 129r. For the eleventh diagram in the appendix, see Eastwood and Graßhoff, *Planetary Diagrams*, pp. 136–8 (Fig. V.16), under the category "Radial lines." To the commentary of Remigius in Paris nal 340 (s. X) we find attached the enlarged appendix of eleven (ff. 82v–83r) with four further diagrams, all four of which are reiterations of the diagrams for the three versions of circumsolar Mercury and Venus. The original appendix of ten diagrams appeared as late as Basel F.V.40, ff. 175v–176r (s. XV ex).

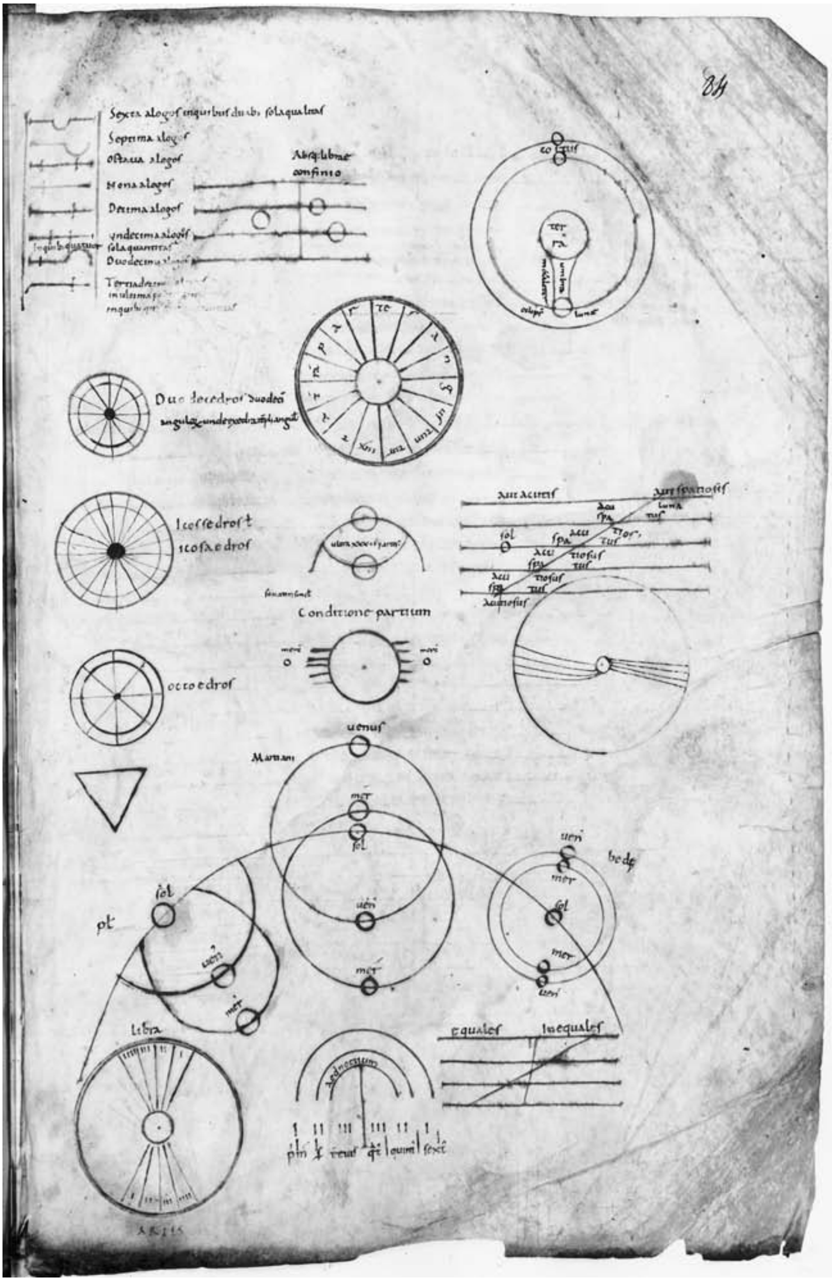

Fig. 6.9. Appendix of Eleven Astronomical Diagrams. Paris, cliché Bibliothèque nationale de France, ms. lat. 8671, f. 84r

lengths of the seasons. In such cases, satisfaction with diagrams and resultant stability meant incomprehension rather than understanding.

3. *Diagrams and Pictures*

In the study of nature neither picture nor diagram is the object of study, and yet the picture or diagram is precisely the object that a reader studies. Our first duty, then, is to state as precisely as possible—or as precisely as our own topic seems to demand—the nature of a diagram.[27] To do this we shall have to retreat one step further. Diagrams as such do not have a single nature. Each diagram is hedged in by its history, its referents, its users, and its uses. We begin with some common notions already employed in our studies in this book, even though we have not examined those notions self-consciously.

'Picture' is commonly used to indicate a representation of something like a group of persons or a landscape or an important object in accord with recognizable modes of representation—photography, neo-realist painting, penciled sketch, impressionist painting, etcetera. This notion of a picture is used as if the picture were an inert and disconnected object, observable in the same way by all viewers. Even the concept of viewing tends to objectify the picture unless qualifications are explicitly stated. This status of independent reality, or objectivity, commonly assigned to pictures, has usually been assumed for scientific diagrams, especially those as simple as the ones we have encountered in the medieval manuscripts of our four Roman authors. At the same time it is obvious that 'picture' and 'diagram' as we have characterized them in this paragraph are not identical. But the diagrams surely are presented as images of independent objects. As an example, we can take the Plinian apsidal diagram, which is a composite image of the paths of the planets with respect to both the earth and the zodiac. The image requires a large amount of preparation to be understood as such. That preparation includes an understanding of abstraction, the

[27] For this section of the current chapter I have found suggestive a number of works, among which the following are most important. I do not claim that any of them directly supports my views. Elkins, *The Domain of Images*; idem, *The Poetics of Perspective*; Harley, *The New Nature of Maps*, ch. 5 ("Deconstructing the Map"); and Mitchell, *Iconology*. My concerns and conclusions in this section of the chapter are different from those of Carruthers, *The Book of Memory*, e.g., pp. 221–3.

understanding (with preliminary images) of circular paths of bodies, and elaborated experience of visual perspective on a plane surface. The preparation requires, in other words, a great amount of both verbal and visual training, and the imagery involved is also both verbal and visual. (Here 'visual' is analogous to 'pictorial.') The Plinian apsidal diagram can only be seen correctly—we indulge in common assumptions here—by a viewer who has learned the concepts and imagery appropriate for seeing it correctly. These, in turn, are known and are assumed to be communicable by a designer who devises a Plinian apsidal diagram. The object, the diagram, is therefore radically dependent on the requisite conventions—concepts, images, and instruction—for communication between designer and viewer.

Staying with the Plinian apsidal diagram as our example, we find that its history in the Carolingian era shows more than one form, and the subsequent individual forms presented no diversity of doctrine. The first form we have on record appeared in conjunction with the Plinian excerpt that gave the locations of the apogees and perigees for the planets, with notches added to the apsidal circles to identify the extreme positions, and instructed the reader of the text to understand that a planet in uniform circular motion would appear to increase and decrease in speed as the viewer within the circle became, respectively, closer to and farther from the path of the planet. The set of eccentric circles in the apsidal diagram of Madrid 3307, dated to the 820s, presented to the prepared viewer an unambiguous image, or diagram, of this information—both the appearance of varying speeds and the zodiacal signs under which the planets had their apogees (Figure 3.3).[28] Subsequently there occurred experiments with more attractive forms of the basic image, a set of eccentric planetary circles within a segmented circle of zodiacal signs. As our discussion of these diagrams in Chapter Three has shown, scholar-copyists recognized that it was possible to retain the basic image and teach the basic apsidal doctrines through a variety of forms of the image. The number of named zodiacal signs could be reduced. The order of zodiacal signs could be changed as long as the associated planetary apsidal circles were correspondingly rearranged (Figure 3.11). The amount of eccentricity of each planetary

[28] The Madrid 3307, f. 65v, diagram is Fig. 3.3. I omit here mention of the apsidal diagram in Paris nal 1615 (a. 820) (Fig. 3.4). A diagram very similar to that in the Paris ms. appears in the *glossa et scholia* to Bede's DNR 14 in PL 90, coll. 227–228. For the Madrid and Monza diagrams, see above, pp. 109–14.

circle could be changed, making them all equally eccentric or all of different eccentricities, since this aspect of the planetary circles was not part of the verbal description in the Plinian excerpt. And, because planetary order had already been dealt with in a preceding excerpt, some apsidal diagrams even ignored the relative sizes of the planetary circles, which suggested the order of the planets, and used planetary circles of equal size (Figure 6.10). We can see that the linear contents of the diagram for apsides vary from one form to another. We would also say that these forms of diagram for apsides tell us the same thing, because we are instructed viewers and know how to read the diagrams. Is this reading any different from our reading of the relevant parts of the Plinian excerpt?

Insofar as the text presents words while the diagram presents continuous lines there is an obvious difference. Beyond that, the continuous line that forms, let us say, a circle imparts to a viewer a coherent image that on first viewing actually explains 'circle,' since no aspect or combination of the letters in the word does so. At the same time 'circle' is a necessary connective to allow a speaker to bring the linear form into linguistic communication. On these simple grounds we understand that neither 'circle' nor the circle can stand alone without at least implying the other. The same situation exists with 'radius' and more elaborate terms like 'zodiacal band,' where each verbal term coexists with its linear image, neither being able to stand as the prior or more basic element, since the verbal and the diagrammatic complete each other.

