The Circulation of Astronomical Knowledge in the Ancient World

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The Circulation of Astronomical Knowledge in the Ancient World

Edited by

John M. Steele

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Introduction

Astronomical and astrological knowledge circulated in many ways in the ancient world: in the form of written texts and through oral communication, and by the conscious assimilation of sought-after knowledge and the unconscious absorption of ideas to which scholars were exposed. The circulation of knowledge happened both between cultures, for example the transmission of astronomical texts, theories or parameters from one culture to another, and within cultures, both spatially, for example, between scholars in different cities, between "elite" and "popular" astronomical traditions, and between different genres of scholarship, and temporally, for example later interpretations of and reaction to earlier works. I use the term "circulation" deliberately here to emphasize that the transmission of knowledge is not a unidirectional process: astronomical knowledge from one group is not imposed upon another group; rather the process is one of negotiation between the two parties. Furthermore, the act of receiving knowledge almost always involves a process of adaptation of that knowledge to make it relevant to and compatible with the existing scholarly practices of the recipients.[1]

As discussed by Rochberg, pioneering work on the transmission of astronomical knowledge between cultures was undertaken by members of Brown University's Department of History of Mathematics during the second half of the twentieth and the first few years of the twenty-first centuries. Through the work of Otto Neugebauer, Gerald Toomer, David Pingree, and others it has become evident how much astronomical knowledge was transmitted between Mesopotamia, Greece, India, the medieval Islamic World, and medieval and Renaissance Europe. As recognized by Neugebauer, a particularly good marker of transmission are precise numerical parameters used within mathematical astronomy.[2] The transmission of broader astronomical or astrological concepts and methods can also be traced between cultures, but the evidence for transmission is not always so clear cut and we must be wary of assuming transmission where there are merely similarities in the tradition.[3] When dealing

1 On this issue, see also the introduction by Jamil Ragep to the volume Ragep, Ragep and Livesey (1996) and the papers contained therein.

2 See, for example, Neugebauer (1989) where he traces the value 29;31,50,8,20 days for the mean length of the synodic month through various cultures.

3 Pankenier (2014) and Steele (2013) discuss claims for the transmission of Babylonian astronomy and astrology to China, both concluding that there is no clear evidence of transmission.

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with celestial omens, for example, how similar must omens be to allow us to conclude that they have been transmitted from one culture to another? In order to answer this methodological question it is necessary to consider things such as wider historical evidence for contact between the two cultures and possible routes of transmission, the number of "similar" cases (a few similar omens may simply be coincidence, a large number, especially if they share other features such as order within a text, making transmission more likely), and whether the similarities are unique to the cultures in question or whether similar material exists from cultures where it is clear that there can have been no contact. The papers by Rutz, looking at the transmission of Mesopotamian astral knowledge to other parts of the near east in the late second millennium BC, Misiewicz, considering the transmission of Mesopotamian lunar omens through the Greek tradition into late antiquity, Montelle, examining the transmission of Babylonian schemes for the rising times of the ecliptic to the Greek world, and Duke, looking at the transmission of Greek astronomy to India, all address these questions.

Once knowledge is transmitted into a culture it then becomes adapted and naturalized to its new cultural setting. Thus process has been studied in detail by Sabra and others for cases of transmission between Mesopotamia, the Greco-Roman World, India, the Islamic world and Europe.[4] A less known case is the transmission of western astrology from India to China during the Tang dynasty and its subsequent "Sinicization". The paper by Song provides a detailed census and analysis of Chinese names and use of the twelve signs of the zodiac and their assimilation within traditional Chinese forms of divination. Niu provides a translation and study of a tenth century Chinese horoscope found at Dunhuang which blends elements of western and Chinese astrology.

The circulation of astronomical knowledge within cultures sometimes shares some of the same characteristics of adaptation and naturalization as cross-cultural transmission. Geographically, texts may be rewritten to fit the norms of local traditions, and a variety of factors including the desire of scholars to retain power over astronomical activity through secrecy and restricting access to material may result in only certain aspects of the astronomical tradition circulating widely. The papers by Steele and Monroe examine cases of the circulation of astronomical and astrological knowledge and texts between the cities of Babylon and Uruk during the first millennium BC, which reveal local traditions of how texts are written, copied, and (perhaps) used. The trans-

4 See, for example, Sabra (1987), Saliba (2007), and the papers in Ragep, Ragep and Livesey (1996).

mission of astronomical knowledge between different groups also shows that the process of transmission is selective: for example, only certain astronomical ideas, terminology, etc, found in "elite" astronomy were relevant in "popular" contexts. Harkness examines the case of the incorporation of astronomical terminology into almanacs in early China. Wee analyzes the interrelation of astronomy, astrology and medicine in Babylonia during the late first millennium BC, showing that what was of interest in astral medicine were simple numerical schemes based upon the moon's motion rather than the contemporary advanced mathematical lunar systems. Quack and Winkler examine the place of astrology and astronomy within broader scholarly activity in late period Egypt.

The transmission of astronomy also occurs across time. Astronomers responding to existing traditions of astronomy often faced particular challenges not dissimilar to those faced by the receivers of foreign astronomical knowledge: What does particular terminology mean? What is the underlying model of an astronomical system? Does the material make sense? Morgan examines the case of early attempts to understand some traditional planetary models in China. Jones discusses Ptolemy's use of historical observations and how he was forced to interpolate between observations when specific observations was not available. Tradition could also constrain astronomy. Guan examines the reforms of official calendrical systems of mathematical astronomy in China and discusses the role of the value placed on certain aspects of an calendrical system or on certain ways of testing the accuracy of a system that became traditional in debates over whether systems should be changed. Wainer examines how the celestial divination schemes found in the fourth tablet of the commentary series *Šumma Sin ina Tāmartišu* relate to those which appear in or underlie other texts, including *Šumma Sin ina Tāmartišu*'s source text *Enūma Anu Enlil*.

This volume has its origins in a conference held at Brown University on 12–13 April 2014. The conference was supported by the Department of Egyptology and Assyriology at Brown University, Brown University's Office of the 250th Anniversary, and the Institute for the Study of the Ancient World at New York University. I take this opportunity to thank Rebecca Barclay, Claire Benson, and Guan Yuzhen for their help in organizing and running the conference, and James Allen, Leo Depuydt, Alexander Jones, Teije de Jong, Kim Plofker, and Clemency Montelle, for chairing sessions at the conference.

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CHAPTER 1

The Brown School of the History of Science: Historiography and the Astral Sciences

Francesca Rochberg

This paper outlines in all brevity the historiographical contribution of two of the most prominent members of Brown's Department of the History of Mathematics, Otto Neugebauer and David Pingree. I refer to the "Brown School" not so as to suggest that the members of that department had any conscious investment in a unified school of thought or historiography. On the contrary, the differences between these two scholars, as well as from others at Brown (Richard Parker, Abraham Sachs, and Gerald Toomer, for example), are the focus of the following discussion. Nonetheless, the fact that Brown University supported the small department of specialists in the astral sciences of the past, astronomy and astrology in the ancient Near East (including Egypt), India, Greco-Roman worlds, lends a notable profile to that department as it existed up to the death of David Pingree, its last surviving member in residence.

Toward the end of the nineteenth century, in tandem with the philological recovery of Hellenistic Greek scientific texts dealing in astrology and alchemy,[1] ancient Mesopotamia too became relevant to the history of science with the rediscovery of the mathematical astronomy of the Late Babylonian period. The Golden Age of decipherment and analysis at the end of the Nineteenth Century, associated with the Jesuit fathers Joseph Epping, Johann Nepomuk Strassmaier, and Franz Xaver Kugler, was followed by the work of Otto Neugebauer, whose 1955 critical edition of the corpus of cuneiform lunar and planetary tables and procedure texts from Babylon and Uruk (*Astronomical Cuneiform Texts*, ACT) and his theoretical presentation of the two basic calculation methods, now known as Systems A and B (Systems II and I in Kugler 1900) established a new foundation for the field of ancient astronomy. As Neugebauer himself pointed out,

> Epping fully realized the significance of his discoveries. The two columns from a lunar ephemeris which he had deciphered, he said, 'give us more

1 Such as in Cumont, Boll and Kroll (1898–1953), and Berthelot and Ruelle (1887–1888).

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> information about Babylonian science than all the notices from classical antiquity combined'–a fact which cannot be emphasized too often. And he [Epping] foresaw clearly that the new material would become of great importance for ancient chronology, for Assyriology in general, and even for modern astronomy.[2]

The recovered astronomical cuneiform texts, in the hands of Otto Neugebauer, would ultimately change the entire face of the history of science. In 1975, Neugebauer's three-volume *A History of Ancient Mathematical Astronomy* (HAMA) placed Babylonian astronomy firmly in line with the tradition of Ptolemy's *Almagest*, and by extension all later Western astronomy up to Copernicus. As significant as Epping's and the other Jesuits' work was, it was really Neugebauer, who, and I quote Noel Swerdlow here, "was the most original and productive scholar of the history of the exact sciences, perhaps of the history of science, of our age … [and] to a great extent created our understanding of mathematical astronomy from Babylon and Egypt, through Greco-Roman antiquity, to India, Islam, and Europe of the Middle Ages and Renaissance. Through his colleagues, students, and many readers, his influence on the study of the history of the exact sciences remains profound, even definitive."[3] Neugebauer's singular contribution through long association with Brown University in the History of Mathematics Department, which he founded in 1947 and is now part of the Department of Egyptology and Assyriology, was to put Brown at the epicenter of the history of astronomy, where it remains to this day, thanks to Professor John Steele.

During the twenty year period between ACT and HAMA, the fruitful collaboration of Neugebauer and Abraham—Abe—Sachs in the heyday of the Brown School of ancient astronomy, together with Asger Aaboe at Yale, saw further work on the mathematical structures, parameters, and methods of Babylonian astronomical texts, both of what they called mathematical and non-mathematical description, terms which have by now become standard in the field. Mathematical texts are counted as the ephemerides, procedures, and auxiliary tables (ACT), and among the non-mathematical genres are the diaries, almanacs, normal star almanacs, eclipse reports and observational texts (NMAT). The unfinished editions of the various non-ephemeris-type text genres were passed from Sachs to Hermann Hunger of the University of Vienna, who has completed the herculean task of publication, now available in 6 splen-

2 Neugebauer (1975: 349 and note 6).

3 http://www.mat.ufrgs.br/~portosil/neugebau.html.

did volumes of transliteration and translation, and another in press, based on the copies of the texts in Sachs and Pinches' *Late Babylonian Astronomical and Related Texts*, otherwise known as LBAT.

To appreciate the impact that the decipherment and explication of cuneiform astronomical texts would have on the historiography of science, probably the most entrenched idea about the history of science, typifying the intellectual landscape of the middle of the Twentieth Century, was the idea that science originated with the Greeks. In the year just before the appearance of Neugebauer's ACT, the great quantum physicist Erwin Schrödinger published the book *Nature and the Greeks* (1954). In the chapter entitled "Return to Antiquity" he quoted Theodor Gomperz, a somewhat older contemporary of Kugler, from his work *Griechische Denker* (*Greek Thinkers*), published in 1911, but still relevant for Schrödinger and his audience in the mid-1950s. The passage says:

> Nearly our entire intellectual education originates from the Greeks. A thorough knowledge of these origins is the indispensable prerequisite for freeing ourselves from their overwhelming influence. To ignore the past is here not merely undesirable, but simply impossible. You need not know of the doctrines and writings of the great masters of antiquity, of Plato and Aristotle, you need never have heard their names, none the less you are under the spell of their authority. Not only has their influence been passed on by those who took over from them in ancient and in modern times; our entire thinking, the logical categories in which it moves, the linguistic patterns it uses (being therefore dominated by them)–all this is in no small degree an artefact and is, in the main, the product of the great thinkers of antiquity.[4]

Then, perhaps even more to the point, Schrödinger quoted John Burnet's *Early Greek Philosophy* to the effect that "… it is an adequate description of science to say that it is 'thinking about the world in the Greek way.'" [p. 20]

It is undeniable that our thought is influenced by the linguistic patterns and logical categories established in and by the Greek language as it is embedded in our own English language and other Indo-European languages. This, however, does not rule out the fact that other civilizations that did not think about the world in the Greek way, thought about the world in a way that produced science. It is still worth stating: Science and its thinking is not limited to ancient Greece and its intellectual legacy. Greek science did not spring as Athena full

4 Gomperz (1911: 419), apud Schrödinger (1996: 19–20).

grown from the head of Zeus, but itself had a debt to other cultures, other traditions and ways of knowing. As Gomperz said, “to ignore the past is here not merely undesirable, but simply impossible.” One might say, Otto Neugebauer, and his fellow historians of astronomy at Brown, Abe Sachs and David Pingree, although he came later, as well as those elsewhere, such as Asger Aaboe, B.L. van der Waerden, and Peter Huber, to name the major participants in that mid-century era, worked in the spirit of Gomperz’ dictum. They brought more of the past to bear on our understanding of science such that it could no longer be claimed, as Schrödinger and Burnet and many others had, that science could be described adequately as “thinking about the world in the Greek way.”

Particularly when it comes to the circulation of astronomical knowledge in the ancient world, such unilateral claims were literally made untenable by the work of the Brown School. Moreover, by now, the rhetoric of a Greek way of thinking has an essentialist, crude, and artificial ring to it. Neugebauer and his colleagues’ attention to sources outside of the Greek corpus opened the way to understanding the complexities of the culture, or the cultures, of astral science in the Hellenistic world. The study of the non-Greek sources for the astral sciences in the Hellenistic period—the Babylonian, Egyptian, and Indian texts—has shown how traditions coexisted, were transmitted, received, appropriated, and reformulated. In other words, the “Greek way” of thinking about science was itself formed by contact and exchange with cuneiform and other cultures with which Greek intellectuals came in contact through the political and cultural *oikoumene*.

As mentioned before, during the very period of the recovery and decipherment of the cuneiform astronomical texts, another scholarly movement was underway that would directly relate to the eventual incorporation of the new field of Babylonian astronomy and astrology into a deeper understanding of the astral sciences of the entire ancient Mediterranean and Near East. A contemporary of Epping, Strassmaier, and Kugler, the Belgian classical philologist and historian Franz Cumont, together with classical philologists Franz Boll and Wilhelm Kroll, were engaged in what would ultimately be the 12-volume *Catalogus Codicum Astrologorum Graecorum* (CCAG), published between 1898 and 1953. The collection of the Greek astrological texts would open new possibilities for the study of how astronomy and astrology were interdependent and how the astral sciences functioned within the *oikoumene*, including, of course, the cultural-geographical area of the Near East (and beyond).

In 1911, for example, in the *Sitzungsberichte* of the Heidelberg Academy of Sciences,[5] Boll, together with Semitist and Orientalist Carl Bezold, set out

5 Bezold and Boll (1911).

extensive parallels between the then newly available cuneiform celestial omen texts and certain Greek works from the CCAG as well as, for example, the 6th century C.E. John the Lydian, or "Lydus"' work on divination entitled *De Ostentis* "On Signs." As Wouter Hanegraaff observed in his treatment of the historiography of esotericism in the West, on the foundations not only of the CCAG, but also of Berthelot and Ruelle's *Collection des anciens alchemistes grecs* (1887–1889),

> serious historical research in these domains began to flourish around the turn of the century, with scholars such as August Bouché-Leclercq, Franz Boll, Richard Reitzenstein, Wilhelm Bousset, Wilhelm and Josef Kroll, Walter Scott, and many others; a tradition that culminated finally in classics such as, notably, André-Jean Festugière's monumental four-volume study *La révélation d'Hermès Trismégiste* (1944–1954).[6]

The recovery of the flesh and bones of Babylonian astronomy made it possible to trace survivals of its parameters and methods in Greek, Indian, and medieval European astronomy. The question of transmission was, indeed, a subject of keen interest to Neugebauer, who once said, "to the historian of science the transmission of ideas is rightly one of his most important problems."[7] The truth is, Neugebauer saw the value of astrological texts principally as conveyers of astronomical knowledge. He made this statement in the now famous one-page rebuttal of George Sarton's condemnation of Lady Drower's publication of the Mandaean *Book of the Zodiac*, which Sarton, the founder of the History of Science Society, had dismissed as "a wretched collection of omens, debased astrology and miscellaneous nonsense." Neugebauer's response came out in *Isis* of 1951 under the title "The Study of Wretched Subjects."[8]

6 Hanegraaff (2012: 314).

7 Neugebauer (1951: 111).

8 The highly ideological basis for the history of science that characterized this mid-century period can also be seen already in full force in Sarton's reception of the magnum opus of Lynn Thorndike (1923–1958). As related by Hanegraaff, "In a large review of the first two volumes of Thorndike's *History*, in 1924, Sarton had to admit that by studying 'an enormous amount of repellant material' the author had made a valuable contribution to scholarly research; but in fact, almost the entire review was devoted to an emotional attack on the implications of the title and on Thorndike's basic historiographical program. These eleven pages of high rhetoric drama—at one point Sarton describes the history of science as 'a growing light eating up the darkness'—are an ultimate example of the reification of 'magic' and 'science' as mutually

Twenty years after Neugebauer's "Wretched Subjects," in the year 1971, David Pingree joined Brown's History of Mathematics Department. He, more than anyone else, would investigate and make available the sources for the study of how astronomy and astrology together functioned in a variety of contexts across the hellenistic *oikoumene*, to and including India, and in the late 4th and 5th centuries of our era in Sassanian Iran, and from there too into the creative period of Arabic astral sciences. In one of Pingree's editions of Sanskrit astrological works, the *Yavanajātaka*, or "Horoscopy of the Greeks," he noted that this author's work was "concerned with horoscopy, or horaskandha," which was "one of the three branches (*skandha*s) of *jyotihśāstra* (astronomy and astrology). The *Yavanajātaka* is the earliest surviving Sanskrit text on this subject," and Pingree argued that it "constitutes the basis of all later Indian developments in horoscopy before the injection of Islamic theories through translations from Persian into Sanskrit of *tājika* works in the thirteenth and the following centuries." Of equal importance in our present context, he noted that "the second skandha (branch) of *jyotihśāstra*, called *samhitā*, goes back to a Mesopotamian tradition similar to that of the great omen series, *Enūma Anu Enlil*."[9] Pingree was, from the beginning, attuned to the multi-cultural nature of scientific tradition, and his wide knowledge of these diverse traditions enabled him to pick out and correctly identify these cultural threads in texts that embodied complex heritage.

Also in the mid-1970s Pingree continued the work of editing Hellenistic astrological treatises. In 1974 he reedited the early 5th century C.E. Hephaistio of Thebes' *Apotelesmatica*, which had been published in first edition by August Engelbrecht in 1887. In 1976 the 1st century C.E. Dorotheus of Sidon's *Carmen Astrologicum*, and in 1986, a reedition of Wilhelm Kroll's 1907 first edition of the *Anthologium* of Vettius Valens from the 2nd century C.E. Thanks to these and many other text editions we now have the materials to pursue further study of the ways astrology and astronomy of widely varying origins circulated in widely disparate societies.

The impact of Pingree's approach to the celestial sciences in antiquity cannot be underestimated. He brought to the fore the multiple forms and contexts science took in pre-modern times. As he put it:

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exclusive universal categories … Sarton emphasized (italics in the original) that '*science is essentially a cumulative, a progressive activity*' characterized by rationality and skepticism. Magic was presented as its radical opposite." See Hanegraaff (2012: 318–319).

9 All quotes from Pingree (1978: I 5).

> One of the most significant things one learns from the study of the exact sciences as practiced in a number of ancient and medieval societies is that, while science has always traveled from one culture to another, each culture before the modern period approached the sciences it received in its own unique way and transformed them into forms compatible with its own modes of thought. Science is a product of culture; it is not a single, unified entity. Therefore, a historian of pre-modern scientific texts—whether they be written in Akkadian, Arabic, Chinese, Egyptian, Greek, Hebrew, Latin, Persian, Sanskrit, or any other linguistic bearer of a distinct culture—must avoid the temptation to conceive of these sciences as more or less clumsy attempts to express modern scientific ideas. They must be understood and appreciated as what their practitioners believed them to be.[10]

In his 1992 article "Hellenophilia versus the History of Science," Pingree took his perhaps most strident historicist stance with regard to the sciences of other cultures and delivered his clearest indictment of Western historians who failed to appreciate the scientific nature of non-Western bodies of knowledge. In what is in effect a response, however indirect, to Schrödinger's claim that science was the "Greek way of thinking," Pingree coined the term Hellenophile (as opposed to a Philhellene), to represent someone who

> suffers from a form of madness that blinds him or her to historical truth and creates in the imagination the idea that one of several false propositions is true. The first of these is that the Greeks invented science; the second is that they discovered a way to truth, the scientific method, that we are now successfully following; the third is that the only real sciences are those that began in Greece; and the fourth (and last?) is that the true definition of science is just that which scientists happen to be doing now, following a method or methods adumbrated by the Greeks, but never fully understood or utilized by them.[11]

Pingree did not set himself up as a relativist, nor did he have any stakes in a philosophy of science that would serve equally for ancient as well as modern sciences. His emphasis was on the sources. In this his position was very much in line with that of Neugebauer, who had said in his "Study of Wretched

10 Pingree (2003: 45).

11 Pingree (1992: 555).

Subjects," that "the foundation of our studies" is "the recovery and study of the texts as they are, regardless of our own tastes and prejudices."[12]

Upon this foundation, not only has our idea of early science changed as a direct result of the recovered sources, so also has our way of approaching the question of the nature of science as a historical phenomenon changed. While this philosophical question might not have been of critical importance in the early days of the Brown School, when the identification of texts and the analysis of their quantitative methods took priority, the direction of science studies since the 1970s, I would suggest, has raised the cultural dimension of the sciences, the contexts within which to see various parts of the ancient astral sciences, to a level of importance today on a par with analysis of quantitative methods.[13] Astronomical knowledge and quantitative methodologies cannot be separated from their contexts of meaning and use, not only across but within the shifting geographical and cultural boundaries of the ancient Near East and the Hellenistic *oikoumene*.

Beyond this very cursory glance at the contributions of Neugebauer and Pingree, it is possible, despite their mutual support and intellectual sympathies, and their agreement on placing emphasis on the recovery of sources, to infer quite different approaches to the question of science as a historical phenomenon. Again, this matter of historiography deserves a deeper treatment, but briefly, Neugebauer, I submit, approached ancient astronomy from the perspective that science and scientific knowledge comprised a unity, while Pingree's approach favored disunity, comprised of a plurality of local practices and epistemologies.

It seems to me important to bring this out, because the transmission and reception of science is materially affected by the particular model adopted. To return for a moment to Schrödinger and Burnet and the supposed identity of scientific thought with a Greek way of thinking, this claim was based on the idea of the unity of science and scientific knowledge, according to which science transcended history, growing independently as an organic body, somewhat along the lines of Francis Bacon's metaphoric "tree of knowledge." Indeed this early modern ideal was already long lamented by the early nineteenth

12 Neugebauer (1951: 111).

13 Granting real value to historical sources for a new historiographical approach to the history of science did not go down smoothly, or rapidly, as is indicated by the fact that it was not until 2002 that *Isis*, founded by George Sarton in 1912 as the History of Science Society's official journal, finally removed the term "pseudo-sciences" from its annual bibliography.

century, when William Whewell, in 1834, in the pages of *The Quarterly Review*, described science as a "great empire falling to pieces."[14]

But the unity of science was once again the orthodoxy of the 1950s, when Schrödinger was writing *Nature and the Greeks*, and Neugebauer was preparing *ACT*. As described in the *Stanford Encyclopedia of Philosophy*, this philosophical orthodoxy is characterized as "a syntactic formal approach to theories, logical deductions and axiomatic systems, with a distinction between theoretical and observational vocabularies, and empirical generalizations."[15] This perhaps accounts for Neugebauer's somewhat indirect and narrow defense of astrology as science in his *Exact Sciences in Antiquity*, originally given as lectures in 1949, published in 1952, with a second edition in 1957. There he said,

> To a modern scientist, an ancient astrological treatise appears as mere nonsense. But we should not forget that we must evaluate such doctrines against the contemporary background. To Greek philosophers and astronomers, the universe was a well defined structure of directly related bodies. The concept of predictable influence between these bodies is in principle not at all different from any modern mechanistic theory. And it stands in sharpest contrast to the ideas of either arbitrary rulership of deities or of the possibility of influencing events by magical operations. Compared with the background of religion, magic and mysticism, the fundamental doctrines of astrology are pure science.[16]

Consistent with his position in "The Study of Wretched Subjects," we can see that this defense was mounted within bounds of the idea of the unity of science. Neugebauer's evaluation of astrology as science sees the importance of context as a qualification, that compared against even less rational practices, such as religion, magic, and mysticism, astrology could be science if its mechanistic dimension is brought to the fore. Despite the nod to context, therefore, his evaluation of astrology, in my view, supports the transmission of science as something autonomous, even disembodied, of context.

David Pingree's historiography of science, on the other hand, seems fundamentally context-driven. As a man of his time, Pingree worked in the period in which the idea of the disunity of science, science's pluralism, was being increasingly embraced, especially by philosophers of science influenced by his-

14 Apud Brooke-Smith (2012: 299).

15 Cat (2013: Section 3.1).

16 Neugebauer (1969: 171).

tory (e.g., the Stanford School of philosophy of science including John Dupré, Ian Hacking, Peter Galison, Patrick Suppes and Nancy Cartwright).[17] As trained philologists, which describes most of us working in this field, we are not accustomed to making our philosophies of science, or our historiographical methods, plain. Whether or not we define our positions explicitly, as did Pingree on the few occasions quoted above, we do apply certain ideas that affect the ways we read and understand the texts we study. If scientific knowledge from a unity of science perspective can be transmitted in an almost disembodied form, say in the form of parameters or ways of expressing numerals, from a disunity position, knowledge or knowledge systems are never simply transmitted, but bound up with other parts of the contexts in which they exist and continue to have value. Indeed, the term transmission itself can be criticized as highly misleading; it connotes a one way delivery process, and generally conjures a picture of a transmitting and a receiving entity in actual historical contact, which we as Assyriologists, Egyptologists, Classicists and Sanskritists, who work on texts with centuries—if not millennia—long traditions, know well did not have to be the case.

For this and other reasons the term transmission must now be conceded as inadequate to the future development of a historiography suitable for the complexities of the matrix of ideas that was astronomy and astrology across the Mediterranean and Near East to India. Transmission alone does not explain complex social or cultural dynamics, nor can the tracing of such transmitted material be an end in itself. It leaves much open and ambiguous.

But neither can reception, as A.I. Sabra argued, be the terminological antidote. In the context of the historiography of the Ninth Century Arabic translation movement that recovered, preserved, and commented upon Greek scientific and philosophical texts, Sabra said,

> reception is sometimes used as a value-free word referring to the bare movement of translation … 'Reception' might connote a passive receiving of something pressed upon the receiver, and this might reinforce the image of Islamic civilization as a receptacle or repository of Greek learning. This, however, was not quite what happened; the transmission

17 For example, as Dupré noted, "on the one hand, to historians and sociologists looking in increasing detail at the fine grain of scientific practice, the contingency and specificity of particular projects of inquiry have made the idea of science as one grand project incredible. And on the other hand, epistemologists concerned with the claims to knowledge of particular branches of science have not easily fitted these local modes of justification into broad patterns with universal applicability." See Dupré (1996: 101).

> of ancient science to Islam would be better characterized as an act of appropriation performed by the so-called receiver. Greek science was not thrust upon Muslim society any more than it was later upon Renaissance Europe.[18]

Sabra points up the politically sensitive nature of the very question of studying the dynamics of intellectual history, the whys and hows that govern the routes and the times in which ideas have life. The cultural approach to the history of science, which Pingree explicitly favored, is more sympathetic to the disunity position, according to which, as Joseph Rouse put it, "cultural studies of scientific knowledge reject the idea that there is an essence of science, or a single essential aim that all genuinely scientific work must aspire to."[19] Rouse also said,

> the practices of scientific investigation, its products, and its norms are historically variant … Scientific work is also culturally variant even within the same field; there are often, for example, important national differences in the style, direction, standards, and goals of scientific work. This does not at all mean that different scientific cultures are self-enclosed or mutually uncomprehending, or that individual scientists or groups cannot navigate their borders quite effectively. Nor does it mean that the epistemically interesting differences in scientific cultures neatly map onto national, linguistic, or other cultural boundaries.[20]

The last statement applies in the circulation of knowledge in the ancient world, where diverse sources and traditions can be seen to cross-cut various political, linguistic, not to mention chronological boundaries.

Regarding the monumental contributions of Otto Neugebauer and David Pingree of Brown University's program in the history of ancient astronomy, the foregoing discussion stands less a historiographical account and more an expression of gratitude. As a direct consequence of their editions of so many primary texts, their brilliant analyses and careful commentaries, we are in a position today to think more deeply about the circulation of knowledge of the heavens in its varied contexts and to understand more fully the character and role of the astral sciences in Hellenistic antiquity. In seeing the shift in histori-

18 Sabra (1987: 225).
19 Rouse (1993: 63).
20 Ibid., 63–64.

ography, from an earlier stance concerning the unity of science, characteristic of Neugebauer's time, and to which Neugebauer seems to have subscribed, to the more recent view of science's pluralism and disunity, which Pingree, for our small field, spearheaded in his papers that commented directly on cultural aspects of science, we can go about our study of the circulation of ideas, of transmission and reception, in a higher state of awareness of how interrelated local politics, society, and culture were to the production and preservation of the astral sciences in Near Eastern and Hellenistic antiquity.

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CHAPTER 2

Astral Knowledge in an International Age: Transmission of the Cuneiform Tradition, ca. 1500–1000 B.C.

Matthew T. Rutz

1 Introduction

The diffusion of the cuneiform script across the Near East was a powerful conduit for transmitting written knowledge and thus provides the primary point of access for tracking and assessing the early circulation and reception of astral knowledge both within and outside of Mesopotamia proper. The topic of this chapter is the transmission of astronomical knowledge in the ancient Near East's first great international age, that is, the latter half of the second millennium B.C. Among the central issues associated with the text corpus from this period is the problem of comprehension and integration: comprehension of the written astral knowledge that was transmitted, and the reception and integration of cuneiform astral knowledge outside of the centers of learning in Babylonia and Assyria. In essence, this topic can be condensed to the following questions: did ancient scribes and scholars read the received tradition of cuneiform tablets with astral contents with the Assyriologists' synoptic but partially obscured view? Or did early scribes read and reproduce cuneiform textual traditions more in keeping with how the anonymous Babylonian authors understood what they were committing to writing? Looking more closely at the period in question, did an Anatolian or Syrian scribe first learning the inner workings of the cuneiform script or functioning as a literate scholar in the service of political and socio-economic elites have, for instance, Ursa Major in mind when copying the signs $^{\text{mul.giš}}$mar-gíd-da in a Babylonian star list? That is to say, were they privy to the intended identifications of astral bodies that are no longer known, or were they just as lost as modern scholars? A distinct but related question is whether and to what extent Babylonian astral knowledge shaped or interacted with various local knowledge and traditions? In what follows I will attempt to address these questions by providing an overview of the sources available for the second millennium B.C. and then by examining the contexts in which the early star lists and divinatory compendia were produced and used, focusing in particular on the textual remains recovered from Emar, Ugarit, and Ḫattuša.

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First it is useful to rehearse the essentials of the historical context. The unprecedented political, economic, and cultural interconnections that emerged in Near East in the late-second millennium B.C. are exemplified in the fourteenth-century international correspondence written in Babylonian cuneiform but found in Egypt at Tell al-Amarna, and, in fact, Amarna Period is often a convenient shorthand for the period as a whole. These letters illustrate the circulation of people (including scribes and learned specialists[1]) and objects (including cuneiform tablets[2]) among the spheres of influence of the self-stylized brotherhood of great kings: from Babylonia and, eventually, Assyria, to Northern Syria (Mittani) and Hittite Anatolia, the Levantine coast, Egypt itself and the Aegean—and outside the scope of the Amarna correspondence there is evidence for Babylonian engagement with Elam to its east. These regional polities, some with imperial aspirations, provide the socio-political matrix in which cuneiform literature circulated, and, assuming the widest possible scope of cuneiform literature, Babylonian and to a lesser extent Assyrian compositions are found at various sites throughout the region in this period.[3] With this background in mind, the first central topic I address in this paper is the basic question of data, namely: what is the evidence for the circulation of astronomical knowledge in the early cuneiform tradition? In particular, what is the distribution of sources in the later second millennium B.C.?

Where sources are attested, they fall into three basic categories: star lists of various kinds; divinatory collections or compendia that interpret hypothetical celestial phenomena on the common Mesopotamian conditional protasis-apodosis format, "If A (observable/imaginable event), B (interpretation/significance)"; and miscellaneous texts with astronomical contents, examples of which are known only from Babylonia and Assyria proper. Dating the texts assigned to all three of these categories relies on four principal features, either combined or in isolation: dates found on documents; inferences from prosopography; inferences from archaeological deposition; and, finally, inferences

1 Zaccagnini (1983: 250–254); Bryce (2003: 126–128); Heeßel (2009).

2 Goren et al. (2004) focus on studying the material provenance of clay tablets from the Amarna period, but numerous other studies have dealt with the issue of imported tablets existing alongside local copies of sources for cuneiform literature.

3 The literature is extensive. For an overview, see Pedersén (1998: 13–125) and Sassmannshausen (2008); Fincke (2012) and Veldhuis (2012) focus on scribal education from a comparative perspective. Additional literature on different areas includes work on Anatolia: Beckman (1983), Riemschneider (2004), Fincke (2004, 2009b, 2010), Klinger (2010), Cohen (2012); Egypt: Izreel (1997); Syria and the Levant: van Soldt (1995; 2011; 2013), Horowitz and Oshima (2006), Cohen (2009), Horowitz et al. (2010), Rutz (2013); and Elam: Rutz (2006).

from the typological analysis of various elements in and around the text itself (palaeography, orthography, a tablet's physical features, and the like).

Beginning with Babylonia itself, the picture is known in outline only. In Nippur only a handful of sources have been identified, and these can be dated based only on typological criteria: two divinatory compendia, one with lunar eclipse omens, the other with solar omens;[4] a star catalogue;[5] a mathematical problem text involving the distances between various stars and the moon;[6] and a short, six-line section from a heterogeneous list of coefficients that is probably Middle Babylonian in date.[7] As will be apparent from the contemporary sources attested outside of Babylonia, the star catalogue, mathematical problem, and coefficient list (if properly dated) are really most relevant to the topic of diachronic transmission within Mesopotamia itself, since parallel texts are so far known only from first-millennium Assyria and Babylonia. The second-millennium evidence from Assyria to the north is scarcely better: the star lists found in the text known as Astrolabe B are known from a dated manuscript that was produced in the mid-twelfth century in Assur,[8] and a handful of compendia of lunar omens probably come from this general period as well.[9] Elam makes an even poorer showing, with just fragments and hints of celestial divinatory texts in circulation.[10] All of the other evidence I will discuss can be dated at least roughly by using archaeological criteria, and beyond the more fragmentary lunar omen compendia from the Syro-Anatolian milieu at Qatna and Alalakh,[11] the most abundant material is found in the Hittite sphere of influence: that is, in northern Syria at Emar inland on the Euphrates and in the coastal town Ugarit as well as in the capital of Hittite Anatolia, Ḫattuša. In contrast, so far no astronomical texts are known from this period in the south-

4 Ni 1856 (unpublished): Rochberg-Halton (1988: 19); Koch-Westenholz (1993: 237 n. 25); UM 29-15-393: Rutz (2006). Note also the unprovenienced Babylonian lunar eclipse compendium published recently by George (2013: 248–257, no. 34).

5 HS 1897: Oelsner and Horowitz (1997/1998).

6 HS 245 (formerly HS 229): Robson (2008: 328); Oelsner (2005/2006).

7 CBS 10996: Robson (2008: 328); Michalowski (2010: 209); Friberg (2011: 140–143). The date is disputed, with some, such as Friberg, arguing that it belongs in a discussion of the first millennium evidence.

8 Schroeder (1920: no. 218); Horowitz (1998: 154–166); Casaburi (2003); Wagensonner (2014: 459–461, 463, 474–475); on the date, see Bloch (2010). W. Horowitz is currently preparing a revised edition of Astrolabe B.

9 Rochberg-Halton (1988: 19, 23–25, 67, 175, 217–218, 273–279); cf. Al-Rawi and George (2006: 36). Presumably others found during the early excavations in Assur remain unpublished.

10 Rochberg-Halton (1988: 31, 271); Rutz (2006).

11 Rochberg-Halton (1988: 32–33, 271–272).

ern Levant, Egypt, or points west of the Hittite capital. However, this absence is not altogether surprising, since compendia of celestial omens were a common genre of astronomical text to import from Babylonia, and no Mesopotamian divinatory compendia of any kind have been found in Egypt or the wider Mediterranean, though it is worth noting that a handful of clay liver models, some inscribed, do constitute evidence for divination (extispicy) in the southern Levant.[12] One conclusion to be drawn—albeit one based in part on an argument from silence—is that the transmission of astronomical knowledge should be viewed as a more limited subset of the total system of exchanges (even literary-cultural exchanges) known throughout the region: connections alone, even connections in scribal culture, were evidently necessary but not sufficient for the transmission of written astral knowledge.

The second basic question is more pernicious in this period of the cuneiform tradition: to what extent was the transmission of astral knowledge a byproduct of scribal training? That is to say: do the major genres of astronomical texts, namely, the star lists and the divinatory collections of celestial omens, necessarily transmit astronomical knowledge per se? If so, then astronomical knowledge of what kind? If not, then what do they represent and why were they transmitted? Which is to ask: why were they received?

Possible interpretations of Mesopotamian astronomical texts found in various contexts outside of Babylonia and Assyria could be plotted somewhere on a spectrum: at one extreme there would be the minimalist view that the scribes who copied and/or kept these texts were automatons who in effect copied inscriptions with only minimal comprehension of the texts' relationships with observable phenomena. Such copyists would have engaged in manipulating symbolic forms with a low commitment to understanding the texts' specific contents, with little tether and, therefore, meaning to the wider local world.[13] At the other end of the spectrum would be the maximalist view that texts represent written knowledge, and so the presence of Babylonian astronomical texts, especially in local copies as opposed to imported manuscripts, indicates a full understanding of whatever Babylonian empirical or conceptual information those texts record, and thus a command of Babylonian astral knowledge to the fullest extent possible for the genres in question.[14] Although these extremes are

12 Horowitz and Oshima (2006: 66–68); Horowitz et al. (2010); cf. Rutz (2014: 110, 112).

13 For example, van Soldt (1995: 177–178) emphasizes the role that such texts played in the early phases of scribal education, though he does not argue that pedagogy was the sole reason that cuneiform literary texts were produced.

14 Koch-Westenholz (1993) provides the clearest articulation of this view.

scarcely occupied in their purest form, they provide a useful heuristic to aid in contextualizing the evidence.

Before examining various facets of the local reception of astral knowledge in the later second millennium outside of Babylonia and Assyria, it is necessary to look at the early second-millennium (Old Babylonian) background of the two major sources of material, the star lists and the collections of astral omens. Any analysis of the early star lists must situate these texts with respect to a discussion of Babylonian scribal education.

2 Star Lists in Context

2.1 *Babylonian Star Lists and Scribal Education*

Scribal training in the conventions of cuneiform writing in all sites and periods proceeded through a series of stages, the specifics of which have been articulated with particular clarity for early second-millennium Babylonia, in particular in the town of Nippur.[15] Central to all educational materials is the list format: apprentice scribes first learned basic lists that practiced sign and word formation (making wedges, sign forms, grouped syllables, personal names), followed by thematic (general nouns, god lists) and complex lists (metrology, syllabaries, professions, acrographic compounds that were visually grouped by the first sign, counterintuitive sign compounds, multiplication/reciprocal tables and lists), then simple Sumerian texts (model contracts, proverbs), and finally advanced Sumerian literary compositions of various genres (royal hymns, narrative/praise poetry involving gods, epics, etc.). For the present discussion, the primary texts of significance are the thematic word lists. Some of the advanced literary compositions exhibit references, both subtle and explicit, to astral phenomena, but these texts will not concern me here, since they are effectively sealed in the Old Babylonian curriculum and failed to be transmitted either within or outside Mesopotamia proper to any significant extent.[16]

2.2 *Early Star Lists and the Ura Tradition*

The thematic word lists organize Sumerian nouns according to a taxonomy that gives primacy to the graphic semantic classifiers commonly known as determinatives, which are either the first or last sign in a sequence of signs used

15 The literature on this topic is vast. For general overviews that include previous discussions, see Civil (1995), Veldhuis (2011: 82–86), and Tinney (2011).

16 For select examples, see, e.g., Cooley (2013: 34, 89–93, 111–116, 130–140, 160–178).

TABLE 2.1 *Section topics of the thematic lexical text ur_5-ra* = ḫubullu (*Ura*) *with their corresponding major divisions in the early second millennium* (*Old Babylonian version from Nippur*), *later second millennium* (*Middle Babylonian version*), *and first millennium* (*Standard version*) *B.C.*

Topic	Old Babylonian	Middle Babylonian	Standard
Business Terminology	–	1	1
Business Terminology	–	2	2
Trees, Wooden Objects	1	3	3–5a
Wooden Objects	1	4	5b–7
Reeds, Reed Objects	2	5	8–9
Vessels	2	6	10
Leather Objects; Metal Objects	2	7	11–12
Domestic Animals	3	8	13
Wild Animals; Meat Cuts	3	9	14–15
Stones; Plants	4	10	16–17
Fish; Birds; Textiles	4	11	18–19
Geography	5	12	20–21a
Geography; Stars; Ropes, Date Palm	5	13	21b–22
Food	6	14	23
Food	6	15	24

to write a particular noun. Not surprisingly the most significant thematic word list is the one in which the earliest star list is found: Old Babylonian (OB) Ura after the incipit of its later incarnations in which Sumerian ur_5-ra is equated with Akkadian *ḫubullu*, both of which are terms for a particular type of loan.[17] Versions of this composition were in circulation throughout the Near East for over two millennia, and in that time a three basic configurations of the text emerged, in which different major divisions of the text cover topics ranging from business terminology and wood products to comestibles (Tab. 2.1).

The other major group of thematic lists are the god lists, which were not incorporated into the Ura tradition despite the fact that gods constitute an

17 Veldhuis (2004: 86–89). The proper title of the Old Babylonian version is its incipit ĝiš (or perhaps ĝeš), "wood". Early Assyriological works that discuss this text commonly refer to it as ḪAR-ra = *ḫubullu* (abbreviated Ḫḫ or Hh) before the correct reading of the ḪAR sign (ur_5) was known.

epigraphically prominent category of entries written with a particular determinative. The first point to appreciate for the present discussion is that the two major astral bodies par excellence, the moon and the sun, are both included in the god lists and not alongside the other celestial objects found in Ura. That is to say, the sun and moon were classified in Sumerian as belonging to the class diĝir (AN), "god," not the class mul (AN×3), "star/astral body," which by the second millennium are distinct though graphically and semantically related signs.[18] There appear to be some literary reflexes of this particular relationship. Various narrative texts convey that the sun and moon were sometimes conceived of as brothers in the divine family of the sky god An, and sometimes the moon was the sun's father.

Turning to the fine astral bodies, the planets and fixed stars, the earliest star list is the one included in the fifth division of Ura in Old Babylonian Nippur (Tab. 2.1), and its text has been reconstructed not from library or archival copies but rather from what are now known to be the fragmentary remains of Babylonian pedagogy in practice.[19] Thus, it comes as no surprise that the sources for the Old Babylonian Ura 5 star list follow the standard manuscript typology developed to classify and interpret curricular tablets in this period: Type I sources (tablets, prisms) generally contain a complete composition, while Type II tablets contain extracts that were either copied from a teacher's model (obverse) or as a review of previously learned material (reverse). The complete text of the star list in OB Nippur Ura 5 is known from just one manuscript,[20] though there are fragments that appear to contain the same text or some excerpt from it.[21] Other fragments appear to be basically the same or

18 An exception that proves the rule is found in the so-called Great Star List, an eclectic first-millennium list of astral bodies known principally from Assurbanipal's library, identified by Weidner (1959/1960) and edited most recently in a composite edition by Koch-Westenholz (1995: 187–205). In a list of "seven planets" (7 $^{\mathrm{mul}}$UDU.IDIM.MEŠ) the moon and sun ($^{\mathrm{d}}$30 *u* $^{\mathrm{d}}$UTU) appear first, followed by Jupiter ($^{\mathrm{d}}$*šul-pa-è*), Venus ($^{\mathrm{mul}}$*dil-bat*), and then "Wild Sheep" ($^{\mathrm{mul}}$UDU.IDIM, perhaps a distinct category?), Saturn ($^{\mathrm{mul}}$SAG.UŠ), Mercury ($^{\mathrm{d}}$UDU.IDIM.GU$_4$.UD), and Mars ($^{\mathrm{mul}_4}$*ṣal-bat-a-nu*), see Koch-Westenholz (1995: 200–201).

19 The first serious attempt to reconstruct the Ura star list is found in Reiner (1974), which is now updated by the Digital Corpus of Cuneiform Lexical Texts project, http://oracc.org/dcclt/, sub OB Nippur Ura 5.

20 CBS 6074+, Type I (tablet), see Reiner (1974: 93, 107–108).

21 3N-T 105, Type I (prism), see Reiner (1974: 96, 107–108); N 6115, Type II rev. (obv. not preserved), see Reiner (1974: 96, 107–108); 3N-T 688, Type II obv. (rev. OB Ura 4, stones), see Reiner (1974: 96, 107–108); type uncertain: N 1579, see Reiner (1974: 96, 108), CBS 6432 (http://cdli.ucla.edu/P231698).

attest to only slightly different versions of the text that either omit or rearrange a handful of entries.[22] Several other early second-millennium Ura star lists depart from the order and entries attested in Nippur; however, the sources are largely of unknown provenience.[23] Below I will look more closely at the later second-millennium versions of the Ura star list, but in anticipation of that discussion it is worth noting here that the so-called Middle Babylonian Ura tradition exhibits features that are similar both to what came before (Old Babylonian Ura) and to what followed (Standard Ura).

In the first-millennium at least two recensions are known for Ura 22, which in turn means that at least two recensions of the Ura star list are known:[24] a recension attested in Neo-Assyrian Ḫuzirīna and Late Babylonian Uruk[25] and a recension known from Assur that is either Middle Assyrian or early Neo-Assyrian in date.[26] To complicate the matter further, a first-millennium thematic lexical compendium found in Neo-Assyrian Nineveh and Neo-Babylonian Sippar overlaps in content with Ura 22 but has a different structure, additional entries (including a particularly lengthy star list) and sections (e.g., one that begins an = *šamû*, "sky = sky," and continues with various signs glossed in Akkadian with "sky," as well as various gods), and, confusingly, a catch line in the Sippar manuscript that is identical with the incipit of Ura 22 (kur = *šadû*, "mountain = mountain").[27] Finally, some of the Ura 22 entries, including star names, are found in the obscure lexical text mur-gud = *imrû* = *ballu*,

22 Entries omitted: CBS 10451, Type I frag., see Reiner (1974: 94, 108; cf. http://cdli.ucla.edu/P227627); YBC 16318, prism (probably not from Nippur), see Cohen (2005). Entries ordered differently: CBS 6429(+), Type II rev. (obv. not preserved), see Reiner (1974: 96, 107–108).

23 CT 44 46, see Reiner (1974: 137–138); CT 44 47, see Reiner (1974: 144); AO 6447, see Jean (1935: 172) and Reiner (1974: 133–134); OECT 4 157, see Reiner (1974: 136–137); OECT 4 161, see Reiner (1974: 143). FLP 2223 (http://cdli.ucla.edu/P460614) is a single-column extract with twelve stars (mul) on the obverse followed by various plant names (ú) on the obverse and reverse. The plants occupy a separate division of Ura in all periods during which the text is known, so these must be extracts that were combined for some other reason.

24 Reiner (1974: 30–31); a revised edition of first-millennium Ura 22 is being prepared by Y. Bloch and W. Horowitz.

25 Reiner (1974: 21); Gurney (1981/1982: 112, Pl. XVIII); von Weiher (1988: no. 114a); cf. Fadhil and Hilgert (2007).

26 Weidner (1959/1960: 112–113).

27 The incomplete tablet from Assurbanipal's library K 2035a + K 4337, edited by Reiner (1974: 54–56), appears to be a duplicate of IM 132506, an unpublished tablet from the Neo-Babylonian library found in situ in Sippar's Šamaš temple, Ebabbar. For a discussion of the contents of this compendium and its myriad textual problems, see Fadhil and Hilgert (2007).

which clearly has some textual relationship with the series Ura but is probably not simply its commentary, as is sometimes claimed.[28] Regardless, all first-millennium manuscripts are Sumerian-Akkadian bilinguals, a point that is significant for understanding the earlier history of the textual tradition.

Looking again at the early second millennium versions, with the exception of the entry mulmi-ši-iḫ-dpa-bíl-saĝ, "Flash/Flare(?) of (the god) Pabilsag", which contains the Akkadian term *mišḫum*, all of the astral bodies in OB Ura 5 bear Sumerian names. This focus on Sumerian star names is hardly surprising given that OB Ura is a unilingual collection that is only attested in fully Sumerian-Akkadian bilingual versions a few centuries later. However, the bias away from the vernacular and toward Sumerian points to an important role of scribal education in early second-millennium Babylonia: inculcating students with an idealized, socially constructed Sumerian worldview through learned taxonomies and a forged mythology, literature, and history.[29]

The text of the Ura star list follows a familiar structure known throughout the corpus of thematic lexical texts: first the general type, the classifier that governs what follows, mul, "star/constellation" (or perhaps "fine astral body/bodies"), followed by a range of constellations and planets, some now identifiable, others not, with an emphasis on the fixed stars. Only three mobile mul are named: Venus, Jupiter, and "wild sheep," muludu-til/idim,[30] which is later glossed with its Akkadian equivalent *bibbum*. The early Babylonian star list's place in the wider context of the composition locates it at a nexus of geographical knowledge: designations for fields, Babylonian toponyms of various kinds, mountains, water courses, wells, levees, and canals, then stars, followed by measuring ropes, ending with date palm leaves. Using a composite edition of the fifth division of the text (OB Ura 5), the star list occupies a mere 6 % of the text as a whole.[31] With such a modest list we are left to wonder whether students would have been instructed in the constellations' identification or were left to imagine what they were required to write and memorize, as was probably the case with some of the exotic and unfamiliar entries in the thematic lexical tradition, such as plants, animals, and, significantly, geographic designations such as city names, watercourses, and mountains. The short Ura star list likely imparted scribal

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28 Reiner (1974: 40–41); Frahm (2011: 250–253). Before the reading mur-gud was settled upon, the text was often referred to as ḪAR-gud in modern scholarship.

29 Veldhuis (2004: 58–62, 65–67).

30 For a discussion of the problem of whether to read the second sign TIL or IDIM, see Horowitz (1998: 152–153 with n. 5).

31 Following the composite edition from Berkeley's Digital Corpus of Cuneiform Lexical Texts: http://oracc.org/dcclt/, Old Babylonian, Thematic Word Lists, OB Nippur Ura 05.

knowledge of a well-known general type (mul, "astral body") but was not itself an astronomical text. It has long been appreciated that the principles used to structure the entries in the Ura star list were not astronomical,[32] just as the toponyms, mountains, and waterways found elsewhere in the same division of the text were not structured geographically.

Between the end of the First Dynasty of Babylon and the transmission of the lexical tradition throughout the Near East in the ensuing centuries, there is a lacuna in the data. During this hiatus the entire tradition of thematic lexical lists underwent a significant restructuring and expansion along fairly conservative lines—and it was this development that laid the groundwork for the expansion of the Ura tradition into its final standard form known in the first millennium. A section on business terminology was added to the beginning of the text as a whole, a version of which had existed separately in the Old Babylonian period (Sumerian incipit: ki-ulutin-bi-šè), and individual divisions were reorganized to accommodate new entries (Tab. 2.1). Turning to the star list, division thirteen of Middle Babylonian Ura (and later division twenty-two of the standard series) is known in at least two and as many as three versions in two formats, one unilingual Sumerian like its Old Babylonian precursor and the other bilingual Sumerian-Akkadian. No sources have yet been recovered from Babylonia or Assyria proper, but none of the extant manuscripts contain translations into a local vernacular or learned language other than Akkadian, such as Hittite, Hurrian, Ugaritic, or the like. The Appendix contains an edition of the Middle Babylonian Ura 13 star lists.

Six manuscripts are presently known. A unilingual format is attested in two manuscripts, one from Emar and one from Ras Ibn Hani (near Ugarit), leaving four Sumerian-Akkadian bilingual sources, two from Emar and two from Ugarit, including one exercise extract. Beyond the Akkadian translations of entries, the Emar tablets in bilingual format (Version 1) also contain a section on mountains (kur) that is not found in either Version 2 (Ugarit, bilingual) or Version 3 (Emar, unilingual), illustrating through macrostructural arrangement that these are not different formats of the same text but fundamentally different versions of the text, i.e., not simply a single text and its translation. Moreover, while the Akkadian translations are generally recognizably Babylonian, there is at least one local creative misreading of the text produced in Emar (Version 1) whereby the constellation $^{\text{mul}}$gu-la (Aquarius), Akkadian *rabû*, "Great One," was glossed with the divine name Ninkarrak, which is a name of the goddess Gula, usually written with the divine determinative, that is, $^{\text{d}}$gu-la,

32 Weidner (1957/1958); Hunger (2011).

not ^{mul}gu-la, and attested in the curricular god list found in Emar.[33] Furthermore, while there are lexical texts known from Ugarit, Emar, and Ḫattuša that incorporated full translations (Ugarit, Ḫattuša) or selective glosses (Emar) in other languages (Hurrian, Ugaritic, and Hittite), no copy of the Ura star list is preserved in a polyglot format. There are no star lists preserved in the lexical corpus from Ḫattuša, but a fragmentary section of the geographical list with fields (a-šà) is known,[34] which suggests that the lack of a star list is merely an accident of preservation.

In sum, the star lists embedded in the Babylonian lexical tradition appear to have undergone significant revision and expansion in comparison to what came before in the Old Babylonian period, but these developments seem to have taken place before the texts diffused into Syria and Anatolia. As a minor subsection of the lexical text Ura, the star list would have likely imparted knowledge of scribal conventions for representing the names of select heavenly bodies. If this is understood as astronomical knowledge, then it is at best the superficial knowledge of a rudimentary taxonomy. Furthermore, just as the early second-millennium Ura tradition appears to have functioned to socialize Old Babylonian apprentice scribes and imbue them with an imagined Sumerian identity, so too scribal acculturation in Syria (and probably Anatolia) would have included taking on the mantle of an identity that may well have been perceived as local but was learned through exposure to Babylonian literature.

In contrast to the Ura star lists' role in the scribal curriculum, what I am calling the embedded star lists shed light on a different facet of second-millennium astral knowledge, namely, its role in ritual behavior.

2.3 *Embedded Star Lists in the Second Millennium B.C.*

Outside the lexical corpus and its focus on education in Sumerian taxa and vocabulary, early Babylonian star lists are also found in ritual contexts. A few texts record offerings to astral deities, such as a short notice from Old Babylonian Tuttul in which various pairs of sheep and tables were offered to astral deities during different watches of the night.[35] However, my focus here will be

33 Emar Weidner God List: Arnaud (1987: no. 539:88′); cf. Rutz (2013: 167–172).

34 Reiner (1974: 170).

35 Krebernik (2001: 145–147, KTT 345). The tablet was found in Room L in Palace A. The astral bodies include Sin, Ninšulpa'e, *lêlum* ("night?"), *zappum* (the Pleiades), *balum* (Mars), Ú-⟨si$_4$⟩-an-na, *siḫrê* (?), and *nīrum* (the Yoke), among other fragmentary astral bodies. I am not persuaded by Krebernik's (2001: 146) suggestion that this short OB offering record has a direct relationship with an enigmatic incantation text from Assurbanipal's library, for which see Stol (1992: 251–253).

on a more circumscribed context associated with ritual practice: the religious texts commonly referred to as the prayers to the gods of the night, a designation based on the Akkadian rubric appended to the two major Old Babylonian manuscripts, *ikrib mušītim*, "prayer of the night". The group consists of three unprovenienced sources, all of which contain embedded star lists in which as many as ten astral bodies are called on by name to "be present" in the extispicy that was to follow:[36]

A 14 *ra-bu-tum i-li-i mu-ši-i-tim*
A 15–17 *na-wa-ru-um* $^{\mathrm{d}}$BIL.GI / *qú-ra-du-um* $^{\mathrm{d}}$*èr-ra* / *qá-aš-tum ni-ru-um*
B 16–17 *nam-ru* $^{\mathrm{d}}$BIL.GI *qú-ra-du er-ra* / *qá-aš-tum e-la-ma-tum*
C 12–13 *šam-ru* $^{\mathrm{d}}$BIL.G[I] / ⸢*qù*$^{?}$*-ra*$^{?}$*-du*$^{?}$ *ìr*⸣*-ra a-nu* $^{\mathrm{giš}}$PA[N ...]
A: Great gods of the night—
Shining (C: Furious) Girra, warrior Erra, (C: Anu$^{?}$), Bow, Yoke (B: Elamite-star; C: [...])

A 18 *ši-ta-ad-da-ru-um mu-uš-ḫu-uš-šu-um*
B 18 *za-ap-pu ši-ta-da-ru* MUŠ.ḪUŠ
C 14 [x x x] ⸢x x x x x⸣ [x (x)]
C (lacuna)
(B: Pleiades,) Orion, Serpent,[37]

A 19–20 $^{\mathrm{giš}}$MAR.GÍD.DA *en*$_6$*-zu-um* / *ku-sa-ri-ik-ku-um ba-aš-mu-um*
B 19 MAR.GÍD.DA ÙZ *ù* $^{\mathrm{d}}$*ku-sa-ri-ku*
Wagon, Goat, (B: and) Bison, (A: Horned-Serpent)—

A 21 *li-iz-zi-⟨zu-⟩ú-ma*
B r. 1 ⸢*i-lu mu-ši*⸣*-tim ra-bi-tim*
B r. 2 *i-zi-iz-za-nim-ma*
A: may they (i.e., great gods of the night in A 14) be pre⟨se⟩nt,
B: gods of the great night, be present for me,

36 Additions and variants are noted in the translation; note the following sigla: A = Erm. 15642, see Horowitz (2000: 195–198, pl. 1); B = AO 6769, see Dossin (1935); C = CBS 574, see Horowitz and Wasserman (1996); note also Wilcke (2007: 224–229); cf. George (2013: 1).

37 Horowitz and Wasserman (1996: 58) read this line: [x x x x x x] UR$^{?}$ [x x x x], "[……]-s[tar? …]." However, the traces could just as easily be read [x x x] ⸢x *muš*$^{?}$*-ḫu*⸣*-u*[*š*$^{?}$*-šu-um*] (collated).

A r. 1–3 ⸢*i-na*⸣ *te-er-ti e-ep-pu-*⸢*šu*⸣ / ⸢*i*⸣*-na pu-ḫa-ad a-ka-ar-ra-bu-ú* / *ki-it-ta-am šu-uk-na-an*
B r. 3 *i-na te-e-er-ti e-ep-pu-šu* / *ik-ri-bi a-ka-ar-ra-bu* / *ki-it-tam šu-*⸢*uk*⸣*-na*
A r. 4 24 MU.BI *ik-*⟨*ri-*⟩*ib mu-ši-tim*
B r. 5 24 *ik-ri-ib mu-ši-*⸢*tim*⸣

and in the extispicy I am performing, in the lamb (B: prayer) I am offering, place the truth!
Twenty-four (A: are its entries): prayer of the night.

Three points should be made about this early example of a textually embedded star list. First, the astral bodies listed all have Akkadian names, written either syllabically or logographically, and there is very little overlap with the OB Ura 5 (Sumerian) star list. Only a handful of star names are common to both,[38] but it should be kept in mind that the best-attested version of the OB Ura star list is from Nippur and other, still-fragmentary versions of the list are known, while the unprovenienced prayers were probably written somewhere other than Nippur. A second related point is that certain entries are scarcely known outside of this limited genre (e.g., *mušḫuššum*, *kusarikkum*, and *bašmum* as star names), perhaps indicating the existence of an alternate set of significant astral bodies that were not important in the Sumerian tradition and the Ura educational paradigm. Third, it is difficult to discern whether the variants among the sources in this group are merely textual variants (i.e., different textual and thus ritual traditions) or are also astronomical variants (i.e., different configurations, actual or idealized). In either case it is worth wondering what the named astral bodies are doing in these texts. Although the ritual setup of extispicy is generally well understood, the precise conceptual role here of the astral bodies is not at all obvious.[39] However their role is conceived, it seems likely that the efficacy of the ritual performance would depend on the diviner's ability to accurately address the gods of the night. Tied as it is to ritual performance, the formulation of the star list should reflect specific, practical astronomical knowledge. The final point relates to the geographic and diachronic transmission and transformation of the "prayer to the gods of the

38 These include: mul-mul / *zappu*, $^{\text{mul}}$mu-sír perhaps related to *nīrum*, $^{\text{mul}}$sipa-zi-an-na / *šitaddarum*, $^{\text{mul.ĝiš}}$mar-gíd-da / *e/iriqqum*, $^{\text{mul.ĝiš}}$pan / *qaštum*, $^{\text{mul}}$ùz / *enzum*, $^{\text{mul}}$elam / *elammatum*.

39 Steinkeller (2005: 16–17, 38–42) suggests that the astral bodies here acted as the (notional) celestial advocates on behalf of the client who solicited a divinatory query; cf. Fincke (2009a: 550–553).

night", versions of which were incorporated into a Hittite ritual text and various first-millennium ritual contexts beyond extispicy, such as the beginning of the anti-witchcraft incantation series *maqlû*.

Another embedded star list is found in an Akkadian recitation to the gods and goddesses of the night that appears a few centuries after the Old Babylonian prayers but in a radically different context: Hittite Anatolia. Known from only two copies found in Ḫattuša, one of which is quite fragmentary, the text contains a ritual to avert the danger and distress posed by an angry personal god.[40] What is unusual about this text is that its ritual procedure appears to have been translated from Akkadian into Hittite, but it retained four recitations in Akkadian, the use of which was presumably important to the incantations' efficacy.[41] The last section of the main manuscript (rev. 32–48) contains one such lengthy Akkadian passage in which a number of astral bodies are named:[42]

r. 41 *er-bá-nim-ma* DINGIR *mu-ši-ti* $^{\text{d}}$IŠTAR *mu-ši-ti*
r. 42 *qa-aq-qa-ad* TÙ.MU.UL.LA TU.ŠI.ŠI TÙ.MU.KU.U.RA TÙ.MU.KAR.TÙ
r. 43 $^{\text{mul}}$*a-ḫa-ti* $^{\text{mul}}$DUG.DUG $^{\text{mul.d}}$DUMU.ZI $^{\text{mul.d}}$*nin-gi*$_5$*-zi-da* $^{\text{mul}}$*e-ku-e*
r. 44 MUL.MUL $^{\text{mul}}$*is le-e* $^{\text{mul}}$*ši-pa-zi-a-na* (= SIPA.ZI.AN.NA) (erasure) $^{\text{mul}}$*ka*$_4$*-ak-zi-zi* (= KAK.SI.SÁ)
r. 45 $^{\text{mul.giš}}$PAN $^{\text{mul}}$GÍR.TAB $^{\text{mul}}$TI$_8$$^{\text{mušen}}$ $^{\text{mul}}$KU$_6$ $^{\text{mul}}$*ša-am-ma-aḫ* (= ŠIM.MAḪ)
r. 46 $^{\text{mul}}$*ka*$_4$*-ad-du-uḫ-ḫa* $^{\text{mul}}$MÁŠ $^{\text{mul}}$MAR.TU *šu-ú-ut* $^{\text{d}}$*é-a iz-zi-za-ni*
r. 47 *šu-ú-ut* $^{\text{d}}$*é-a nap-ḫar šu-ú-ut* $^{\text{d}}$*a-ni* (erasure) *ru-ṣá-ni šu-ú-ut* $^{\text{d}}$*en-l*[*íl*]
r. 48 *gi*$_5$*-me-er-ku-nu* ZU*-ra-ni me-ḫe-er-ku-nu tá-mì-tù*

Enter, god(s) of the night, goddess(es) of the night!
Qaqqad,[43] (stars of the?) south (TUMU.U$_{18}$.LU), north (TUMU.SI.SÁ), east (TUMU.KUR.RA), west (TUMU.MAR.TU),[44]

40 Weidner (1922: pls. 23–25, no. 47); Beckman (2007).

41 Schwemer (2013: 158–159).

42 For an edition, see Beckman (2007: 73, 75–76). The star list is discussed by Reiner and Pingree (1981: 2–3), Lambert (1987: 94–96), and Friedrich et al. (1991–2004: 437–438).

43 As Krebernik (2006) notes, a constellation or deity Qaqqad is so far unknown outside of the text under discussion. If transliterated correctly here, it could relate to Akkadian *qaqqadu*, "head", and so may pertain to a personal god, i.e., the god "of the head" (*qaqqadu*, *rēšu*), see van der Toorn (1996: 76–77); cf. the difficult reading *ka*$_4$*-ak-ka*$_4$*-ad* proposed early on by Meier (1939: 197–198).

44 Phonetic, unorthographic writings predominate in this line, the most obscure of which is KAR.TÙ for MAR.TU (cf. $^{\text{mul}}$MAR.TU in line r. 46), which is perhaps based on some obscure

Sister(?),[45] DUG.DUG(?),[46] Dumuzi (Saturn), Ningišzida (Mercury), Field (Pegasus),
Stars (Pleiades), Bull's Jaw (Hyades), True Shepherd of Anu (Orion), Arrow (Sirius),
Bow (Canis Major?), Scorpion (Scorpius), Eagle (Aquila), Fish (Pisces Austrinus), Swallow(?) (Pisces W?),
Open-Mouthed/Panther(?) (Cygnus+Cepheus?),[47] Goat(-Fish) (Capricorn),[48] Western (Perseus). Those (stars in the path) of Ea, stand by me!

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connection in the syllabary, e.g., GAR_7(MAR) versus GAR_{14}(KAR), cf. Edzard (1989: 433–434). The orthography of three of the four cardinal points seem to suggest that the Sumerian reading tumu (sometimes read tum_9 or tu_{15}), "wind", for the sign IM was still known in Ḫattuša in the later second millennium B.C. The first-millennium parallel (K 2315+ obv. 40) explicitly indicates that it is the stars (MUL) seen in the four cardinal directions that are meant, see Oppenheim (1959: 283).

45 Weidner (1914: 18) was the first to identify [mul]*a-ḫa-ti* as Mars, followed by Beckman (2007: 76) without comment. However, the epithet of Mars is usually *aḫû*, not *aḫâtu*, see Reynolds (1998: 351). The term *aḫâtu* should derive from the noun *aḫītu*, "misfortune, (out)side" etc. (CAD A/1 189–192) or from the adjective *aḫû*, "strange, hostile" (CAD A/1 210–213), but in the feminine plural. In contrast Lambert (1987: 95), followed by Kurtik (2007: 36), suggests reading *aḫāti*, "sister", perhaps in reference to Ištar (sister of Šamaš), i.e., Venus.

46 Weidner (1914: 18) first proposed translating [mul]DUG.DUG as "Jupiter," based on its alleged equivalence with MUL DÙG.DÙG, thus *kakkab ṭābāti*, "star of good things," which to my knowledge is without parallel; Beckman (2007: 76) translates "Jupiter" without further comment. In contrast, Lambert (1987: 94–95) read this name *kà-kà*, i.e., the god Kakka, the vizier of Anu/Ištar, but in the present source the signs are clearly DUG, not GA (Beckman 2007: 73; also collated from photo). I know of no other attestation of this star/constellation name other than what is found in the first-millennium parallel to the present text, K 2315+, which appears to have [mul]⸢*kà*⸣-*kà*, Oppenheim (1959: 282); cf. Kurtik (2007: 142).

47 Presumably following Weidner (1957/1958: 73), Beckman (2007: 73) sees [mul]*ka₄-ad-du-uḫ-ḫa* as a phonetic writing for KA.DÙ.A, by which is meant the equivalent of the Old Babylonian star name now read [mul]saĝ-dù-a; however, it seems more likely that [mul]*ka₄-ad-du-uḫ-ḫu* is a writing of [mul](UD.)KA.DU_8.A, see Kurtik (2007: 520–527). Unlike DÙ, DU_8 has /ḫ/ as its *Auslaut*, i.e., DU_8 = DUḪ. Compare the entry *kaduḫḫû*, "raging (lit. with open mouth)" (CAD K 35), which is glossed with *nā'iru*, "raging, roaring, howling," in the first-millennium synonym list *malku* = *šarru*, see Hrůša (2010: 34–35, 201–202). Finally, note the enigmatic constellation [mul]ka-an-du_8 = *pāṭiru* attested in the lexical corpus from Emar and Ugarit (see Appendix below, with n. 84).

48 Beckman (2007): Lyra.

> Those (stars in the path) of Ea (and) all those (stars in the path) of Anu, help me! Those (stars in the path) of Enl[il], all of you, … me(?)[49] your answer! A query[50] (*tāmītu*).

This embedded star list raises all the same questions as the Old Babylonian texts circulating in the south a few centuries earlier but adds the significant issue of its Hittite context and the problems posed by a literature that was imported and translated for local consumption. In addition this text contains what is presently the earliest reference to the stars in the paths of Anu, Enlil, and Ea, but the relationship between the plea at the end of the text and the preceding star list is unclear. The inclusion of the rubric *tāmītu*, "query," at the end of the text suggests that the star list was, like its Old Babylonian predecessor, originally associated with an oracular query and later adapted to another ritual context. However, it is unclear whether this process of textual amalgamation took place in Babylonia or Anatolia.

Whereas the star lists had practical pedagogical and ritual taxonomy as their principal concern, celestial divinatory literature focused on describing and interpreting the behavior of astral bodies.

3 Celestial Divination: Transmission, Adaptation, and Appropriation

Although omen compendia as a genre originate in the Old Babylonian period, collections of celestial omens in the early second millennium B.C. are nevertheless quite rare. Only ten manuscripts are presently known, seven of which deal with lunar eclipses, two of which contain solar omens, leaving one tablet with miscellaneous meteorological phenomena.[51] Of these tablets only one was properly excavated (at Mari), though it has been suggested that the others came from sites in Babylonia such as Sippar and Dūr-Abi-ešuḫ. Although it has been published only in part, it appears that there are no real duplicates in this corpus, and the schemes the texts employ are standard ones found in the genre, for example, the prime importance of the Standard Babylonian calendar, which

49 Compare *šu-ut* ^{d}50 *na-as-ḫu-ra-ni šu-ut* ^{d}*é-a gi-mir-ku-nu pu-uḫ-ra-ni*, "Turn to me, those (stars in the path) of Anu! All of you gather around me, those (stars in the path) of Ea!", in the Neo-Assyrian parallel K 2315+, see Oppenheim (1959: 284). Lambert (2007: 13) translates ZU-*ra-ni* here with "guard", presumably taking the word as an apocopated form of (or scribal error for) ⟨*ú-*⟩*ṣú-ra-ni*.