When an error appears in a diagram, we recognize and call it an error through our comprehension of the complex of interrelated meanings of the two sides we have just outlined. In other words, we have learned the language and the linear forms of the diagram. For a Plinian apsidal diagram we have learned that eccentric circles are necessary, as is the zodiacal band that makes the framework. Certain words, or symbols that equal those words, are also necessary—the words or symbols needed to identify the planets and to identify the signs of the zodiac. Since there are only six planets with apogees in the Plinian scheme, only six zodiacal signs are absolutely necessary in the diagram; the others are optional, unless the scribe wishes to indicate the signs of perigee as well. This was not often done. Thus within a zodiacal circle, or band, six eccentric circles of any desired size(s) could be drawn to satisfy the needs of a coherent communicative diagram for apsides. Likewise only the six zodiacal signs under which planetary apogees were placed were needed in the diagram. These signs could

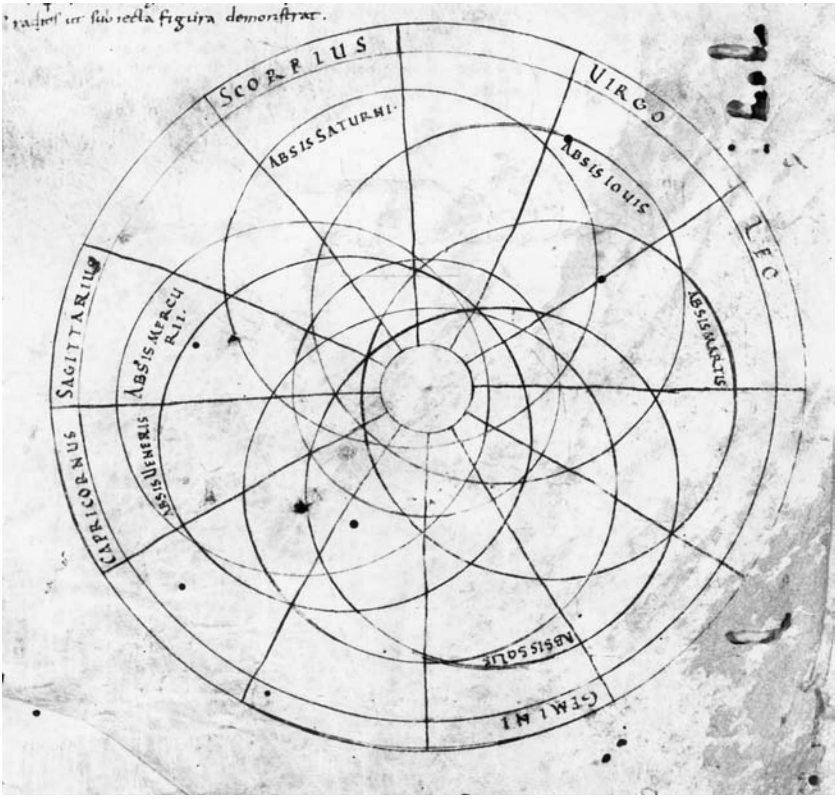

Fig. 6.10. Plinian Apsides. Munich, Bayerische Staatsbibliothek clm 6364, f. 24r

be set in their traditional sequence or in some other sequence, since the sequence of signs was in no way an essential part of the diagram. Moreover the variety of choices for zodiacal sequence in the Plinian apsidal diagrams found in medieval manuscripts makes clear that teachers (and students) using them understood the diagrams correctly, for the association of zodiacal sign and apogee for each planet virtually always appeared correctly. Quite simply, then, we see that diagrams and texts were not independent, that neither text nor diagram was prior in any fundamental sense—any sense of meaning—despite the obvious temporal priority of the Plinian excerpts to the creation of the diagrams that came to accompany them. Were the created diagrams superfluous, because the meanings of the terms in the excerpt for apsides were fully understood? In fact, this question can not be answered, because the answer depends on the audience. The diagrams were an extension of the excerpt to ensure that full comprehension occurred. This was no more than the process of teaching the meanings of terms by the fullest of explanations. And as for the variety of apsidal diagrams, this variety simply reinforced the fact that the elements of these Plinian diagrams had a limited number of relationships. The sizes and relative positions of the eccentric circles did not matter as long as the proper associations of planetary apogee and zodiacal sign appeared.

Can we say that the apsidal diagram is also a picture? What does a picture of a planetary orbit look like? Can a planetary orbit be pictured? Is a picture always of something that can be viewed directly, either practically or in principle? To the last question, "yes." And since the most significant lines in the diagram are markers either of a momentary event—the passing of the planet—or of a spatial relationship—the radial lines and the sign segments—the diagram seems to offer no representation of a viewed material object. Instead the diagram is itself the viewed object. It has a different relationship to planets and zodiacal constellations than what we call a picture has to its referents. If the planet leaves no material markers of its passing along a path, there can be no picture of a planetary orbit. While we can view both a mountain and an impressionist's painting, or picture, of the mountain, thus forming our own visual memory and sense of the relationship of mountain and picture, we can not view a planetary orbit in the same way. We can hardly even view a planet in a state of motion, if we wish to assert that the motion was actually seen directly. In short, we can not compare directly the diagram of a planetary path with a picture as we have used the word 'picture.' There are far too many rules involved in the creation of a diagram, and these rules are different from those involved in establishing the content of a picture. To discuss the relationship of text and image, an image that represents a text in the form of a diagram, we need to keep in mind that the text-diagram relationship is not the same as the text-image relationship of the art historian. The text-diagram relationship may be simpler at times; it remains nonetheless different. This conclusion holds for scientific diagrams, such as the apsidal diagram. It may require modification for schemata that combine a scientific diagram with other, affective elements. An example would be an image of concentric planetary circles with a cross, an apparently Christian symbol, imposed at the periphery (Figure 6.11).[29] Such an image would no longer be a scientific diagram, although it made use of a scientific diagram as part of its construction. On the contrary, if the cross is seen as more than a marginal decoration, then the cross, a religious symbol, becomes the conceptual center. It was placed approximately at Easter time in Figure 6.11 and signified perhaps Christ as the guarantor of order in the cosmos (or at Creation) or the crucifixion as the salvation of the created world. However, we shall not pursue here such schemata, as they are not part of our collection of diagrams under discussion in conjunction with the texts of the four Roman authors used as sources for astronomy and cosmology.[30]

4. *Diagrams and Precise Meanings*

The meanings of astronomical texts are subject to many limitations. Taking the text of Martianus Capella's *astronomia* as an example, we have already found a number of ambiguities there. The ambiguity of the text describing the circumsolar paths of Mercury and Venus (VIII, 857) led to a creative set of three diagrams to fix more concretely the

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[29] This image can be seen as a frontispiece to one of the mss. of the second version of the Anonymous commentary to Capella's *De nuptiis,* that is, Leiden BPL 88, f. 2r. The design is Macrobius's diagram for the houses of the seven planets, dominated by a Christian cross placed at Aries 30° and at the top of the diagram according to its layout on the ms. page.

[30] Bober, "An Illustrated Medieval School-book," p. 65 n. 1, applied the term 'schema' to any of various composite and abstract designs, and I use the term here in that general sense to distinguish straight-forward astronomical diagrams, like the apsidal diagram, from such as Fig. 6.11, a schema. I discuss one, more elaborate schema at pp. 411–17 below.

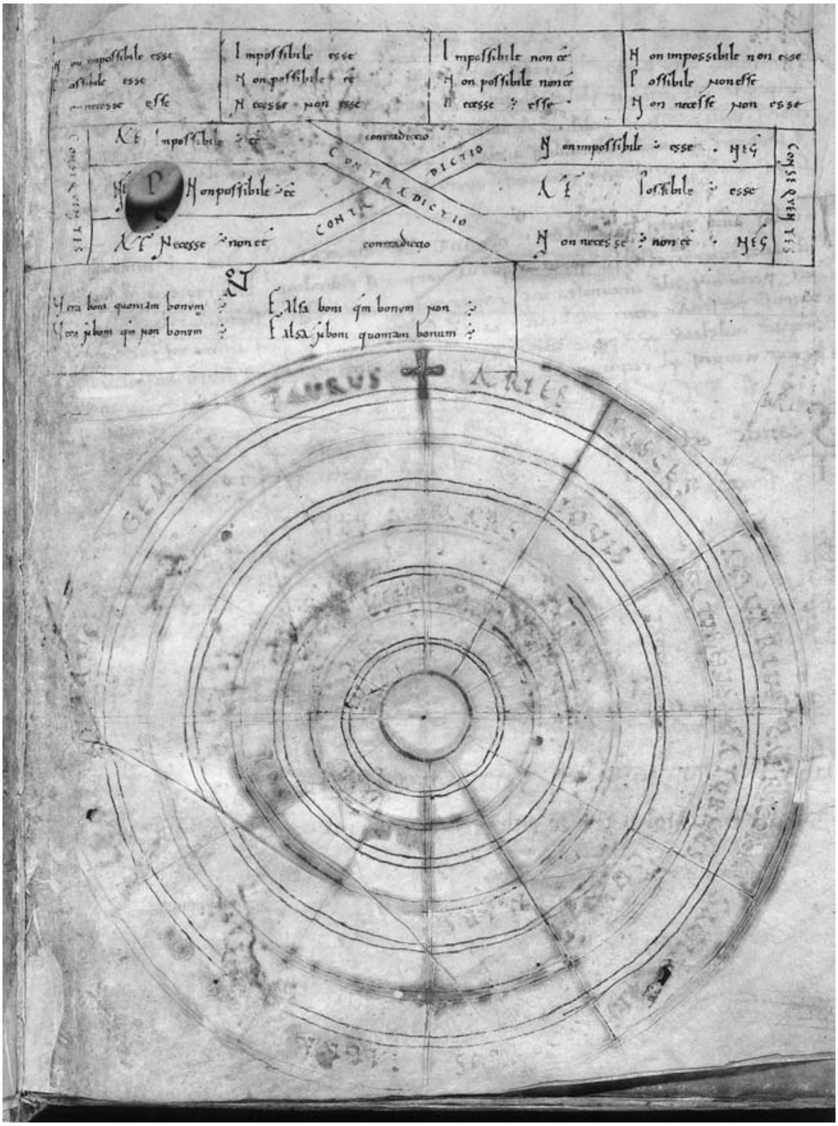

Fig. 6.11. Frontispiece to Capella, *De nuptiis*, in Leiden, Universiteitsbibliotheek, Special Collections, ms. BPL 88, f. 2r

possibilities of the text in accord with three different authorities (Figures 4.6, 4.7, 4.8). But the text that set forth rising and setting times for the zodiacal constellations was reasonably clear (VIII, 844–845), while the marginal diagram invented for this topic in the first version of the Anonymous commentary was ambiguous—decidedly more ambiguous than the text (Figure 4.4); it was not included in the appendix of diagrams and found no use in any further manuscript of any commentary on Capella's *astronomia* in the early Middle Ages. Ambiguity was not limited to texts, and precise meaning required care in the wording of a text and in the linear design of a diagram. It was with the appendix diagrams that the Anonymous commentary came most clearly to the aid of readers and students of Capellan astronomy.

The appendix of ten diagrams (Figure 4.10), assembled for the first version Anonymous and repeated, with an additional diagram, a number of times in the ninth century as well as later in the Middle Ages,[31] presented an intriguing diversity of images. In the Vossianus manuscript of the first Anonymous commentary only six of the images in the appendix appeared as marginal drawings in the same manuscript, and no other Carolingian copy of the commentary included more than two as marginal diagrams for Capella's Book 8.[32] When we look carefully at the diagrams newly created for the appendix, we find an apparent concern for precision beyond that associated with the six diagrams that were carried over (sometimes with improvements) from the margins of the astronomy text to the appendix. The four new diagrams were those with the following tags, or connected phrases of text: (1) *absque Libra*, (2) *partes confustent*, (3) *condicione partium*, and (4) *Aries—Libra*. The first of these (Figure 6.12) seems to have been a conscious retort to Pliny's well known assertion that the Sun departs from the centerline of the zodiac by one degree above and below. This view was spread widely

[31] Repetitions of the Anonymous appendix appeared during the latter half of the ninth century most notably in Leiden BPL 36, f. 129r; BPL 36, f. 129r; and Paris 8671, f. 84r; other examples are Paris 8669, f. 122r–v (diagrams unlabeled), and Munich 14729, 221v (only seven diagrams).

[32] Leiden BPL 36, Paris 8669, and Paris 8671 have none. Besançon 594 has two diagrams from the appendix plus one other. Paris 13955 has one from the appendix plus one other. BPL 88 and Vat. Regin. 1987 both have one plus separated images of two of the three versions of circumsolar motion. BPL 87 has two from the appendix plus the Capellan diagram of intersecting circles for circumsolar motion. For further, though not complete, details on the astronomical diagrams in various manuscripts of *De nuptiis*, VIII, see Eastwood and Graßhoff, *Planetary Diagrams*, pp. 117–47.

by the excerpt from Pliny with added diagram for planetary latitudes (Figure 3.10). What the Capellan text (VIII, 867) with its Carolingian diagram proposed was a tacit correction to Pliny's assertion that the Sun oscillates between one degree above and one degree below the plane of the ecliptic throughout the year to the effect that the Sun remains precisely on the ecliptic except in the sign of Libra, where the Sun departs only one half a degree (not a full degree) from the central plane of the zodiac (Figure 6.12).

The second diagram appears at first sight to be quite simple, making it difficult for us to see why it was needed at all (Figure 6.13). The image is no more than a pair of concentric circles, the inner circle much smaller than the outer, joined by a set of sixteen equally spaced radial lines. The text inscribed around this circular design said, "Near the earth the portions [of orbits] are smaller." The Capellan text for which it stood (VIII, 861) described the relative sizes of planetary orbits in terms of the metrical expansion of circular lengths and angular arcs as the radial distance from the earth increases. However, this diagram had clear application to other situations such as the relative (apparent) sizes or speeds of objects in circular paths around a fixed observation point like the earth. In this enlarged sense the diagram helped clarify and make more precise the Plinian apsidal diagram's message that planets farther away appear to move more slowly, although they have uniform motion. Furthermore Carolingian scholars could have used this diagram to help explicate the astrological claim that very small changes in observed angles of elevation of planets or zodiacal signs should lead to significant changes in planetary or zodiacal effects on the earth.

The third diagram, *condicione partium* (VIII, 880), describes the brief but brilliant appearance of Mercury when it rises in the morning at adequate elongation from the Sun (Figure 6.14). The two-word phrase points to the importance of a measured, or numbered, minimum distance from the Sun and its bright rays, which, in some examples of the diagram, extend towards but do not yet reach the body of the planet.[33] In its form in the Vossianus, this diagram has no circle or inscription for Mercury, at least allowing the notion that the diagram applied to both Venus and Mercury, the two planets with limited elongation. It seems that the question of the precise minimum elongation for visibility of

[33] Examples that include a tiny circle for the planet Mercury, just beyond the reach of solar rays, include Paris 8671, f. 84r, and Leiden BPL 36, f. 129r.

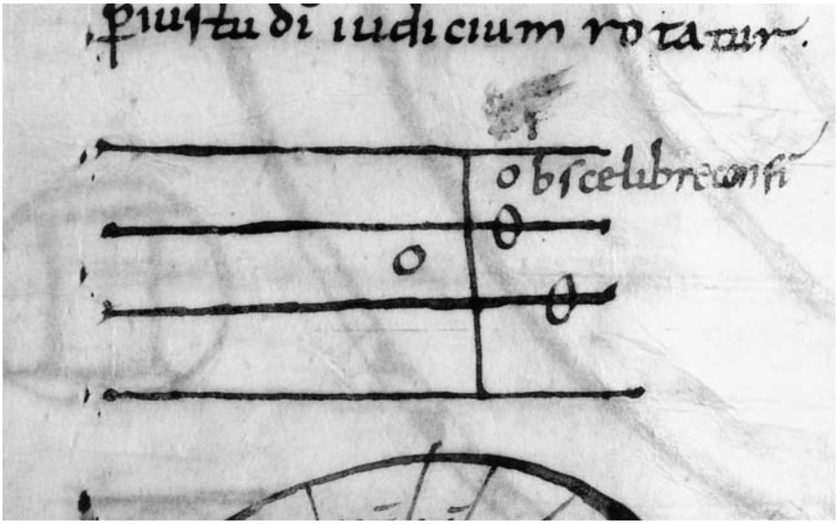

Fig. 6.12. Appendix Diagram for *Absque Libra*. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 92v

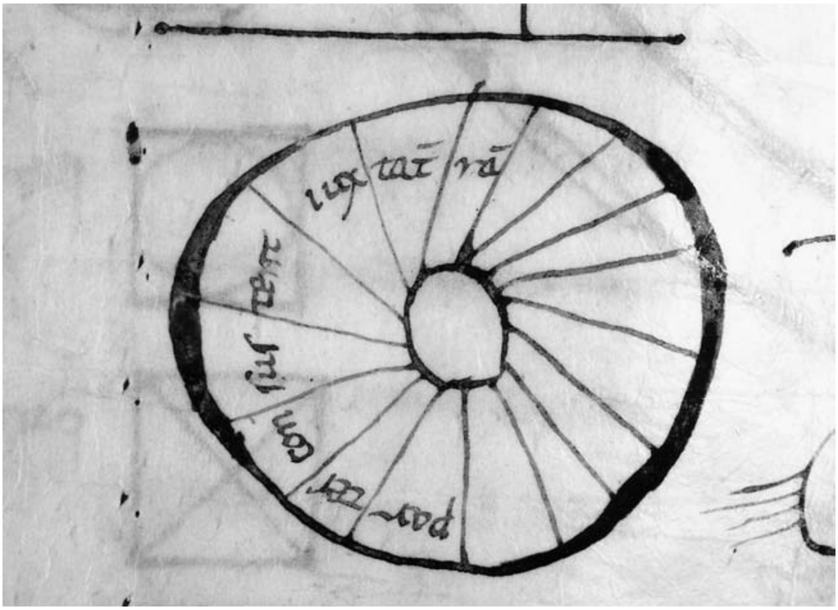

Fig. 6.13. Appendix Diagram for *Partes confustent*. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 92v

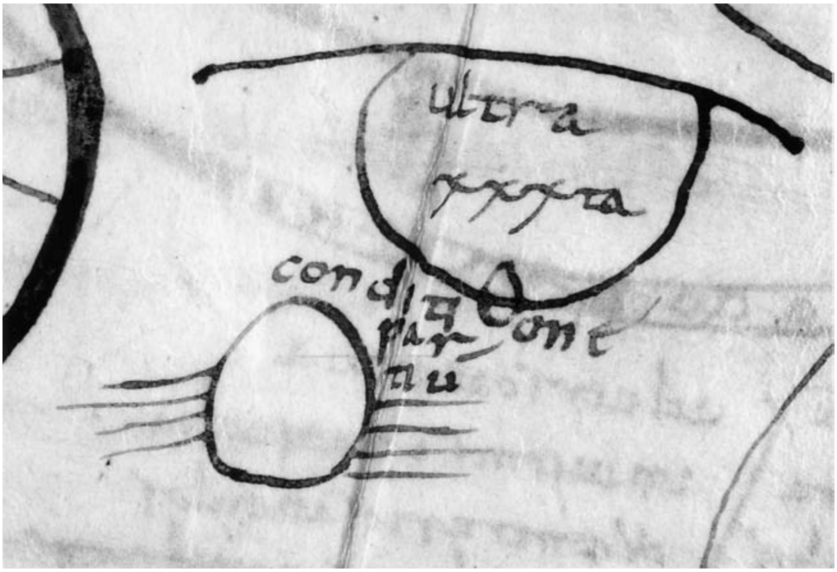

Fig. 6.14. Appendix Diagram for *Condicione partium*. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 92v

each of the two planets was implied by this diagram as well—in effect a reminder to seek and memorize the numerical value(s) rather than simply to notice the appearance of the planet(s).

The fourth of these new diagrams in the appendix (Figure 6.15), the *Aries—Libra* (VIII, 872), referred not only to a text of Capella but also to a distinctive doctrine made familiar by Bede. Although only one manuscript containing the Anonymous commentary placed this diagram in the margin next to its text,[34] and only one Carolingian scholar clarified adequately the meaning of the five lines under Aries and under Libra,[35] the omission by so many scholars seems to have been based on a common understanding. Martianus had pointed out,

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[34] Leiden BPL 87, f. 126v.

[35] John, *Annotationes*, p. 168.30–32 (VIII, 808, *ad* Phoebos cursus): "C vero LXXX circulos habet, id est dimidia pars trecentarum LX partium. Nam due partes signiferi unum circulum faciunt. Verbi gratia, quarta pars Arietis in aequinoctio vernali oritur in eodem loco ubi quarta pars Librae oritur in aequinoctio autumnali post sex menses." No manuscript of the Anonymous commentary offered any such explication of the diagram; Remigius of Auxerre made use of John's example but with a straightforward simple reference to the first three degrees of Aries, ignoring John's precise reference to four degrees of Aries; see Remigius, *Commentum*, vol. 2, p. 286.9–17 (VIII, 872).

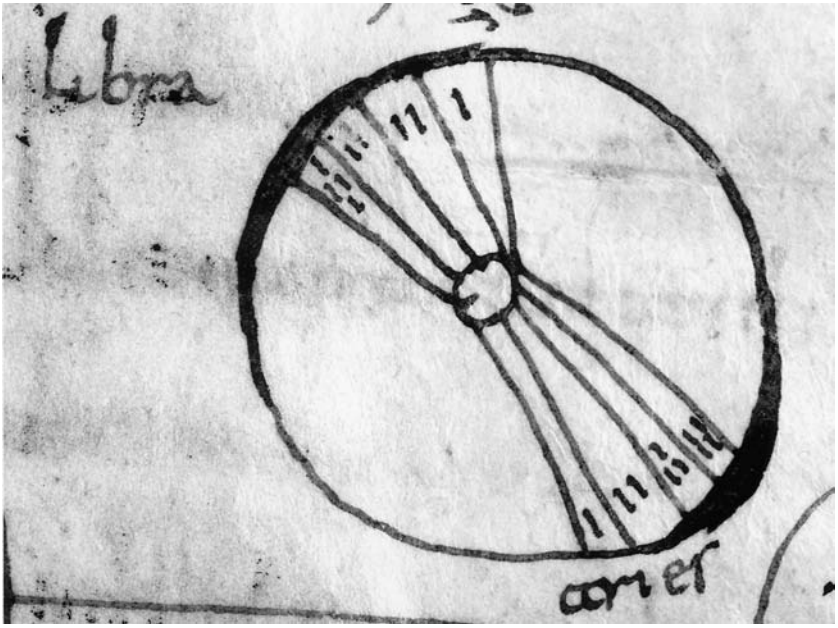

Fig. 6.15. Appendix Diagram for *Aries-Libra*. Leiden, Universiteitsbibliotheek, Special Collections, ms. Voss. lat. F.48, f. 92v

viz., that as the Sun circled the zodiac through the year it crossed one great circle daily; each of these great circles cut the zodiac twice at points exactly 180° apart, and the first great circle mentioned by Capella cut the first degree of Aries and of Libra. The Carolingian diagram for this text was based on Bede's DTR 6, where Bede wrote that at the Creation the Sun first rose on the fourth day in the fourth degree of Aries, and this was equinox.[36] The *Aries—Libra* diagram thus brought into the Capellan text a distinctive Christian debate and an authoritative position in the debate to remind students of the religious significance of the vernal equinox and of the need for careful calculation (or regulation) of the date for this astronomical event, on which in turn the Easter date is based.