50 Following Lambert (2007: 13).

51 Rochberg (2006); George (2013: 70–84).

was itself first consolidated in the Old Babylonian period, as well as principles such as the watches of the day and night. Because the manuscripts are mostly unprovenienced and lack scribal colophons, these early celestial omen compendia's contexts of circulation are extremely difficult to articulate with any precision. No early second-millennium observational reports are known.[52]

Turning to the later second millennium B.C., the situation with the compendia of celestial omens is rather different from what is evident in the star lists from the lexical corpus or those embedded in ritual recitations, and the sources are more dispersed, numerous, and varied.[53] Some six omen compendia (plus about fourteen fragments) are known from Emar that deal primarily with lunar, solar, and stellar/planetary phenomena;[54] in Ugarit only two compendia (both solar omens) are attested in the syllabic script (that is, in Akkadian),[55] while one lunar omen compendium found in nearby Ras Ibn Hani was written in the local language and alphabetic cuneiform script.[56] Numerous sources were found in the Hittite capital, including tablets with text in Akkadian, Hittite, and Hittite-Akkadian bilinguals.[57] The topics of the tablets include lunar omens (ca. 40 sources[58]) pertaining to eclipses, the "horns" of the lunar crescent, and

52 The exceptions are controversial, e.g., the solar eclipse mentioned in the so-called Mari Eponym Chronicle, see Glassner (2004: 162). As far as I know there is no reason to doubt the veracity of the claimed observation of the sun darkening (necessarily an eclipse?), rather the controversy stems from the ways in which this notice has been used in discussions of absolute chronology (e.g., Pruzsinszky 2009: 75–79, 154–156). In any case, it is an observation that made its way into a literary yet practical textual genre, that is to say, literary in the sense that an eponym list of any significant length was transmitted. Discussion of the so-called Venus Tablet of Ammi-ṣaduqa is even more contentious, since its manuscripts are known only from the first millennium B.C., see Pruzsinszky (2009: 70–72).

53 Hunger and Pingree (1999: 8–12).

54 Arnaud (1987: nos. 650–665); Rutz (2013: 229–240, 526–527).

55 RS 23.038 and RS 22.226 (+) RS 22.230, see Arnaud (2007: 51–54, nos. 7–8); the short text on RS 34.172 mentions the moon and sun (as well as the term *tar-ba-ṣa*, "halo"), but it is not obvious that the text is divinatory, see Lackenbacher (1991: 88–89, no. 44).

56 RIH 78/14, see Pardee (2000: 859–871, 1294 fig. 32; 2002: 142–144).

57 Laroche (1971: 91–93), with significant updates and modifications proposed by both Riemschneider (2004: 4–6 and *passim*) and S. Košak and G.G.W. Müller's site hethiter.net/CTH/, accessed September 10, 2014; cf. Güterbock (1988), Koch-Westenholz (1993), and Fincke (2009c).

58 The fragmentary state of many manuscripts, the existence of a number of collective tablets or *Sammeltafeln*, and differences of opinion among Laroche, Riemschneider, and Košak and Müller on generic classification make it difficult to come to firm manuscript counts without considering each source individually.

miscellaneous lunar phenomena, including what appears to be a Hittite translation of the mythological introduction to the divinatory series *Enūma Anu Enlil*, solar omens (ca. 25 sources), and stellar phenomena (ca. 16 sources). Interestingly, enough sources are preserved for both the lunar and the solar omen collections to see actual parallels between the Akkadian and Hittite versions of the respective texts.

Looking across the corpora from these three prominent sites, I suggest that there are three types of textual transmission at work here. Type 1 consists of the reception and local reproduction, perhaps with minor adaptation, of teaching tools (lexical texts for certain; omen compendia less so) and prestige objects (tablets with esoteric knowledge which may therefore have been exotica). Reception problems associated with this type include identifying constellations from Babylonian names, understanding technical terminology of astral phenomena in the omen compendia, and assimilating pronounced Babylonian features in the texts, such as the Babylonian calendar or names for the cardinal directions as structural or schematic elements in the organization of the protases of the omen compendia. In the omen apodoses there are likewise references to the Babylonian political universe, for example, "king of Akkad," or the schematic use of Elam-Subartu-Amurru-Akkad.

Unfortunately there are no astrological reports from this period that might illustrate ancient scholars working with a written tradition, and this has led some modern scholars to assume that the so-called Mesopotamian texts as a group were set off and isolated from local knowledge practices. Emar lunar omens exemplify these issues. One tablet uses the calendrical scheme and misplaces one of the months, inserting the twelfth month where the fourth month should be.[59] However, two other tablets seems to show a deeper knowledge of the text: two copies exist, one written in an older style commonly referred to in modern parlance as the "Syrian" or "Conventional" style, which exhibits a distinctive ductus and orthography, and its duplicate written in the later style now referred to as "Syro-Hittite" or "free-form", which appears in tablets that date to the site's final period of occupation. At least three basic scenarios could account for the presence of duplicates: (1) the presence of duplicates is a random accident and there is no relationship between the copies beyond their textual content; (2) the older (Syrian) copy of the text was reproduced in an updated script and orthography by an scribe in Emar familiar with its contents; or (3) for whatever reason a non-local (Babylonian? Hittite?) scribe saw the older (Syrian) tablet and either used it as the *Vorlage* to produce an

59 Arnaud (1987: no. 652).

updated copy or sought out an updated version of the same text from which the later manuscript was copied. I find the first scenario, random chance, unlikely because the two manuscripts were found in a single, albeit disturbed archaeological deposit (Emar's "Temple" M_1), and the second and third scenarios suggest a level of comprehension beyond just basic sign or word recognition. That is to say, updating sign forms and in particular updating specialized orthography requires a deep knowledge of a text's contents.[60]

The second type of transmission, Type 2, consists of reception of the texts, followed by local reproduction with local translation. Hittite examples of this phenomenon abound, and, as Theo van den Hout has pointed out, these sources existed in multiple copies, with duplicates as well as parallels between Akkadian copies and what were presumably their Hittite translations, attesting to their active life in the archives of the Empire period.[61] The fact that the Hittite versions were translations of Babylonian texts is evident when individual entries are compared side-by-side.[62] A number of Hittite texts that use the calendar as a scheme tend to simply number the months 1, 2, 3, etc. rather than use the Babylonian month names that are typically found in the Akkadian versions.[63] Take for example an entry pertaining to lunar eclipse in the eighth month, following EAE 21:[64] "If an eclipse occurs on the 21st day (month VIII), the king's troops will revolt against him, and he will be handed to the enemy; variant: attack of Elam; variant: attack of locusts." A version from Emar preserves only the last two apodoses: "Attack of Elam and locusts will be present in the land."[65] The Hittite version reads: "If on the 21st day the moon dies (= is eclipsed), Elam, death."[66] The texts here exhibit sufficient correspondence

60 Arnaud (1987: no. 651); Rutz (2013: 41, 234–236, 526). The orthography found in the Nippur solar omen compendium that was copied from a original from Susa presents a different manifestation of a similar phenomenon, see Rutz (2006).

61 van den Hout (2005; 2008).

62 The most lucid exposition of translation techniques is by Riemschneider (2004: xli–xlvii), who also draws attention to poorly known designations for parts of constellations in Hittite; on the parts of the "Wagon", see Riemschneider (2004: 300–301).

63 For example, KBo. 34.121 (Hitt.) // KUB 4.63, Riemschneider (2004: 50, 165); KUB 8.2+ obv., Riemschneider (2004: 69); KBo. 34.121, see Riemschneider (2004: 165); KUB 8.5 (+) KBo 34.114 (curiously months 12 and [1]3), see Riemschneider (2004: 74–75). The formulation of the Akkadian text of KBo. 13.27 is unusual on this count.

64 Rochberg-Halton (1988: 244).

65 Arnaud (1987: no. 652: 45).

66 Koch-Westenholz (1993: 246); Riemschneider (2004: 66, 68, 211). The apodosis is laconic and thus unclear without the benefit of Akkadian duplicates.

across the versions (the Hittite version, an Akkadian version from Emar, and the entry in first-millennium *Enūma Anu Enlil* Tablet 21) to view the Hittite text as dependent on some Babylonian original. However, the situation is hardly monolithic. In one particularly famous instance a Hittite translation actually replaces "Akkad" with "Ḫatti" in its apodosis, shifting the Babylonian-centered cosmos to suit local needs.[67] Another text appears to translate "the man of Subartu" with "the Hurrian" (LÚ ^{kur}ḪUR-*la-aš*), a designation that is unknown in divinatory texts from Mesopotamia proper.[68]

The final transmission type is perhaps the most interesting because it is the most indirect. Like Type 2, Type 3 may rest on reception and local translation, but it may also represent local innovation inspired by the formal characteristics of the Babylonian tradition. Here the most significant case is Ugarit and its immediate environs, where there is evidence of what looks to be an original divinatory literature composed in the local language and its alphabetic script and inspired by Babylonian formulations, but not translated from any known Mesopotamian original. The first three entries on the obverse of the Ugaritic lunar omen compendium read as follows:[69]

1 ⌜*h*⌝*m . b ḥd*[*ṯ*] *. y*[x] ⌜. x⌝ [x (x)] ⌜*r*⌝*šn . ykn*
2 *hm . yrḫ . b* ⌜*ʿl*⌝[*y*]⌜*h*⌝ *. w pḥm*
3 *nʿmn . y*⌜*kn*⌝[(x)]*h*
4 [*hm .*] ⌜*yr*⌝*ḫ . b ʿlyh .* ⌜*yr*⌝*q*
5 [...] ⌜*b*⌝*hmtn . tḫlq*

If at the time of the new moon [...], there will be [po]verty.
If the moon, when it rises, is red, /there will be prosperity.
[If] the moon, when it rises, is yellow-green, /[...] the cattle will perish.

In Babylonian tradition it is the visible characteristics of the moon at first appearance that are most significant, usually not its appearance as it simply rises. On the reverse the tablet ends with the following entries:

r. 12′ [*hm .*] *ṯlṯ . id . ynphy . yrḫ . b yrḫ . aḫrm*
r. 13′ [x x]*lt . mẓrn y*⌜*l*⌝*k*
r. 14′ [*hm .*] ⌜*k*⌝*bkb . yql . b ṯlṯm . ym . mlkn .* ⌜x x x⌝ [...]

67 Fincke (2004: 220, 222, 235–236); Riemschneider (2004: 103–106).

68 Riemschneider (2004: 39–40, 108, 216).

69 RIH 78/14, see Pardee (2000: 859–871, 1294 fig. 32; 2002: 142–144).

> [If] three times a moon is seen in a month and thereafter /[…], there will be rain.
> [If] a star falls on the thirtieth day, the king […].

What is meant by "three times" here is unclear. Perhaps it means the first and last sighting of the lunar crescent along with the full moon, or it could be an imaginable but, to us, astronomically impossible three "first" sightings of the waxing lunar crescent. The falling star at month's end in the final omen exhibits a common construction in which a lunar event (the 30th day of the month) provides the context in which another portentous astral event occurs. In any case, the protasis-apodosis structure and basic contents suggest an understanding of some version of the Babylonian textual tradition, which, because of the use of the local language and script, has all but completely fallen from view. The central outstanding and ultimately unanswerable question presented by oblique (Type 3) transmission is whether or not local compositions such as this were translated from Babylonian originals that are not preserved in the archaeological record.

There is reason to be optimistic that Ugaritic astronomical knowledge was more than just passive reproduction and translation of Babylonian lore: the only astrological report I am aware of from this period is a short Ugaritic text found on a small tablet recovered from somewhere in the western part of the royal palace in Ugarit.[70] The text reads: (obv.) *b ṯṯ . ym . ḥdṯ / ḥyr . ʿrbt / špš* ⸢.⸣ *ṯǵrh / ršp /* (rev.) ⸢*w a*⸣*dm* ⸢. ⸣*tbqrn / skn*, "During the six days of the new-moon festival of (the month of) Ḥiyyāru, the sun (Šapšu) set, her gatekeeper being Rašpu.[71] The men (?) shall seek out the governor." The crux of this report is the precise astronomical interpretation of the phrase *ṯǵrh ršp*, which is epigraphically, lexicographically, and grammatically unproblematic. The cryptic final two lines of the text are also difficult and may be akin to an omen apodosis (i.e., a socio-political correlate of the observed sign), or it may provide an instruction, a suggested course of action to interpret or manage the observed astral phenomenon. Alternatively, the last lines may be translated: "They shall seek out the liver(s);[72] danger(?)," which would suggest a connection between the observation of a significant astronomical event and the practice of another form of divination well known in Ugarit, namely,

70 RS 12.061, see Pardee and Swerdlow (1993); Pardee (2000: 416–427, 1271 fig. 9; 2002: 131–132).

71 The divine name Rašpu or Rašap may refer to Mars.

72 Reading ⸢*kb*⸣*dm* instead of ⸢*w a*⸣*dm*, which itself is problematic.

extispicy. In any case, the contrast with Babylonian lexical and divinatory texts could not be more stark: here we see not transmitted traditions of knowledge, but rather local practice.

4 Conclusion

In each second-millennium context in which astral texts are found, the star lists and omen compendia fit into a wider economy of knowledge production and practice, including lexical texts, incantations, rituals, and divinatory lore. The so-called Temple M_1 library belonging to Emar's diviners contains a wider array of scholarly textual genres, only a handful of which relate to astral knowledge. The presence of duplicates as well as translated parallels of astral omens in the archives of the Hittite capital suggest that these texts, unlike other Babylonian divinatory genres had an active life in the Hittite court.[73] The unilingual Ura star list and Ugaritic lunar omen compendium were both found in close proximity in the queen's residence in Ras Ibn Hani,[74] while the single second-millennium report (RS 12.061) came from the royal palace in Ugarit proper. Other star lists and compendia were found distributed across a handful of different non-royal but nevertheless elite domestic archives. While written knowledge is by its very nature a rather restricted kind of knowledge in the ancient Near East, the sources are spread across a wide enough variety of sites and contexts to appreciate the distinctive contours of astral knowledge in each case.

Let me conclude by revisiting the question of the astronomical content of the written forms of astral knowledge in the later second millennium Near East. Looking at the corpora of lexical texts and divinatory collections, it would seem that cuneiform scribes and scholars outside of Babylonia learned the nomenclature of Babylonian celestial taxonomy and mastered the basic textual schemes of lunar and solar divination in particular; divinatory texts about stars and planets are scarcely known, though it should be noted that they are not well attested in Babylonia or Assyria in this period either. The other limits on

73 For example, one manuscripts contains as many as five omens in Hittite, two of which are clearly lunar, on the left edge of a fragmentary tablet with Hittite KIN and MUŠEN *ḪUR-RI* oracles concerning royal purity, see van den Hout (1998: 194, 208–211, 214–217) and Riemschneider (2004: 93–94).

74 RIH 78/14 and RIH 77/3+ were found near to where room VII opens onto courtyard II, see Bounni et al. (1981: 288–291, fig. 49, 294–295, fig. 54) and Bounni et al. (1998: 93–94, 116–117, figs. 4–4bis).

the exported text corpus are telling: no mathematical problems or non-lexical (Ura) lists of stars have survived outside of Babylonia and Assyria, with the exception of the "prayer to the gods of the night" found in Ḫattuša. However, the existence of translation literature and, perhaps, original compositions of celestial lore speak to an active engagement with the received tradition.

Appendix: Star Lists from the Middle Babylonian Ura 13 Tradition

Middle Babylonian Ura 13 Star List, Version 1 (*Emar, Ugarit*)

A	Msk 74115+[75]
B	Msk 74187 rev.[76]
RIH	RIH 77/3+ rev.[77]
RS_2	RS 34.132 (exercise extract)[78]

A vi 1 [x x x] *i-ki* BU [ ]
[…] … […]

A vi 2 [mu]l : *ka-ak-k*[*a-bu*]
[sta]r : sta[r]

A vi 3 [mul-m]ul : *sa-ap-pu*
[Star]s : Pleiades

A vi 4 [mul-m]ul : *ka-lu-tu₄*
B (lacuna)
[Star]s : Kidney

A vi 5 [^mul^dil-bat] : *dì-il-bat*
B 1′ ⸢mul⸣[(x)] ⸢x⸣[
[Venus] : Venus

75 Arnaud (1985: 287–288), edited by Arnaud (1987: 151, no. 559: 149′–184′); cf. Rutz (2013: 201–202, 508).

76 Arnaud (1985: 461) edited by Arnaud (1987: 151, no. 559: 149′–184′); cf. Rutz (2013: 201–202, 508).

77 Arnaud and Kennedy (1979: 323–324, pl. VIII, 3).

78 André-Salvini (1991: 120, no. 60, 196, pl. XVI, p. 205, pl. XXV).

A vi 6	[$^{\text{mul}}$gu-l]a : *ni-ik-ka-ra-a*[*k*]
B 2′	$^{\text{mul}}$gu-la : ⸢*ni*$^{?}$-*x*⸣-[
	[Great O]ne : Ninkarrak
A vi 7	[$^{\text{mul}}$sipa-e-n]e : *ti-ša-at-ta-lu*
B 3′	$^{\text{mul}}$sipa-e-ne : *ti-ša*-⸢*at*⸣-[
RIH v	(lacuna)
	Shepherds : Orion[79]
A vi 8	[$^{\text{mul}}$x x x d]u$^{?}$: ki-kéš-da : *ni-ru-u*
B 4′	$^{\text{mul}}$e-mu-un-du-ki-kéš-da : *n*[*i-ru*]
RIH vi 1	⸢$^{\text{mul}}$⸣e-mu-ki-k[éš$^{?}$-d]a$^{?}$
	... : Yoke[80]
(ruling?)	
A vi 9	[$^{\text{mul}}$amar]-utu(ERIM) : *ma-ru-du-uk*
B 5′	$^{\text{mul}}$amar-utu(ERIM) : *ma-ru-du-uk*
RIH vi 2	$^{\text{mul}}$mar-ru-u[d$^{?}$-]⸢(x?)⸣
	[Mard]uk[81] : Marduk
A vi 10	[$^{\text{mul}}$šul-p]é-en : *šul-pè*
B 6′	$^{\text{mul}}$šul-pé-en : *šul-pè*
RIH vi 3	$^{\text{mul}}$šul-pè-[e]n$^{?}$
	Šulpa’e : Šulpa’e[82]
A vi 11	[$^{\text{mul}}$tir]-an-na : *ma-an-za-ta*
B 7′	$^{\text{mul}}$tir-an-na : *ma-an-za-ta*

79 The otherwise unknown, *tišattalu* is preserved in both sources and is probably a metathesis of the expected Akkadian *šitaddalu*; interestingly the metathesis is phonetic, not graphic.

80 For various writings and Akkadian glosses of $^{\text{mul}}$mu-BU-kéš-da, see CAD N/2 261a sub *nīru* lex.

81 The sign used to write Marduk’s name is distinct from the typical UD sign and looks more like ERIM, but it must be kept in mind that the two signs can be very close in appearance in the second millennium.

82 On orthographies of the divine name Šulpa’e, including *šu-ul-pé* in a lexical text from Ḫattuša (ká-gal = *abullu*, Kagal Bo. B), and astral associations with Jupiter, see Delnero (2012: 284, 286). I am not aware of any other writings of Šulpa’e that end with the sign EN.

RIH vi 4 $^{mul.d}$tir-ra-an-⸢na⸣
[Rain]bow : Rainbow

A vi 12 [^{mul}ni]n-si$_4$-an-na : *il-tar* ⟨*ka*⟩*-ka-bi*
B 8′ ^{mul}nin-si$_4$-an-na : *il-tar ka-ka-bi*
RIH vi 5 $^{mul.d}$nin-si$_4$-an-⸢na⸣
Brilliant [La]dy of Heaven : goddess/Ištar of the ⟨s⟩tar(s)

A vi 13 [(^{mul})]dil-bat : *il-tar ka-ka-bi*
B 9′ dil-bat : *il-tar ka-ak-ka-bi*
RIH vi 6 ^{mul}dil-bat ⸢(x?)⸣
Venus : goddess/Ištar of the star(s)

A vi 14 ⸢^{mul}⸣eridu^{ki} : *e-ri-du$_4$*
B 10′ ^{mul}eridu^{ki} : *e-ri-du$_4$*
RIH vi 7 ^{mul}eridu^{k}[^{i}]
Eridu : Eridu

A vi 15 ^{mul}en-te-na-bar-ḫ̮um ⸢:⸣ MUL *ḫ̮a-ba-ṣi-na-nu*
B 11′ ^{mul}en-te-na-bar-ḫ̮um$^{!}$(Ḫ̮UŠ) : MUL *ḫ̮a-ba-ṣi-na-*⸢*nu*$^{!}$⸣
RIH vi 8 $^{mul.d}$en-de-na-ba[r$^{?}$-ḫ̮u]m$^{?}$
Shaggy Winter : Star of the Mouse-like one

A vi 16 ^{mul}im-šu-rin-munus-ús-KA$^{?}$-DA$^{?}$-ta$^{!}$(UŠ)-e-ne MUL⸣ *ti-nu-ur al-*[*ma-na-a-ti*]
B 12′ ^{mul}im-šu-rin-munus-ús-RU$^{?}$-DA$^{?}$-ta-e-ne ⸢:$^{?}$ MUL⸣ *ti-n*[*u-ur*
RIH vi 9 ⸢^{mul}⸣im-šu-rin-KU$^{?}$-⸢x⸣-[(x)]-⸢e⸣-ne
Oven of …[83] : Star of the W[idows'] Oven

(ruling)

A vi 17 ^{mul}mar-gíd-da : *i-ri-iq-qu*
B 13′ $^{mul.giš}$mar-gíd-da : *i-ri-iq-qu*
RIH vi 10 ⸢^{mul}mar-gíd-da$^{?}$⸣
Wagon : Wagon

83 Clearly garbled in the Syrian tradition, this entry corresponds with Old Babylonian ^{mul}im-šu-rin-na-nu-mu-(un)-kuš-e-ne and first-millennium ^{mul}im-šu-rin-na-nu-kúš-ù-e-ne = *kakkab tinūri* (var.: *tinūru*, both for *tinūr*) *almanāti*, "Star of the Widows' Oven" (CAD T 420b sub *tinūru*).

A vi 18	⸢$^{\text{mul}}$⸣ùz : *en-zu*	
B 14′	$^{\text{mul}}$ùz : *en-zu*	
RIH vi 11	[$^{\text{mul}}$ù]z$^{?}$	
	Goat : Goat	
A vi 19	$^{\text{mul}}$pan : *qa-al-tu*$_4$	
B 15′	$^{\text{mul}}$⸢pan⸣ : *qa-al-tu*$_4$	
RIH vi	(lacuna)	
	Bow : Bow	
A vi 20	$^{\text{mul}}$gag-si-sá : *ša-ku*$_8$*-du*	
B 16′	$^{\text{mul}}$gag-si-sá : *ša-ku*$_8$*-du*	
	Arrow : Arrow	
A vi 21	$^{\text{mul}}$gag-ú-tag-ga : *ši-il-ta-ḫu*	
B 17′	$^{\text{mul}}$gag-ú-tag-ga : *ši-il-*⟨*ta-*⟩*ḫu*	
	Arrow : Arrow	
A vi 22	[$^{\text{mu}}$]$^{\text{l}}$maš-tab-ba : *tu-ʾu-ú-mu*	
B 18′	$^{\text{mul}}$maš-tab-ba : *tu-ʾu-ú-mu*	
	Twins : Twins	
A vi 23	[$^{\text{mu}}$]$^{\text{l}}$ĝír-tab : *zu-qì-qí-pu*	
B 19′	$^{\text{mul}}$ĝír-tab : *zu-qì-qí-pu*	
	Scorpion : Scorpion	
A vi 24	[$^{\text{m}}$]$^{\text{ul}}$uga$_{\text{x}}$(Ú.NAGA)$^{\text{mušen}}$: *e-ri-bu*	
B 20′	$^{\text{mul}}$uga$_{\text{x}}$(Ú.NAGA)$^{\text{mušen}}$: *e-ri-bu*	
RS$_2$ 1	[$^{\text{mul}}$uga(?)]⸢$^{\text{mušen}}$⸣	⸢MIN$^{?}$⸣ MIN [
A/B	Raven : Raven	
RS$_2$	[Raven(?)]	ditto(?) ditto(?) [
A vi 25	[$^{\text{m}}$]$^{\text{ul}}$ti$_8$$^{\text{mušen}}$: *e-ru-u*	
B 21′	$^{\text{mul}}$ti$_8$$^{\text{mušen}}$: *e-ru-u*	
RS$_2$ 2	[$^{\text{mul}}$]⸢ti$_8$⸣$^{\text{mušen}}$	⸢*gi*$^{?}$*-ri*$^{?}$⸣*-ti* ⸢*e*$^{?}$⸣[*-ru-u*(?)
A/B	Eagle : Eagle	
RS$_2$	Eagle (pronounced) *giriti*(?) E[agle(?)	
A vi 26	[$^{\text{m}}$]$^{\text{ul}}$udu-til : *bi-i-bu*	
B 22′	$^{\text{mul}}$udu-til : *bi-i-bu*	

RS$_2$ 3	⸢$^{\text{mul}}$⸣udu-til	⸢*u*$^?$⸣*-tu-ta-l*[*i*$^?$] ⸢*be-eb*$^?$*-bu*$^?$⸣
A/B	Wild Sheep : Wild Sheep	
RS$_2$	Wild Sheep (pronounced) *ututali* Wild Sheep	
A vi 27	$^{\text{mul}}$ka-an-du$_8$: *pa-ṭí-rù*	
B 23′	$^{\text{mul}}$ka-an-du$_8$: *pa-ṭí-ru*	
RS$_2$ 4	[$^{\text{mul}}$]gá-na-an-du$_8$-ḫi-a	*gá-na-na-*⸢*du*$^?$*-x*⸣ MIN [
A/B	? : ?[84]	
RS$_2$	? (pronounced) *gananadu* … ditto [	
A vi 28	$^{\text{mul}}$mar-tu : *a-*⸢*mur-ru*⸣	
B 24′	$^{\text{mul}}$mar-tu : *a-mur-ru*	
RS$_2$	–	
A/B	West : West	
A vi 29	$^{\text{mul}}$ka$_5$-a : *še-la-*⟨*bu*⟩	
B 25′	$^{\text{mul}}$ka$_5$-a : *še-la-bu*	
RS$_2$ 5	⸢$^{\text{mul}}$⸣ka$_5$-a	*u-ga* MIN *š*[*i*]*-le-bi*
A/B	Fox : Fox	
RS$_2$	Fox (pronounced) *uga*(?) ditto F[o]x.	
A vi 30	$^{\text{mul}}$ku$_6$: *nu-ú-nu*	
B 26′	$^{\text{mul}}$ku$_6$: *nu-ú-nu*	
RS$_2$ 6	⸢$^{\text{mul}}$⸣ku$_6$	⸢*ku*$^?$⸣ MIN
A/B	Fish : Fish	
RS$_2$	Fish (pronounced) *ku*(?) ditto	
A vi 31	$^{\text{mul}}$mušen : *iṣ-ṣu-ri*	
B 27′	$^{\text{mul}}$mušen : *iṣ-ṣu-ru*	
RS$_2$	–	
A/B	Bird : Bird	
A vi 32	$^{\text{mul}}$sim-maḫ : *si*$^!$(ḪU)*-nu-un-tu$_4$*	
B 28′	⸢$^{\text{mul}}$sim-maḫ⸣ : *si-nu-un-tu$_4$*	

84 This entry does not have good parallels, but it has been proposed that the gloss should be read *paṭīru*, "portable shrine," see Kurtik (2007: 236); note that GI.DU$_8$ = *paṭīru* and GI = *qanānu*. Also possible is *pāṭiru*, "the one who loosens (the mouth)" or the like, related to the constellation $^{\text{mul}}$UD.KA.DU$_8$.A and, perhaps, the rare Sumerian loanword *kaduḫḫû* (< ka du$_8$/duḫ), "raging (lit. with open mouth)" (CAD K 35), see n. 47 above.

RS$_2$ 7	⌜$^{\text{mul}}$⌝sim-maḫ [(x) x	s]im-maḫ ZA BE
A/B	Swallow : Swallow	
RS$_2$	Swallow (pronounced) *simmaḫ* ... (?)	
A vi 33	$^{\text{mul}}$lú-sa-gaz : MUL *ḫa-am-ba-t*[*a*]	
B 29′	[$^{\text{mul}}$lú-sa(g)-gaz] ⌜: MUL⌝ *ḫa-am-ba-ti*	
RS$_2$ 8	⌜$^{\text{mul}}$⌝lú-sag-[gaz(?)]	$^{\text{lú}}$*sag-gaz* MIN *ḫa-ba-ti*
A/B	Plunderer : Star of the Plunderer	
RS$_2$	Plund[erer(?)] (pronounced) *saggaz* ditto Plunderer	
A vi 34	$^{\text{mul}}$lú-ḫun-gá : MUL *a-ga-ri*	
B	(lacuna)	
RS$_2$ 9	⌜$^{\text{mul}}$⌝lú-⌜ḫun⌝:gá	$^{\text{lú}}$*ḫu-nu-gal* MIN *a-gàr*
A/B	Hired Man : Star of Hiring	
RS$_2$	Hired Man (pronounced) *ḫunugal* ditto Hired Man/Hiring	
A vi 35	$^{\text{mul}}$ní-zu : *šar*$^{!}$*-ra-qu*	
RS$_2$	–	
A	Thief : Thief	
A vi 36	$^{\text{mul}}$ud-zil-lá : MUL *ni-ma-ra-t*[*i*$^{?}$]	
RS$_2$ 10	[$^{\text{mul}}$]ud-zal-⌜le⌝	⌜*u*⌝*-tu-zi-le-la* MIN *nam-ra-ti*
A	Morning Watch : Star of Bright(?)[85] One[s]	
RS$_2$	Morning (Watch) (pronounced) *utuzilela*(?) ditto Bright Ones	
(ruling)		
A vi 37	éš : *eb-lu*$^{!}$	
RS$_2$ 11	⌜éš	*e*$^{?}$*-eš/še*$^{?}$ MIN *eb-x*⌝
A	rope : rope	
RS$_2$	rope (pronounced) *eš*(*e*) ditto r[ope(?)]	

85 Perhaps *nimarāt*[*i*] as a metathesized form of **namirāti*? Compare forms of *namru* (CAD N/1 239–244) such as *na-ma-ra-a-tum* (for expected *namrātum*) or *na-me-ru-ti* (for expected *namrūti*). Arnaud (1987: 151) suggests the difficult reading *ni-iṣ*$^{!}$*-ra-pa*[ ] but provides neither parallels nor comment. If that reading is based on *naṣrapu* (CAD N/2 51a), then the otherwise unattested form **niṣrapu* requires explanation.

Middle Babylonian Ura 13 Star List, Version 2 (*Ugarit*)[86]

RS$_1$ RS 23.082 + RS 23.364[87]

col. iv

RS$_1$ iv 60	[mul]	⌜*ka*⌝-⟨*ka*⟩-*bu*
	[star]	st⟨a⟩r(?)
RS$_1$ iv 61	[mul]	(MIN$^?$) ⌜*x*⌝-*ka-bu*
	[star]	ditto[88] [s]tar(?)
RS$_1$ iv 62	[mul-mul]	(MIN) *za-pu*
	[stars/Pleiades]	Pleiades
RS$_1$ iv 63	[$^{\text{mul}}$bir]	(MIN) *ka-li-tu*$_4$
	[Kidney]	Kidney
RS$_1$ iv 64	[$^{\text{mul}}$gu-la]	(MIN) *ra-bu-ú*
	[Great One]	Great One
RS$_1$ iv 65	[$^{\text{mul}}$en-te-na-bar-ḫum]	(MIN) ⌜*ḫu-mu-un*⌝-*sì-ru*
	[Shaggy Winter]	Mouse

(lacuna)

Middle Babylonian Ura 13 Star List, Version 3 (*Emar*)

I Msk 74198b[89]

col. vii[90]

I vii 1	$^{\text{mul}}$šul-pa-è-a
	Šulpae'a
I vii 2	$^{\text{mul}}$amar$^?$-utu
	Marduk

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86 Referred to as "Ras Shamra Recension A" by Reiner (1974: 42, 49).

87 Not "RS 23.83 + 23.364" as in Reiner (1974: 42). RS 23.021 + RS 23.083 is a unilingual copy of MB Ura 4 (wooden objects), while RS 23.082 + RS 23.364 is a bilingual copy of the geographical list, see Bordreuil and Pardee (1989: 293–294).

88 The format of the text edition makes it rather difficult to determine scribal peculiarities for individual lines, e.g., does col. iv exhibit the use of MIN in the right-hand column as Reiner (1974: 43) notes for col. i?

89 Arnaud (1985: 485); Rutz (2013: 201–202, 508).

90 There is a lacuna at the end of col. vi, and col. vii (the third column on reverse) is the last column that is preserved.

I vii 3 $^{\text{mul}}$ùz
Goat
I vii 4 $^{\text{mul}}$⸢pan$^{?}$⸣
Bow
I vii 5 $^{\text{mul}}$gag-pan
Arrow
I vii 6 $^{\text{mul.giš}}$apin
Plow
I vii 7 $^{\text{mul}}$ĝír-tab
Scorpion
I vii 8 $^{\text{mul}}$al-lul
Crab
I vii 9 $^{\text{mul}}$ka$_{5}$-a
Fox
I vii 10 $^{\text{mul}}$ti$_{8}^{\text{mušen}}$
Eagle
I vii 11 $^{\text{mul}}$kur-gi-a$^{\text{mušen}}$
Goose
I vii 12 $^{\text{mul}}$lú-ḫuĝ-ĝá
Hired Man
I vii 13 ⸢$^{\text{mul}}$⸣ud-zal$^{!?}$(LÚ)-le-ta-ĝá
Morning Watch(?) …
I vii 14 [$^{\text{mul}}$x x]⸢x⸣ NA$^{?}$ U$^{?}$
?
I vii 15 [$^{\text{mul?}}$x x x x]-e-ne
?[91]
I vii 16 [$^{\text{mul?}}$x x x x]-⸢x⸣
?
(lacuna)

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91 Perhaps reconstruct: [$^{\text{mul}}$im-šu-rin-na-nu-mu-un-kuš]-e-ne (or the like), "[Widow]s' [Oven]", which is badly garbled in the bilingual versions.