The precision of diagrams for Capellan astronomy was at times spatial, as in the *partes confustent* diagram, and at times numerical, as in

[36] Bede, DTR 6 (ed. Jones, p. 291.16–24); see Wallis, *Bede: Reckoning*, pp. 273–4, pointing out the relevant computistical debate over the equinox, which, Bede claimed, could be no earlier than the fourth day of Creation, and this was at Aries 4°.

the *Aries*—*Libra* diagram, but the precision of astronomical diagrams in Calcidius's *Commentarius* had a different character than did the Capellan diagrams. Previously we have tried to make some distinctions between arithmetical and geometrical doctrines in astronomy, but these have been variable and not categorically distinct differences. When we turn to certain—not all—of Calcidius's astronomical diagrams, we find geometrical drawings that are wholly new to the Carolingians, most especially the diagram explaining the lengths of the seasons and the diagram explaining the retrograde motion of Venus. One way to characterize these images is to label them visual geometry in contrast to tactile-metrical geometry.[37] As an example of tactile geometry we can take the Plinian design for planetary apsides. In this image each planetary circle is a unit unto itself within the zodiacal circle. We observe the intended doctrine, that planet *q* has its apogee under sign *t*, as if we had placed the planetary circle as a determinate object in position by hand with the center of the planetary circle between the zodiacal sign concerned and the center of the zodiacal circle. The space of each of these objects has its own absolute and invariant properties, and there is no notion of relative eccentricity of the planetary circles in this diagram. Most certainly, there is no sense of viewing one of these planetary circles in terms of another. We simply observe absolute objects—positions, lengths, radial arcs.

An example of visual geometry is the Calcidian diagram explaining the different lengths of the four seasons (Figure 5.3). Here the topic is not a point on one or another circle as such but the appearance of a sequence of points on one circle tracked through the circumference of a second circle eccentric to the first. This appearance is a relationship that is seen between points on two circles. The framework created by one circle, the Sun's orbit, is not the same spatial framework as that of the zodiacal circle; they have different centers and different metrics. The appearance of changing speeds, or times, can not be located on either circle alone; it depends on our eyesight, not on our placement or measurement of a circle. The sort of precision required for the diagram of the four seasons involved much more detailed instruction, and, if our surviving evidence is any guide, a scribe who did not already understand this sort of geometry was almost certain to fail in

[37] Here I adapt the vocabulary of Ivins, *Art and Geometry*, pp. 1–6, et passim. Ivins contrasted Greek (tactile) and Renaissance (perspective) geometry.

the task of producing a correct diagram for the Calcidian explanation of the phenomenon. The precision of this diagram has thus become the crucial key to understanding the explanation, but the proposition must be understood fully in order to produce the correct diagram. Here we seem to have a circular argument, but the answer comes from outside the circle. As long as Carolingian astronomy consisted only of Plinian and Capellan doctrines and diagrams, the geometry was tactile and could not comprehend a Calcidian account of the four seasons. The precision needed to understand the lengths of the seasons as a problem of relative motion and to understand the relationships of the parts was a visual rather than a tactile-metrical precision. This new geometrical understanding seems to have occurred as an 'aha!' insight after a great amount of diagrammatic experimentation. Carolingians had no difficulty recognizing and describing the facts of the matter, i.e., the different numbers of days in each of the four seasons, but this descriptive approach was for some time the limit of their diagrams. To explain the cause, which was a visual phenomenon, required a new kind of geometrical understanding. With the advent of certain Calcidian astronomical diagrams the Carolingian scholar had to learn how to deal with visual, or optical, precision of diagrams in addition to the metrical precision with which he was already familiar. We speak of precision in diagrams, but I know of no Carolingian scholar who spoke of precision. The relevant concern for Carolingian readers, students, and commentators of astronomy was a concern for truth. Diagrams were often capable of bringing greater truth than words in astronomy, for diagrams were seen to provide a clearer path to understanding the order of the heavenly spheres and the part of God's plan embodied in the motions of the stars.

5. *Computistical, Cosmological, and Astronomical Diagrams*

Diagrams exist in profusion for computistical as much as for cosmological and for astronomical texts. Any attempt to distinguish three structural types of diagram for these three categories of material is doomed to fail. Even the texts, which often appear to focus on different, characteristic topics and questions for each of the three, may combine materials from two or all three. Nonetheless we can identify in any diagram the computistical, the cosmological, and the astronomical elements. And we can find diagrams that are solely computistical, even though we can not distinguish uniquely computistical elements in the structure of a diagram. A computistical diagram is a tool for collecting and organizing in sequence data allowing the computation of solar, lunar, monthly, annual, and other temporal intervals in order to identify multiple lengths and points of intersection of any of these intervals. The sequential arrangement in diagrams for computus appears virtually always in circular form, especially appropriate for the recurrent cycles of time, and perhaps the most suitable way to gather and structure temporal information for memory and use.[38] An example is a north French diagram for finding the times taken by the Sun and the Moon to travel through each zodiacal sign, thus identifying the concordance of their motions through the year (Figure 6.16).[39] There are so many other kinds of computistical diagram that I shall simply refer to one small collection, readily accessible, including as well cosmological and astronomical diagrams, reproduced from a manuscript made in the Cologne cathedral scriptorium ca. 800.[40] The information in such a diagram as Figure 6.16 is arranged so that it can be easily found to solve the questions that computus will ask. The diagram, therefore, is not truly necessary, but it facilitates the work of computation. We should notice that in the word-image relationship here, the word is clearly dominant and the diagram subservient. In the most famous computistical work of the early Middle Ages, Bede's DTR, diagrams do not appear in eighth-century nor in most of the ninth-century copies. However, in Carolingian manuscripts of Bede's DTR with other texts one can find a variety of computistical diagrams in these other texts. It is, in fact, in the astronomical-computistical collections of the ninth century that we see the multiplication of computistical diagrams along with the repetition and frequent elaboration of astronomical and cosmological images.

Cosmological diagrams describe the structures or theoretical relationships of the parts of the created world and are not designed as aids in solving practical questions in the way that computistical diagrams are. Celestial cosmology focuses on the realms above the earth, most

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[38] See Carruthers, *The Craft of Thought*, pp. 22–35, for structural considerations relevant to computus images.

[39] See above, p. 164, n. 138, for discussion of the ms., Laon 422. A color photograph of this diagram appears in Kühnel, *End of Time*, p. 303.

[40] See von Euw, "Die künstlerische Gestaltung," in *Science in Carolingian Times*, pp. 251–68, with 26 figures, unpaginated, appended; examples from Cologne 83(II), the figures numbered 3, 5–6, 10–13.

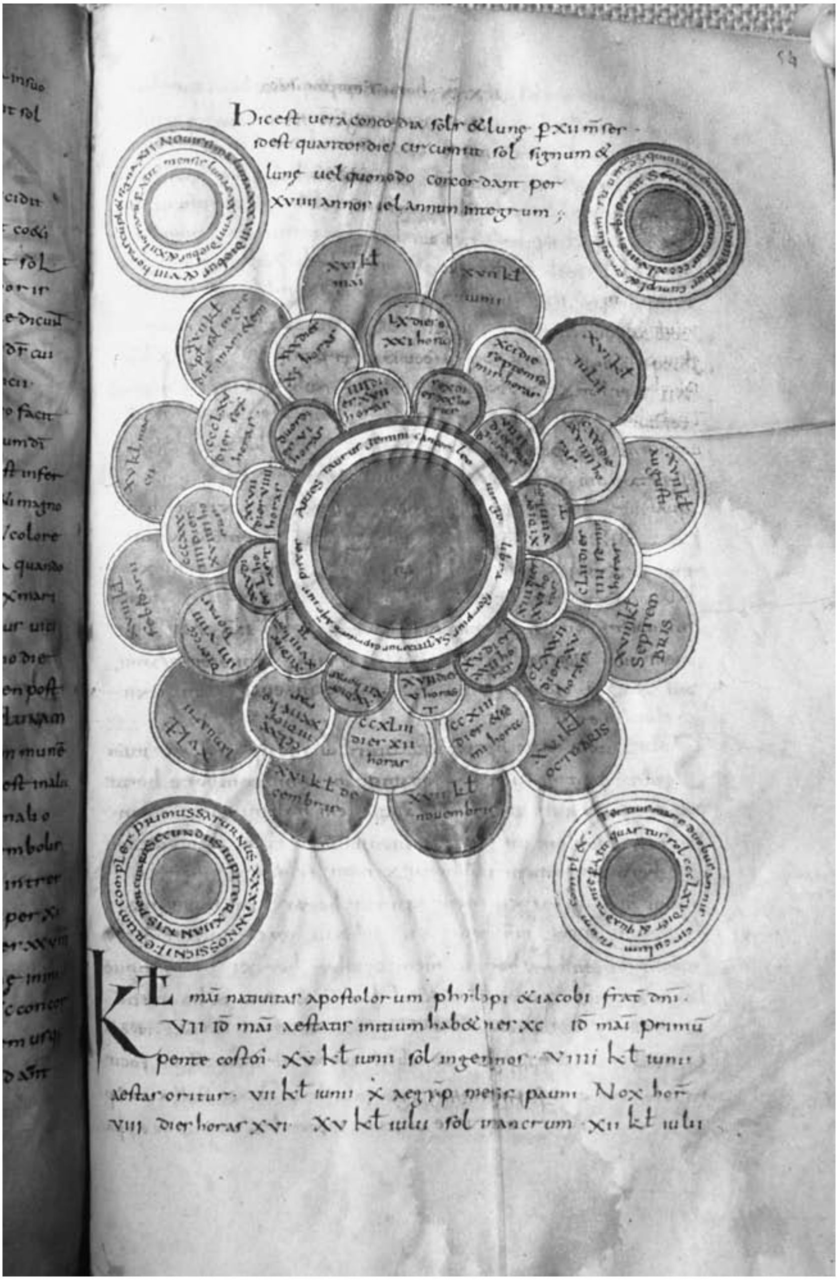

Fig. 6.16. Concordance of Solar and Lunar Motions through the Twelve Signs of the Zodiac. Laon, Bibliothèque municipale ms. 422, f. 54r

often from the Moon upwards. Terrestrial cosmology provides images for understanding the placement, properties, and relationships of the elements and other coherent entities, like the winds, below the lunar sphere. While diagrams of the heavens almost always take circular shape, terrestrial cosmology shows us arrangements in circles, squares, and other forms—sometimes bizarre (possibly degenerate) shapes. There is, for example, a diagram for the four elements and their properties that Isidore invented for his DNR, unlike any of the other, circular cosmological diagrams, which he took from earlier traditions. This "geometrical solid" of the elements—originally a pair of connected squares in perspective—posed difficulties for scribes, and copies over the next three centuries developed an amazing diversity of shape (Figure 6.17).[41] Despite its degeneration as a presentation of Isidore's design, this development, taken in its entirety (through the Carolingian era), might as readily be called the flowering of a figural tradition as the corruption of that tradition.