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CHAPTER 3

Traditions of Mesopotamian Celestial-Divinatory Schemes and the 4th Tablet of *Šumma Sin ina Tāmartišu*

Zackary Wainer

1 Introduction

One of the hallmarks of the Mesopotamian mantic tradition is the omen, with its characteristic "if P then Q" format. Though certainly foundational to Mesopotamian divination on the whole and divinatory compendia in particular, other mantic formats existed side by side with the omen. One of the more popular alternative formats is the scheme, where phenomena are associated with one another outside of an "if P then Q" structure.[1] These schemes are often quite general, relating basic characteristics that may be found in protases to those that are otherwise at home in apodoses. For example, the final section of the 33rd tablet of the diagnostic-prognostic series SA.GIG is comprised of schemes that relate single symptoms or illnesses to individual divine "hands," so that the illness *samānu* is associated with the hand of Gula, *tākaltu* with the hand of Ninurta, white boils with the hand of Shamash, and so on.[2] Outside of SA.GIG, a number of omen compendia and commentaries include sections with schemes, including the extispical commentary *Multābiltu*, where formations of the liver are associated with general events and entities,[3] and the assumed 50th tablet of *Enūma Anu Enlil* (*EAE*), which, along with its commentaries, connects constellations to worldly phenomena.[4] Both of these texts tend to include omens after each scheme that reinforce the veracity of the respective principles, and which tacitly show that schemes were used in conjunction with omens in ancient Mesopotamia.

1 For the first description of this format, see Reiner and Pingree (1981: 25), who only mention this format in relation to the assumed texts of *EAE* 50, and where it is dubbed a "quasi-equation."

2 For SA.GIG 33: 103–123, see Heeßel (2000: 357–358 and 363–364); for these specific examples, see SA.GIG 33: 103, 107, and 113.

3 For this series, see Koch (2005) and Heeßel (2008).

4 For this text, see Reiner and Pingree (1981).

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In addition to these texts, mantic schemes are found in at least two tablets of the serialized commentary to EAE, *Šumma Sin ina tāmartišu* (SIT). Though at least one scheme is found in a later tablet of SIT, K 2254,[5] the lion's share of these celestial-divinatory principles are included in tablet 4 of the series.[6] Unlike the scheme in K 2254, those from SIT 4 are known not only from commentary and excerpt texts, but from a celestial-divinatory text and celestial-divinatory reports written by Mesopotamian scholars to the 7th century Assyrian kings Esarhaddon and Assurbanipal. This paper will focus on the schemes found in SIT 4, as they are the only celestial-divinatory schemes found in both scholarly reports and divinatory compositions from the received tradition, showing that they were deemed both useful and traditional by ancient scholars. Though modern scholars have noted that a number of omens seem to operate on the same principles that are found in certain schemes, this study will be restricted to an examination of the schemes themselves, and not their derivatives. After briefly introducing these schemes and surveying previous scholarship on the subject, I will examine the many texts in which these principles are found, with a focus on the stability, utilization, traditions, and transmission of these schemes both amongst Neo-Assyrian scholars and across chronological boundaries. Finally, I will comment on how this expanded view of celestial-divinatory schemes contributes to our knowledge and understanding of SIT 4.

2 Celestial-Divinatory Schemes of *SIT* 4

2.1 *The Schemes*

The celestial-divinatory schemes of SIT 4 connect important aspects of Mesopotamian celestial and eclipse theory to mundane phenomena, terms of efficacy, and most commonly, geographical entities. Though thematically and stylistically related, the schemes found in SIT 4 should be thought of as individual divinatory principles that enjoyed wide scholarly currency in the first millennium, which most probably led to their aggregation by the compilers of SIT.[7]

5 For copies of this text, see ACh Sin 22 and AAT 5; for a transliteration, see ACh Sin 22; I am currently in the process of preparing a full edition and discussion of this text, and all other tablets of SIT, as part of my dissertation on this series.

6 The main exemplar of SIT 4 is K 3123; for a partial edition of which, see Koch-Westenholz (1995: 105–107) and below.

7 Though one could also see their compilation in SIT as the driving force behind their popularity, evidence for certain schemes as early as the Old Babylonian period (for which, see below) mitigates such a view.

What follows is a transliteration and translation of that portion of *SIT* 4 concerned with celestial-divinatory schemes:

9′. [diš an.ku$_{10}$ en.nun.AN.úsan] ⸢*a-na* nam.ug$_{7}$.meš : diš an.ku$_{10}$⸣ en.nun.murub$_{4}$.ba *a-na* ki.lam tur.ra

10′. [diš an.ku$_{10}$ en.nun.ud.]⸢zal.le *a-na* gig an.ti.la (:)⸣ diš ud.⸢dug$_{4}$.⸣ga en.nun.AN.úsan *a-na* 3 iti ud.10.kám

11′. [diš ud.dug$_{4}$.ga] ⸢en.nun.murub$_{4}$.ba *a-na* 6⸣ iti ⸢ud.⸣20.kám ⸢:⸣ diš ⸢ud.⸣dug$_{4}$.ga en.nun.ud.zal.⸢le⸣ *a-na* 10 iti.meš

12′. [diš an.ku$_{10}$ en.]⸢nun.AN.úsan *a-na* kur uri.ki⸣ : diš an.ku$_{10}$ en.nun.murub$_{4}$.ba *a-na* kur su.bir$_{4}$.ki

13′. [diš an.ku$_{10}$ en.nun.]⸢ud.zal.le *a-na*⸣ kur ⸢nim.ma.ki⸣ : diš ^{iti}bára ^{iti}NE ^{iti}gan kur uri.ki

14′. [diš ^{iti}gu$_{4}$ ^{iti}kin] ⸢^{iti}ab kur nim.⸣ma.⸢ki⸣ : diš ^{iti}sig$_{4}$ ^{iti}du$_{6}$ ^{iti}zíz kur mar.tu.ki

15′. [diš ^{iti}šu ^{iti}apin ^{iti}še kur] su.bir$_{4}$.⸢ki⸣ iti.meš *šá* an.ta.lù ^{d}30

16′. [diš ud.13.kám kur uri.ki ud.14.]⸢kám⸣ kur ⸢nim.⸣ma.⸢ki⸣ ud.15.kám kur mar.⸢tu.⸣ki ud.16.kám kur su.bir$_{4}$.ki ud.meš *šá* an.ta.lù ^{d}30

17′. [diš IM.u$_{18}$.lu kur nim.ma.ki] ⸢IM.si.sá⸣ kur uri.ki ⸢IM.⸣kur.ra kur su.bir$_{4}$.ki *u gu-ti-i* IM.mar.tu kur mar.tu.ki

18′. [diš kaskal *šu*]-⸢*ut* $^{d+}$en.líl⸣ [kur uri.]⸢ki kaskal⸣ *šu-ut* ^{d}*a*-⸢*nim*⸣ kur nim.ma.ki kaskal *šu-ut* ^{d}*é-a* kur mar.tu.ki *u* su.bir$_{4}$.ki

9′. [an eclipse (during) the first watch of the night is] for deaths : an eclipse (during) the middle watch of the night is for diminishing business

10′. [an eclipse (during) the fin]al watch of the night is for sick (people) becoming well : the term of (an eclipse of) the first watch of the night is for three months and ten days (100 days)

11′. [the term of] (an eclipse of) the middle watch of the night is for six months and twenty days (200 days) : the term of (an eclipse of) the final watch of the night is for ten months (300 days)

12′. [an eclipse (during) the fi]rst watch of the night is for the land of Akkad (S) : an eclipse (during) the middle watch of the night is for the land of Subartu (N)

13′. [an eclipse (during) the fin]al watch of the night is for the land of Elam (E) : the months of Nisan (I), Ab, (V) (and) Kislev (IX) are (for) the land of Akkad (S)

14′. [the months of Iyyar (II), Elul (VI), (and)] Tebet (X) are (for) the land of Elam (E) : the months of Sivan (III), Tishri (VII), (and) Shebat (XI) are (for) the Westland (W)

15′. [the months of Tammuz (IV), Marcheshvan (VIII), (and) Adar (XII) are (for) the land] of Subartu (N)—(the preceding were) months of an eclipse of the moon

16′. [the 13th day is (for) the land of Akkad (S); the 14th] day is (for) the land of Elam (E); the 15th day is (for) the Westland (W); the 16th day is (for) the land of Subartu (N)—(the preceding were) days of an eclipse of the moon.

17′. [the south is (for) the land of Elam (E);] the north is (for) the land of Akkad (S); the east is (for) the land of Subartu and Guti (N); the west is (for) the Westland (W).

18′. [the path o]f the Enlil [(stars) is (for) the land of Akkad (S)]; the path of the Anu (stars) is (for) the land of Elam (E); the path of the Ea (stars) is (for) the Westland (W) and Subartu (N).

In order to aid cross-textual comparison, I have labeled the schemes in *SIT* 4 with the letters A through G based on their order within *SIT*. Schemes A and B are the only sets of principles that do not associate aspects of celestial divination with geographical areas. Scheme A associates eclipses that occur during each of the three watches of the night with deaths, diminishing business, and recovery from illness, respectively, while Scheme B associates each of the night watches with a period of time wherein an eclipse may be effective. Here, an eclipse of the first watch of the night has a 100 day period, one that occurs in the middle watch has a 200 day period, and an eclipse of the final watch has a 300 day period. Scheme C is transitional, as it associates the night watches with the geographical territories of Akkad (S), Subartu (N), and Elam (E), respectively. Scheme D connects the month in which a lunar eclipse occurs to the geographic area that it affects, so Nisan (I), Ab (V), and Kislev (IX) are associated with Akkad (S); Iyyar (II), Elul (VI), and Tebet (X) with Elam (E); Sivan (III), Tishri (VII), and Shebat (XI) with the Westland (W); and Tammuz (IV), Marcheshvan (VIII), and Adar (XII) with Subartu (N). Scheme E associates the date of a lunar eclipse with a country, with the 13th connected to Akkad (S), the 14th to Elam (E), the 15th to the Westland (W), and the 16th to Subartu (N). Scheme F connects directionality, or alternatively winds, to a territorial entity, so that South is for Elam (E), North for Akkad (S), East for Subartu and Guti (N), and West for the Westland (W). The final set of principles, Scheme G, associates the band of the sky in which an eclipse occurs with a geographic location, so that the Path of Enlil is associated with Akkad (S), the Path of Anu with Elam (E), and the Path of Ea with the Westland (W) and Subartu (N).

TABLE 3.1 *Celestial divinatory schemes in* SIT *4 and parallels*

Scheme	Principle 1	Principle 2	Principle 3	Principle 4
A	1st watch—deaths	2nd watch—diminishing business	3rd watch—recovery from illness	
B	1st watch—100 days	2nd watch—200 days	3rd watch—300 days	
C	1st watch—Akkad (S)	2nd watch—Subartu (N)	3rd watch—Elam (E)	
D	Months I, V, IX—Akkad (S)	Months II, VI, X—Elam (E)	Months III, VII, XI—Westland (W)	Months IV, VIII, XII—Subartu + (N)
E	13th—Akkad (S)	14th—Elam (E)	15th—Westland (W)	16th—Subartu + (N)
F	South—Elam (E)	North—Akkad (S)	East—Subartu + (N)	West—Westland (W)
G	Path of Enlil—Akkad (S)	Path of Anu—Elam (E)	Path of Ea—Westland (W) / Subartu + (N)	

2.2 *Prior Scholarship*

Though all of these schemes are found in *SIT* 4, the first sustained engagement with these principles since the introductory work of Kugler and Schaumberger came with Francesca Rochberg's work on the lunar eclipse tablets of *EAE* in her *Aspects of Babylonian Celestial Divination*.[8] Here, Rochberg publishes transliterations of three excerpt texts, EAE 20 texts e–g, each of which include a number of schemes also found in *SIT* 4.[9] Additionally, she makes a number of astute observations about the eclipse schemata, including the fact that these schemes should not be understood as the basis for the lunar-eclipse omens, as many of the omens do not follow the principles laid out in the schemes.[10] While Rochberg contends that there may have been multiple accepted versions of certain schemes, she tentatively accounts for the incongruence between eclipse schemata and omens by arguing that schemes are not codified material, but are idiosyncratic, and thus tend to reflect the needs of individual scribes at specific times.[11]

8 See Kugler and Schaumberger (1935: 246–250), where they include Schemes C–F, amongst others.

9 These are UET 6 413; 1881-7-27, 22; and 1882-5-22, 77, which are published in transliteration, with notes, in Rochberg-Halton (1988: 222–224); though many of the schemes in these texts are found in *SIT* 4, two, found in *EAE* 20 text f: r.5, 8–9 and probably *EAE* 20 text e: 13 (as well as other compositions), are not.

10 This is well argued for the case of Scheme D in Rochberg-Halton (1988: 37–38); additionally, see her remarks on p. 55.

11 See specifically Rochberg-Halton (1988: 37–38 and 39, n. 22).

Though Rochberg was the first scholar to examine Mesopotamian lunar-eclipse schemata at any length, Ulla Koch followed soon after by identifying *SIT* 4, and transliterating, translating, and discussing the section of the text that includes celestial-divinatory schemes in her *Mesopotamian Astrology*.[12] Aside from this, the major step taken by Koch in her examination of these schemes was the comparison between the principles expounded in *SIT* 4 and those employed by the ancient Mesopotamian scholar Munnabitu in a celestial-divinatory report written to Esarhaddon.[13] Here, Koch notes that Munnabitu uses the principles derived from a number of schemes found in *SIT* 4, including Schemes D, E, and F, to interpret a lunar eclipse. Koch clearly shows through her brief case study that multiple celestial-divinatory schemes were employed by a royal scholar to interpret a lunar eclipse.

In addition to Rochberg and Koch, David Brown examines many of the lunar-eclipse schemes of *SIT* 4 in his discussion of his "*EAE* Paradigm Code" in *Mesopotamian Planetary Astronomy-Astrology*.[14] Brown argues that the "*EAE* Paradigm Code," of which some of the schemes from *SIT* 4 are a part, was simply used to determine whether a celestial phenomenon was positive or negative.[15] Brown continues by asserting that the "*EAE* Paradigm Code" not only runs through *EAE*, but probably predates the writing of the first celestial omens.[16]

2.3 *The Question of Stability*

Part of the current investigation will focus on the stability of the celestial-divinatory schemes in *SIT* 4, as scholars have argued that Mesopotamian eclipse schemes were idiosyncratic, non-codified entities. If this were the case, one would expect to find a number of parallel schemes that include the same information connected in different ways; so if we take Scheme E as an example, along with the version that associates an eclipse on the 13th day with Akkad (S), there should be exemplars that connect the 13th with Elam (E), Subartu (N), or the Westland (W) as well. Additionally, if these schemes were truly idiosyncratic, then we should expect to find minimal correspondence between parallel schemes; once again, using Scheme E as an example, not only should the 13th day be connected with Elam, or Subartu, or the Westland in various schemes, but few if any of these schemes should be exactly alike.

12 See Koch-Westenholz (1995: 105–108).
13 The report in question is SAA 8 316.
14 See Brown (2000: 139–142 and 151–153).
15 Brown (2000: 151–152).
16 Brown (2000: 152).

TABLE 3.2 *Schemes C and C′*

Scheme	Principle 1	Principle 2	Principle 3
C	1st watch—Akkad (S)	2nd watch—Subartu + (N)	3rd watch—Elam (E)
C′	1st watch—Akkad (S)	2nd watch—Westland (W)	3rd watch—Elam (E)

In terms of parallel schemes with alternate associations, scholars have noted variants of Schemes C and D.[17] Kugler and Schaumberger, followed by Rochberg, and Brown, point out that Scheme C seems to be preserved in at least two different versions in *EAE* 20 text f. The final lines of the reverse of this text are the same as Scheme C in *SIT* 4, whereas the 5th line of the reverse preserves a scheme that like Scheme C, associates the first watch with Akkad (S) and the third watch with Elam (E), though unlike Scheme C, the middle watch is connected to the Westland (W) instead of Subartu and Guti (N).[18] For simplicity's sake, I will refer to this variant of Scheme C as Scheme C′.

Though these two entries in *EAE* 20 text f may indeed represent two different versions of night-watch–land schemes, subtle differences in the wording

17 Though scholars have noted alternatives to Scheme F in the Neo-Assyrian period, most of these are only bourn out through omens, and are not expressed in schemes proper. The only proper scheme that some have understood as an alternative to Scheme F is one that I will dub the side–land scheme, and that connects sides of the moon with geographical entities, so that the right side is connected to Akkad (S), the left to Elam (E), the upper part to the Westland (W), and the lower portion to Subartu and Guti (N). This scheme can be found in a number of texts, including those cited in Rochberg-Halton (1988: 53, n. 101). If one understands Scheme F as referring to the direction of the lunar-eclipse shadow, then these schemes would seem to be concerned with the same phenomenon, though they do not employ the same language to do so. But if Scheme F is understood as indicating the direction of the wind that blows (perhaps during a lunar eclipse), then these two schemes are mutually exclusive. For the suggestion that the directional quality of the four winds eventually led to this scheme's usage in reference to lunar quadrants during an eclipse, see Rochberg-Halton (1984: 127); for reports that explicitly understand this scheme to refer to the direction of the lunar-eclipse shadow, see SAA 8 316: 8–10 and 469: r.6–7.

18 See Kugler and Schaumberger (1935: 249–250); Rochberg-Halton (1988: 44); and Brown (2000: 141); In this instance, Rochberg errantly states that the two schemes agree on their associations with the first and second watch and diverge in their connections with the third. Brown confuses the evidence as well, as he not only asserts that *EAE* 20 text f: r.11–12 diverges from Scheme C as found in *SIT* 4, but also that this part of *EAE* 20 text f associates the middle watch with the Westland (W), and the final watch with Subartu and Guti (N).

of these schemes apart from their variant associations may point to a different situation. The scheme preserved in line 5 of the reverse, that is, Scheme C′, simply states that each watch of the night is associated with a certain geographical area, whereas Scheme C in both SIT 4 and EAE 20 text f specifically states that an eclipse of a certain watch corresponds to a particular geographical entity. Scheme C′ is not confined to the reverse of EAE 20 text f, but is also found in what may be a Neo-Babylonian exemplar of the so-called *Great Star List* (*GSL*), and as Rochberg notes, *EAE* 20 text e.[19] While in the *GSL*, Scheme C′ is seemingly unconnected to lunar eclipses, in *EAE* 20 text e, the scheme is used to interpret an eclipse that occurred in the middle watch of the night. Thus, *EAE* 20 text f may preserve two different night-watch–land schemes that may have applied to two partially overlapping sets of circumstances. In such a scenario, Scheme C′ may have been applicable to general ominous celestial phenomena that occurred during the night, including lunar eclipses, while Scheme C was operative only in the event of a lunar eclipse.[20]

Since the 1930s, scholars of Mesopotamian celestial divination have noted that there are two different month–land schemes that associate groups of 3 months with one of the basic geographical locations. The first of these is Scheme D, which is known from *SIT* 4, *EAE* 20 texts e-g, K 8088,[21] the *GSL*, and a number of celestial divinatory reports. The other was alluded to previously, as it is found, amongst other places, in a later tablet of *SIT*. As opposed to Scheme D, this scheme associates consecutive months with a specific terrestrial area, so that Nisan–Sivan (I–III) are associated with Akkad (S), Tammuz–Elul (IV–VI) with Elam (E), Tishri–Kislev (VII–IX) with the Westland (W), and Tebet–Adar (X–XII) with Subartu (N).

19 For the composition known as the *GSL* see Weidner (1915: 6–22); Weidner (1959); Koch-Westenholz (1995: 187–205, Appendix B), the edition upon which citations in this text are based; and Horowitz (In Press), who suggests that the ancient name for the *GSL* was *Jupiter = Šulpa'e*; for the scheme in question, see Koch-Westenholz (1995: 202–203, lns. 290–292); for questions as to whether AO 8196 should be considered an exemplar of the "Great Star List," see Horowitz (1998: 8–9). For the remarks about *EAE* 20 text e: 13, see Rochberg-Halton (1988: 44).

20 Because all of the citations of Schemes C or C′ in the celestial-divinatory reports refer to the first or last watch of the night, they are unhelpful for testing this hypothesis; for these schemes in the celestial-divinatory reports, see SAA 8 300: r.15; 336: r.11; and 535: r.10 (all of which refer to the first watch of the night), as well as SAA 8 4: 10; 103: r.2; 308: 6; 351: r.2; and 487: 8 (which refer to the last watch of the night).

21 K 8088, hitherto unpublished, is seemingly some sort of excerpt text as well. Unlike the three excerpt texts published by Rochberg, it has a portrait, as opposed to a landscape, orientation. For an edition of this text, see below.

TABLE 3.3 *Month–land schemes*

Scheme	Principle 1	Principle 2	Principle 3	Principle 4
D	Months I, V, IX—Akkad (S)	Months II, VI, X—Elam (E)	Months III, VII, XI—Westland (W)	Months IV, VIII, XII—Subartu + (N)
Mišḫu	Months I–III—Akkad (S)	Months IV–VI—Elam (E)	Months VII–IX—Westland (W)	Months X–XII—Subartu + (N)

Scholars such as Kugler and Schauemberger, Weidner, Rochberg, and Brown have noted that these schemes are variants of one another.[22] Though Koch does refer to the consecutive-month scheme when she mentions Scheme D, she notes that unlike Scheme D, which refers to lunar eclipses, the consecutive-month scheme was applied to stellar *mišḫu*-, or "flashing," phenomena.[23] Indeed, all of the texts known to me that include the consecutive-month scheme explicitly state that the scheme applies to stellar *mišḫu*-phenomena.[24] Moreover, scholars who explicitly utilize a month scheme in their reports to the Assyrian king never employ the consecutive-month scheme to explain lunar phenomena but exclusively use Scheme D. Thus, these schemes should not be considered variants of one another, but rather, complementary, as they were used in connection to different celestial phenomena.

3 Celestial-Divinatory Schemes in the Neo-Assyrian Period

3.1 *Excerpt and Serialized Texts*

For most, if not all of the schemes examined above, only one set of correlations obtains between phenomena. The excerpt texts and commentaries from which the majority of the data has been culled so far seem to employ most of these schemes for the same reason—to interpret lunar-eclipses. Additionally, because each of these texts employ multiple celestial-divinatory schemes, one may opine that at least some of these schemes were transmitted together. More-

22 See Kugler and Schaumberger (1935: 249); Weidner (1959–1960: 109); Rochberg-Halton (1988: 38, n. 12); and Brown (2000: 140).

23 Koch-Westenholz (1995: 107, n. 2).

24 See K 12068 + Rm 2, 38 + Rm 2, 340: r.7′–9′ in van Soldt (1995: 41–42); K 2254: r.10′–11′; and IM 62257: r.11–14 in van Dijk (1976: pl. 67, no. 84).

over, in each of the excerpt texts, the same general ordering principle obtains, with lunar eclipse omens preceding all of the celestial-divinatory schemes.[25] In terms of geographical distribution, two of Rochberg's excerpt texts were found in Neo-Assyrian Nineveh, as was K 8088, the main exemplar of *SIT* 4, and the exemplar of the *GSL* that includes Scheme D; thus, these texts most probably come from the so-called Library of Assurbanipal.[26] Rochberg's third excerpt text does not come from Nineveh, but from the Babylonian city of Ur. Indeed, a colophon preserved on this text dates it to the 10th year of Šamaš-šuma-ukīn, or 658 BCE.[27] From these Neo-Assyrian texts, one gets a basic sense of the stability and proliferation of these schemes. These principles seem to have been known in Assyria and Babylonia in the same form where they were used alongside omens, at least in the excerpt texts, to interpret lunar eclipses. This suggests that these celestial-divinatory schemes were not ad-hoc scholarly creations, but were, like omens, an important part of the scholarly tradition.

3.2 *Celestial-Divinatory Reports*

Though the texts examined above may be combed by the modern scholar for clues about how these schemes may have been transmitted and employed in the Neo-Assyrian period, they can only provide part of the picture. Unlike traditional scholarly texts, such as omen compendia and serialized commentaries like *SIT*, excerpt texts should probably be seen as unique compilations created by individual scholars at specific times for discrete purposes. Because of the nature of excerpt texts, these compositions are better fit to answer questions pertaining to the utilization of schemes and omens by specific scholars than are traditional divinatory materials. That being said, excerpt texts are at best indirect sources for scholarly praxis. But for most periods and topics studied by Assyriologists, the partial picture of individual reception and usage afforded by excerpt texts is the most one can hope for. For the Neo-Assyrian period, on the other hand, scholars who study celestial-divination have access to a significantly larger part of this picture, in the form of celestial-divinatory reports. Unlike excerpt texts, the reports directly bear on how Neo-Assyrian scholars accessed and employed omens and schemes in service to the Assyrian king. Moreover, because hundreds of these reports are extant, I am able to present, in

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25 In *EAE* 20 text e, a single omen and comment concerning an eclipse of venus follows the celestial-divinatory schemes.

26 The two excerpt texts are *EAE* 20 text f, and *EAE* 20 text g, while the main text of *SIT* 4 is K 3123.

27 EAE 20 Text e: r.17–18; for the tenth year of Šamaš-šuma-ukīn, see Frame (1992: 30).

what follows, an aggregate picture of how a very specific subset of ancient scholars, specifically those who had some access to the Assyrian monarch, interacted with and employed a small part of their celestial-divinatory heritage in service to the crown.

Of the 567 extant scholarly reports, only 21 contain references to the celestial-divinatory schemes examined above.[28] Yet of the 12 reports that mention lunar eclipses in their protases or include lunar eclipse schemes, 9 of them use these schemes.[29] As many as 15 different scholars employ one or more celestial-divinatory schemes in their reports to the crown.[30] Of these scholars, four are Assyrian, while the remaining 11 are Babylonian.[31] At first glance, many of the conclusions from the examination of schemes within excerpt texts obtain for scholarly reports as well. Most of the schemes found in the reports are used to interpret lunar eclipses.[32] In support of the conclusion that these schemes were probably transmitted in groups, eight of the ten reports that use these schemes to interpret lunar eclipses include more than one scheme.[33] Moreover, three of these reports employ at least five schemes in their interpretive efforts, which lends further support to this hypothesis. In 18 of the 20 reports that employ at least one omen and one scheme, the schemes are included after all of the

28 Additionally, there are three references to one element of Scheme G in two scholarly letters written to the Assyrian king (SAA 10 79: r.8–10, r.18–20 and 362:16′–17′) that are not included in the following discussion.

29 The reports that include omens with lunar eclipse protases or lunar eclipse schemes are SAA 8 4; 103; 208; 230; 250; 251; 300; 316; 336; 469; 487; and 535. SAA 8 208; 230; and 250 do not include any lunar eclipse schemes (though both SAA 8 208 and 230 are very fragmentary).

30 Because two reports that employ these celestial-divinatory schemes, SAA 8 527 and 535, cannot be assigned to a known author at this time, this number could drop to 13.

31 That is, four of these scholars write in Assyrian script, while the remaining 11 employ the Babylonian sign forms. The Assyrian scholars are Issar-šumu-ēreš, Akkullānu, Bulluṭu, and Bāmāya, while the known Babylonian authors are Nergal-īṭir, Zākir, Munnabitu, Ašarīdu the Younger, Bēl-šuma-iškun, Nādinu, Nabû-šuma-iškun, Bēl-upaḫḫir, and Šuma-iddin.

32 See SAA 8 4: 9–10; 103: r.2 and 6; 251: r.6; 300: r.13–15; 316: 5–10; 336: r.9–11; 469: r.6–7; 487: 6–8; 535: r.9–12; and perhaps 308: 6, where Scheme C is included after an omen about the color of the rising sun that is said to portend an eclipse.

33 SAA 8 4: 9–10 (includes Schemes A–F—the inclusion of Schemes A and C is noted in Rochberg-Halton (1988: 44, nn. 54 and 55)); 103: r.2 and 6 (includes Schemes B and C, and perhaps Scheme A in r.5—the usage of Scheme C is noted in Rochberg-Halton (1988: 44, n. 55)); 300: r.13–15 (includes Schemes A–E); 316: 5–10 (uses Schemes D–F, as well as the side–land scheme described in n. 17); 336: r.9–11 (employs Schemes A–E—the inclusion of Schemes A and C is noted in Rochberg-Halton (1988: 44, nn. 54 and 55)); 469: r.6–7 (includes Schemes D and F); 487: 6–8 (employs Schemes C–E); and 535: r.9–12 (uses Schemes A–E).

omens concerned with the same phenomena as the schemes, so that if there are any omens written after the schemes, they address different topics, such as weather, or the stars.[34] This evidence, combined with that of the excerpt texts, suggests that there was some sort of etiquette connected to the employment of these interpretive techniques, whereby the schemes were only included after omens concerned with the same topic. Because this convention is followed by almost all of the Assyrian and Babylonian scholars who employed these schemes, it may have been in place before these schemes were transmitted throughout Mesopotamia.

Though some of the information found in the scholarly reports reinforces the conclusions about schemes drawn solely on the evidence from excerpt texts, the reports also augment and alter this picture. In fact, a majority of the reports that include at least one celestial-divinatory scheme employ these principles to interpret celestial phenomena that are unconnected to lunar eclipses. Overall, 11 reports employ these schemes to interpret non-eclipse lunar phenomena, with five reports referring to the new moon, five to the full moon, and one to the lunar conjunction with the Pleiades.[35] The schematic repertoire of these reports is much more restricted than those that deal with lunar eclipses. The one report concerned with the moon's conjunction with the Pleiades uses Scheme C or C′ to interpret this phenomenon. Each of the five reports concerned with the new moon employs a single scheme, Scheme E, to interpret the phenomenon in question. Similarly, each of the reports that schematically interprets the full moon employs Scheme D, with two of these utilizing Scheme E as well.[36] Because the utilization of Schemes D and E to interpret basic lunar phenomena is unknown from any other texts, this should

34 The two reports that do not include all pertinent omens before schemes are SAA 8 4 (which includes a single eclipse omen before the schemes, and a number afterward) and 102 (where the scheme is included before all omens, and immediately after a statement about the observed phenomenon at the beginning of the text). Two of the 18 cases are slightly ambiguous; SAA 8 351 includes an omen that only refers to the Pleiades, but that is interpreted as referring to the conjunction of the Pleiades and the moon after a scheme is employed to explain omens concerning the conjunction of the Pleiades and the moon; while one may understand SAA 8 316: r.3–4 as an omen, it begins in the middle of a line and lacks the DIŠ sign that marks the beginning of an omen throughout the scholarly reports.

35 The celestial-divinatory schemes used to interpret new-moon sightings are found in the reports SAA 8 106: r.2; 120: 4; 372: r.4; 472: 6; and 500: 3; those used to interpret the full moon are found in SAA 8 102: 2; 174: r.1–2; 275: 5; 276: 6; and 527: r.1–2; SAA 8 351: r.2 uses a celestial-divinatory scheme to interpret the lunar conjunction with the Pleiades.

36 These are SAA 8 174: r.1–2 and 527: r.1–2.

probably be regarded as a secondary development from their roles in lunar-eclipse interpretation. But whether or not this proves to be true, these two usages need not be considered mutually exclusive. Indeed, Nergal-īṭir employs Scheme D to interpret both the full moon and a lunar eclipse in different reports.[37] Thus, the only thing one can say for certain about Schemes D and E in this setting is that they evince a wider scope than the other schemes in question.

Thankfully, more can be said about Schemes D and E in a larger context. In examining the order of schemes within the reports, there seems to be little connection from report to report in terms of the overall organization of the schemes. This should be expected, as each of the excerpt and commentary texts evinces different schematic arrangements. Though *SIT* 4 orders the schemes A–G, *EAE* 20 text e arranges them A, D, E, C, and B, *EAE* 20 text f sets them out A, D, C′, F, E, and C (with an additional scheme in between Schemes F and E), *EAE* 20 text g arrays them A, B, D, E, C, F, and G (with an omen included in between Schemes B and D), and K 8088 lays these schemes out A, B, E, F, D, and C (with an additional scheme between Schemes D and C).[38] That being said, there is a small group of schemes that is found frequently enough in the reports in a specific order to be noteworthy. Schemes D and E are included in the same reports eight times. Unlike the excerpt and commentary texts, where Scheme D immediately followed by E is found in three out of five exemplars, in seven of the eight reports in question, Scheme E directly precedes Scheme D, while in the eighth, Scheme D is included immediately before Scheme E.[39] The connection between these two schemes outlined here, as well as in the previous discussion of utilization, points to a closer connection between Schemes D

37 These are SAA 8 275 and 276 (new moon), and SAA 8 251 (lunar eclipse); though at first glance, Ašarīdu the Younger seems to employ Scheme C to interpret both the moon's interaction with the Pleiades (SAA 8 351: r.2) and a lunar eclipse (SAA 8 336: r.11), the possibility exists that he used Scheme C′ to interpret the former. The only other scholar to use celestial-divinatory schemes to interpret both typical lunar and lunar-eclipse phenomena is Akkullānu, who does not repeat schemes; he employs Schemes B–C (and perhaps Scheme A—for which, see n. 30) to interpret a lunar eclipse (SAA 8 103: r.2 and 6), Scheme D in relation to the full moon (SAA 8 102: 2), and Scheme E in relation to the new (SAA 8 106: r.2).

38 The additional scheme found in *EAE* 20 text f, the so-called side-land scheme, is discussed above in nn. 17 and 30; the additional scheme in K 8088 associates the 30th–3rd and the 20th–23rd of the month with the 12th–15th of the month, respectively. For more information on the additional scheme in K 8088, see below.

39 For the former, see SAA 8 174: r.2; 300: r.15; 316: 5 and 7; 336: r.11; 487: 6–7; 527: r.1–2; and 535: r.9; for the latter, see SAA 8 4: 10.

and E than any of the other schemes examined here. Not only does there seem to have been one or more traditions of organization of Schemes E and D, but multiple traditions of exegetical employment as well, each of which was known throughout Assyria and Babylonia.

This examination of celestial-divinatory schemes in compositions from the received tradition, excerpt texts, and divinatory reports showcases a number of aspects of the celestial-divinatory schemes from *SIT* 4 in the Neo-Assyrian period. From a macro-perspective, that is, on the scheme to scheme level, there is little in common in terms of how schemes are organized or the order of schemes in different texts, aside from the general primacy of Scheme A and the connections exhibited between Schemes D and E.[40] Conversely, scholars seem to have employed all of these schemes to interpret lunar phenomena. In many cases, schemes are employed with other schemes, and are often included after all omens concerned with the same topic. From a micro-perspective, the content of each scheme seems to be very stable, with only one scheme possibly existing in two forms (Schemes C and C′). Moreover, though the schemes in question should not be regarded as basic principles for celestial omens, they were clearly employed by scholars along with omens to interpret celestial phenomena.

4 Celestial-Divinatory Schemes before and after the Neo-Assyrian Period

Though we lack evidence for these organizational and practical traditions outside of the Neo-Assyrian period, there is evidence for celestial-divinatory schemes both before and after the early first millennium. As noted by Rochberg, Scheme A is attested as early as the Old Babylonian period, where it is found alongside lunar-eclipse omens.[41] Additionally, another Old Babylonian text published by George from the Schøyen collection seems to begin with Scheme A before continuing with various omens.[42] The Old Babylonian compositions in which this scheme was found seem to be some of the oldest proper celestial-divinatory texts extant, and thus show that from the earliest periods, at least

40 For more on the ordinal primacy of Scheme A, see below.

41 See Rochberg-Halton (1988: 20); for a further discussion of these Old Babylonian lunar-eclipse texts, though one that does not admittedly bear on the discussion at hand, see Rochberg (2006).