More common images in early medieval cosmological writings were the *rotae* (wheels/circles/cycles) for certain topics in Isidore's DNR.[42] Isidore himself drew six *rotae* from earlier, late antique traditions for this work and appears to have created only one diagram as his own contribution—the "geometrical solid" to which we have already referred. This was the only diagram of the DNR not cast in a circular form. The first and the next-to-last *rotae* are computistical; the former shows the successive monthly dates producing 30-day intervals, and the latter presents different cyclic intervals of the planets. The remaining figures show properties and relationships in the cosmic order, using simple elements of design to convey symbolic connections. These elements include the enclosing circle, intersecting circular arcs, and a radial unity, or connectedness, of substance. The outstanding example in

[41] This tradition is described by Eastwood, "Diagram of the four elements in the oldest manuscripts," pp. 547–64 (with 9 figures); for reproductions of four further examples see Gorman, "Diagrams in the Oldest Manuscripts of Isidore," pp. 529–34, with whose reconstruction of the diagram tradition for the four elements I partly agree; there are various reasons why a stemma for a text will not match the tradition of diagrams in the text.

[42] For these figures see Isidore of Seville, *Traité de la nature*. Common versions of the seven figures appear on the pages opposing the following page numbers: 190 (months), 202 (seasons), 210 (earth's bands), 212 (non-rota: solid of elements), 216 ("mundus-annus-homo"), 260 (planetary periods), 296 (winds). Fontaine, pp. 15–18, discusses the seven diagrams; on p. 17 he notes that Isidore probably invented the fourth diagram.

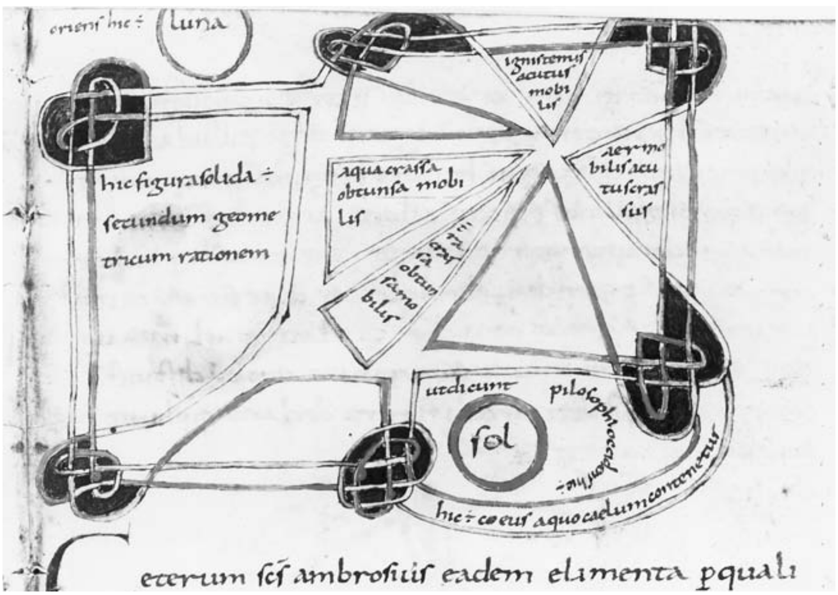

Fig. 6.17. A Divergent Example of Isidore's Diagram for the Four Elements. Munich, Bayerische Staatsbibliothek clm 396, f. 12r

DNR is the fifth diagram, Isidore's rota for the interrelationships of the four elements, the four qualities (rather than the six used earlier in DNR 11), the four seasons, and the four humors of the human body (Figure 6.18).[43]

Isidorean cosmological *rotae* were used widely in the ninth century, and adaptations or new cosmological wheels appeared as well. The form was ubiquitous. One notable example of the use of diagrams of cosmological (and astronomical) cycles is an image produced for an Aratea manuscript late in the Carolingian era. From the monastery of Saint Bertin in northern France (near Boulogne) a manuscript containing a calendar, calendrical tables, rules for establishing an ecclesiastical calendar, and an illustrated copy of Aratus's *Phaenomena* in the translation of Germanicus included also a remarkable planetary configuration accompanied by four *rotae* of Isidorean and post-Isidorean materials (Figure 6.19).[44] The large central image, as in the ninth-century manuscript from which it was copied, has drawn planetary orbits that provide the following information. First and foremost the medallions for the planets are located under the signs of the zodiac in a pattern that indicates a date of 18 March 816. As well, the image displays by means of its eccentric orbits the Plinian apsides of the planets, and there are both apsidal circles and heliocentric circles for Mercury and Venus. If we look closely at the parts of the Boulogne manuscript figure, we discover fine points that lead us to a larger characterization. Comparison of the tenth-century copy with its ninth-century original (Figure 3.12) shows that the later copyist (and the scriptorium director) had no interest in and perhaps no knowledge of the placement of the planetary discs as a means of dating the image. The copy moves the disc for Mars much

[43] Fontaine's image is at p. 216 bis with discussion at p. 17. I refer to this figure as the *mundus-annus-homo* rota because of the three thematic words at its center. It is noteworthy that no surviving ms. diagram before the ninth century includes the texts for the winter and summer humors, drawn from the *Etymologies*, that Fontaine specifies on p. 217, lines 34 and 36. The eight extant pre-ninth-century examples of this figure follow the incomplete texts shown by Fontaine in the edited diagram, p. 216 bis, or are yet more incomplete. Figure 6.18 shows a new, Carolingian version of this figure. For a helpful survey of the prior conceptual traditions and of Isidore's imagery, see d'Alverny, "L'Homme comme symbole," pp. 171–6.

[44] This full-page, folio-size illustration in the Boulogne ms. drew its large, central image directly from the famous Leiden Aratea, Leiden Voss. lat. Q.79, f. 93v (ca. 816?), for which see our Figure 3.12. Munk Olsen, *Étude des auteurs classiques latins*, vol. 1, p. 406, briefly describes the Boulogne ms. For both mss. see Bischoff et al., *Aratea Kommentar*, pp. 9–14.

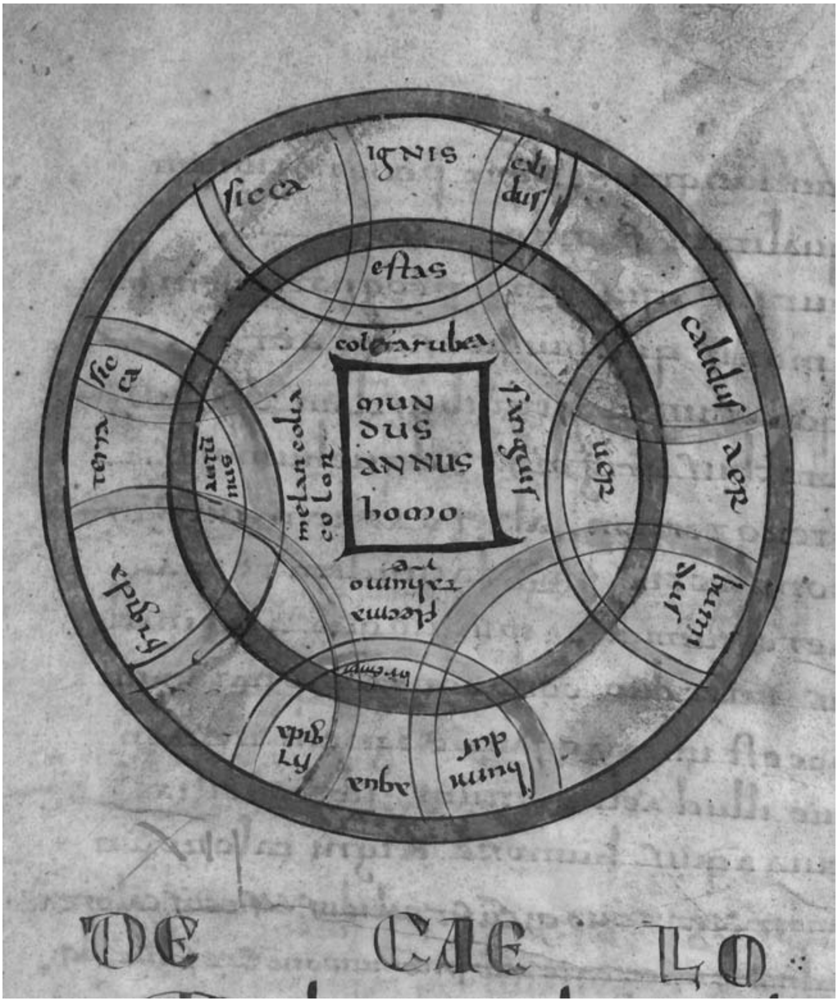

Fig. 6.18. Isidore's Rota *mundus-annus-homo* with Carolingian Elaboration. Besançon, Bibliothèque municipale ms. 184, f. 19v

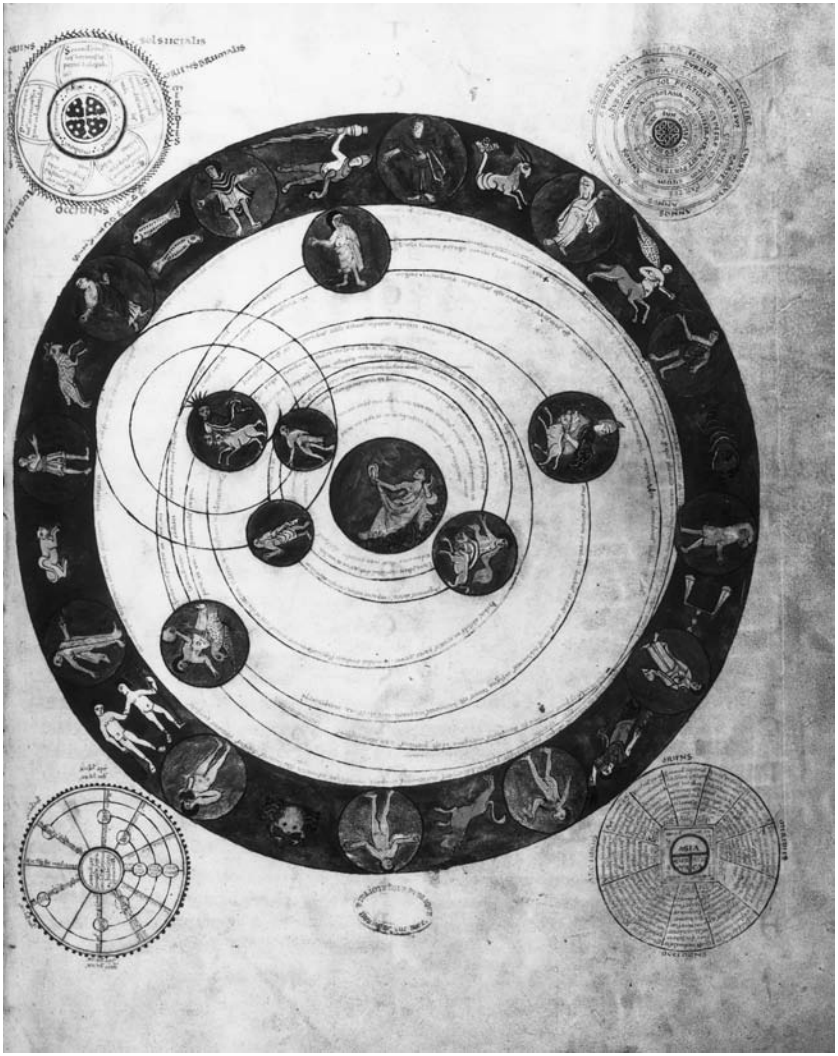

Fig. 6.19. A Five-Rota Cosmological Schema. Boulogne, Bibliothèque municipale ms. 188 (360), f. 30r

closer to the boundary between Scorpio and Sagittarius, and the Moon is not so clearly in opposition to the Sun as the ninth-century original intended. In fact, the Moon's disc has moved to the boundary line between Libra and Virgo, suggesting that the precise location of each planetary disc had no astronomical significance for the copier. Finally, the apsidal circle for Saturn has been revised, somewhat deformed to avoid cutting into the zodiacal belt, for purposes of visual neatness, thus obscuring the geometrical placement of Saturn's apogee in Scorpio and requiring a viewer to read the text written on the image to learn which of three consecutive signs holds the apogee. This need of a viewer to read the inscriptions on the figure tells us that the tenth-century copy must have been appreciated primarily as a cosmological rota rather than an astronomical design with a particular purpose.