42 The composition is MS 3117, which is text 14 in George (2013).

one celestial-divinatory scheme had a place alongside omens, even if its principles are not necessarily evident in the omens themselves. Moreover, Scheme A as found in these Old Babylonian texts seems to be all but indistinguishable from the Neo-Assyrian examples, showing that this scheme was fairly stable, even if the avenues of its transmission over hundreds of years are murky. Though the Old Babylonian origins of Scheme A are incontrovertible, there is no direct evidence for other celestial-divinatory schemes before the Neo-Assyrian period, making Brown's assertion of primacy for all celestial-divinatory schemes dubious. Though this may be going too far, the antiquity of Scheme A with respect to the other celestial-divinatory schemes may be reflected in the pride of place afforded to it in all of the excerpt and commentary texts, as well as in three of the four scholarly reports where it is clearly employed.[43]

More of the celestial-divinatory schemes examined above are known from the Neo-Babylonian period than from the second millennium. Two different texts attest to the transmission of at least some of these schemes after the Neo-Assyrian period. Schemes C′, D and F are found in AO 8196, a text that may be a Neo-Babylonian exemplar of the *GSL*. Whether AO 8196 is an exemplar of the *GSL* or not, it is clearly associated with this composition, and thus its preservation of these schemes may simply reflect the Neo-Assyrian celestial-divinatory milieu in which the *GSL* was created rather than the importance of these schemes after the Neo-Assyrian period. In AO 8196, the schemes in question are included amongst other schemes, including those that associate different levels of the heavens with types of stone, various days of the month with deities, and winds with animals. As opposed to many of the celestial-divinatory texts in which these schemes are found, there is nothing explicit, and very little implicit within this composition that associates Schemes C′, D and F with any particular celestial phenomenon, including lunar eclipses or other lunar events.

In addition to AO 8196, BM 47494 preserves a celestial-divinatory scheme known from *SIT* 4.[44] According to Hunger, BM 47494 is most likely an Achaemenid tablet from Babylon,[45] and indeed, the text's Achaemenid origins are reflected in the scheme from *SIT* 4 that is included therein. The obverse of BM 47494 seems to be comprised of numerous schemes that associate constellations with various Babylonian cities and foreign lands on the one hand, and

43 For these reports, see SAA 8 4: 9; 300: r.13; and 336: r.9; the single report that does not include Scheme A before all others is SAA 8 535: r.11.

44 For this text, see Hunger (2004).

45 See Hunger (2004: 16).

different items and ideas otherwise at home in celestial-divinatory apodoses on the other. As opposed to the obverse, the reverse of the tablet is almost wholly composed of omens focused on the moon and various planets. A large portion of these omens are concerned with the impact that the luminosity of celestial bodies (within constellations) has on business. These omens are bracketed by a permutation of Scheme D, which replaces months with their corresponding zodiacal constellations, so that Aries (I), Leo (V), and Sagittarius (IX) are associated with Akkad (S), Taurus (II), Virgo (VI), and Capricorn (X) with Elam (E), and so forth.[46] While the luminosity of the celestial body in question is associated with economic fortunes, the constellation in which the specific celestial body is located ostensibly determines what region will be affected by the particular economic circumstances.[47]

The usage of Scheme D in BM 47494 demonstrates a direct connection between scheme and omen, where the scheme in question plays an integral role in determining which region the omen would affect. Moreover, the development of Scheme D in BM 47494 attests to the adaptability of schemes in light of changing circumstances. As alluded to above, this permutation of Scheme D was clearly influenced by the advent of the Zodiac earlier in the Achaemenid period.[48] Additionally, the economic focus of Scheme D in BM 47494 may reflect the period in which the text was created. Traditional Mesopotamian celestial-divination was not concerned with individuals, but with king and country. The strongest example of the connection between celestial divination and the crown is found in the Neo-Assyrian period, where the royal concern for celestial divination seems to have reached its peak. By the reigns of Esarhaddon and Assurbanipal, scholars were sending reports to the king to inform the ruler of any ominous celestial event. In these celestial-divinatory reports, Scheme D could be employed to asses which land would be affected by any number of

46 See also Rochberg-Halton (1984), who remarks that the principles behind some of these celestial-divinatory schemes, including Scheme D, are incorporated into the Late Babylonian text BM 36746 with zodiacal signs replacing their corresponding months. That being said, the text itself is composed of omens, and not schemes, and so it will not be considered in this study.

47 Though the role of the constellation is only made explicit in the first part of the scheme, BM 47494: r.1–2 (where Aries (I), Leo (V), and Sagittarius (IX) are associated with the economic fortunes of Akkad (S)), the other constellations almost certainly have the same function.

48 Modern scholars have put the emergence of the zodiac at the middle to end of the fifth century; for the most recent discussion of the advent of the zodiac, see Britton (2010), who argues that the zodiac was created closer to 400.

positive or negative portended occurrences, from the death of a ruler to the attack of an enemy or the lengthy reign of a king. By the Achaemenid period, the author of BM 47494 had restricted the scope of Scheme D to the economic sphere. This limiting of Scheme D may be associated with the changing political landscape and shift in celestial divination in the Late Babylonian period. With the rise of Cyrus and the end of the Neo-Babylonian empire, Mesopotamia would be controlled by successive rulers who reigned from afar, and who do not appear to have been interested in Mesopotamian celestial divination. At the same time, scholars seem to have broadened the focus of celestial divination so that it would appeal to the private individual,[49] who was mainly concerned with the health, well-being, and fortunes of himself and those around him. With these developments in mind, the evolution of Scheme D in BM 47494 into a scheme focused on the economic fortunes of different areas, but especially Akkad, is understandable.

5 Celestial-Divinatory Schemes and *SIT*

Through this study of Mesopotamian celestial-divinatory schemes, I have examined issues relating to both the content and context of the schemes in question, especially in relation to the Neo-Assyrian celestial-divinatory reports. Yet I have said very little in relation to *SIT* 4, the only serialized text in which these schemes are found. Before concluding, I will rectify this situation by briefly examining how the present work on Mesopotamian celestial-divinatory schemes may affect our understanding of *SIT* 4, as well as the rest of the series *SIT*. At present, our knowledge of *SIT* 4, like the rest of the series, is somewhat limited.[50] Koch's comments on the text are the only significant observations on any part of *SIT* 4 to date.[51] Though these comments are (understandably) brief, they are substantive. As recounted above, Koch demonstrates in her remarks on *SIT* 4 that some of the schemes preserved in this text are employed in at least one of the Neo-Assyrian celestial-divinatory reports. In a later publication, Koch shows that many of the entries in *SIT* 1 find parallels amongst the contents

49 See, for example, the advent of the horoscopic tradition at the end of the 5th century; for babylonian horoscopes, see Rochberg (1998).

50 For (relatively) recent discussions of various aspects of *SIT*, see Koch-Westenholz (1995: 84–86 and 105–108); Koch-Westenholz (1999); Gehlken (2007); Veldhuis (2010); and Frahm (2011: 155–159). The present author is in the process of preparing an analysis and edition of the preserved portions of *SIT* as part of his doctoral dissertation.

51 See above.

of the celestial-divinatory reports,[52] which supports her earlier conclusion that *SIT* had a special status due to its wide currency amongst royal scholars.[53] More recently, Veldhuis, building on the work of Koch and others, has argued that the series *SIT* occupied a special place as a practical tool for Neo-Assyrian scholars.[54] As both Koch and Veldhuis marshal most of their evidence from *SIT* 1,[55] the examination of celestial-divinatory schemes undertaken here buttresses their conclusions by showing that the lunar-eclipse schemes compiled in *SIT* 4 were extensively employed by a cross-section of both Assyrian and Babylonian royal scholars. Indeed, there are few reports that include lunar-eclipse omens without also incorporating at least one of the lunar-eclipse schemes known from *SIT* 4. The employment of so many schemes found in *SIT* 4 by Mesopotamian royal scholars strongly suggests that *SIT* was an important component of celestial-divinatory praxis in the Neo-Assyrian period.[56]

In addition to the celestial divinatory reports, some of the schemes in *SIT* 4 find parallels amongst the schemes included in the *GSL*.[57] Though it would be imprudent to claim, at this stage, that parallel schemes in *SIT* 4 were drawn from the *GSL*, one could reasonably hypothesize interactions between the *GSL*, or its sources, and *SIT*. Indeed, as more of *SIT* and the *GSL* are published and analyzed, additional similarities may come to light between these important Neo-Assyrian celestial-scholarly texts. That being said, the limited correspondences recognized at present are significant, as they open the possibility of influence between *SIT* and other celestial-divinatory texts from the received tradition beyond *EAE*. Such interactions would expand the importance of *SIT* for Neo-Assyrian scholarship, as *SIT* would cease to be a simple commentary on a specific text, and instead become a celestial-divinatory handbook of sorts.

52 Koch-Westenholz (1999).

53 Koch-Westenholz (1995: 84).

54 Veldhuis (2010); here, Veldhuis argues that the series both distilled and interpreted important omens from *EAE*, which was too cumbersome for extensive practical application.

55 The exception in Veldhuis (2010: 82–83) comes in the form of a quotation from what seems to be *SIT* 6 (for the problems with the numbering of this text, see now Frahm (2011: 158), as well as my forthcoming dissertation).

56 Though we cannot know for certain whether the lunar-eclipse schemes included in the reports were taken directly from *SIT* 4 or were adapted from some other written or non-written source(s), it seems likely that at least some such citations are connected to *SIT* 4 when one considers (1) the known parallels between many entries of *SIT* (especially tablet 1) and the celestial-divinatory reports, and (2) the fact that the overwhelming majority of lunar-eclipse schemes used in the celestial-divinatory reports are known from SIT 4.

57 See above.

6 Conclusions

Most of the evidence for the celestial-divinatory schemes found in *SIT* 4 comes from the Neo-Assyrian period, though it seems that at least some of these schemes were known in the Old and Neo-Babylonian periods. In terms of how these schemes were used, there is little evidence that they were simply employed to determine whether a phenomenon was positive or negative, and there is similarly little evidence that these same schemes were the basis of the entire celestial-divinatory tradition, even if similarities do exist between certain schemes and omens. That being said, there is abundant evidence that schemes existed alongside celestial omens, and were used in conjunction with them. There is also evidence from the Neo-Assyrian period that schemes were used to specifically interpret a phenomenon, which area this phenomenon would affect, and how long such an interpretation would be valid. In short, celestial schemes, like celestial omens, were used to interpret ominous phenomena encountered by Mesopotamian scholars. Like celestial omens, celestial schemes were transmitted and employed by Mesopotamian scholars for more than a millennium. Like celestial omens, celestial schemes had stable contents. And like celestial omens, scholars seem to have expanded the range of at least two celestial schemes, so that they could be employed to explain phenomena that they may not have been used to originally interpret. At their cores though, schemes seem to be reductive tools, the austerity of which stands in stark contrast to the complicated, and often contradictory, Mesopotamian omen tradition. Indeed, this simplicity may have aided their transmission and proliferation, so that by the Neo-Assyrian period, they were included in important interpretive works such as *SIT*, with scholars from Nineveh to Ur using the same schemes to interpret ominous celestial events.

7 Appendix

The following is an edition of K 8088. It is included here as K 8088 is the only one of the texts discusses above that includes a number of schemes found in *SIT* 4, but which has yet to be published. This edition includes transliteration, translation, select notes, and photographs of the text. Commentary on those schemes also found in *SIT* 4 is not included. For notes on these schemes, see my forthcoming dissertation.

K 8088 seems to be an excerpt tablet written in the Neo-Assyrian script. At present, the tablet is 7.8 × 6.6 × 3.0 cm at its largest points, though the only edge even partially extant is the left. The obverse of the tablet consists of 21 lines, while the 6 lines of the reverse that remain are very fragmentary.

FIGURE 3.1 *K 8088 obverse*
PHOTOGRAPH © ZACKARY WAINER. TAKEN COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

FIGURE 3.2 *K 8088 reverse*
PHOTOGRAPH © ZACKARY WAINER. TAKEN COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

Transliteration

Obverse

1′. …] (traces) […

2′. …] gar-*an* ⸢x x⸣ […

3′. …] ⸢x su.gu$_{7}$⸣ *ina* ⸢kur⸣ gál ki.min šub-*tí bu-lim*[58] ⸢*šá*⸣ *ina* ⸢IM⸣ […

4′. …] ⸢x⸣ *da-ʾi-im nu-šur-re-e bu-lim*[59] IM[60] *me-ḫu-ú* : IM ⸢x⸣ […[61]

5′. …] ⸢KI?⸣ *kal u$_{4}$-me* ug$_{7}$.meš gál.meš : diš an.ku$_{10}$ en.nun.AN.úsan *ana* ⸢nam.⸣[ug$_{7}$.meš

6′. diš an.ku$_{10}$] ⸢en.⸣nun.murub$_{4}$.ba *ana* ki.lam tur.ra : diš an.ku$_{10}$ en.nun.ud.zal.le *ana* gig ⸢an.⸣[ti.la

---

7′. diš ud.]⸢dug$_{4}$.⸣ga en.nun.AN.úsan *ana* iti.3.kám ud.10.[kám

8′. diš ud.]⸢dug$_{4}$.⸣ga en.nun.murub$_{4}$.ba *ana* iti.6.kám ud.20.[kám

9′. diš ud.]⸢dug$_{4}$.⸣ga en.nun.ud.zal.le *ana* iti.10[.kám

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10′. diš an.]⸢ku$_{10}$⸣ 30 ud.13.kám kur uri.ki ud.14.kám kur nim.ma.ki ud.15.kám kur mar.⸢ki⸣ [ud.16.kám kur su.bir$_{4}$.ki

11′. diš IM.]si.sá kur uri.ki IM.u$_{18}$.lu kur nim.ki IM.kur.ra kur su.[bir$_{4}$.ki *u gu-ti-i*

12′. ⸢IM.⸣mar.tu [kur mar.tu.ki

13′. diš] ⸢^{iti}⸣bára ^{iti}NE ^{iti}gan kur uri.ki ^{iti}gu$_{4}$ ^{iti}kin ⸢^{iti}⸣[ab kur nim.ma.ki

14′. [diš(?)] ^{iti}sig$_{4}$ ^{iti}du$_{6}$ ^{iti}zíz kur mar.tu.ki ^{iti}šu ^{iti}apin [^{iti}še kur su.bir$_{4}$.ki

15′.] ⸢diš ud.⸣30.kám ud.12.kám ud.1.kám ud.13.kám ud.2.kám ud.14.kám [ud.3.kám ud.15.kám

16′. diš ud.20.kám ud.12.kám ud.21.kám ud.13.kám ud.22.⸢kám⸣ ud.⸢14.⸣[kám ud.23.kám ud.15.kám[62]

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58 For this very common apodosis, see CAD M/II: 101, s.v. *miqittu* 2.

59 For this apodosis, see CAD N/II: 355, s.v. *nušurrû* c.

60 This sign could either be a phonetic complement for the previous sign, or a pseudo-determinative for the following lexeme, though admittedly, *meḫû* is not normally preceded by a determinative.

61 Though, due to the break, the understanding of the end of this line is uncertain, it seems that the term *meḫû*-storm is associated with another sort of wind. If this were the case, then the traces at the end of the line would support a restoration of "north wind" (IM.si.sá) or "south wind" (IM.u$_{18}$.lu), amongst others.

62 It seems clear that this scheme equates the 30th–3rd and the 20th–23rd of the month with days in the middle of the month, even if the reasoning behind some of these associations

17′. ⸢diš en.⸣nun.AN.úsan kur uri.ki : en.nun.murub$_4$.ba kur su.⸢bir$_4$.⸣[ki (…)

18′. [diš] ⸢en.⸣nun.ud.zal.le [kur nim.ma.ki]

19′. diš ⸢$^{\text{iti}}$⸣bára en.nun.AN.úsan kur uri.ki $^{\text{iti}}$⸢NE⸣ [kur uri.ki …[63]

20′.] ⸢diš $^{\text{iti}}$⸣gan kur uri.ki ⸢ITI⸣ [...

21′. ...] ⸢x x⸣ [...

(remainder of the obverse broken)

Reverse

r. 1′. ...] ⸢x.kám⸣ an.ku$_{10}$ ⸢gar x⸣ [...

r. 2′. ...] ⸢(x) x x ud.⸣21.kám an.ku$_{10}$ gar [...

---

is unclear. Because the other preserved schemes on this tablet are concerned with lunar eclipses, and because the common days in this scheme (that is, the 12th–15th) are days when a lunar eclipse could occur, it seems that this scheme is associating impossible lunar eclipse days with possible lunar eclipse days.

Indeed, there is some support for such an interpretation. In the *EAE* lunar eclipse tablets, the days most-often mentioned as eclipse days are the 14th–16th, and the 20th–21st (so Rochberg-Halton (1988: 38)). That being said, there is evidence from *EAE* 17–18 for eclipses on the 1st, and in one case, the 3rd of the month (for the latter, see *EAE* 17 §VI.5 F: r.15). In a properly kept Mesopotamian lunar calendar, a lunar eclipse could not occur on the 20th or 21st of the month (or for that matter, the 1st or 3rd), while an eclipse could occur on the 12th or 13th of the month. As noted in Rochberg-Halton (1988: 39), there are rituals to protect the king from an eclipse that recognize that eclipses occurred on the 12th–13th of the month (See CT 4 5: 1). Additionally, the 29th *aḫû*-tablet of *EAE* includes eclipse omens for the 12th and 13th of the month as well (Rochberg-Halton (1987)). Thus, even if the reasons for the specific associations are opaque (if there were specific reasons in the first place), the associations between the 12th and 20th and between the 13th and 21st, as well as the inclusion of the 1st and 3rd, are more understandable in light of Mesopotamian eclipse traditions. If one expands the purview of texts examined beyond those that are directly connected to eclipses, then one finds evidence for the association of the 14th and 22nd of the month as well (found in the numerical composition i.NAM.giš.ḫur.an.ki.a, K 2164 +: 16–17, in Livingstone (1986: 22–23)).

63 This line, and at least the line that follows, preserve portions of a potential hybrid of Schemes C and D. The preserved portions of the entries seem to be schemes rather than omens, and are concerned with the watch and months associated with Akkad. Little else can be said about these lines at present.

r. 3′. ...] ⸢(x) x x ta⸣ ud. ⸢(1)1.⸣kám en ⸢ud.x.⸣[kám ...
r. 4′. ...] ⸢x⸣ U ⸢gu$_7$(?).meš x⸣ [...
r. 5′. ...] (traces) [...] ⸢X LÚ(?)⸣ MEŠ ⸢x⸣ [...
r. 6′. ...] ⸢x x x ⸣ ŠÚ(?) ⸢x⸣ [...

Translation

1′. (no translation warranted)
2′. ...] will occur [...
3′. ...] there will be famine in the land; alternatively, loss of cattle—(the protasis means) that in [...
4′. ...] will become dark, decrease of cattle—(in the protasis, the word) *meḫû*-storm (is associated with): the [...] wind

---

5′. ...] all day, there will be deaths : an eclipse (during) the evening watch (I) is for deaths [
6′. An eclipse (during)] the middle watch (II) is for diminishing business : an eclipse (during) the morning watch (III) is for sick (people) becoming well [

7′.] The term of (an eclipse of) the evening watch (I) is for three months and ten days (100 days) [
8′.] The term of (an eclipse of) the middle watch (II) is for six months and 20 days (200 days) [
9′.] The term of (an eclipse of) the morning watch (III) is for ten months (300 days) [

10′.] An eclipse of the moon (on) the 13th is (for) the land of Akkad (S); (on) the 14th is (for) the land of Elam (E); (on) the 15th is (for) the Westland (W); [(and on) the 16th is (for) the land of Subartu (N)
11′.] The north (wind) is (for) the land of Akkad (S); the south (wind) is (for) the land of Elam (E); the east (wind) is (for) the land of Subartu [and Guti (N)
12′.] The west (wind) is (for) [the Westland (W)
13′.] The months of Nisan (I), Ab (V), (and) Kislev (IX) are (for) the land of Akkad (S); the months of Iyyar (II), Elul (VI), (and) Tebet (X) are (for) [the land of Elam (E)
14′.] The months of Sivan (III), Tishri (VII), (and) Shebat (XI) are (for) the Westland (W); (and) the months of Tammuz (IV), Marchesvan (VIIII), (and) [Adar (XII) are (for) the land of Subartu (N)

15′.] The 30th (is associated with) the 12th; the 1st (is associated with) the 13th; the 2nd (is associated with) the 14th; [(and) the 3rd (is associated with) the 15th

16′. The 20th (is associated with) the 12th; the 21st (is associated with) the 13th; the 2nd (is associated with) the 14th; [(and) the 23rd (is associated with) the 15th

---

17′. (An eclipse of) the evening watch (I) is (for) the land of Akkad (S) : (an eclipse of) the middle watch (II) is (for) the land of Subartu (N) [

18′. (An eclipse of) the morning watch (III) is (for) [the land of Elam (E)

19′. The month of Nisan (I) (and) the evening watch (I) are (for) the land of Akkad (S); the month of Ab (V) [is (for) Akkad (S) ...

20′.] The month of Kislev (X) is (for) the land of Akkad (S); the month [...

21′. (no translation warranted)

(remainder broken)

r. 1′. ...] (on) the nth, an eclipse occurred [...

r. 2′. ...] ... (on) the 21st, an eclipse occurred [...

r. 3′. ...] ... from the 1st/11th(?) until the nth [...

r. 4′. ...] ... consume [...

r. 5′. (no translation warranted)

r. 6′. (no translation warranted)

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Abbreviations

AAT	Craig 1899
ACh	Virolleaud 1905–1912
CAD	The Assyrian Dictionary of the Oriental Institute of the University of Chicago
CT	Cuneiform Texts from Babylonian Tablets in the British Museum. London, 1896–
SAA 8	Hunger 1992
SAA 10	Parpola 1993

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CHAPTER 4

The Circulation of Astronomical Knowledge between Babylon and Uruk

John M. Steele

1 Introduction

Substantial numbers of Late Babylonian cuneiform tablets containing astronomical and astrological texts have only been found at two sites in Mesopotamia: Babylon and Uruk. Between four-and-a-half and five thousand tablets covering the complete range of observational, predictive, and mathematical astronomy, celestial divination, and astrology are known from Babylon. The number of astronomical tablets that have been recovered from Uruk is smaller, numbering approximately two hundred and fifty, but covers the same range of genres of astronomy as the tablets from Babylon. By contrast, only a handful of astronomical tablets have been found at other Late Babylonian sites—less than ten each from Nippur, Sippar and Ur. Whether this reflects a lack of astronomical activity in these cities or simply that the archives containing astronomical texts have not been discovered remains an open question.[1]

The aim of this article is to explore the relationship between astronomy at Babylon and Uruk during the Achaemenid and Seleucid periods: Did astronomical knowledge and/or astronomical texts circulate between Babylon and Uruk?[2] If so, did that knowledge travel in both directions or only from one city to another? Were there local traditions of astronomical practice in these two cities? In order to answer these questions I compare the preserved examples

1 For simplicity, throughout this article I will generally use "astronomy" and "astronomical texts" to refer to all branches of astronomy and astrology.

2 The circulation of astronomical knowledge and the circulation of astronomical texts are related but not identical processes. Texts may be copied and move from one location to another without being read or used, thus the knowledge contained in the text is not itself circulated. On the other hand, astronomical knowledge may be passed between individuals or communities without an accompanying transfer of textual material (the standard list of 25 *ziqpu* stars provides an example where a body of knowledge appears to have circulated widely, sometimes being written down, without the direct transmission and copying of texts—see Steele 2014). Most of the time, however, knowledge and texts probably circulated together.

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from Babylon and Uruk of four genres of astronomical texts: texts containing astronomical observations (Astronomical Diaries and collections of lunar or planetary data), texts containing predicted astronomical phenomena (Normal Star Almanacs and Almanacs), texts of mathematical astronomy (Synodic Tables, Auxiliary Tables and Procedure Texts), and late astrological texts (Horoscopes and astrological treatises). Before making this comparison, however, it will be helpful to present a broad overview of the preserved sources from Babylon and Uruk, their archival contexts, and the possible routes of and obstacles to the circulation of knowledge between these two cities.

2 Astronomical Tablets from Babylon and Uruk: Some Broad Trends

More than four-and-a-half thousand cuneiform tablets from Babylon contain astronomical texts. The tablets date from the mid-eighth century BC down to the first century AD, with the majority preserved from about 400 BC onwards. Unfortunately, all but a handful of these tablets were recovered either through unscientific excavations conducted on behalf of the British Museum during the 1870s and 1880s or by purchase from dealers at around the same time.[3] Thus, it is not known where these tablets were found, or even whether they were found together in one archive or whether we have the remains of several archives. The German excavations of Babylon led by Koldewey from 1899–1917 recovered many thousands of cuneiform tablets but only a handful (less than twenty) of astronomical tablets.[4] These tablets were found at a number of locations including temples and private houses. Administrative documents from the Achaemenid and Seleucid periods demonstrate that some astronomers were employed by the Esagila temple in the heart of the city,[5] but this need not imply that all astronomers were functionaries of the temple, nor that all of the astronomical texts come from a temple archive. On the contrary, Koldewey's discovery of astronomical tablets from other sites in the city implies that at least some astronomical tablets were held outside of the Esagila temple.

3 See Reade (1986) for a survey of the British Museum's excavations and purchases. The British Museum was the major purchaser of tablets from Babylon and as a result now holds the vast majority of astronomical tablets from Babylon. Smaller groups of astronomical tablets from Babylon, also acquired by purchase, are found in Berlin, Birmingham, New York, and Paris.

4 Pedersén (2005) catalogues all of the tablets excavated by Koldewey. Almost all of the astronomical tablets remain unpublished and are either in Berlin but currently inaccessible to researchers, or cannot be located.

5 Beaulieu (2006).

Whether these other sites can be deemed "astronomical archives", given the small number of astronomical tablets found at them, is an open question, but it seems best to conclude that the "Babylon astronomical archive" known to us from the material in the British Museum and elsewhere probably includes tablets from more than one site in Babylon.

The Babylon astronomical archive contains the complete range of genres of astronomical text known to us from Babylonia: copies of standard texts of traditional Babylonian astronomy such as the compendium MUL.APIN, the celestial omen series *Enūma Anu Enlil*, and the so-called Astrolabes, most of which are also known from the major Neo-Assyrian archives in Nineveh, Ḫuzirina and Kalḫu; large numbers of texts from the practice of observational and predictive astronomy (Astronomical Diaries, Goal-Year Texts, Almanacs, Normal Star Almanacs and Lunar and Planetary Observation Texts); texts of mathematical astronomy (Procedure Texts, Synodic Tables and Auxiliary Tables); late astrological texts (Horoscopes and treatises); and many other astronomical texts including star lists, texts of schematic astronomy and goal-year procedure texts.

By contrast, the preserved texts from Uruk are both fewer in number and less representative of all the genres of astronomical texts. The Uruk tablets can be ascribed to three distinct archives based upon archaeological evidence and information from colophons.[6] A small number of tablets come from the archives of the Eanna temple dating to the sixth and fifth centuries BC. These tablets all contain copies of standard texts such as MUL.APIN and *Enūma Anu Enlil*. Between twenty and thirty astronomical tablets dating from the fifth to the and early third century BC were found among a larger number of scholarly tablets in a private house occupied by several generations of a family of *ašipu*s. These tablets include copies of *Enūma Anu Enlil*, commentaries and other texts of celestial divination, texts concerned with astral medicine, a small number of texts containing collections of observations, and two texts of mathematical astronomy (Synodic Tables for Saturn and the moon). Interestingly, all of the observational texts which can be dated contain observations from the fifth century BC or earlier—I will discuss the significance of this in section 4.1 below. Finally, over one hundred and fifty tablets have been recovered from the archives of the Bīt Reš sanctuary of the god Anu, dating from the third and second centuries BC. The majority of tablets from the Bīt Reš contain mathematical astronomy; smaller numbers of tablets contain observations and predictions, star lists, copies of *Enūma Anu Enlil*, and several texts of late astrology, including horoscopes.

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6 The three archives are described in detail by Ossendrijver (in press).

TABLE 4.1 *A rough comparison of the numbers of different genres of astronomical texts at Babylon and Uruk*

Text type	**Babylon**	**Uruk**
Standard Texts:		
MUL.APIN	Some	Very few
Enūma Anu Enlil	Many	Some
Observational Texts:		
Astronomical Diaries	Many	Very few
Goal-Year Texts	Many	None
Lunar and Planetary Texts	Many	Few
Predictive Texts:		
Almanacs & Normal Star Almanacs	Many	Few
Mathematical Astronomical Texts:		
Synodic Tables	Many	Many
Auxiliary Tables	Some	Many
Procedure Texts	Many	Few
Other Astronomical Texts	Some	Some
Late Astrological Texts	Some	Some

In order to form a general picture of the differences between the astronomical material at Babylon and Uruk, in Tab. 4.1 I give a very rough qualitative survey of the number of different genres of astronomical texts known from the two cities. It is immediately apparent from this table that the preserved archive of astronomical tablets from Uruk is very different in distribution to that from Babylon: very few observational or predictive texts have been found at Uruk whereas these texts are common at Babylon; on the other hand, the number of Synodic Tables and late astrological texts known from the two sites is more comparable, and there are many more Auxiliary Tables from Uruk than from Babylon. This begs the question, however, of whether these differences are real or simply an artefact of the archives which have been excavated. The archive of the Bīt Reš is very rich in Synodic and Auxiliary Tables—were there other archives which have not been discovered which contained large numbers of observational texts? Any explanation for the apparent difference in the contents in the Babylon and Uruk archives must take this uncertainty into account. Nevertheless, I think that the scarcity of observational tablets at Uruk reflects actual astronomical practice in that city, for reasons which I will discuss in section 4.

3 The Circulation of Astronomy Between Babylon and Uruk: Opportunities and Potential Obstacles

Throughout the Late Babylonian period Babylon and Uruk were two of the main political, religious and economic centres in Babylonia. The cities are approximately 200 km apart but well connected by the Euphrates river which ran through Babylon and southeast to the Persian Gulf, passing close to Uruk which was connected to the river by canal. In addition, a second canal connected Uruk with Nippur which was then connected to Babylon by a further waterway.[7] Economic documents and letters from the archive of the Eanna temple dating to the sixth and early fifth century BC provide considerable evidence for the transportation of people and goods between Babylon and Uruk: in addition to goods and workers, messengers travelled regularly between the two cities, high-ranking officials in the Eanna temple frequently visited Babylon, and on occasion officials from Babylon would visit Uruk.[8] As the seat of government, Babylon exercised some measure of political and legal oversight on Uruk.

Communication between the two cities extended beyond simple economic and administrative matters into the realm of cultic practice. In particular, the Eanna temple in Uruk was expected at some level to accede to the authority of the Esagila temple in Babylon. For the present discussion, one particular example of Babylon's authority is especially significant: it was at Babylon that decisions over the calendar were made. Three letters are preserved which inform the Eanna temple that a decision has been made to intercalate an extra month in the year. Two of these letters were sent by the king to the high officials of the Eanna; the third was sent from the Esagila to the Eanna.[9] In all three cases, it is clear that the decision to intercalate has been made at Babylon and that Uruk was expected to follow this decision.

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7 van Driel (1988: 151).

8 Jursa (2010: 64–65).

9 The letters are Clay (1919) nos. 15, 115 and 196. See the discussion by Parker and Dubberstein (1956: 1) and Kleber (2008: 267–268).

It would appear, therefore, that all of the conditions were in place for the circulation of astronomical knowledge between Babylon and Uruk: extensive and frequent contact between the two cities including travel back-and-forth by state and temple officials, possible family connections between scholars in the two cities, and a tradition of communicating information on the calendar to the temples in Uruk from the king and the Esagila temple in Babylon. *A priori*, therefore, we would expect that astronomical texts and astronomical knowledge were exchanged between the scholars of the two cities. And it is very evident that they were. Astronomy at Babylon and at Uruk are clearly part of the same tradition: the same types of texts were written and new developments within Babylonian astronomy such as the zodiac, horoscopic astrology, and the System A and System B methods of mathematical astronomy are attested at both cities, making it impossible to imagine that astronomy at these two cities developed completely independently in the Late Babylonian period out of a shared background of early Babylonian astronomy. Furthermore, the colophons of a small number of texts from Uruk state that they were copied from originals from Babylon.[10]

Nevertheless it is worth considering whether there might have been any obstacles to the exchange of astronomy between Babylon and Uruk. Such obstacles, although clearly not preventing this exchange, may have hampered it at times, potentially restricting the flow of knowledge and texts during certain periods or limiting the exchange to certain aspects of astronomical knowledge or particular groups of astronomical texts. The most likely cause of any disruption of the contact between the scholars of Babylon and Uruk is the aftermath of the Babylonian rebellions against Xerxes in 484 BC. In the summer of Xerxes' second year revolts against the Persian king were led by two Babylonians, Bēl-šimânni and Šamaš-erība, who gained control of the cities of Babylon, Sippar, Dilbat, Borsippa and Kish and held them until the autumn of that year before Xerxes regained control of northern Babylonia.[11] After the revolts it appears

10 I know of four such examples from the astronomical corpus: VAT 7827, a copy of tablet 1 of *Enūma Anu Enlil* (see Weidner 1941–1944: pl. V); TU 16, a copy of tablet 56 of *Enūma Anu Enlil* written in Uruk in SE 97 is said to have been "written and checked according to a writing board, copy from Babylon"; ACT 155, a lunar System B auxiliary table for years SE 104–124 from Uruk, states that it is "[co]py from Babylon"; and BRM 4 20, an text which combines incantations with astrology, contains the remark that the main part of the text was "Based upon copies from Ur (error for: Uruk) and Babylon" (see Geller 2010: 36).

11 It remains unclear whether Bēl-šimânni and Šamaš-erība coordinated their revolts against Xerxes or whether they both saw an opportunity to seize control at an opportune moment.

that Xerxes moved against the old Babylonian urban elite families in the cities that had revolted, removing them from positions of power. The traditional families of Uruk and other cities in southern Babylonia, however, did not participate in the revolts and as a result were not subjected to punishment from Xerxes.[12] Interestingly, however, it appears that in Uruk members of the powerful families from Babylon who had held important roles in the administration of the Eanna temple were replaced by individuals from Uruk families.[13] This set the stage for a major change in the cult of Uruk with the god Anu replacing Ištar as head of the pantheon, which led to the end of the Eanna as the main temple of Uruk and the construction of the Bīt Reš sanctuary of Anu as the principal religious centre of Uruk.[14] These major transitions in both the cult and, crucially, cult personnel at Uruk may have hindered the communication between astronomical scribes in Babylon and Uruk, many of whom held temple positions themselves. It is worth noting, however, that Xerxes removal of members of families from Babylon from many positions of influence in Uruk did not result in a complete absence of scribes from Babylon in Uruk. By the Hellenistic period, if not earlier, we occasionally find scribes with names indicating that they are from Babylon on Uruk documents.[15]

A second potential obstacle to the circulation of astronomy between Babylon and Uruk is the tradition of "secret" or protected knowledge. The colophons of some cuneiform tablets containing scholarly texts include prohibitions against teaching the knowledge contained on the tablet to individuals outside of certain groups. The most detailed example from the astronomical corpus is found on a tablet from Babylon containing a text with instructions for calculating the lunar six (unusually, the passage is found at the beginning of the tablet rather than in a colophon at the end):

Šamaš-erība seems to have lasted longer than Bēl-šimânni, taking control over cities that were previously in Bēl-šimânni's possession by the seventh month of the year. For a detailed study of the chronology of the revolts, see Waerzeggers (2003–2004).

12 Xerxes' moves against the traditional Babylonian elite families can be seen very clearly from the so-called "end of archives" in 484 BC, when the archives of many important families across northern Babylonian come to an abrupt end. By contrast, archives in southern Babylonia and the archives of those Babylonians who did not come from the traditional urban elite families and who mainly did business with the Persians, continue uninterrupted after this date. See Waerzeggers (2003–2004).

13 Kessler (2004).

14 Beaulieu (1992a).

15 Boiy (2011).

> Tablet of the secret of heaven, the hidden thing of the great gods. He must not give it out of hand; let him teach (it) to his son whom he loves. To teach (it) to a non-citizen of Babylon or a non-citizen of Borsippa or anyone who is not learned, is a taboo of Nabu and Nisaba. [...] a non citizen of Babylon or a non-citizen of Borsippa or anyone who is not learned who does not [...] and speaks anything, may Nabu and Nisaba not confirm him in the knowledge of the learned, in poverty and loss may they bring his [life] to an end, and kill him with dropsy.[16]

This text suggests that the secret knowledge it contains—instructions for calculating the lunar six and the day of the beginning of months—is to be restricted only to scholars from Babylon and Borsippa. Similar prohibitions against teaching outsiders are found on a few astronomical tablets from Uruk. For example, the colophon of ACT No. 135, a System B table of eclipse possibilities, includes the statement that the tablet contains:

> Wisdom of *Anūtu*, secret of the [great] god[s], wisdom of the scholars. One who knows may show [one who knows]; one who does not know may not [see. Restriction] of Anu, Enlil and [Ea, the great gods].[17]

Other tablets include warnings against the theft of tablets. There has been considerable debate in recent years over how to interpret these prohibitions: were they intended as real warnings with expected consequences (legal or otherwise) if the prohibition was broken, or were they simply traditional demonstrations of scribal pride, without real meaning?[18] It is not my intention here to enter into this debate, but rather to highlight this as a potential obstacle to the transmission of knowledge between Babylon and Uruk. It is worth noting, however, that even if there were genuine prohibitions against the transmission of certain texts, these cannot have been particularly effective. For example, sections of the text containing instructions for calculating the lunar six which it is said must not be taught to anyone who is not a citizen of Babylon or Borsippa are duplicated on several other tablets,[19] including one from Uruk.[20] In practice, it would be almost impossible to restrict the spread of astronomical

16 BM 42282+42294 Obv. 1–5; translation by Brack-Bernsen and Hunger (2008: 6).

17 ACT No. 135 Rev. 13–16; translation by Stevens (2013: 252).

18 See, for example, Beaulieu (1992b), Lenzi (2008) and Stevens (2013).

19 Brack-Bernsen (2002).

20 Brack-Bernsen and Hunger (2002).

knowledge through the prohibitions expressed on the tablets, but such prohibitions may have slowed down this transmission, potentially resulting, for example, in delays between newly developed techniques from one city being available in the other city.

4 A Comparison of Astronomical Texts and Practice at Uruk and Babylon

In order to explore the relationship between astronomy at Babylon and Uruk, in the following sections I will compare the preserved texts from Uruk with similar texts from Babylon. The comparison is made in this direction largely for the practical reason that there are far fewer texts from the former city than the latter. This factor of course raises the danger of possible biases in the analysis due to the particular archival contexts of the Uruk material, but there is no *a priori* reason to believe that any such biases will be significant, and even if they are, the comparison at least provides information about the circulation of knowledge between individual archives.

4.1 *"Observational" Texts*

Regular and systematic observation of the night sky and a formalized practice of recording these observations in a standard format lies at the centre of Late Babylonian astronomy. The preserved evidence from Babylon suggests that systematic observations were carried out on a nightly basis from the mid-eighth century BC to the first century AD. The primary observational text is the Astronomical Diary, of which preserved datable examples date from between 652 and 61 BC.[21] These texts typically contain reports of observations (and sometimes predictions) for a six-month period, arranged into sections for each month. Related to the Astronomical Diaries are texts which contain collections of lunar or planetary data.[22] These texts may be arranged either as straightforward lists of observations (sometimes interspersed with predictions) or in a tabular format which highlights the repetitive behavior of the planet or the moon according to its particular period. They may cover anything from a single observation up to several centuries worth of data. It is highly likely that most of these texts were compiled using data abstracted from the Astronomical Diaries.

21 All datable Diaries are published in Sachs and Hunger (1988, 1989, 1996).

22 The majority of such texts are published in Hunger (2001).

The astronomical observations recorded in the Astronomical Diaries include: the dates of the passages of the moon past certain reference stars (usually referred to as "Normal Stars") with measurements of the distance of the moon from that star; the lunar six (measurements of the time interval between the moon and sun crossing the horizon at six specific points of its monthly cycle); the dates, times and appearances of lunar and solar eclipses (also the dates and times of predicted eclipses which were not visible); the dates of the passages of the planets past either the other planets or the Normal Stars with measurements of the distance of the planet from that star; the dates and positions of the planets on the occasions of their first visibilities, last visibilities, stations, and acronychal risings (known collectively as "synodic phenomena"); and solstices, equinoxes, and the first visibility, acronychal rising, and last visibility of Sirius.[23] In addition, at the end of an entry for a month the level of the Euphrates river, the value of six staple commodities in the market, and important historical events were also recorded, as well as a summary of planetary phenomena which took place during the month and, in later Diaries, the signs of the zodiac in which the planets were located and the dates on which they entered new signs.

Only a subset of the observations in the Diaries were copied into the lunar and planetary compilation texts: eclipses, lunar six data, and planetary synodic phenomena and passages by references stars. This subset of observations reflects those astronomical phenomena which the Babylonians were able to predict using lunar and planetary periodicities (observations of passages of the moon by stars and planets, which are very frequently reported in the Diaries, are never collected into compilation texts because they cannot be predicted effectively). In order to make these predictions, Goal-Year Texts containing collections of observations from one period earlier than the "goal" year were compiled.[24] The resulting predictions were recorded in two related types of texts: Almanacs and Normal Star Almanacs (see next section).

More than one (and in some cases several) hundred examples of each of these types of observational texts are known from Babylon. The situation at Uruk, however, is very different, as mentioned already above in section 2. A total of only eleven such texts are known from Uruk (and, as I shall discuss below, two of these almost certainly contain predicted data not observations). These texts are listed in Tab. 4.2. In this table, I have divided the texts into two

23 For a detailed summary of the phenomena observed by the Babylonians and the terminology used in recording the observations, see Sachs and Hunger (1988: 20–36).

24 All of the known Goal-Year Texts are published in Hunger (2006).

TABLE 4.2 *"Observational" texts from Uruk*

Tablet	Content	Studies
House of the *ašipu*:		
SpTU V 266	Mars observations from Nebuchadnezzar II 1–14 (604–591 BC)	Steele (forthcoming a)
SpTU IV 171	Saturn observations from Nebuchadnezzar II 28–31 (577–575 BC)	Hunger (2000), de Jong (2002)
SpTU I 100	Summary of observations (?) from the reigns of Nabonidus, Cambyses and Darius (late 6th and early 5th century BC)	
SpTU V 268	Mixed planetary and eclipse observations from Artaxerxes I 2–4 (463–461 BC)	Hunger (forthcoming)
SpTU V 267	Mercury observations from Artaxerxes I 2–3 (463–462 BC)	Hunger (forthcoming)
SpTU V 271	Eclipse observation? (very fragmentary)	
Bīt Reš:		
W.20030/142	Astronomical Diary for Artaxerxes I 1 (464 BC)	Sachs and Hunger (1988: No. -463)
U 192	Astronomical Diary (small undated fragment)	Unpublished
A 3456	Mercury observations for SE 116–132 (196–180 BC)	Hunger (1988)
MLC 1883	Lunar six data for SE 124 (188 BC)	Hunger (2001: No. 42)
IM 44152	Jupiter data for SE 160–172 (152–140 BC)	Hunger (2001: No. 82), al-Rawi and Roughton (2003–2004)

groups according to their provenance: the house of the *ašipu* or the Bīt Reš sanctuary. Before looking at each group of texts in detail it is worth making a general comment. At Babylon, the most common type of observational text is the Astronomical Diary (several hundred preserved), followed by Goal-Year Texts (about one hundred and seventy five known), and then compilations of lunar and planetary texts (about one hundred). At Uruk, however, only two Diaries and no Goal-Year Texts have been discovered. The remaining nine texts are compilations of lunar and planetary data.

Six observational texts have been discovered at the house of the *ašipu*.[25] All but one of these texts contain compilations of observations: a collection of

25 For a detailed discussion of these texts, see Steele (forthcoming b).

Mars observations dating to Nebuchadnezzar II 1–14 (604–591 BC); a collection of Saturn observations covering at least Nebuchadnezzar II 28–31 (577–575 BC); a compilation of planetary, eclipse, and solstice, equinox and Sirius data for Artaxerxes I 2–4 (463–461 BC); a compilation of Mercury data for Artaxerxes I 2–3 (463–462 BC), which was almost certainly one of the sources for the preceding text; what appears to be a summary of observations with statements of the years and months where no data was available to the compiler covering parts of the reigns of Nabonidus, Cambyses and Darius I (late 6th and early 5th century BC); and a very fragmentary text which appears to contain a report of an observation of an eclipse.

The six tablets containing observations were part of the scholarly archives of Anu-ikṣur and his family, who resided in the house in the early fourth century BC, and Iqīšâ and his family, who lived there in the late fourth and early third century BC.[26] At least some of the tablets from the former archive found their way into the latter. What is more significant, however, is that the five tablets containing observations which can be dated (if only approximately in the case of SpTU I 100) all contain collections of observations from well before the date of either archive: SpTU V 266 and SpTU IV 171 both contain observations from the reign of Nebuchadnezzar II, approximately one hundred and fifty years before Anu-ikṣur; SpTU I 100 refers to dates about one hundred years before Anu-ikṣur; and SpTU V 267 and SpTU V 268 contain data from about fifty years before his time.[27] These tablets, therefore, are not records of observations made by the scholars who lived in this house but compilations of earlier astronomical data from somewhere else. Three possibilities exist for how these tablets ended up in this house: (1) the tablets were compiled around the time of the observations they contain and later the originals were acquired by Anu-ikṣur or one of the other occupiers of the house; (2) the tablets were compiled around the time of the observations they contain and copies were made of these tablets by Anu-ikṣur or one of the other occupiers of the house; or (3) the tablets were compiled by Anu-ikṣur or one of the other occupiers of the house from data that was available to them from some other source. In favour of option (3) it appears that the Mercury data on SpTU V 268 was copied directly from the tablet SpTU V 267. But where did the original observations come from? One possibility, recently suggested by Ossendrijver, is that the

26 On these archives, see Robson (2008: 227–240), Clancier (2009), Ossendrijver (in press).

27 A collection of the computed dates of solstices from the same archives, SpTU IV 169, contains data covering 604–506 BC, also a century before the time of Anu-ikṣur. For this text, see Hunger (1991) and Britton (2002: 30–32).

scholars of the Eanna temple conducted regular astronomical observations and wrote Astronomical Diaries, just like their counterparts in Babylon.[28] This is certainly possible and would provide an obvious source for the observations recorded in the texts discussed above, although it is worth noting that none of these texts are themselves Diaries—they are all compilations of observations. A second possibility is worth considering, however: the observations were made in Babylon and the texts are either copies of texts from Babylon or were compiled by a scholar from Uruk who had access to the Astronomical Diaries or other astronomical texts from Babylon. The texts themselves do not allow us to solve this problem. In format, style and use of terminology the six observational texts from the house of the *ašipu* are indistinguishable from those from Babylon (unlike the later texts from the Bīt Reš—see below), but this cannot be taken as conclusive proof that the texts or their sources originated there. Nevertheless, in the absence of direct evidence of observational activity among the scholars of the Eanna, this alternative possibility—that the observations originated in Babylon—seems to be to be somewhat more likely.

Five observational texts have been recovered from the Bīt Reš.[29] Of these, two are Astronomical Diaries and three are compilations of lunar or planetary data. One of the Diaries dates to year 1 of Artaxerxes I (464 BC), long before any other text known from this site, suggesting that it must either have been brought to the Bīt Reš by an astronomer in the third century BC or later, or else it is a copy of an original from elsewhere. The content, format and terminology of the Diary are consistent with Diaries from Babylon from the same period. The second Diary is a small undatable fragment; so far as can be judged from the small amount of text preserved, the content, format and terminology is also identical to that known from Babylon. By contrast, the two texts containing compilations of planetary data, A 3456 containing Mercury observations for SE 116–132 (196–180 BC) and IM 44152 containing Jupiter data for SE 160–172 (152–140 BC), frequently use different terminology from the texts from Babylon. For example, A 3456 uses *ina* EN and *ina* ZÁLAG rather than the standard terms from Babylon *ina* ŠÚ and *ina* NIM to indicate that first and last visibilities occur in the west (as an evening star) and the east (as a morning star) respectively. A 3456 also frequently abbreviates the names of Mercury and Jupiter to $\mathrm{GU_4}$ (normally $\mathrm{GU_4}$-UD) and BABBAR (normally MÚL-BABBAR), and gives the year numbers in decimal format (e.g. 1-ME-16 for 116) rather than

28 Ossendrijver (in press).

29 The assignment of several of these tablets to the Bīt Reš is based primarily on their date as they were purchased on the antiquities market.

as a sexagesimal number as we usually find in Babylon (e.g. 1,56 for 116). The similarities and differences between the style of recording observations on A 3456 and on texts from Babylon can most clearly be seen by comparing the reports of the observation of the same astronomical event. As an example, let us consider the observation of the first visibility in the west of Mercury in Month VII of SE 118 reported on A 3456 and on an Astronomical Diary from Babylon (the Diary is heavily restored at this point, but the restorations are certain from the consistency of terminology found elsewhere on the Diary and from surrounding observations):

A 3456 i 40: [A]PIN 22 *ina* EN GU_4 *ina* PA IGI 15 NA-*su in* 20 IGI
Diary -193B: [APIN ... 22 GU_4-UD *ina* ŠÚ *ina* PA IGI] 15 NA-*su in* 20 IGI

Both accounts can be translated identically:

> Month VIII, the 22nd, Mercury's first appearance in the west in Sagittarius. Sunset to rising of Mercury: 15 (UŠ); (ideal) first visibility on the 20th.

On the 22nd day of Month VIII, Mercury was seen for the first time as an evening star. On that day, Mercury was in the zodiacal sign of Sagittarius. The time interval between sunset and the setting of Mercury (called NA) was measured as 15 UŠ (time-degrees). Because this interval is greater than would be expected for the day of first visibility, the observer concluded that the ideal date of first visibility when he should have seen Mercury if the observing conditions were perfect was on the 20th, two days earlier.

Despite the differences in terminology both of the accounts just quoted record exactly the same observation of this event. This is quite remarkable if we consider that one tablet is from Babylon and the other from Uruk, which would seem to suggest that they are reporting observations were made at these two cities, some 200 km apart. The visibility of Mercury is highly dependent upon the local observing conditions and upon the eyesight of the observer; a small difference in either of these factors could easily lead to a difference in the date of the observation by one or more days. The time interval between sunset and Mercury's visibility is even more sensitive to local conditions. Thus exact agreement between observations of Mercury's first visibility at Babylon and Uruk would be the exception rather than the rule. Could it be that A 3456 and the Diary from Babylon are both reporting the same observation?

Comparing entries on A 3456 with reports of observations of the same astronomical event in Astronomical Diaries and Goal-Year Texts from Babylon it is found that there is a remarkable level of agreement between the data on A 3456 and the texts from Babylon: in 21 out of 24 cases the phenomena is reported for the same day; in 35 out of 39 cases the same statement of position is given (in two of the other cases the statement of position is shortened from “at the beginning/end of” a zodiacal sign to simply “in” the zodiacal sign); in 5 out of 8 cases both sources report that Mercury was “bright” (KUR or KUR_4); in 12 out of 16 cases the ideal date is the same; in 7 out of 9 cases both sources say that Mercury was not seen (NU PAP); and in 7 out of 9 cases a distance measured in cubits is the same.[30] The high level of agreement between the data on A 3456 and the records from Babylon cannot be chance. For the NA measurements there is a poorer agreement between A 3456 and the texts from Babylon: ten cases agree, seven disagree (although in some of these cases one or both of the numbers is damaged and the reading uncertain), and two further only have the NA measurement in one source. But even in this case, an agreement rate of 50 % cannot be seen as chance, especially given how sensitive NA measurements for Mercury are to local conditions. I suggest, therefore, that the observations on A 3456 were not made in Uruk but were copied from texts containing observations from Babylon. The lack of complete agreement between the data on A 3456 and the records from Babylon is fully consistent with the evidence for small discrepancies between different texts from Babylon (compare, for example, the three Diaries and the Goal-Year Text from Babylon containing the last visibility of Mercury in the west in Month XII of year 125: two of the Diaries and the Goal-Year Text give the position as “in the end of Pisces” while the third Diary abbreviates the position to “in Pisces”).[31] It is likely, therefore, that in some cases we are comparing with the wrong Diary from Babylon, the correct Diary being lost.

Several other pieces of evidence support the conclusion that the data on A 3456 was taken from observations recorded in Babylon. As already noted by Hunger, the statement in VI 38 that TA DU_6 EN ŠE NU SAR “From Month VII to Month XII nothing was written down” suggests that A 3456 was compiled from a series of Astronomical Diaries. The Diaries typically cover periods of half a year so the missing six months of data not available to the compiler of A 3456 can most easily be explained as he not having access to the requisite Diary.[32] Secondly, several unusual observations are reported identically in A 3456 and on a Diary. For example, a missing appearance of Mercury in month X of SE 122 is reported as follows:

30 The full comparison may be downloaded from www.babylonianastronomy.org/data/A3456.pdf.

31 For a study of the discrepancies in texts from Babylon, see Gray and Steele (2008: 570–573).

32 Hunger (1988: 203).

A 3456 iii 24–25:	AB 1 *ina* EN GU_4 *ina* GU ŠÚ TA 27 *šá* GAN *ki* PAP NU IGI
GYT No. 48 Obv. 6–7:	[…] ŠÚ *šá* GU_4-UD *ina* ŠÚ *ina* GU [TA x] *šá* GAN *ki* PAP NU IGI

Month X, the 1st. Mercury's last visibility in the west in Aquarius; from the 27th of Month IX, watched for (but) not seen.

And on an occasion where clouds prevented observation:

A 3456 v 44:	[…] *ina* EN GU_4 *ina* MAŠ-MAŠ ŠÚ DIR NU PAP
Diary -182a Obv. 13:	23 GU_4-UD *ina* ŠÚ *ina* MAŠ-MAŠ ŠÚ DIR NU [PAP]

The 23rd, Mercury's last visibility in the west; clouds, not seen.

Whilst it is possible that clouds would have prevented the observation of Mercury at both Babylon and Uruk, it seems more likely that both accounts report the bad weather at Babylon.

If A 3456 contains reports of observations made in Babylon but rewritten using terminology found only in texts from Uruk, what of the final two "observational" texts from the Bīt Reš? IM 44152 contains a collection of Jupiter data for SE 160–172 (152–140 BC). Like A 3456, IM 44152 uses some terminology that differs from what we find in Babylon. For example, IM 44152 distinguishes between first and second station using UŠ IGI ("front station") and UŠ *ár* ("rear station") whereas texts from Babylon usually use simply UŠ ("station") for both, and it states that passages of Jupiter past the Normal Stars took place either during the first part of the night or the last part of the night using the terminology EN and *ina* ZÁLAG respectively whereas this information is never given for observation of Jupiter in texts from Babylon (and if it were we would expect the terminology to be either USAN and *ina* ZÁLAG, which is what we find for passages of the moon past the Normal Stars, or *ina* ŠÚ and *ina* NIM, which is how morning and evening visibilities are distinguished in reports of observations of the Mercury and Venus). Unlike the Mercury text A 3456, the Jupiter data given on IM 44152 never remarks on the brightness of the planet, nor gives a NA measurement or an ideal date of visibility, or remarks on the weather. This might suggest that the text contains predicted rather than observed data. Indeed, al-Rawi and Roughton have already argued that the data on this text was computed using the 71 Goal-Year period for Jupiter.[33]

33 Al-Rawi and Roughton (2003–2004).

MLC 1883 is a collection of lunar six data for SE 124 (188 BC). The tablet is damaged but clearly contained a full run of lunar six data for the year. The entries are very brief: simply the date, the lunar six time interval given to the nearest 0;10 UŠ, and the name of the lunar six interval. None of the entries contain comments such as *muš* "measured", NU PAP "I did not watch", or references to weather which prevented or may have hindered observation. Such comments are very common in collections of lunar six data from Babylon. This suggests that MLC 1883 contains predicted rather than observed data. This conclusion is supported by the lunar six data itself, which shows a high preponderance of values with fractional endings. A statistical analysis of several hundred lunar six records from the Astronomical Diaries has demonstrated that observed lunar six time intervals are most frequently given either in whole numbers of UŠ or with the fractional ending ;30 (= 1/2). Predicted values, however, show a much higher frequency of other fractional endings, in fact an almost equal distribution of whole numbers and each fractional ending ;10 (= 1/6), ;20 (= 1/3), ;30 (= 1/2), ;40 (= 2/3), and ;50 (= 5/6).[34] The prevalence of these fractional endings in predicted data is a direct result of the Babylonian methods for calculating lunar six values which involved adding one-third of the sum of two lunar six taken from 223 or 229 months earlier.[35] The presence of such a large number of lunar six intervals with fractional endings on MLC 1883 provides convincing evidence that the tablet contains predicted rather than observed data.[36]

Of the three texts from Uruk containing what appeared to be observations dating to the Seleucid period, one, the Mercury text A 3456, almost certainly contains copies of observations made in Babylon, and the other two, the Jupiter text IM 44152 and the lunar six text MLC 1883, contain predicted data. Thus we have no direct evidence for observations being made in Uruk during this period. Given the fact that all of the other texts containing datable observations, the five compilation texts from the house of the *ašipu* with data from the late seventh to the early fifth century BC, and the Diary from the early fifth century BC found in the Bīt Reš, all contain copies of observations from well

34 Huber (2000: 226).

35 For these methods, see Brack-Bernsen (2002).

36 A further piece of evidence in support of MLC 1883 containing predicted data is found in the entry for the new moon NA of Month XI on Rev. VI 1. The entry reads ZÍZ 1 23 TAB (Hunger (2002: 123) read PAP? for TAB, but TAB is clear on the photograph). TAB is used to indicate a particularly large NA interval at the beginning of the month, so large that the moon could perhaps be seen on the previous day. This use of TAB is only otherwise found in Normal Star Almanacs which contain predicted data.

before the time of the archives in which they have been found, it is at the very least possible that the observations on these texts were also made in Babylon.

4.2 *Almanacs and Normal Star Almanacs*

Almanacs and Normal Star Almanacs contain predicted data for a single year, arranged chronologically in sections for each month of the year.[37] The predictions were made using observations made in earlier years which correspond to particular planetary and lunar periods (71 and 83 years for Jupiter, 8 years for Venus, 46 years for Mercury, 59 years for Saturn, 79 and 47 years for Mars, and 18 and 18 1/2 years for the Moon). These observations were collected in the Goal-Year Tablets. Because the phenomena of the planets repeat according to these periods, in order to make predictions for a coming year all that needed to be done was to take the observations from one period earlier, change the year to the current year, if necessary make a +/- 1 month correction to take into account intercalation, and finally correct the date by a known small number of days to take in account imperfections in the planetary periods. Lunar and solar eclipses and the lunar six were predicted using related but somewhat more complicated methods that made use of the 18-year Saros period.[38]

There are slight differences in the content of the Almanacs and Normal Star Almanacs from Babylon: the Almanacs include the dates on which a planet enters a new sign of the zodiac whereas the Normal Star Almanacs record instead the passages of the planets by the Normal Stars, and the Normal Star Almanacs include predictions of the complete lunar six whereas the Almanacs only give the dates (but not the time intervals) of three out of the lunar six.

Eight Almanacs and Normal Star Almanacs are known from Uruk (see Tab. 4.3). All but one of these texts comes from the Bīt Reš and date to a fairly narrow time period between SE 82 and SE 156 (230–156 BC). The final tablet was found at the site of the house of the *ašipu* and is an Almanac apparently containing predictions for the year SE 390 (AD 79). If this tablet has been correctly dated then it is considerably later in date than any of the other astronomical tablets from this house; there is some evidence that this tablet might have been a surface find from a later stage of occupation of the area and therefore not connected with the archives containing the other astronomical

37 All of the known Almanacs and Normal Star Almanacs are published in Hunger (2014).

38 For details of these methods, see Gray and Steele (2008) and (2009) and Steele (2011) on planetary phenomena, Steele (2000a) on eclipses, and Brack-Bernsen (2002) on the lunar six.

TABLE 4.3 *Almanacs and Normal Star Almanacs from Uruk*

Tablet	Content	Studies
House of the *ašipu*:		
SpTU I 99	Almanac for SE 390(?) (AD 79?)	Hunger (2014: No. 219), Hunger and de Jong (2014)
Bīt Reš:		
MLC 1860	Normal Star Almanac for SE 82 (230 BC)	Hunger (2014: No. 24)
MLC 1885	Normal Star Almanac for SE 133 (179 BC)	Hunger (2014: No. 57)
U 180(3)+193a+193b	Normal Star Almanac for SE 150 (162 BC)	Hunger (2014: No. 64)
U 194	Normal Star Almanac for SE 151 (161 BC)	Hunger (2014: No. 65)
AO 8530	Normal Star Almanac for SE 156 (156 BC)	Hunger (2014: No. 69)
W.20030/109	Almanac for SE 147 (165 BC)	Hunger (2014: No. 159)
MLC 2195	Almanac for SE 147 (165 BC)	Hunger (2014: No. 160)

tablets.[39] Interestingly, the two other Almanacs are both for SE 147 and are almost identical duplicates.

The Almanacs and Normal Star Almanacs from Uruk exhibit several differences in terminology, content and format to those from Babylon.[40] For example, Normal Star Almanacs from Babylon usually give the lunar six whereas those from Uruk give the lunar three; predictions of planetary conjunctions are always written as verbless phrases in texts from Babylon whereas similar predictions are sometimes written with the final verb DIB "it passes" in Uruk texts; multiple entries for the same day simply follow one another in texts from Babylon whereas in the Uruk texts they are preceded by U_4 BI "That day"; the dates of the entrances of the planets into the signs of the zodiac are never found in Normal Star Almanacs from Babylon whereas they are consistently given in Uruk Normal Star Almanacs; Aries is always written ḪUN at Babylon whereas it can be written using either ḪUN or LU at Uruk; solstices and equinoxes are written GUB-*za* and LÁL-*tú* respectively at Uruk rather than just GUB for solstice and LÁL-*tí* for equinox in texts from Babylon; when distinguishing between morning and evening appearances of the inner planets, "in the east" is written *ina* KUR at Uruk rather than *ina* NIM at Babylon; and the dates of the phenomena

39 For a discussion of the date of this tablet and its findspot, see Hunger and de Jong (2014).

40 See already Hunger (2014: xvi).

of stars other than Sirius are common in Normal Star Almanacs from Uruk but rare in texts from Babylon. Most of these differences are simply matters of style rather than substantive variations in content.

There are three basic possibilities for source of the predictions in the Almanacs and Normal Star Almanacs from Uruk: (1) the predictions were made using the methods of Goal-Year astronomy from observations made in Uruk; (2) the predictions were made in Uruk using these same methods but applied to observations that were made in Babylon; or (3) the predictions were copied from Almanacs and Normal Star Almanacs from Babylon. If possibility (3) is correct it would require that the Uruk Normal Star Almanacs were not directly copied because the dates of sign entrances found in these texts do not appear in Normal Star Almanacs from Babylon. Instead the Uruk Normal Star Almanacs would have to combine material from Almanacs and Normal Star Almanacs from Babylon.

Comparing texts from both cities which contain predictions for the same period should help us decide between the three possible sources for the data in the Uruk texts. Unfortunately, however, only one pair of overlapping texts are known: MLC 1860 from Uruk and Rm 731+ from Babylon, both of which are Normal Star Almanacs for year SE 82.[41] Tab. 4.4 compares the overlapping predictions in these two texts. Although there are several entries which are in agreement, a few disagree to the date of the phenomena, the distance of a planet from a Normal Star, or both.[42] By comparison, where more than one Normal Star Almanac from Babylon is preserved, entries agree to a significantly high proportion.[43] This suggests that the predictions in the Uruk Normal Star Almanac were not copied directly from an Almanac and a Normal Star Almanac from Babylon. This is only one example, however, and it would be dangerous to draw too many conclusions from it. We know, for example, that there are some differences between different Diaries and Goal-Year Texts from Babylon. Furthermore, there was clearly some inconsistency in how the various corrections to the Goal-Year periods were applied in the construction of Almanacs

41 U 194 from Uruk and BM 132287 from Babylon are both Normal Star Almanacs for SE 151, but the latter tablet is very fragmentary and not enough entries are preserved to allow a meaningful comparison of the two sources.

42 Some of these disagreements may be due to scribal errors or to modern misreadings of damaged tablets, but others are must represent clear differences (e.g. Venus' passage by the Normal Star η Piscium is predicted for the 1st of Month II in the Uruk text but the 28th of Month I in the Babylon text).

43 The same is true of overlapping predictions in Almanacs and Normal Star Almanacs from Babylon; see Gray and Steele (2008: 566–568).

and Normal Star Almanacs from Babylon.[44] Thus, we cannot rule out the possibility that MLC 1860 was copied from a different set of Almanacs and Normal Star Almanacs than Rm 731+.

TABLE 4.4 *Overlapping data on the Normal Star Almanacs MLC 1860 from Babylon and Rm 731+ from Babylon*
TRANSLATIONS TAKEN FROM HUNGER (2014)

MLC 1860	**Rm 731+**
(Month I.) [The xth … after sun]set, lunar eclipse, two-thirds […]	(Month I.) Night of the 13th, 49°? after sunset, lunar eclipse […] it will make more than two-thirds of the disc.
(Month I.) [The xth] … after sunrise, solar eclipse to be [watched for].	(Month I.) The 28th, 54° after sunrise, solar eclipse to be watched for.
(Month II.) The 1st, last part of the night, Venus [will pass] 3 1/2 cubits below η Piscium.	(Month I.) Night of the 28th, last part of the night, Venus 3 cubits below η Piscium.
(Month II.) The 4th, last part of the night, Mars' first appearance in the east in the beginning of Taurus.	(Month II.) The 7th, Mars' [first appearance] in Tau[rus.]
(Month II.) The 9th, last part of the night, Venus [will pass] 5? [cubits] below α Arietis.	(Month II.) [Night of the xth (between 7th and 10th), last part of the night], Venus […] below α Arietis.
(Month II.) The 10th, Sirius' last appearance in the west.	(Month II.) The 10th, Sirius' last appearance.
(Month II.) The 23rd, last part of the night, Venus [will pass] 3 [… cubits below η Tauri.]	(Month II.) Night of the 22nd, […]

44 Gray and Steele (2008: 572–579).

TABLE 4.4 *Overlapping data on the Normal Star Almanacs* (cont.)

MLC 1860	Rm 731+
(Month II.) The 28th, Mercury's [last appearance] in the west in the end of Gemini.	Month II. The 25th?, Mercury's [last appearance] in the west in [(…) Gemini.]
(Month III.) The 2nd, Jupiter's first appearance in the beginning of Gemini.	(Month III.) [The xth, Jupi]ter's first appearance in the beginning of Gemini.
(Month IV. The 15th) On this day, Sirius' [first appearance] in [the east].	(Month IV.) The 15th, Sirius' first appearance.
(Month IV.) The 16th, Mercury's last appearance in the east in Cancer.	(Month IV.) The 17th, Mer[cury's last appearance in the east in Cancer.]
Month V, (the 1st of which will be identical with) the 30th (of the preceding month.)	Month V, (the 1st of which will be identical with) the 30th (of the preceding month.)
(Month IX.) [The xth (a day before the 30th), Saturn] stationary in Virgo.	(Month IX.) The 29th, Saturn stationary in Virgo.
(Month IX.) The 30th, solstice.	(Month IX.) The 30th, solstice.
(Month XII.) [The xth (day less than 9th)] Saturn's acronychal rising in Virgo.	(Month XII.) The 8th, Saturn's [acronychal rising …]
Year 83. Month I, the 1st (of which will follow the 30th of the preceding month).	Month I, the 1st (of which will follow the 30th of the preceding month).

4.3 *Mathematical Astronomy*

Mathematical astronomy refers to methods for calculating astronomical phenomena using mathematical procedures which do not rely upon regular empirical input in the way that Goal-Year astronomy does. By the late fourth century, several systems of mathematical astronomy for calculating lunar and planetary phenomena had been developed in Babylonia. These schemes can be divided into two basic groups depending upon how the longitude of the moon or a planet is calculated: schemes which use step functions to calculate longitudes are customarily designated as "System A" schemes whereas those which use linear zigzag functions to calculate longitudes are designated as "System B" schemes.

Three basic types of mathematical astronomical text are known: (1) Synodic Tables which contain computed data for successive synodic phenomena of the moon (i.e. conjunctions or oppositions) or a planet (first and last visibilities, stations, and acronychal risings); (2) Auxiliary Tables which contain calculated material related to the synodic tables (e.g. extracts from Synodic Tables, data to be used in constructing synodic tables, etc); and (3) Procedure Texts which contain instructions for computing Synodic Tables.

Many mathematical astronomical texts are known from Babylon and Uruk including examples for the moon and each planet from both cities. Although the content of the tablets from Babylon and Uruk are essentially the same, there are certain differences in layout and style between the texts from the two cities. For example, tabular astronomical texts from Babylon usually turn from bottom to top (like regular cuneiform tablets) whereas those from Uruk often turn from side to side; the two-wedge separation or "zero" marker is always used between sexagesimal digits which end in a zero and digits less than ten (e.g. between 10 and 1 to distinguish 10,1 from 11) in texts from Uruk but is rare in texts from Babylon; year numbers in Synodic Tables are always written sexagesimally at Babylon but often use a hybrid system of hundreds with sexagesimals (e.g. 1-ME 1,27 rather than 3,7 for 187) at Uruk; and the zodiacal sign Aries is always written using ḪUN at Babylon but either LU or ḪUN may be used in texts from Uruk, Scorpio is always GÍR at Babylon but GÍR-TAB at Uruk, and Pisces is *zib*.ME at Babylon but *zib* at Uruk.[45]

The history of the development of the various lunar and planetary systems of mathematical astronomy is far from clear, despite extensive research in this area by scholars over the past three decades.[46] Reconstructing the origin of the two systems of lunar theory is particularly complicated: all that can be said with certainty is that System A lunar theory is attested in its fully developed form by 318 BC and parts of the System B lunar theory are attested by 258 BC. Some of the planetary systems are also attested in the late fourth century BC, although others are not attested until much later. Related to the question of the relative chronology of the different systems of mathematical astronomy is their place of origin.