The Boulogne manuscript figure is a combination of images, the large planetary rota in the center surrounded by four smaller wheels in the corners of the page. Bianca Kühnel refers to this combination of images as a quincunx diagram, derived from a Carolingian form of *maiestas domini*, with a central Christ and four encircled evangelists at the four corners, used in psalter and gospel illumination.[45] Certainly the familiarity of such an ordering of images could have inclined the tenth-century designer of this cosmological combination to employ it in the St. Bertin manuscript; this formal structure had appeared in the computistical image of Figure 6.16 and elsewhere. It remains for us to see whether there is a deeper significance to the similarity of forms. In Figure 6.19 the four smaller *rotae* are the following. One diametrically opposed pair presents temporal cycles. The upper right wheel, an Isidorean planetary rota, lists in its seven concentric circles a combination of annular, synodic, and calendrical numbers as the periods of the seven planets, but the rota changes some of the numbers from Isidore's and names each sphere according to the order of the planets relative to the Sun rather than simply giving the individual planetary name.[46] The lower left wheel, a Carolingian version of an *horologium* traced by Barbara Obrist back to St. Willibrord and earlier, lays out the paths

[45] Kühnel, *The End of Time*, pp. 37–41, 68–81.

[46] The periodic numbers are different for Sun, Venus, and Mercury. For four of the planets, excluding Mercury and the Moon, the planets are named "super solana suprema" (for Saturn), "super solana media" (for Jupiter), "super Solana prima" (for Mars), and "prima subsolana" (for Venus). For Isidore's rota for DNR 23, see ed. Fontaine, p. 260 bis.

of the Sun at the solstices and the equinoxes along with the lengths of daylight at each of these points.[47] In the Boulogne figure this rota errs by making the innermost arc, the winter solstice, produce eight hours of daylight and sixteen of night while the outermost arc, the summer solstice, produces twenty hours of daylight and four of night; the solstitial extremes should, of course, mirror each other. Nonetheless, we can see that the designer's intent was to set in diametrical opposition (and connection) two wheels on the page, lower left and upper right, that describe temporal intervals in terms of solar position and motion.

The other pair of opposed *rotae*, upper left and lower right on the page, are terrestrial cosmographical wheels. The upper left rota presents the Isidorean scheme of the climatic zones with interesting additions. The design uses Isidore's rota of five leaves, or petals, for the parallel zones and adds a band around the central circle with the names of the five fingers of the right hand in clockwise arrangement, with the thumb (*pollex*) at the top. Each finger name is directly inside a corresponding petal of the five-lobed rose/rota in the outer band. From thumb to little finger (*extremus*) they proceed from the *secundus circulus*, or northern temperate and habitable zone, to the *primus circulus*, or arctic zone. This set of connections of fingers and zones, unfortunately, shows either carelessness or ignorance of the purpose of this element in the picture. Isidore stated clearly the origin of the five-lobed rather than five-parallel design for the climates in DNR 10. The open right hand, with five parallel fingers, represented the five climatic parallels on the globe.[48] The fingers were then brought together with the tips touching so that the five finger tips were in a circle, and this circular sequence was laid down as the five lobes of the rota with the thumb as the uppermost parallel, that is, the arctic zone, and the little finger as the lowest parallel, or antarctic zone. In circular form the two extremes, zones one (*pollex*) and five (*extremus*), would be found next to each other. The pattern in the Boulogne manuscript figure must have been copied from another example, not designed anew, since Figure 6.19 connects the thumb with the second parallel and thus creates an incorrect finger-to-zone correspondence thereafter. At the same time,

[47] See Obrist, "Saint Willibrord's Calendar," esp. 73–81; for Obrist's article and further discussion of diagrams for the topic, see above, p. 284, n. 238.

[48] Isidore, DNR, X.1 (ed. Fontaine, p. 209): "Sed fingamus eas in in modum dexterae nostrae, ut pollex sit circulus arcticos, frigore inhabitabilis; secundus circulus therinos, temperatus habitabilis; medius. . . ." See the rota on p. 210 bis.

this rota attends in another way to the proper correspondence between the five lobes and the climatic zones by placing external labels for the four cardinal and four other terrestrial directions around the rota. We find the first, or northernmost, climatic zone labeled with an external 'septemtrionalis' and the fifth, southernmost, climatic zone labeled 'australis;' other directions are placed consistent with these two indices of the extreme, polar zones.

Finally, the lower right wheel on the page displays a version of Isidore's rota of the twelve winds (DNR 37).[49] The central zone shows a circle within a square. The circle contains a 'T,' the typical 'T-O' world map associated with manuscripts of Macrobius's *Commentary on Scipio's Dream* as well as Isidore's *Etymologies* but not the early manuscripts of Isidore's DNR. Our Boulogne illustration locates Asia at the top of the 'T' and the top of the rota, which is in turn oriented towards the external label 'ORIENS.' With 'ARCTURUS' on the left and 'MERIDIES' on the right as well as 'OCCIDENS' below, we observe a standard pattern of cardinal directions. However, the inner circle with 'T' map lies within a square that has the inscription, "mundus iiii angulos habet et tres partes divisas." While the three parts are clearly the three continents of the world map, the 'four corners of the world' offer some latitude for interpretation. Is the number 'four' simply a reference to the four sides of the square, around which the twelve winds are arranged? Could the four elements be implied here? Might the 'four corners' in conjunction with the winds even signify the threatened apocalyptic destruction in Revelation 7.1: "I saw four angels standing at the four corners of the earth, holding back the four winds of the earth, that no wind might blow on earth or sea or against any tree."? Given the (late?) tenth-century construction of the Boulogne manuscript illumination, the last of these possible interpretations is not unlikely. In any case, the winds themselves are arranged not only cosmographically but also temporally, for each trio of winds is based on one side of the square and contains the names of three consecutive months along its side of the square. The trio for the East is the cardinal wind, *Subsolanus*, plus *Vulturnus* and *Eurus* seen by us on its left and right sides respectively.[50] Inscribed at the bases of these wind

[49] Isidore, DNR, XXXVII.1–4 (ed. Fontaine, pp. 295–7); rota at p. 296 bis. Obrist, "Wind Diagrams," provides extensive discussion of the ancient and medieval traditions. For further elaboration related to Pliny, see above, pp. 158–69.

[50] Both Isidore and his source, Pliny, described the relative positions of the two

segments are the months of summer: July, August, September. Similarly the next wind trio clockwise is, in circular order, *Euroauster, Nothus*, and *Euronothus*, the southern winds, associated with the autumn months: October, November, December. Next we find the winter months of January, February, March at the base of the west winds *Africus, Fabonius, Chorus*. Last come the spring months of April, May, June at the base of the north winds *Circius, Septentrio, Aquilo*.[51]

When we put all these *rotae* together conceptually we have five circles, arranged at least formally as a quincunx, with a large central image of both the heavens and the earth, one diagonal pair of *rotae* presenting temporal periods in solar terms, and the other diagonal pair of *rotae* describing the ordering of things on the earth. These two pairs of lesser *rotae* can also be called the orders of the heavens above and the earth below. Furthermore, the two terrestrial *rotae* notably contain in their centers (1) a cross, presumably a Christian cross of salvation, on the image of the habitable zones of the earth, and (2) a cosmographic 'T-O' within a square, the four corners of the earth encased by the four cardinal winds with their subordinates (suggesting an apocalyptic threat). This latter pair of *rotae* would seem to offer, if not an overwhelming, at least a thought-provoking reflection in the later tenth century of the possible end of time. One thing is quite certain in the Boulogne figure. The overall combination of circular images is meant to be a complex cosmological presentation of the ordering forms and forces of the world. Beyond this, the images would appear to present religious symbols of coherence (the Cross) and dissolution (the winds at the four corners of the world). On this Boulogne manuscript page we have the most elaborate form of cosmological schema, going beyond any image that we would name a 'diagram.'[52]

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subordinate winds as *Vulturnus* on the right and *Eurus* on the left, and that description is preserved in this and other wind diagrams. The description is based on observing the positions of the winds inside a very large wind rota with the observer standing outside the circle and looking towards the center.

[51] Except for the names of the months at the ends of each wind segment, the texts for the twelve winds in the Boulogne rota are virtually identical to the wind texts for the wind rota in the computistical ms., Berlin Phillipps 1830 (Rose 129), f. 3v. However, folio 3 may well have been added much later to this late ninth-century ms., because f. 3r has a large rota with the twelve signs and individual stars within the signs given Arabic names. Perhaps this rota was added to the page subsequent to its inclusion in the codex? In any case, there is a definite relationship between the wind rota texts, and the Berlin texts have the better readings.

[52] In addition to Kühnel's work, *The End of Time*, a useful discussion of eschatological

Following our descriptions and examples of computistical and cosmological diagrams (and schemata), we turn to the topic of astronomical diagrams in order to set out their distinguishing characteristics. Computistical and astronomical diagrams both offer information for answering practical questions, such as the date for a specific feast day in a particular year or a particular date on which the planets fall under a given set of signs in the zodiac. A distinctive difference between the two categories of diagram is the use to which the structure of the diagram itself can be put. As we have already seen, a diagram for computus uses its linear form to contain and present sequentially the information for solving problems. The wheel pattern that is almost ubiquitous in computus is an ordering, and thereby a memory, device. The astronomical diagrams we have studied include the many diagrams invented for the Anonymous commentary to Martianus Capella, the Carolingian inventions to accompany four astronomical excerpts from Pliny, and Calcidian diagrams for retrograde motion and for the seasons of the year. These three Roman texts were educational, and their diagrams were used to demonstrate positions and motions of the planets for all manner of observed phenomena. Because the diagrams were not constructed with quantitative precision, they were, somewhat ironically, less practical than computus diagrams, for the Capellan, Plinian, and Calcidian astronomical diagrams did not, as far as we have found, produce geometrical problems leading to quantitatively precise answers. The geometry of Carolingian astronomical diagrams was qualitative and produced quantitative answers only in rare instances as in the date 18 March 816 (of unknown significance) incorporated in the planetary configuration in the Leiden Aratea manuscript (Voss. lat. Q.79, f. 93v). In this last example, quantitative precision was not needed; placement of planetary discs anywhere within an arc subtending a specified sign was sufficient. Nonetheless the qualitative astronomical diagrams of Carolingian courts and schools represented directly, visually, in linear rather than verbal forms, certain attributes of celestial (usually planetary) motions.