45 See already Neugebauer (1955: 4–5).

46 See, in particular, Aaboe (1980), Brack-Bernsen (1997), Swerdlow (1998), and Britton (2007) and (2009).

Britton has taken the strongest position on this issue arguing, albeit with due caution, that lunar System A was developed in Babylon and lunar System B was developed in Uruk:

> the invention of the first comprehensive lunar theory, known as System A, … appears to have occurred in the city of Babylon, shortly after the beginning of the 4th century B.C. Roughly a century later an alternative theory known as System B was developed, possibly in Uruk, which addressed the same issues with different mathematical schemes.[47]

Other scholars have alluded to the idea that lunar System A was created in Babylon and System B in Uruk. For example, while Brown does not make this claim directly, he clearly has this in mind when he writes that "It is remarkable that the vast majority of the system A lunar MAATs [Mathematical Astronomical-Astrological Texts] were found in Babylon, while it was in Uruk that the majority of the system B lunar MAATs were located, the earliest examples of each dating to around 260 BC"[48] and later refers to the two systems as "the Uruk and Babylon lunar MAAT schemes".[49] Similarly, Robson claims that the two systems were mostly used in different cities: "System A, fully developed by 320 BCE and mostly attested at Babylon, is based on so-called step functions … System B, perfected by about 260 BCE, and apparently mostly used at Uruk, was based upon linear zigzag functions".[50]

In order to assess these claims about the origin and use of the various lunar and planetary systems between Babylon and Uruk, in Tab. 4.5 I give counts and attested date ranges of all the synodic tables and (for the lunar systems only) auxiliary tables known to me from each city. The date ranges must be treated with some caution as they refer to the dates of the data contained on the tablet, which might not be the date when the tablet was written. In particular, it is possible, and in the case of many of the planetary Synodic Tables which typically contain data for several decades very likely, that the data was calculated at a later date by projecting the scheme backwards.

It is immediately apparent from Tab. 4.5 that the number of preserved planetary synodic tables of each kind is too small to make any claims for whether certain systems were used only in one city or the other (as an extreme

47 Britton (2007: 84).
48 Brown (2000: 172, n. 405).
49 Brown (2000: 226).
50 Robson (2008: 218). Although she does not say so, Robson is presumably referring only to the lunar systems.

TABLE 4.5 *Number and attested date ranges for tablets containing lunar and planetary synodic and auxiliary tables at Babylon and Uruk. Date marked with a * indicate that the tablet is broken at the beginning/end and so the date range of the original table extended earlier/later.*

Type	Babylon	Uruk
Lunar System A synodic table	43 (318–36 BC)	3 (272–188 BC)
Lunar System A auxiliary table	28 (306 BC–42 AD)	0
Lunar System B synodic table	21 (136–76* BC)	11 (206–175 BC)
Lunar System B auxiliary table	4 (258–69 BC)	41 (208*–164 BC)
Mercury System A_1 synodic table	7 (180–88 BC)	1 (194 BC)
Mercury System A_2 synodic table	2 (313–302 BC)	0
Venus System A_0 synodic table	0	2 (201–137 BC)
Venus System A_1 synodic table	3 (216–47 BC)	0
Venus System A_2 synodic table	4	0
Mars System A synodic table	3 (142–125 BC)	3 (223–189 BC)
Mars System B synodic table	0	1
Jupiter System A synodic table	6 (182–95 BC)	4 (199–155 BC)
Jupiter System A′ synodic table	9 (178–73 BC)	0
Jupiter System B synodic table	1 (151–110 BC)	5 (127* BC)
Jupiter System B′ synodic table	0	1 (181 BC)
Saturn System A synodic table	1	0
Saturn System B synodic table	4 (157–83 BC)	9 (311–189 BC)

example, we only know of one Mars System B Synodic Table (from Uruk) and only one Saturn System A Synodic Table (from Babylon); if those tablets had not been identified we would have said that those systems were not used anywhere and so the fact that we have examples from only one city in each case cannot be taken as evidence that the systems were not used at the other city).

The greater number of lunar tables preserved offers some hope for investigating the use of the two lunar systems at Babylon and Uruk.[51] As noted by previous scholars, lunar Synodic Tables calculated according to System A are

51 The larger number of lunar Synodic Tables preserved compared to planetary Synodic Tables may be explained by the circumstances of production of the tables. Typically, lunar Synodic Tables cover only one or a small number of years, whereas planetary Synodic Tables frequently cover several decades. Thus many more lunar Synodic Tables than planetary Synodic Tables need to be written to cover any given period.

attested much more frequently at Babylon than at Uruk, by a factor of more than ten. The same is true of System A Auxiliary Tables, of which more than twenty are known from Babylon but not a single example from Uruk. The discrepancy between attested lunar System A texts from Babylon and Uruk does seem to suggest that System A was predominantly used at the former city. In support of this conclusion, it may be significant that of the three System A Synodic Tables from Uruk, two provide full moon and new moon data for an overlapping time period (full moons for SE 124–125 (ACT No. 1) and new moons for SE 124–126 (ACT No. 2)), while the third is the only lunar synodic table found at the house of the *ašipu* (SpTU I 98) and dates to SE 40.[52] One can easily imagine that the former pair were either brought together from Babylon to Uruk or were produced in Uruk by a single scribe who was perhaps from Babylon.[53] If this is the case, then it is extremely likely that lunar System A was created in Babylon.

Unfortunately, the evidence from the preserved System B tablets does not provide such a clear-cut case for the use and place of origin of lunar System B. Looking only at the numbers of System B Synodic Tables preserved, we find nearly twice as many examples from Babylon as from Uruk. However, nearly ten times as many System B Auxiliary Tables are known from Uruk as from Babylon. Contrary to Brown and Robson's statements quoted above, this does not support the conclusion that System B was mainly used at Uruk rather than at Babylon. This should not surprise us: given that we have several System B Synodic Table preserved from both sites, it seems very reasonable to suppose that at least one such table was constructed for each year, and that only a relatively small proportion are preserved to us. What do seem to be more common at Uruk are Auxiliary Tables, although I can offer no explanation for why this may be so other than to suggest that it is simply an accident of what has been preserved.

Knowing that lunar System B was used extensively at both Babylon and Uruk we can now investigate the question of whether it was created and used first at one city and then transmitted to the other. Considering merely the preserved dated System B Synodic Tables, System B is attested in Uruk in the late third and early second century BC and only later, in the late second and early first century BC, is it attested at Babylon. This could be taken to imply that System B was created in Uruk and only transmitted to Babylon at a later date. However, this

52 As noted by Hunger (1976: 100), SpTU I 98 contains a major error of calculation.

53 Based upon inspection of photographs the script looks sufficiently similar to make it quite possible that both tablets were written by the same hand.

conclusion is almost certainly incorrect because it is fails to take into account a basic methodological problem in the process of dating of lunar System B Synodic Tables.[54] Unlike lunar System A, which ran uninterrupted for several centuries, lunar System B was reset quite frequently with new initial values of each column. As a consequence, it is often not possible to date System B synodic tables by connecting them to other synodic tables unless they are separated by only a small number of years. As it happens, none of the lunar System B synodic tables from Babylon preserve the date column. Eight synodic tables can be dated by connecting columns to ACT No. 122, which itself is dated by connecting columns to three tables from Uruk. The other thirteen lunar System B Synodic Tables from Babylon cannot be dated, and so are likely to be from either several decades or more earlier or later than ACT No. 122, which itself dates to 104–102 BC. Thus the lack of dated lunar System B Synodic Tables from Babylon which are contemporary with or earlier than the examples from Uruk is likely to be purely an artefact of the way in which the tablets can be dated, and therefore cannot be used to argue for an Urukean origin of lunar System B. Indeed, the earliest attestation of lunar System B is in fact an Auxiliary Table from Babylon (ACT No. 149, containing eclipse magnitudes for at least 258–245 BC), and the earliest attestation of this system at Uruk is an Auxiliary Table (ACT No. 155 containing values of the lunar velocity function for at least 208–188 BC) says in its colophon that it is a "copy from Babylon". In conclusion, therefore, there is no evidence that lunar System B was invented in Uruk. The system was used in both Babylon and Uruk and could have been developed in either city. In the absence of any evidence to the contrary, it seems to me to be most likely that lunar System B, like System A, was developed in Babylon, where we have extensive evidence of the observational activity which provided the necessary empirical data to construct the system, rather than in Uruk, where we have no firm evidence of observations being made at the time of the system's development.

If I am correct that both of the main lunar systems were created in Babylon, and it would seem reasonable in that case to also suppose the same for all of the planetary systems, it is interesting to note the extent of transmission of knowledge of the systems from Babylon to Uruk. This transmission extended not only to the basic mathematical rules of the various systems but also, in some cases, to the transmission of initial values that result in Synodic Tables from one city connecting to tables from the other city, which implies a close connection between the astronomers in the two cities.

54 See already my comments in Steele (2002: 295).

4.4 *Astrology*

Several new forms of astrology were developed during the Late Babylonian period including the personal horoscope and mathematical and other schemes which associated celestial bodies, constellations and signs of the zodiac with cities, illnesses, medical remedies, the state of the market, and cultic practices. Texts concerned with these new forms of astrology are attested from both Babylon and Uruk, along with copies of the traditional celestial omen series *Enūma Anu Enlil* and its commentaries. Central to many of the new forms of astrology created in the late period was the concept of the zodiac as a uniform division of the path of the sun, moon and planets into twelve equal parts, each containing 30°, making a full circuit of the zodiac equal to 360°.[55]

Thirty-two horoscopes are currently known of which twenty-four are from Babylon and six are from Uruk.[56] All of the Horoscopes contain the same basic information: a range of astronomical phenomena, primarily the positions of the sun, moon and planets, at or around the time of the birth of a child. However, there are considerable differences in the specific information given in the Horoscopes from Babylon and Uruk (see Tab. 4.6). For example, the Horoscopes from Uruk often include the name of the child and give some predictions for his life, both of which are rare among the Horoscopes from Babylon. A much wider range of astronomical information is included in the Horoscopes from Babylon, whereas those from Uruk usually give only the positions of the sun, moon and planets in the zodiac. Furthermore, this position in the zodiac is usually given as a precise value to the degree (or even fraction of a degree) in Uruk Horoscopes; precise longitudes are rare in the Babylon texts except for the very late examples.[57] There is a similar difference in astrological data included in the Horoscopes from the two cities: references to the *bīt niṣirti* ("secret house") of a planet is commonly found in Horoscopes from Babylon dating to before 141 BC but is never included in Horoscopes from Uruk. On the other hand, references to the "place" (KI) of a planet (something different to its *bīt niṣirti*) is found in Horoscopes from Uruk but never in Horoscopes from Babylon. Thus, although there is a shared basic tradition of constructing Horoscopes at Babylon and Uruk, there were

55 One the concept of the zodiac and the date of its invention, see Steele (2007) and Britton (2010).

56 Two Horoscopes tablets from Babylon and one from Uruk contain two horoscopes each. For an edition and translation with commentary of all the known Horoscopes, see Rochberg (1998).

57 This point was noted already by Jones (1999) and Rochberg (2003: 34).

TABLE 4.6 *A comparison of the preserved Horoscopes from Babylon and Uruk*

	Babylon	**Uruk**
Number preserved	24 (22 tablets)	6 (5 tablets)
Date range	409–68 BC	262–199 BC
Native's data:		
Name of individual given	Rare	Sometimes
Predictions given	Rare	Yes
Astronomical data:		
Distance of the Moon to a Normal Star	Common before 141 BC	No
Lunar Three	Yes	No
Solstice/Equinox	Yes	No
Eclipse	Yes	No
Lunar latitude	No	Common
Precise longitudes	Rare and only after 124 BC	Yes
Astrological data:		
bīt niṣirti	Common before 141 BC	No
"Place" of a planet	No	Sometimes

distinct local traditions of what should be included in a Horoscopes at these two cities.[58]

The inclusion of precise zodiacal positions in the horoscopes from Uruk may be particular revealing about the different local traditions of the Horoscopes. As Rochberg has shown, a likely source of much of the content of the Horoscopes from Babylon are the Almanacs, which ultimately rely on the tradition of observational astronomy. If I am correct in suggesting above that there was not a systematic programme of observational astronomy in Uruk during the Seleucid period (and perhaps never), then the source of the astronomical data in the Uruk Horoscopes can only have been the texts of mathematical astronomy.[59]

58 It would appear that some of what could be called the "Uruk" Horoscope tradition was adopted in the Horoscopes from Babylon towards the end of the second century BC.

59 Rochberg (1999) is more cautious about whether the longitudes in the Horoscopes were taken from the texts of mathematical astronomy.

Indeed, one tablet from Uruk, A 3405, contains a collection of computed planetary data which may well have been intended for use in constructing horoscopes.[60] The differences between the Uruk and Babylon Horoscopes may therefore provide additional support for my suggestion about the lack of a tradition of systematic observational astronomy in Uruk.

5 Discussion

In the preceding sections I have outlined some of the similarities and differences between astronomy at Babylon and Uruk. Overall, as would be expected, it is clear that the astronomical texts from Babylon and Uruk are closely related parts of a shared tradition: the main genres of texts, their basic content and structure, and the astronomical methods they attest to are essentially the same at both sites. However, looking closer at the preserved texts a somewhat different picture emerges which shows that there were distinct local practices within this larger shared tradition. These differences can be grouped into two categories: (1) real differences in actual astronomical practice and (2) differences which are merely to do with how astronomical practice is presented in written form.

The most important difference in astronomical practice is the apparent lack of a tradition of astronomical observation in Uruk, at least during the Seleucid period. The few observation texts that we have from Uruk all contain either copies of observations made at an earlier period (whether the observations were made in Uruk or Babylon is not clear), copies of more or less contemporary observations which were made in Babylon, or texts that turn out on closer inspection to contain predicted data rather than observations. Of course, it is possible that this is merely a consequence of the fact that all (or almost all) of the astronomical texts from the Seleucid period appear to have originated from the archive of the Bīt Reš; perhaps a large body observational texts remain undiscovered in unexcavated archives from other sites in Uruk. But the apparent use of mathematical astronomy to provide the data for Horoscopes in Uruk in contrast to the Horoscopes from Babylon which seem to have drawn on the

60 Steele (2000b). As I note in that article, the planetary data contained in A 3405 (dates and zodiacal positions of the synodic phenomena of the planets) could not be used directly to give the necessary positions on dates which are not one of the synodic phenomena which is what is generally needed in the Horoscopes. However, the necessary positions could be easily obtained using the various daily motion schemes for the planets which are well attested.

tradition of observational and Goal-Year astronomy for their data, also suggests the absence of regular astronomical observation in Uruk.

The small presentational differences between texts of the same type from Babylon and Uruk is even more intriguing. These differences, such as the use of different terminology and the inclusion of slightly different or extra data within a particular type of text (but always data that can easily be determined without requiring any additional empirical input), are, in a sense, trivial—they do not change the basic astronomical content of the text—but perhaps all the more significant for that. For example, it does not change the meaning of a lunar Synodic Table if the year numbers are written sexagesimally or using the sign for one hundred, nor if the name of the zodiacal sign Aries is written ḪUN or LU. Similarly, the meaning a report of an observation of Mercury's visibility in the evening is the same whether it is written using *ina* EN ... IGI or *ina* ŠÚ ... IGI. Nor was it a significant change to include the date when a planet entered a new sign of the zodiac in a Normal Star Almanac given that the date was calculated from other data already included in the Normal Star Almanac.[61] One must ask, therefore, what is the reason for these different terminologies and practices as to what was included within particular texts?

The answer, I suggest, lies in an attempt by the Uruk scribes to promote their self-identity through a process of "Urukization". If I am correct in my arguments that Uruk was essentially a receiver of astronomical knowledge from Babylon rather than an equal partner in the creation of astronomy in Babylonia—a conclusion I base on the evidence for Uruk scribes copying observations from Babylon, for Babylon as the place in which the various schemes of mathematical astronomy were developed, and for Uruk scribes occasionally noting in colophons of astronomical texts that they copied the text from Babylon, a phenomena which is not attested in the other direction—and recalling the political situation in Uruk which led to the rise of the Anu cult and the cutting of ties with many of the high ranking families of Babylon, such an attempt to make this knowledge Urukean may not be too surprising. Indeed, it may be seen as part of a wider attempt to promote Anu as the city god of Uruk during this period. A clear example of this may be found in the text MLC 1866, a text containing descriptions of the constellations that is related to earlier texts from Assur and Babylon.[62] In its first line MLC 1866 quotes the standard compendium MUL.APIN, with one change:

61 Similarly, the astrological "Micro-zodiac" tablets from Babylon and Uruk have differences in layout but crucially not content. See the paper by Monroe in this volume.

62 For the Assur text, see Weidner (1927). An edition and study of all texts from this group, including MLC 1866, is in preparation by P.-A. Beaulieu, W. Horowitz and J.M. Steele.

MUL.APIN I i 40:
¶ $^{\text{mul}}$AŠ.IKU *šu-bat* $^{\text{d}}$*É-a a-lik* IGI MUL.MEŠ *šu-ut* $^{\text{d}}$*A-nim*
¶ 'The Field,' the seat of the god Ea, the forerunner of the stars of Anu

MLC 1866 Obv. 1:
[¶] ⸢$^{\text{mul}}$IKU⸣ *šu-bat* $^{\text{d}}$60 *a-lik pa-na-at* ⸢MUL.MEŠ *šu-ut* $^{\text{d}}$60⸣
[¶] 'The Field,' the seat of the god Anu, the forerunner of the stars of Anu

MLC 1866 substitutes Anu's name for Ea's, perhaps in response to the promotion of the god Anu to the head of the Uruk pantheon. A distinctly Urukean pantheon is also found in other parts of MLC 1866.[63] A desire to promote Uruk as a centre of scholarly knowledge may also lie behind the prevalence of colophons on Uruk astronomical (and other) tablets which claim the content of the tablet as part of the "Wisdom of *Anūtu*, secret of the [great] god[s], wisdom of the scholars",[64] and of the various protection formulas on Uruk astronomical texts, despite the fact that the astronomical schemes contained within those tablets were well known (and were probably developed) in Babylon.

Astronomical knowledge circulated frequently, and probably quite quickly, from Babylon to Uruk during the Achemenid and Seleucid periods (there is no convincing evidence for knowledge passing in the other direction). This knowledge covered almost the whole of Babylonian astronomy including observations made in Babylon, the various systems of mathematical astronomy, and new forms of astrology, and must have included the transmission of written texts as well as direct contact between astronomers in the two cities. Upon reaching Uruk, the astronomy often went through a process of Urukization, an attempt to make it distinct—if not substantially different in most cases—from the original material from Babylon.

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63 Beaulieu (1992a).

64 ACT No. 135.

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CHAPTER 5

The Micro-Zodiac in Babylon and Uruk: Seleucid Zodiacal Astrology

M. Willis Monroe

Introduction

The Hellenistic period in Mesopotamia provides a rich context in which to study the transmission of knowledge both from earlier Mesopotamian sources as well as on to other cultural horizons. This period benefits from the incredible richness of the source materials and the interconnected social, historical, and geographical contexts in which they are found and can be analyzed. Mark Geller has characterized the interconnectedness of the scholarly texts of this period as representing a "globalisation of knowledge in the ancient Mediterranean world …"[1] It is important to note that this "globalisation of knowledge" is the beneficiary of a period of intense scribal production which functioned to distill millennia of Mesopotamian knowledge into innovative new texts and formats which found commonality with other scholarly work in other cultures. In reference to the process of transmission Ulla Koch has noted that during this period omen material, in particular, went through a period of remarkable innovation where new texts were developed using old content and concepts together with new material.[2] An excellent example of this process is the group of tablets which preserve the micro-zodiac series from Babylon and Uruk. These texts combine the micro-zodiac, a new astrological concept, with long standing Mesopotamian knowledge. This paper aims to describe this process through a re-analysis of the micro-zodiac texts in light of new sources which preserve more of this astrological series.

Before continuing it is worth outlining the specific form of the micro-zodiac texts. The overriding astrological structure of these texts is a scheme which extends the zodiac by sub-diving each zodiacal sign into twelve equal parts each named after the original twelve signs of the zodiac, essentially multiplying the zodiac by itself. Each Major sign (and I use here the terms Major and minor

1 Geller (2010: 3).
2 Koch-Westenholz (1995: 162).

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for the two classes of signs) then has twelve minor signs starting with the same sign for the Major-minor pair. This scheme creates a total of 144 unique pairings allowing, in the Mesopotamian mind-set, a plethora of further analogous links and associations, as well as creating a schematic structure on which to hang references to existing texts of Mesopotamian knowledge.

The Mesopotamian scribes of the Hellenistic period were heirs to a literary tradition stretching back thousands of years encompassing collections of knowledge concerned with all aspects of daily life and celestial affairs. This collected knowledge allowed these scholars to compose and tie together diverse groups of knowledge in new formats and compose creative texts that were unique to this period. The main urban centers of Babylon and Uruk were centers of textual production and reception with scribes in both cities working on similar texts. The similarities and differences between textual traditions found in both sites illustrate interesting trends in scribal culture during the Hellenistic period. The micro-zodiac texts from Babylon and Uruk exhibit remarkable stability in content, but at times radical differences in format.[3] These texts therefor serve as an example of how knowledge could be created, transmitted, and experimented with through the work of close-knit scholarly communities.

The known micro-zodiac tablets come from Uruk and Babylon. The geographic separation between the preserved tablets makes subtle changes in traditions between scribal families working in different cities more apparent. The varying traditions, especially in the case of this astrological material, sheds light on the ways in which knowledge could be shifted and restructured into new organizational formats.

Mesopotamian astrology diverges in the late period into two primary new disciplines, that of horoscopy on one hand and descriptive texts like the micro-zodiac on the other.[4] The former follows on the traditional system of divinatory logic;[5] although very few of the horoscopes actually include a fortune for the client they clearly fit into an older tradition of birth omens. The descriptive texts diverge from this form of divinatory logic, specifically the idea of a protasis and apodosis. In fact the descriptive texts seem to deal exclusively with the regular, predicted occurrence and their potential natural or inherent influ-

3 By using the term content here I am not referring to the composition as a whole but to the small pieces of text in individual cells contained within the overarching micro-zodiac table. The format is the way in which these small pieces of text are related to each other physically on the surface of the tablet.

4 These are both in addition to the continuation of the long-standing celestial omen material, in particular the series *Enūma Anu Enlil*.

5 Rochberg (2009).

ence over aspects of daily life. The analogous relationships created in these texts begin to approach the idea of a natural affinity or attribute rather that implied prognostication as in traditional conditional logic. What is clear is that the micro-zodiac was not created for a predictive purpose. Instead it lays out the various affinities between Major and minor signs and the varied content included in the table: medicine, deities, diet and behavior. The micro-zodiac eschews explicit conditional logic and problems of impossibility for a descriptive format that is wholly predictable.

Looking at the various fragments of the micro-zodiac both from Uruk and Babylon one can begin to see how such a descriptive text was compiled and used. An analysis of texts over time and space allows for the creation of a model of textual transmission specific to the extant texts but applicable to a wider tradition. Martin Worthington in his book on Akkadian textual criticism has noted that the study of variants in texts can inform us of the "geography of textual transmission in antiquity."[6] While Worthington is primarily concerned with "reconstructing the original wording of a composition"[7] (what he terms textual or lower criticism), many of his methods still apply when working with larger aspects of text, revealing historical and geographical traces of transmission. Collecting these divergent patterns or traditions reveal patterns in the way texts were worked with and recopied in new contexts. In the case of the micro-zodiac the evidence is sparse at best, but two distinct geographical locations allow for some recognition of textual traditions. In this case, the difference between texts from Babylon and those from Uruk. At the same time the different formats of the micro-zodiac including a tabular layout, as well as other unique formats give hints at the production and conception of the text in its scholarly context. The unknown question with all of this late material in Mesopotamia is to what degree Hellenistic theoretical thought influenced the work of Babylonian scholars. Certainly many of the ideas that the scribes working with the micro-zodiac used quickly found currency in Greek astrology: the zodiac, triplicities, and hypsomata among other concepts. In regards to the new texts written during this period and their associated novel concepts and formats, Koch attributes some of this creativity to the development of mathematical astronomy during this period.[8] Certainly, more accurate predicative methods allowed for the creation of horoscopes and other texts.

6 Worthington (2012: 39).

7 Worthington (2012: 1).

8 Koch-Westenholz (1995: 162).

Any discussion of transmission must also include a tentative discussion of directions of influence and potential historiography of a text. However, in the case of the micro-zodiac where the content has been collected from a wide range of traditional, but opaque, sources, it is difficult to identify individual pieces of original text. Worthington in his discussion of *Urtexts* quotes Elizabeth Bryan, “trying to identify what is original to the author is ‘a characteristic product of print culture’.”[9] It is difficult especially in the case of a text such as the micro-zodiac where the concept of novel and original content is a rare occurrence, and much of the novelty in this case is the combination of excerpts into a new format.

The majority of the currently published tablets of the micro-zodiac series were first noted in an article by Abraham Sachs on Babylonian horoscopes in 1952.[10] He made mention of the scheme and in a footnote catalogued the tablets on which it could be found. Ernst Weidner subsequently edited most of the known tablets and published a comprehensive study of the material in 1967.[11] Already, prior to Weidner and Sachs’ studies, a number of these texts had been identified, in particular the famous examples which feature depictions of the zodiacal signs inscribed on the surface of the tablets. These fragments, one in the Louvre joining to one of two more fragments in Berlin, as well as a few fragments in the British Museum, formed the bedrock of Weidner’s study of the micro-zodiac series. Since then little work has been done investigating these texts further. Instead, the texts have often appeared in studies of wider astrological material as an important example of a unique concept in late Babylonian astrological practice.

Structure of the Micro-Zodiac Tablets

The micro-zodiac scheme subdivides each sign of the zodiac into the twelve signs of the zodiac, creating Major-minor sign pairs. For each Major sign in the zodiacal series, there are twelve more minor signs associated with it, the minor signs starting with the same sign as the Major sign. Tab. 5.1 illustrates the overall schematic pattern. Each sign has twelve signs under it and the sequence rotates in a predictable and logical way, each row moving one space to the left, with the leftmost sign rotating out and reappearing on the right. This overall pattern is important for locating and identifying smaller fragments of the larger series.

9 Worthington (2012: 42).
10 Sachs (1952).
11 Weidner (1967).

In its basic form, each side of each tablet of the series is assigned to a Major sign with twelve columns, one for each of the minor signs. This would, in theory, create a total of six tablets, each with two Major signs, one on the obverse and another on the reverse of the tablet. Situated within this overall scheme is a large collection of typically Mesopotamian knowledge: medical ingredients, cultic observances, omen material, and advice for daily action. Arranged in a spreadsheet, with the minor signs demarcating the columns, each row contains a different subset of knowledge.

The first row is a collection of medical material taken from the stone, plant, and wood tradition.[12] In the micro-zodiac texts, however, a further item is added to the traditional stone, plant and wood material: a place, either a temple or gate, or sometimes just a city. Most probably these lists referred to medical ingredients to be used to create poultices, amulets and other treatments in accordance with the time specified in the scheme. What is important to note is that these lists of ingredients are unique to each combination of Major and minor sign, meaning that there are 144 possible combinations of the ingredients, although many of the individual ingredients themselves are repeated in one column or another.

Following on from this initial row there follows three rows termed by Weidner as A, B, and C, according to their order on Weidner's main exemplars from Uruk. These three rows contain a range of information relevant to each minor sign, and in rows A and B, unlike the initial medical material row and row C, the content remains the same regardless of which Major sign the minor sign is associated with. This stability of these two rows, A and B, creates a very useful method for identifying and locating material on smaller fragments within the larger series.

Row A contains short excerpted material from celestial omens, mostly apodoses, but a few protases. Each cell of the row begins with "KI" meaning "place of" presumably associating these omen excerpts with the particular situation designated by the minor sign. The second row, B, lists days associated with gates and gods. The gates are generally named as gates of certain gods. This section seems to be advising the reader to which gods prayers and/or offerings would be particularly effective and has some parallels in the material found in hemerological texts.[13] Again these two rows, A and B, have the same contents under the same minor-sign even within different tables assigned to different Major-signs. Row A under the minor-sign Aries will always be the same, give or take orthographic differences and small differences in word choice.

12 Heeßel (2005).

13 For the hemerological texts, see Livingstone (2013).

TABLE 5.1 *The Micro-Zodiac Scheme*

Aries					
Aries	Taurus	Gemini	Cancer	Leo	Virgo
Taurus					
Taurus	Gemini	Cancer	Leo	Virgo	Libra
Gemini					
Gemini	Cancer	Leo	Virgo	Libra	Scorpio
Cancer					
Cancer	Leo	Virgo	Libra	Scorpio	Sagittarius
Leo					
Leo	Virgo	Libra	Scorpio	Sagittarius	Capricorn
Virgo					
Virgo	Libra	Scorpio	Sagittarius	Capricorn	Aquarius
Libra					
Libra	Scorpio	Sagittarius	Capricorn	Aquarius	Pisces
Scorpio					
Scorpio	Sagittarius	Capricorn	Aquarius	Pisces	Aries
Sagittarius					
Sagittarius	Capricorn	Aquarius	Pisces	Aries	Taurus
Capricorn					
Capricorn	Aquarius	Pisces	Aries	Taurus	Gemini
Aquarius					
Aquarius	Pisces	Aries	Taurus	Gemini	Cancer
Pisces					
Pisces	Aries	Taurus	Gemini	Cancer	Leo

Libra	Scorpio	Sagittarius	Capricorn	Aquarius	Pisces
Scorpio	Sagittarius	Capricorn	Aquarius	Pisces	Aries
Sagittarius	Capricorn	Aquarius	Pisces	Aries	Taurus
Capricorn	Aquarius	Pisces	Aries	Taurus	Gemini
Aquarius	Pisces	Aries	Taurus	Gemini	Cancer
Pisces	Aries	Taurus	Gemini	Cancer	Leo
Aries	Taurus	Gemini	Cancer	Leo	Virgo
Taurus	Gemini	Cancer	Leo	Virgo	Libra
Gemini	Cancer	Leo	Virgo	Libra	Scorpio
Cancer	Leo	Virgo	Libra	Scorpio	Sagittarius
Leo	Virgo	Libra	Scorpio	Sagittarius	Capricorn
Virgo	Libra	Scorpio	Sagittarius	Capricorn	Aquarius

The last row, C, contains daily advice for activities to engage in or avoid, very similar to hemerological material such as the Babylonian Almanac.

The novelty of these texts, which is part of their appeal, is in associating these well-known and long-standing Mesopotamian cultural traditions with a new form of schematization, the zodiac, and a further iteration, the micro-zodiac. Whereas before this material was linked to the calendrical tradition or organized in a linear prosaic format, here they gain extra significance and meaning by invoking the rich figures of the zodiacal signs in connection with their content.

Catalog of Micro-Zodiac Tablets

The micro-zodiac texts appear during a time of important scribal activity in southern Mesopotamia. The scribes writing and presumably using these tablets were deeply engaged with the development of astronomical predictive methods and the reception of older Mesopotamian knowledge. Most of the tablets in the collection of the British Museum were either excavated by Rassam or purchased from dealers during the later 19th century. We can provisionally assign these tablets a rough location, Babylon.[14] The quantity of astronomical and astrological tablets in these collections at the British Museum suggests that they were coming out of contexts rich in scholarly material, either temple libraries, or house archives. The tablets in Berlin and Paris were found in Uruk.

Only one tablet, VAT 7847, preserves a dated colophon, which records that the text was written in Uruk from an old writing board by Anu-ab-uter and owned by his father Anu-bēlšunu. The date is fragmentary but gives the king's name as Antiochus. Better dating is provided by the identification of this Anu-bēlšunu with a well-known scribe active in the Seleucid period.[15] Anu-bēlšunu had a lengthy career where he served as both scribe and owner to a variety of scholarly tablets, including the micro-zodiac text mentioned above, as well as witnessing a number of sales, and receiving property through division. Later in his life he is only listed as the owner of tablets, generally written by his son Anu-ab-uter. Anu-bēlšunu's scholarly material is typical of Uruk scribes at this period, a mix of *kalûtu*, astronomical and astrological material. Luckily his birth date is known, thanks to the preservation of a horoscope that he probably

14 Reade (1986).

15 Ossendrijver (2011).

TABLE 5.2 *Catalogue of micro-zodiac tablets*

Museum number	Major sign(s) preserved	Publication
W 22554/7a	Gemini and Cancer	von Weiher (1993: number 167)
VAT 7847 + AO 6448	Leo and Virgo	Weidner (1967: text 2)
VAT 7851	Taurus	Weidner (1967: text 1)
K. 11151 + BM 68063 + 76348 + 82976 + 83006	Aries, Taurus, Gemini, Cancer, and Leo	Weidner (1967); much has been added since Weidner's publication of this text.
BM 32517 + 32716	Libra and Scorpio	Unpublished
BM 33535	Sagittarius	Hunger (2007)
BM 34572	Gemini and Cancer	Weidner (1967: text 3)
BM 35784		Weidner (1967: text 4)
BM 36292	Aquarius and Pisces	Unpublished
BM 38452	Cancer	Unpublished
BM 39680	Gemini	Unpublished
BM 39788		Unpublished
BM 41041		Unpublished
BM 41583	Libra and Scorpio	Weidner (1967: text 4)
BM 42288 + 43414 + 43716 + 42644	Aries	Unpublished

wrote for himself.[16] We therefore know that he was an active scholar from about the ages of 20 to 83, (229 B.C.E.–168 B.C.E.). His son, Anu-ab-uter, was similarly productive, but has received less scholarly attention.

Here follows a descriptive catalogue of the micro-zodiac tablets (summarized in Tab. 5.2). Most of the smaller fragments that have come to my attention and are currently unpublished but will be edited in my forthcoming dissertation. Even among this small collection of texts a few joins have come to light.

Descriptive Catalog

W 22554/7

This text from the excavations in Uruk was first edited by von Weiher in SpTU IV and later re-edited by Hunger.[17] It preserves both sides of a tablet which

16 Beaulieu and Rochberg (1996).

17 von Weiher (1993: number 167), Hunger (2007: 149).

contained the micro-zodiac tables for the Major signs Gemini and Cancer. The obverse and reverse are interchanged in von Weiher's copy and edition of the text. The only remaining material is from rows A, B, and C and a small part of the numerical scheme on the obverse (Gemini) and rows A, B, and C on the reverse (Cancer). Both sides contain the last three columns of the Major signs. The numerical scheme here can be restored and would have started with 1;50.

VAT 7847 + AO 6448

These two halves of the same tablet were separated after illicit excavation and eventually made their way into two different collections, the Vorderasiatische Museum and the Louvre respectively. They remain the best preserved copy of a micro-zodiac tablet currently known. Not surprisingly Weidner used them as a core part of his treatment of the micro-zodiac. Together they preserve all sections of the micro-zodiac for the Major signs Leo and Virgo. After the table on the reverse the tablet contains a long list of glosses some of which reference astronomical terminology. These two halves are perhaps best known for the illustrations in the upper portion of the tables on each side. The obverse has Leo the lion standing on the back of the constellation Hydra with the planet Jupiter drawn and labeled. The reverse shows on the left edge the constellation Corvus biting the tail of Hydra from the obverse side and in the center of the band Virgo standing facing the planet Mercury.

VAT 7851

This tablet is unfortunately missing all but the top edge of the micro-zodiac table, however its illustration of Taurus makes it clear that it would have contained the material for the Major sign Taurus. The band of illustration at the top of the table contains a depiction of the Pleiades (with the label "mul.mul"), the moon showing a hero fighting a monster in its interior,[18] and finally the drawing of Taurus the bull. The image of the moon has been discussed at length by Beaulieu. Preserved on the reverse near the bottom edge is a piece of a circular astrolabe similar to those discussed by Horowitz.[19]

K. 11151+

Weidner published the central part of this tablet in his study of the micro-zodiac. However, since then many more pieces have been added to it, expand-

18 The image of the moon has been discussed at length by Beaulieu (1999).

19 Horowitz (1998).

ing its dimensions greatly. The joined fragments all belong to collections clearly from Babylonia which solves the issue of the Kuyunjik number, which must simply be a error in accessioning.[20] With the new pieces, it is now clear that it contains six Major signs of the micro-zodiac on each side in an abbreviated form. The whole micro-zodiac table has been condensed to three rows, with the omission of row A and some of the other extraneous material. This tablet represents a new form of the micro-zodiac that will be commented upon later in this article. The text does not preserve any zodiac names for either the Major or minor sign designations, but identification of its content can be done through parallel sections. Interestingly the order of the rows mirrors that of the Uruk tablets, with the medical material first, followed by rows B and C (omitting row A).