In a Plinian diagram such as the apsidal diagram, not only the far and near points but also the gradual, regular approach of the planet

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themes prior to and during the Carolingian era appears in Landes, "Lest the Millenium be Fulfilled."

to these points and the regularly changing speed of the planet along a circular path appeared as part of the linear structure of the diagram. The absence of a Plinian geometry for retrograde motion was subsequently resolved—it required many steps over many decades—by the planetary epicycle described by Calcidius (Figure 5.1) and already acknowledged and described in the Paris Compend of the mid-ninth century. Here again the geometrical diagram was absolutely essential to convey a reasoned understanding of the regular motion of a planet as it proceeded through retrograde motion. If the accompanying verbal text was also necessary, it was not sufficient for teaching students how individual uniform motions could combine to produce observed non-uniform motion. Similarly, many, though not all, of the Capellan diagrams succeeded in sketching ways to understand planetary motions in terms of regular linear patterns such as the diagrams for circumsolar inner planets and for the changing lengths of daylight through the year. In all these cases the geometry of the diagrams was fundamental to the explanations of the phenomena. Without the geometry there would be no explanation, no orderly pattern of motion, in which to frame the phenomena. Here we see the basic difference between computistical and astronomical diagrams.

If astronomical diagrams present images of geometrical order and regularity, how do astronomical and cosmological diagrams differ? Surely the cosmological diagrams we find in Macrobius's *Commentary on Scipio's Dream*, such as those illustrating the correspondence of celestial and terrestrial zones, are geometrical and show the order and regularity of nature. But as said above, while both astronomical and cosmological diagrams describe the regular order of nature, astronomical diagrams go beyond description by explaining how a goal or a motion comes about through the form of the diagram. Our final example of an astronomical diagram in the Carolingian era has been the Calcidian design to explain the different lengths of the four seasons of the year. Even when limited to a qualitative rather than a quantitative account, the manuscript diagram, reworked to show an adequate presentation of Calcidius's original diagram, was explanatory and not simply descriptive, for it demonstrated the production of apparently varying motion by a uniform motion when this invariant motion was an eccentric motion viewed against a circular framework with a different center. In this diagram the geometry explained why variation occurred when the only moving body in the diagram, the Sun, moved without variation. Of the different kinds of diagram used in astronomical texts, only astronomical diagrams provided explanations; other kinds provided descriptive structure and information for calculating time intervals.

6. *Word and Image: the Case for Diagrams*

It has been traditional and become conventional to assume that the images we talk about in the medieval word-image contrast are pictorial or symbolical, usually religious. A recent conference on "verbal and pictorial imaging" exemplifies this with its table of contents presenting seventeen essays that conform to such a characterization; there is only one that focuses on diagrams—in fact, Carolingian computistical and cosmological diagrams.[53] It is to Bianca Kühnel's credit that she has taken diagrams as a serious topic of study in the continuing word—image dialogue. At the same time we need to correct a familiar constant in this dialogue, that is, the assumption that word and image commonly stand in opposition. When modern scholars, especially those studying painted images (as in Gospel books), have found and admitted a mixture of words and image, their response has tended to be one of disappointment in the presence of the mixed medium of image and text.[54] Such a purity is non-existent in medieval diagrams and not a standard for other images.

Of all the diagrams described in this book, there is virtually none without words. The computistical diagrams are in general the most replete with text, since these images were designed to focus upon and to order in different ways the important names and numbers used in the practice of computus. In computistical images the words gave the truth; the diagram facilitated memory. Cosmological diagrams invoke a spare vocabulary, often more symbolical, and occasionally seem to hold no more than individual letters of the alphabet as labels for parts. In the extreme situation, as with Macrobius's rainfall diagram (Figure 6.1), we have discovered that the diagram is meaningless without the accompanying text and that the text is quite imprecise and unsatisfying

[53] Kühnel, "Carolingian Diagrams, Images of the Invisible."

[54] I take this point from Mitchell, *Picture Theory*, pp. 96–7; see also p. 100. Mitchell's account of the purist's ideology of a higher aesthetic in pictures and contamination through the addition of words is the modernist's view and requires a complete reformulation in order to deal with early medieval, especially Carolingian, images.

without the diagram; we can hardly conclude that either text or image in the Macrobian account of rainfall is independent or could ever be so. Most Carolingian cosmological designs show the sorts of mixture we have seen in Figures 6.18 and 6.19. Such diagrams and schemata stand on their own in so far as they require a significant amount of preparatory instruction to be understood and as they do not depend upon any precise or particular texts for their meanings. Similarly, astronomical diagrams will at times embed text extensively, as in the Plinian apsidal diagram (Figure 6.10), where zodiacal signs and planetary circles are labeled, but at other times, as in the Calcidian generic epicycle (Figure 6.6), will include in the diagram no more than alphabetical letters, explained by the accompanying text.

Kühnel's approach to Carolingian scientific diagrams builds upon her selection of many computistical, cosmological, and astronomical images in which a cross, understood reasonably as the Christian cross, appears and, according to her interpretations of various examples, orients and controls the basic meaning of each of the images.[55] I make no attempt here to criticize Kühnel's argument. Indeed, her interpretations of individual diagrams are largely persuasive, and my discussions above of Figures 6.11 and 6.19 take a similar approach. We only need to remember that, when lacking such obvious symbols as the cross, Carolingian astronomical and cosmological diagrams most often had distinctly technical and/or classical goals. The products of individual designers and copyists have been shown throughout this book to be diverse in goal, in understanding, and in competence of execution. Time, place, and purpose had significance in the content and meaning of diagrams, and we can not impose universal judgments on the Carolingian diagrammatic enterprise.

[55] Kühnel, "Carolingian Diagrams," p. 375, gives the following summary statement after analyzing different images in the light of biblical and theological texts. "As we have seen, medieval diagrams never attempted to make faithful copies of ancient sources but were rather intent on improving, correcting, and modifying them, with one aspiration in mind: to transcend classical culture and to maintain, disseminate, and purify the Christian religion, as the work of salvation in all its aspects. This was an approach shared by science and exegesis, which obliges us to evaluate medieval diagrams—as any other motif, iconographical or stylistic—according to their makers' own aims and measures, and not according to classical categories." A reader may want to know that the reference to copying classical sources or diagrams is an explicit disagreement (see Kühnel, pp. 360–1) with the thesis behind Barbara Obrist's extensive explorations into classical backgrounds for medieval scientific diagrams.

What we do know rather securely and have mentioned often is the pedagogical intent of almost all the diagrams associated with the Roman astronomical and cosmological texts studied in the ninth century. The proposal to teach unlettered Christians via religious images in the early Middle Ages has a long history, but that history has not been interrogated by moderns with regard to non-religious imagery and diagrams. The famous position in two letters ca. 600 of Pope Gregory I (590–604) to the bishop of Marseilles offers many points for consideration.

> Pictures are used in churches so that those who are ignorant of letters may at least read by seeing on the walls what they cannot read in books (*codicibus*).
>
> What writing (*scriptura*) does for the literate, a picture does for the illiterate looking at it, because the ignorant see in it what they ought to do; those who do not know letters read in it. Thus, especially for the nations (*gentibus*), a picture takes the place of reading. . . . Therefore you ought not to have broken that which was placed in the church in order not to be adored but solely in order to instruct the minds of the ignorant.[56]

These statements by Pope Gregory, explicitly limited to the realm of religious instruction, set the purpose of images in parallel to that of the written word, given two different audiences. The literate have scripture to read; the illiterate have a picture to read. We do not find that images offer teaching equivalent to words, nor are we told that images are useful to instruct non-readers on all religious topics. Where Gregory writes, "a picture takes the place of reading," it seems that he must have assumed, as we would also, that the prior knowledge needed for reading the picture was available to illiterate viewers. Such prior knowledge would certainly have included oral instruction by way of sermons and other means. And the reading itself may well have involved a social framework—group reading, questions and answers, interaction with a literate and knowledgeable interpreter, a sequence of increasingly penetrating readings and interactions over time. One point remains clear in Gregory's statements. The written word of Scripture is superior to religious pictures, or religious imagery.

If we now bring our focus more sharply, first, to Carolingian views of Pope Gregory's theme and, second, to the possible application of these views to non-religious imagery, we shall have a more nuanced

[56] Translation with references in Duggan, "Was Art Really the 'Book of the Illiterate'?," at p. 63.

appreciation of the Carolingian development of scientific, especially astronomical, diagrams. First, with regard to the Carolingian appraisal of the Gregorian theme, we find more than one response. Although not the most characteristic view, perhaps the best known to modern scholars is the so-called *Libri Carolini*, a tract under the king's name, written for Charles by Theodulf ca. 792, against the Eastern Church and its claims made for religious images at the Second Nicene Council in 787.[57] For our purposes we need only recognize that the king wished to condemn the Greek view as he understood it, to wit, that images of holy persons such as the mother of God are worthy of adoration. With this as his stimulus, Theodulf produced a series of arguments against the equivalence of sacred Scripture and images intended to represent the narrative of the bible. He avoided the vocabulary of Pope Gregory the Great to the effect that religious pictures are appropriate for teaching the unlettered just as the Holy Writ teaches those who can read. The Libri Carolini always described the proper uses of religious images as the decoration of churches and the commemoration of deeds, never as the teaching of the illiterate.

Two points connect the discussions of religious images by Gregory I and Theodulf with our discussion of astronomical and cosmological diagrams. The first point is teaching; the second is truth. Are diagrams either necessary or appropriate for teaching the words of a text? Can diagrams represent truthfully the words of a text? Given the differences in subject matter in the two sorts of text involved, we can see how different will be the answers about teaching the truth of the Scripture to illiterates from the answers about teaching the truths of an astronomical text to new (but literate) students. The basic issues are, in fact, tremendously different. Nonetheless, we include the subject of religious imagery and the teaching of Scripture, because this is the primary framework recognized in modern studies of representational art in the Carolingian world. With astronomical diagrams we do not have an audience of true illiterates, although we do find that the Carolingian audience for such diagrams was in need of instruction and that the instruction provided had different ultimate goals than we would expect in a modern schoolroom. Likewise with astronomical diagrams we find a very different relationship between image and text than existed

[57] For the position of Charlemagne, and of Theodulf as his spokesman, see Freeman, "Scripture and Images in the Libri Carolini," pp. 163–95 (including discussion).

for Carolingian religious images. Carolingian astronomical images at times contained greater, that is, more precise, truth than the related astronomical texts, and the images were always treated as helpful, often as necessary, never as misleading or dangerous.

A further connection between the apparently distinct topics of teaching by religious images and teaching with astronomical diagrams emerges in the Carolingian concern for moral reform and the use of the liberal arts as one tool in this process.[58] Someone who sees an image of Jesus lifting up a beggar is likely to experience an affective change or insight. The image supplements with deeper insight the words of Scripture describing the event, and, when the image creates an affective, or moral, response, it enlarges the person's understanding of the text of Scripture. Pope Hadrian I (d. 795) emphasized in a letter to the Frankish king the importance of affective responses by devout Christians to images.[59]

The concern for textual understanding—correct and full understanding—was a major goal of the Carolingian reform program from Charlemagne's *Admonitio generalis* onward. Alcuin and many other scholars and teachers sought to employ the knowledge of the liberal arts as a foundation for correct and full understanding of the word of God. In pursuit of understanding in the art of astronomy, teachers realized more and more over the course of the ninth century that images—diagrams—could instill precise understanding efficiently, since the subject matter required clear perception of point positions, linear motions, and spatial models of the stellar sphere and planetary orbits. In astronomy an effective diagram—there were, of course, defective diagrams as well—not only repeated a text; it explained and clarified its text. It could even redefine the text. We have seen this in our studies of Macrobius, Pliny, Capella, and Calcidius. The manipulation of Macrobius's diagram for planetary order made a significant revision in the Carolingian understanding of the text. The invention of diagrams for Plinian planetary doctrines helped give the texts wide currency and at times replaced the textual excerpts completely. Martianus Capella's

[58] An essay that points to questions relevant to our topic but does not enter the realm of the liberal arts beyond grammar, rhetoric, and dialectic is that of Appleby, "Instruction and Inspiration through Images," pp. 85–95. Ultimately Appleby sees the Libri Carolini as an index of the outlook held by most of the Carolingian reformers.

[59] More detailed discussion of Hadrian's letter appears in ibid., pp. 88–91.

text posed difficulties that astronomical diagrams either answered or clarified; these diagrams established a program of inquiry for readers. And with the diagrams in Calcidius's *Commentary* ninth-century scholars encountered for the first time a geometrical rationalization of all planetary motions in the heavens, making diagrams the foundation for understanding the text adequately.

The diagram was a learning device for students and a memory device for the teacher. And diagrams were not only objects of teaching; they were active instruments for teaching well. It was possible to ask a student to construct a diagram for a text lacking a figure and to use the diagram under construction as a medium for testing the student's understanding of the text. An incorrect diagram could become a tool for assessing (and correcting) a student's knowledge. The abacus and the wax tablet remained at hand for attempts to imitate, modify, correct, and invent diagrams. Without diagrams, many astronomical texts were incomplete and could only be explained by those who knew or could create appropriate diagrams. Through teaching, the criticism and invention as well as the copying and correction of astronomical diagrams became essential and fundamental parts of the Carolingian revival and study of Roman astronomy and cosmology. In astronomy the diagram could often show a higher truth than words alone.

APPENDIX
CONTENT OF THE PARAGRAPHS OF CALCIDIUS'S *COMMENTARIUS* ON ASTRONOMY AND COSMOLOGY

Calcidius created in sixty three paragraphs (cc. 56–118) a succinct although not complete treatise on astronomy. Its incompleteness was simply the result of his goal to fit Plato's *Timaeus* to late Hellenistic astronomy rather than to write a thorough introduction to astronomy for students. Calcidius divided his material into two parts, the first on the fixed stars and the planets (cc. 56–97) and the second part on the heavens and on time (cc. 98–118), which was directed largely against the Stoics. Some of the paragraphs are quite routine. Others reveal the fundamental agenda of their author.

I. The fixed stars and the planets.

56. The Soul is the source of the circular motion of the cosmos. Quotation of text of *Timaeus* 37A,2–C,5.
57. Appeal to and quotation of *Phaedrus* 245C–246A.
58. Text of *Timaeus* 36B,6–D,7.

(i) *59–64*. Centrality and sphericity of the earth.

59. Earth is at the center of the celestial sphere.
60. Earth is a sphere as shown by lunar eclipses.
61. Heavy bodies tending towards the center form a sphere.
62. The sea and all liquids tend to form a spherical surface.
63. Despite mountains and surface roughness the earth is spherical, as reason rather than the senses shows.
64. The uniformity of assumption for sundials at different positions on the earth shows the centrality of the earth in the cosmos.

(ii) *65–68*. Definitions of the circles in the heavens.

65. North and south poles, polar circles, and the equator.
66. Two tropics, the zodiac with seven planets, the horizon, and the meridian circle.

67. Changing positions of appearances of certain circles according the observer's location: meridian, horizon, and polar circles.
68. Difference between the band of the zodiac and other celestial circles, with only its central circle being a great circle.

(iii) *69–71.* General description of planetary and stellar motions.

69. Single motion of the fixed stars, three motions for the planets, variation in size and speed of the planets in relation to distance from the earth.
70. Planetary latitudes and orbital periods, the bounded elongation of Mercury and Venus with respect to the Sun.
71. Different meanings of rising and setting, the risings and settings of planets and stars.

(iv) *72–73.* Planetary orders.

72. Pythagoreans: Moon-Mercury-Venus-Sun-Mars-Jupiter-Saturn. The significance of the Sun's middle position.
73. Orders of the planets according to Eratosthenes, the *mathematici*, and Plato.

(v) *74–77.* Diverse motions of the planets, their real nature and their relationship to changes on earth.

74. Stations and retrograde motions among the planets are appearances only.
75. Divine Providence guides the cosmos in uniform spherical motion. The purposes of different planetary motions.
76. Change below the lunar sphere comes accidentally, from the attempt of lower things to imitate divine happiness.
77. The planets move in well-ordered patterns.

(vi) *78–86.* The use of eccentrics and epicycles to explain the observed solar motions and the phenomena of the other planets as well. These circles do not carry the planetary bodies.

78. Seen against the zodiac the Sun traverses four equal quadrants in four unequal times.
79. The inequality in observed solar motion comes from making the earth the center of the solar circle, contrary to reality.

80. The Sun moves uniformly on its circle, within which the earth is eccentric.
81. This solar motion can be equally well represented by a uniform epicyclic motion, in which the rotation of the epicycle is contrary to that of the deferent.
82. Such an epicyclic motion recreates the diverse phenomena of solar motion.
83. The techniques used to explain solar motion will explain all elements of the motions of the other planets, viz., all their variations.
84. The hypothesis of eccentrics and epicycles, which are immaterial circles, fails to explain the natural motion of corporeal bodies. Spheres of a fifth element in every planetary realm (*caelum*) explain the various observed motions.
85. How the motion on an epicycle, when seen projected against the zodiac, produces the forward motions, stations, and retrogradations.
86. Philosophers and *mathematici* disagree, referring on the one hand to natural motions and on the other hand to phenomena. Contrary to the philosophers, the *mathematici* can make the epicycle rotate against the motion of the cosmos. The phenomena can be produced with either sense of epicyclic motion.

(vii) *87–91.* Conjunctions and eclipses.

87. Conjunctions and eclipses of moon, sun, other planets, and stars.
88. Solar and lunar latitudes, conditions for a solar eclipse.
89. Conditions for a lunar eclipse.
90. The shadows of bodies that are the same, larger, or smaller than the light source.
91. The relative sizes of the earth, moon, and sun according to Hipparchus. How the moon may either pass through the earth's shadow or evade it.

(viii) *92–97.* The motions and the spacings of the stars and the planets are subject to the motions of the Same and the Different in the World Soul of the *Timaeus*.

92. Text of *Timaeus* 36B,5–C,2. Being, Same, and Different in the Soul; numerical sequences and ratios in the Soul;

the equator, the ecliptic, and the motions of the stars and planets.

93. Text of *Timaeus* 36C,4–7. Motions of the Same and Different. The cosmos is a living intelligent being.
94. Text of *Timaeus* 36C,7–D,2. The single motion of the stars is given to the Same. The diverse motions and natures of the planets are given to the sphere of the Different.
95. Text of *Timaeus* 36D,2–3. The Different is partitioned according to musical intervals to achieve the spacing of the seven planets.
96. The planetary harmonic intervals, derived from the constitution of the Soul.
97. The contrary direction of the motion of the planetary circles, the risings and settings of planets, the bounded elongations of Mercury and Venus. Text of *Timaeus* 36D,5–6. Yet all planetary movements are reasoned.

II. The heavens (*caelum*) and time.

(i) *98–101.* The infusion of the cosmos by the Soul.

98. Text of *Timaeus* 36D,8–E,5. The different meanings of the word "heavens."
99. The infusion of the cosmos by the Soul from the middle towards both extremes.
100. The Soul extends not form the earth, the corporeal middle, but from the sun, the vital middle.
101. The Soul turns mentally, not bodily, and is prior to time.

(ii) *102–107.* The existence and knowability of rational natures and of bodies.

102. Text of *Timaeus* 36E,5–37A,2. A body exists only when perceptible to the senses. A rational nature without a body can be described. From the same, the Different, and individual substance all manner of created things are conceptually conceived.
103. Text of *Timaeus* 37A,2–B,3. All things are known by the Soul to be of the Same, the Different, becoming, or being. Text of *Timaeus* 37B,3–C,3.
104. True opinions are produced in the mind by heavenly bodies which rise and set and are sensed to move

directly, or truly (*recte*). True knowledge, of a divine character, is produced by motion like that of the sphere of the fixed stars.

105. Relationship of intelligible and sensate worlds.
106. Text of *Timaeus* 37D,4–38E,1. The character of temporality.
107. The "non-existence" of matter (*silva*) and the imperfection of material things (*silvestria*).

(iii) *108–118.* Time and planetary phenomena. The observed motions of the sun, moon, and other planets are diverse but reasoned and well-ordered.

108. The birth of time is necessarily established through intervals in space, i.e., the visible phenomena of the moon, the sun, and the planets. Text of *Timaeus* 38D,1–6. Mercury and Venus travel with the sun.
109. Two explanations for the oscillation of Mercury and Venus with respect to the sun.
110. The bounded elongation of Venus and its appearances as an evening and a morning star.
111. Description of a diagram to define the bounded elongation of Venus and its appearances as an evening and a morning star.
112. The epicyclical interpretation of the motion of the motion of Venus with respect to the sun and the division of Venus's epicycle into parts with precise numbers of days for the passage through each interval.
113. Text of *Timaeus* 38E,3–6. The celestial bodies follow divine commands. The Soul participates in the reason of planetary motions.
114. Text of *Timaeus* 38E,6–39A,3. The diverse westward motion of the planets and their speeds relative to the stellar sphere.
115. Text of *Timaeus* 39A,4–5. Planets with small circles follow those moving slower in larger circles. The moon seems to be overtaken by the sun, and so likewise with the other planets.
116. Text of *Timaeus* 39A,5–6. We can draw instrumentally a planetary circle that describes a spiral before reaching its starting point. The more it spirals, the more a planet tends back to the previous zodiacal sign,

as does Venus. With less spiraling the planet moves forward with the variant motions of the "helix."

117. Text of *Timaeus* 39B,2–5. The sun was created as a light to show the order of the cosmos. Text of *Timaeus* 39B,5–C,5. The sun orbits in 365¼ days, involving the addition of one day every four years.

118. Text of *Timaeus* 39D,2–5. Attack on the [Stoic] doctrine of a Great Year. If anything, a grand conjunction of planets should signal a new revival rather than a dissolution of the world.

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