BM 32517 (+) 32716

These two small fragments clearly are part of the same tablet all though a physical join is not possible. The smaller of the two, BM 32516, shows obvious continuation of the incised lines on the larger fragment and preserves the names of two micro-signs which follow those preserved on the larger piece. The obverse and reverse are both preserved in part and contain the middle part of the micro-zodiac table for the Major signs Libra and Scorpio. On the obverse, Libra, the ends of three columns with row A are preserved as well as the numerical scheme. The reverse, Scorpio, preserves the beginning of the table with the minor-sign names and a small part of the introductory omen. The identification of this text can be made through two features. First the numerical scheme on the obverse is not preserved fully, but the extent numbers allow the total range to be determined which limits the identification to only two signs. This in conjunction with the preserved material from row A helps to identify the location, i.e. if one of the two signs specified by the numerical scheme were present in the preserved contents of row A it could be ruled out because row A for that sign should be on the left edge of the tablet not in the middle. Secondly the omen on the reverse has direct parallels with material on BM 36746, edited by Rochberg.[21] This fragment preserves part of the Scorpio omen as reconstructed by Rochberg which in conjunction with the numerical

20 It seems initial joins were done by Lambert (2007:10). The accession dates of at least one of the joined tablets is 82-9-18, a lot which Reade notes as from Sippar with intrusive elements. (Reade 1986:xxxiii) The join fragments from this collection almost certainly belong to the intrusive fragment from Babylon and are not from Sippar.

21 Rochberg-Halton (1984).

scheme on the obverse identifies this fragment with the major signs Libra and Scorpio as mentioned above.

BM 33535

Hunger published this complete tablet in an article in 2007.[22] It contains two sections of the micro-zodiac in a slightly different format. Instead of a tabular layout this tablet lays out the micro-zodiac material in a linear arrangement with the medical material first, then row B, followed by a section of ritual and medical instructions. Only two minor signs, Gemini and Cancer of the Major-sign Sagittarius, are present in this alternate format. Interestingly the ritual section is given in terms of month long periods, so the minor-sign Gemini is associated with the month Simanu, and the minor sign Cancer with Du'uzu. One would expect that the minor sign would be associated with small intervals of time since they make up two and a half days (or degrees) of the entire year. This may be a case of scribal confusion, however, as Gemini and Cancer as zodiacal signs, governing the entire lunar month, are both analogous for the months Simanu and Du'uzu. Still the use of the phrase "from the 1st to the 30th day" with both month designations seems to run counter to the overall structure of the micro-zodiac.

BM 34572

This larger fragment was included in Weidner's study of the micro-zodiac. It preserves a vertical slice of the center of the table of two Major signs, Gemini and Cancer. Both sides contain all rows of content and the numerical scheme at the bottom. The identification of this piece was aided by the addition of a small fragment to the right side of the obverse, which happened after its publication by Weidner. This small fragment preserves the edge of the tablet allowing for the full sequence of the micro-signs to be reconstructed. The method is as follows: since the micro-signs form a loop of twelve items the last micro-sign on the right edge of the table is the sign before the first sign on the left edge. Since the Major-sign is the same is the first minor-sign on the left edge, having the right edge allows for the left edge and subsequently the Major-sign to be reconstructed. This method can be applied to both the obverse and reverse of the tablet, although technically only one is required.[23]

22 Hunger (2007).

23 All of these texts show a very characteristic pattern in the curvature of the physical tablet. The obverse is flat, and the reverse has a significant convex shape. Thus, if enough of a

BM 35784

This small fragment preserves the beginning of the table for the minor-signs Libra, Scorpio, and Sagittarius. Only the minor-sign names and the beginning of the medical section are preserved; there are small unreadable traces of the initial omen. The lack of an edge or later rows currently prohibits the identification with a Major-sign.

BM 36292

This tablet preserves parts of the micro-zodiac table for the Major signs Aquarius and Pisces. The obverse contains the end of the row A cells for six minor-sign columns, and the numerical scheme. The reverse preserves traces of the initial omen, the labels, the minor-sign names, and the first two rows of the micro-zodiac table. The fact that the left edge is preserved on both the obverse and reverse makes its identification quite easy. The row A material on the obverse and the numerical scheme both start with their first column which allows for the positive identification of the first minor-sign and thus the Major-sign for the obverse. Furthermore the reverse contains the first column of the minor-signs, in this case Pisces. In addition, on the reverse, there are two rows after the traces of the initial omen which preserve the labels that would normally be found on the illustration section of the Uruk tablets. The first label in this case reads “Pisces”, securing its identification.

BM 38452

This tablet probably joins the next two texts to form one larger micro-zodiac text for the Major-signs Gemini and Cancer. On this small fragment only the medical material for four minor-signs of Cancer are preserved. The identification of this fragment rests on a small section of a row after the medical material. In this section the number 1;50 is preserved roughly in the same horizontal position as the name of the minor-sign Scorpio written two rows above it. On the Leo side of VAT 7847 + AO 6448 in a similar section the number 1;40 is written similarly close to the same position, under Scorpio. Following the pattern of the numerical system used in these texts it follows that this small fragment would come on the side prior to Leo, i.e. Cancer.

tablet is present it is immediately obvious which is the obverse and reverse, regardless of whether the content reveals where in the micro-zodiac series it belongs.

BM 39680

Like the tablet above, this small fragment only preserves a small section of the micro-zodiac table but luckily the medical material preserved on this piece parallel material on BM 34572 allowing for its identification as belonging to the Major-sign Gemini. The small complete section here preserves the medical section for the minor-sign Capricorn under the Major-sign Gemini. If it is part of the same tablet as the previous fragment it would be from the obverse.

BM 39788

This small fragment preserves a small piece of the end of the micro-zodiac table before the numerical scheme. Its placement in the series is uncertain but judging from the script and color of the clay it most likely belongs with the previous two fragments. It is at this point uncertain whether this fragment would join the obverse or reverse of the larger tablet.

BM 41041

This small unpublished piece was brought to my attention by Jeanette Fincke and Christopher Walker. It preserves row B and C from the minor signs Cancer and Leo; no hints to the Major sign of this fragment remain.

BM 41583

This fragment preserves the table for two Major signs: Libra and Scorpio. It was briefly mentioned by Weidner, who noted the existence of the medical material on its reverse. The obverse preserves both row A and B for the Major sign Libra, and the reverse contains fragmentary portions of the medical material for Scorpio. In both cases only the right edge of the side is preserved which aided in the tablet's identification through the rows on the obverse, through the same method as used above for BM 34572.

BM 42288 + 43414 + 43716

These three fragments were joined in the British Museum by the author and represent a slightly unique form of the micro-zodiac table. Unlike the other tablets mentioned here both sides of this tablet refer to the Major-sign Aries with the beginning of the table starting on the obverse and then continuing onto the reverse. This is contrary to most examples of the micro-zodiac where each side of the tablet is assigned to a unique Major-sign. Curiously, the minor-sign headings begin roughly in the middle of the tablet judging by the thickness visible due to its fragmentary nature. This suggests that other material was inserted above the micro-zodiac table on this particular tablet. In general the columns on this text are much longer and narrower than as found on the other examples of the micro-zodiac, perhaps giving a reason for the fact that it contains only a single sign. Another distinguishing factor is that this tablet, despite its Babylonian provenance, follows the Uruk order of the rows, with the medical material first, followed by rows A and B (row C is not preserved on this text) (see below). This is somewhat similar to K11151+, however both of these texts diverge from the normal layout in other ways as well.

BM 42644

Lastly, this small fragment preserves a small section of the micro-zodiac table on its reverse, containing parts of the medical section as well as row C. The obverse has the beginning of a list of stars. While the lack of micro-zodiacal content on the obverse is puzzling, one potential solution solves the issue. The material on the reverse is located near the top of the micro-zodiac table for that side, making the material on the obverse near the end of the tablet. Other texts, in particular VAT 7847 + AO 6448 have non-tabular non-micro-zodiac material after the table included on the tablet. The list of stars could be a collection of related material inserted after the end of the tabular layout on the obverse.

Discussion

The overriding feature of all these texts is the organizational pattern of Major and minor signs, as explained above. This scheme is inherent to the micro-zodiac and serves as the framework on which the rest of the text rests. After this overarching organizational structure the texts also, for the most part, all include four rows of content which show a remarkable amount of textual stability. These four rows, explained above, have their own rules governing the content. Two of them, A and B, repeat their contents the same minor sign under different Major signs, i.e. row A for the minor sign Aries is always the same content, with only minor variations. The other two rows contain unique content for each combination of Major and minor sign. These general features allow for the identification of fragments, and also illustrate some of the divergent formats between the various recensions of the text.

The two main traditions, Babylon and Uruk, exhibit distinct differences between their tablets. The most obvious difference between them is the lack of any illustrations on the tablets from Babylon. With the recently identified tablets from Babylon which belong to the micro-zodiac, this now makes the *Hypsomata-bilder* as Weidner called them, a minor part of the series whereas they were previously considered to be one of its defining features. Obviously these illustrations are still immensely important for their astronomical and art historical content but their association with the micro-zodiac scheme is restricted to the two larger fragments from Uruk.

Interestingly, in a few cases the tablets from Babylon have vertical wedges or other markings between two horizontal rulings, where the image would be on a text from Uruk, suggesting that its inclusion was a potentiality never realized on the Babylon tablets.[24] In either case its clear that the combination of the planets, signs, and other celestial objects whether illustrated or just written made up a fundamental part of the beginning section of the micro-zodiac table. Another substantial difference between the two traditions is the re-ordering of the rows (see Fig. 5.1). The tablets from Babylon preserve the medical material section first, just as the Uruk material. However after this initial row the Babylon material reverse the order of the rows, so that they run C, B, and A as opposed to the opposite from Uruk. This is the case on all Babylonian tablets except K11151+ and BM 42288+ both of which have their own additional oddities in their layout.

The re-ordering of the rows brings up an interesting development in the organization of knowledge present on the micro-zodiac. Even though the rows are found in a reversed order the content is roughly the same, albeit with minor orthographic changes or differences in vocabulary. It is important to note that even with these two substantial differences the content between the two traditions is similar enough to solidify these geographical distinct exemplars as part of one continuous textual tradition. In fact the re-ordering of rows, but maintenance of the content in the same rows supports the idea that this text was stable across its geographical range. In addition the re-ordered rows might suggest that the content itself came from stable sources which were excerpted in different formats but the same general organizational structure.

The text K. 11151+ illustrates another aspect of how the content itself stayed the same while the layout changed dramatically. K. 11151+ was originally identified by Weidner as part of the microzodiac series, however at that time it was a small fragment with a few lines. Since the publication many more pieces have been joined, roughly tripling it in size, as was mentioned in the catalog above. The traditional micro-zodiac material all have roughly the same format, a large table governed by a Major sign, with columns assigned to minor

24 These tablets are: BM 32517+ and BM 36292. BM 34572 includes a band at the top where the image would be. Within this band the planet Jupiter is written. The images from Uruk have the names of the celestial bodies depicted written as labels. It is possible that the inclusion of Jupiter in this band on BM 34572 is referencing the use of labels on the Uruk texts.

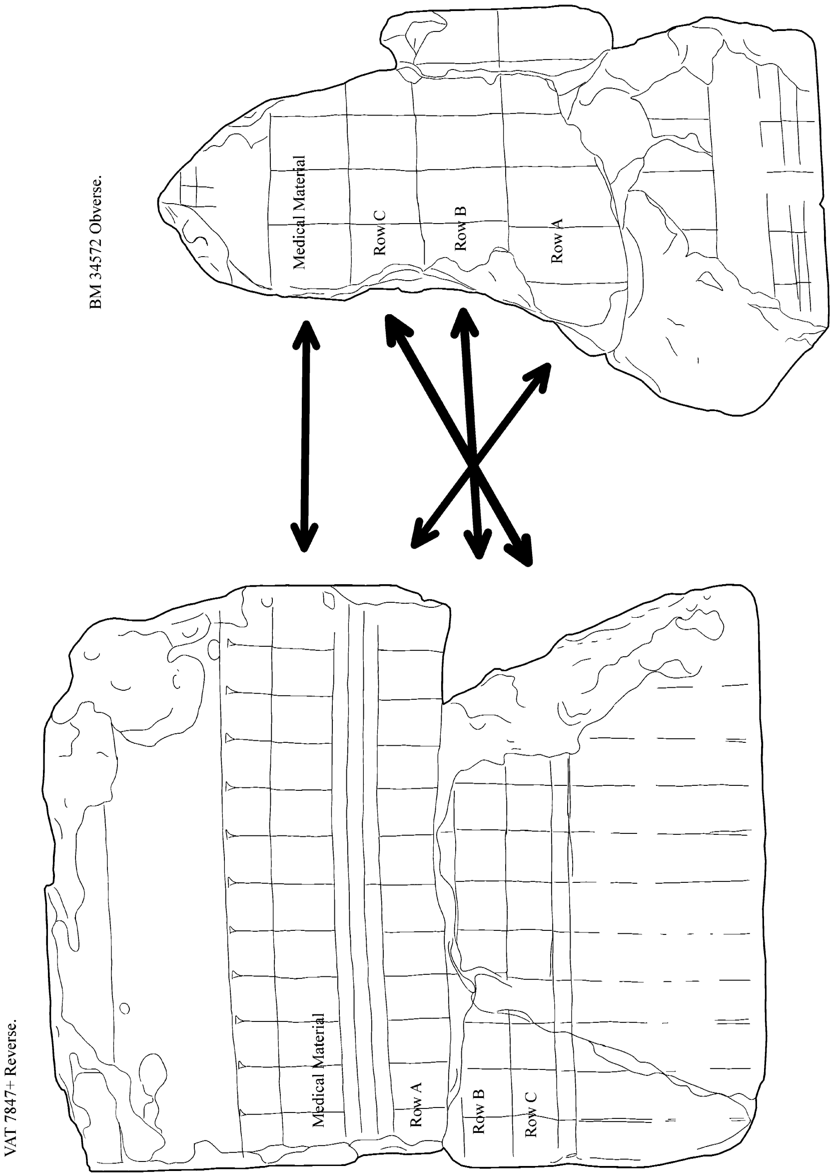

FIGURE 5.1 *Layout of typical micro-zodiac tablets from Uruk* (VAT 7847+) *and Babylon* (BM 34572)

signs. Four main rows were found on the other tablets, the medical material, and rows A, B, and C. This text, however, preserves a different configuration of the scheme. Missing are all references to the zodiac, no overarching Major sign, and no minor sign labels for each column. Each section is marked off by a double ruling, the first row is the medical material and the second row is B, and the third, C; this ordering follows, with the omission of row A, the order from Uruk. Thanks to the addition of these new joins we are able to locate much of the row B, and C material in the wider series. Tracking the rows B, and C, across the sections they always rotate one column to the left as we go down the tablet, which mirrors the movement of each individual minor sign through the series (as illustrated on Tab. 5.1 above). This allows us to assign minor signs to all of the preserved columns. From there the medical material, which remains unique for each combination of Major and minor sign pairs could be used to locate a duplicate section on another tablet with the same Major sign as the subsection of K. 11151+. A small, badly preserved section parallels the same medical material section from BM 34572, of which BM 39680 is a duplicate. This identification then links this subsection with the Major sign Gemini, working backwards we find that the first section of this tablet is assigned to the Major sign Aries, and thus it is most likely that this tablet contained six Major signs on the obverse and six on the reverse, which is unfortunately not preserved. The last section preserved here would then be the Major sign Leo which allows for comparison with VAT 7847 + AO 6448, and in fact the medical material section here parallels the tablet from Uruk. This new format means that the whole micro-zodiac series could be found in abbreviated form on one tablet.

Interestingly, the overarching tabular layout which could be seem to characterize the micro-zodiac material is absent from at least one more example from Babylon. The text BM 33535, mentioned above, contains part of the Micro-zodiac for the Major sign Sagittarius. Not only is this text in a linear layout, unlike the other examples of the micro-zodiac, it also includes a ritual section, which gives hints at how the material in the micro-zodiac could have been used. It would be tempting to suggest that this text represents an early form of the micro-zodiac, pre-tabular format, however the orthography of the zodiacal constellations, “pa” for Sagittarius, and use of the mul_2 sign suggests a later date. Similarly K. 11151+ seems to be predicated on the development of a stable text for the micro-zodiac as it eschews any mention of the Major or minor-signs which designate the layout of the text. Both of these texts suggest that they were excerpted from a stable tabular form of the micro-zodiac such as the many fragments listed in the catalog above.

However, the collection of exemplars and their particular features give hints to the development of the text over time. Specifically the wide variety of formats and content found in the Babylonian exemplars suggests that the text was initially developed there. In contrast the examples from Uruk, few though they are, all present a homogeneous interpretation and representation of the text. Both K. 11151+ and BM 33535, although perhaps hinting at later use of the text illustrate the creativity at work with the scribes who perhaps were the composers or related to the composers of the overall micro-zodiac series.

The micro-zodiac, as it is currently preserved, presents a number of exemplars from both Babylon and Uruk. These exemplars all attest to a shared knowledge of associations and references for each of the cells in the larger table with their unique combination of Major and minor sign pairs. What is not the same among all exemplars however, is the format that this knowledge takes. The connections with previous texts suggest that the micro-zodiac and related content were assembled at some point in to a standard scheme. Later, it is clear that at some point the micro-zodiac was set out in a tabular layout which proved to be very popular, as the majority of our fragments preserve the content in this format. This tabular format was used in various ways and perhaps even influenced further developments such as the final two tablets discussed above. However, even among this small corpus there are a few tablets where show the micro-zodiac in different formats, both linear paragraph based layouts, as well as different tabular formats. Unfortunately only one text preserves enough of a colophon to give it a relatively secure dating. The other texts are difficult to date as the paleography and choice of signs are all relatively similar. Some of the micro-zodiac tables even use both old and new ways to write the zodiacal signs simultaneously, in a few cases the two forms are written together. While there is little secure data to pinpoint the location of most of these texts in time and place, the threads of knowledge which run through the various forms and recensions of this text hint at a remarkable story of composition, borrowing and creative reuse during the Seleucid period by Mesopotamian scholars.

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CHAPTER 6

Virtual Moons over Babylonia: The Calendar Text System, Its Micro-Zodiac of 13, and the Making of Medical Zodiology*

John Z. Wee

To Eckart Frahm, Benjamin Foster, and Kathryn Slanski
in Gratitude

1 Introduction

The zodiac was a latecomer in Mesopotamia's history of ideas. Long before the imagined boundaries of the zodiac partitioned the skies for Babylonian astrologers, ideas about celestial influence on human health and on the treatment of sickness were already part of native medical traditions.[1] The late construction of medical zodiology, however, provides us with greater access to the science in its infancy, offering a fascinating glimpse at its cacophony of ideas in a culture whose tendency otherwise was to systematize knowledge and to serialize texts. Despite efforts to standardize the relationship between zodiacal units and therapeutic ingredients like wood, plant, and stone, for example, late cuneiform tablets display a lack of uniformity in their contents and for-

* Readers outside the field of Assyriology (and perhaps also those within) may find it inconsistent that cuneiform sources are denoted sometimes by their museum or archaeological tablet numbers and sometimes by numbers from their scholarly publications. As a general rule, tablet numbers are used except when groups of tablets of similar content or provenance have been studied, joined, copied, and/or edited together in published volumes like the *Late Babylonian Astronomical and Related Texts* (LBAT), *Spätbabylonische Texte aus Uruk* (SpTU), *Babylonian Records in the Library of J. Pierpont Morgan* (BRM), and *The Sultantepe Tablets* (STT) series, for the convenience of Assyriologists who tend to first consult these volumes when approaching the tablets.

1 Reiner (1995: 43–60), Heeßel (2008), and Wee (2014).

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mats.[2] This diversity derived, at least in part, from different attempts to harmonize existing notions of celestial healing with fresh schemes of zodiacal astrology. The invention of the zodiac and micro-zodiac greatly increased the precision of celestial categorization, multiplying the number of astrological variables that had to be linked to features of the natural and civilized world, such as cities, temples, deities, and parts of animals, plants, and minerals. Terrestrial meanings assigned to celestial events could be arbitrary and were not necessarily intuitive or corresponded to existing human experiences of time and space.

It is therefore difficult to speak about the circulation of astronomical knowledge with respect to Babylonian medical zodiology, especially since we detect the transmission of ideas largely by the emergence of novel terminology, theories, and practices in local contexts.[3] On the one hand, though zodiacal schemes described in cuneiform tablets may include elements not found in earlier astrological texts, these could represent indigenous responses to new developments in zodiacal astrology, rather than the involvement of non-Babylonian professionals, observational techniques, or mathematical methods. Indeed, the most significant contributions to the field could have resulted from the circulation and collision of ideas among local practitioners who were already intimately familiar with their subject matter, and who were skilled enough to articulate new concepts in ways that were coherent and persuasive to their contemporaries. On the other hand, we may well question the validity of classifying all cuneiform astrology as "Babylonian astrology," since several authors of such works lived and worked in the intellectually vibrant and cosmopolitan environments of the final centuries BCE and may have imbibed influences from their Achaemenid, Seleucid, or even Parthian counterparts. I have emphasized continuities with existing traditions of astrology in speaking of "Babylonian" Calendar Texts, while not dismissing the possibility of genuine innovation arising from external stimuli.

The above considerations come into play in particularly interesting ways for a cuneiform astrological genre known as "Calendar Texts" (*Kalendartexte*). In spite of their various manifestations, Calendar Texts are unconfusable as a

2 Hunger (2007: 145–146). Similarly, he discussed "one more instance of an ad-hoc compilation of astral lore by a particular scribe of the Late period" in Hunger (2004: 30). In contrast, note the optimism expressed by Geller (2010: 86) that "theoretically, one should eventually be able to reconstruct a complete table or grid showing a schedule of zodiac influences, when all relevant texts become known."

3 See discussions on the Babylonian precursors of Hellenistic astrology in Rochberg (1988: 51–62 = 2010: 143–164) and Steele (2011b).

distinct group of tablets that build upon on a peculiar mathematical scheme involving the manipulation of zodiacal numbers. The earliest Calendar Texts (BM 96258 and BM 96293) may come from Babylon or Borsippa in the 5th century BCE, a date that is remarkably near to the first clear evidence of the zodiac itself.[4] Another tablet crucial for illustrating how the ancients thought about Calendar Texts (LBAT 1586+1587) has likewise been ascribed to Babylon.[5] Towards the other end of the spectrum, several Calendar Texts appear in late Achaemenid and Seleucid Uruk tablets belonging to Iqīšāya of the Ekurzakir family (SpTU III, 104 and 105) and Anu-bēlšunu of the Sîn-leqe-unnīnī family (VAT 7815 and probably VAT 7816) among others (W 20030/127 and W 20030/133).[6] Although available Calendar Text manuscripts cannot be described as numerous, their attestations in the cities of Babylon and Uruk, their distribution throughout the final centuries BCE, and their consistent employment of an unusual and difficult mathematical scheme seem characteristic of a well-recognized astrological system that was later applied to medical zodiology. As the name "Calendar Texts" suggests, individual tablets of the genre are concerned with days as organized in months, and we can see how the sources below cover an extensive range that includes all or parts of Months 1–5 and 8–9:

Tablet no.	Publication	Calendar text dates
VAT 7816	Weidner (1967: 50)	Month 1 Days 1–30
BM 96258	Brack-Bernsen and Steele (2004: 96)	Month 1 Days [1]–10, 22–[30]
BM 35072	LBAT 1622 obv. ii 1′–5′	Month 1 Days 10–14[7]
BM 36995 obv.	Brack-Bernsen and Steele (2004: 98 n. 3)	Month 2 Days 1–[4]
W 20030/127	van Dijk (1980: no. 79)	Month 2 Days [4]–8

4 Brack-Bernsen and Steele (2004: 95, 105). Note also the tablet BM 36326 with *Dodekatemoria* numbers, which is "almost certainly from Babylon" with features "suggestive of a date in the fifth or fourth century B.C." Jones and Steele (2011: 2).

5 Brack-Bernsen and Steele (2004: 99).

6 Anu-bēlšunu of the Sîn-leqe-unnīnī family is not to be confused with another Anu-bēlšunu from the Ekurzakir family, to which Iqīšāya belonged. The magician Iqīšāya also owned Tablet BRM IV, 20, which displays characteristics of the Calendar Text System (together with Tablets BRM IV, 19, LBAT 1626, and SpTU V, 243).

7 I thank J.M. Steele for alerting me to this text. The relevant lines read: BAR 10 G[AN(?) 10 …] / BAR 11 AB.S[ÍN 17 …] / BAR 12 SIG 20[+4 …] / BAR 13 BAR 1 X[…] / BAR 14 MÁŠ 8 […] (LBAT 1622 obv. ii 1′–5′).

(cont.)

Tablet no.	Publication	Calendar text dates
BM 96293	Brack-Bernsen and Steele (2004: 97)	Month 2 Days [8]–[25]
BM 34452+34738	LBAT 1586+1587; Hunger (1975)	Month 3 Days 1–15
W 22704	von Weiher (1988) = SpTU III, 104	Month 4 Days 1–30
BM 47851	Hunger (1996)	Month 5 Days 1–30
W 20030/133	Unpublished, cf. Hunger (1975: 43)	Month 5
W 22619/9+22554/2b	von Weiher (1988) = SpTU III, 105	Month 8 Days 1–30
BM 36995 rev.	Brack-Bernsen and Steele (2004: 98 n. 3)	Month 8 Days [9]–[13]
VAT 7815	Weidner (1967: 50)	Month 9 Days 1–30

In addition to the above exemplars organized by increments of days within a month, there are other tablets that do not as clearly display the numerical progression of dates, but that also belong to the "Calendar Text System" and adopt its 'micro-zodiac of 13' for both solar and lunar motion. I will shortly explain what these terms mean. It will be helpful, however, to have a (non-comprehensive) list of some of these tablets and their publication information here at the beginning for easy reference:

Tablet no.	Publication	Description
MLC 1886	Clay (1923) = BRM IV, 19; Geller (2010: 42–44)	Spells/Rituals for the Sun's Micro-zodiac[8]
MLC 1859	Clay (1923) = BRM IV, 20; Geller (2010: 27–41)	Spells/Rituals for the Sun's Micro-zodiac
BM 35537	LBAT 1626; Geller (2010: 54–55)	Spells/Rituals for the Sun's Micro-zodiac
W 23293/34	von Weiher (1998) = SpTU V, 243; Geller (2010: 55–56)	Spells/Rituals for the Sun's Micro-zodiac
BM 76483	Heeßel (2005: 2–4)	Prescriptions for Virtual Moon's Micro-zodiac?
BM 77971	Heeßel (2005: 4–6)	Prescriptions for Virtual Moon's Micro-zodiac?

8 As I will discuss later, Tablets BRM IV, 19 and 20, LBAT 1626, and SpTU V, 243 derive from ritual calendar traditions exemplified by the Sultantepe tablet STT II, 300, which recommends spells/rituals for specific dates in hemerological fashion without relating them to the sun's micro-zodiac.

Tablet no.	Publication	Description
W 22729/15	von Weiher (1983) = SpTU II, 49; Heeßel (2005: 7–10)	Prescriptions for Virtual Moon's Micro-zodiac?
BM 33535	Hunger (2007: 141–144)	Dream Incubation[9] for Months 3 and 4
BM 36303+	Steele (2015)[10]	*Dodekatemoria* Numbers on same tablet as the 'Terms' of Greco-Roman Astrology

In this essay, I will examine how Calendar Texts represented an outgrowth from late Babylonian semiotics connecting everyday realia with deeper meanings, how they emblematized selected features of the zodiac and micro-zodiac to create hemerological meanings for calendar dates, and how the use of such hemerologies as medical zodiology presented contradictions that may have been resolved by incorporating into the Calendar Text System categories of sickness and the human body.

2 Dodekatemoria and Calendar Text Schemes

An important breakthrough in the study of Calendar Texts came with the 2004 publication of an essay on "Babylonian Mathemagics" by L. Brack-Bernsen and J.M. Steele, which revealed how a purely theoretical manipulation of numbers in so-called *Dodekatemoria* tablets yielded number sequences typical of Calendar Texts.[11] I have summarized their argument in Fig. 6.1.

9 I have interpreted the statements below as speech from the gods via the medium of dreams while the suppliant sleeps: "In Simanu (Month 3), from Day 1 to Day 30, let the man wash himself, … let him sleep on the roof … the gods of the night will speak with him" (BM 33535, obv. 7–13); "In Du'ūzu (Month 4), from Day 1 to Day 30, let the man wash himself, … let him lie on a bed and sleep, his goddess will speak with him" (BM 33535, rev. 7–12).

10 Three fragments of this tablet are preserved: (1) BM 36303+36326, (2) BM 36628+36786+36817+37178+37197, and (3) BM 36988, the first two of which include *Dodekatemoria* numbers (Personal communication by J.M. Steele). The joined tablet will be published in Steele (2015), and parts of it have been earlier discussed in Brack-Bernsen and Steele (2004: 103) and Jones and Steele (2011: 2–3).

11 Brack-Bernsen and Steele (2004).

(A) *Dodekatemoria* Scheme in increments of 1 Day		(B) Calendar Text Scheme in increments of 1 Degree		(C) Calendar Text Scheme in increments of 1 Day	
(Date)	(Sign)	(Sign)	(Date)	(Sign)	(Date)
1 1	1 13	1 1	1 13	10 7	1 1
1 2	1 26	1 2	1 26	7 14	1 2
1 3	2 9	1 3	2 9	4 21	1 3
1 4	2 22	1 4	2 22	1 28	1 4
1 5	3 5	1 5	3 5	11 5	1 5

FIGURE 6.1 Dodekatemoria *and Calendar Text Schemes*

Fig. 6.1(A) displays the first five number sequences of the *Dodekatemoria* scheme, which roughly represents the moon's average motion of 13° per day. This representation of lunar motion likely had an observational basis: The occurrences of consecutive New Moon crescents (at the beginnings of lunar months) in consecutive zodiacal signs implied that the moon traveled through 13 zodiacal signs (= 13 × 30° = 390°) during the period of a lunar month (~30 days), which works out to an average of 13° per day.[12] The first sequence 1 1 1 13 expresses the fact that, on Month 1 Day 1, the moon is at zodiacal sign 1 (Aries) 13°. The next day (Month 1 Day 2), the moon moves an additional 13° and ends up at zodiacal sign 1 (Aries) 26°, which is then indicated by the number sequence 1 2 1 26.

The headings of "(Date)" and "(Sign)" were understood implicitly and were not actually written out on *Dodekatemoria* tablets. By mentally "swapping" these headings, however, one arrives at the Calendar Text scheme of Fig. 6.1(B). The sequence 1 1 1 13 now indicates that Month 1 Day 13 corresponds to zodiacal sign 1 (Aries) 1°. Furthermore, cuneiform tablets attested with the Calendar Text scheme organize their sequences not in increments of 1 degree, but in increments of 1 day. Fig. 6.1(C) shows how an actual Calendar Text tablet might look, with its incipit entry 10 7 1 1 expressing the relation between Month 1 Day 1 and zodiacal sign 10 (Capricorn) 7°. In such a tablet, zodiacal positions in consecutive entries shift by 277° per day. Thus, on Month 1 Day 2, the Calendar

12 Calculations involving modern values of a sidereal month of 27.32 days yield the result of 13.18° per day.

Text position at zodiacal sign 7 (Libra) 14° represents an advancement of 277° from the preceding day's position at zodiacal sign 10 (Capricorn) 7°.[13]

In short, whereas *Dodekatemoria* tablets contained a schematic portrayal of the moon's average motion (13° per day) ratifiable in part by observation, Calendar Texts were created by artificially manipulating *Dodekatemoria* numbers and cannot be said to describe the movements of any known celestial body (277° per day). While these insights by Brack-Bernsen and Steele represent a significant contribution to our understanding of Calendar Texts, they would benefit from a few points of clarification:

First, the distinction between *Dodekatemoria* and Calendar Text schemes results from paradigmatic rather than syntagmatic considerations. In the structural analysis of language, syntagmatic relations occur among signifiers co-existing in the same plane (horizontal axis) and producing meaning as a result of their interactions, whereas paradigmatic relations connect an existing signifier with others of the same class or category (vertical axis) with which it may be substituted. While it is true that several Calendar Texts display their entries in the order "(Sign)—(Date)" as in the examples given by Brack-Bernsen and Steele (cf. Fig. 6.1(c)), this horizontal order is not absolutely essential. Calendar Texts linking Month 8 Day 10 to zodiacal sign 4 (Cancer) 10°, for example, are attested in the number pattern "8 10 4 10" (SpTU III, 105, obv. 10) as well as in the pattern "4 10 8 10" (BM 36995 rev. 2′). In fact, taken in isolation, one cannot even say for certain whether the sequence "8 10 4 10" belongs to a Calendar Text or to a *Dodekatemoria* tablet where it would indicate zodiacal sign 8 (Scorpio) 10° on Month 4 Day 10. In the absence of clear labels, the identification of Calendar Text or *Dodekatemoria* scheme comes from recognizing which number increases vertically downwards in increments of 1.[14]

Secondly, Brack-Bernsen and Steele's method of producing Calendar Texts by "swapping" *Dodekatemoria* headings of "(Date)" and "(Sign)" succeeds as a formal description of how *Dodekatemoria* and Calendar Text schemes relate to each other, but may not reflect how ancient astrologers actually constructed these schemes. In fact, such "swapping" of *Dodekatemoria* headings results in Calendar Texts organized by increments of 1 degree (Fig. 6.1(B)), which cannot be easily converted to the format of attested Calendar Text tablets that organize their entries in increments of 1 day (Fig. 6.1(c)). Short of replicating schemes

13 277° (Capricorn 7°) + 277° = 554° = 360° + 194° (Libra 14°).

14 As we will see, logograms typically used for Babylonian month names can sometimes be employed for zodiacal signs in these texts, and they therefore may not constitute clear labels for calendar dates.

found in earlier tablet copies, astrologers could have produced *Dodekatemoria* and Calendar Text schemes by working from first principles and calculating their zodiacal positions by daily increments of 13° and 277° respectively.[15]

Thirdly, our current definitions of the *Dodekatemoria* scheme as a rough representation of lunar motion and the Calendar Text scheme as a function of "calendar" dates may be overly restrictive. As we will soon discover, tablets such as LBAT 1586+1587, LBAT 1593, and BRM IV, 19 suggest that calendar dates and zodiacal signs related to the moon are not the only possible ways of assigning meaning to these number sequences. By adopting schematic models of the Babylonian month and year, Calendar Text and *Dodekatemoria* schemes could extend their applicability to the sun's zodiacal signs, as well as to micro-zodiacal signs of the sun, moon, and a so-called "virtual moon."

Finally, though *Dodekatemoria* tablets do not specify the exact point in a day when the moon occupies a certain zodiacal position, one may reasonably assume that dates in these tablets indicate the moon's location at the end (not beginning) of the Babylonian day.[16] According to this assumption, the moon finds itself at the start of the zodiac (Aries 0°) at the beginning of the year (i.e., beginning of Month 1 Day 1 = end of Month 12 Day 30), and it returns to the start (0°) of each subsequent zodiacal sign at the beginning of each month. Not only is this scenario aesthetically pleasing, it receives indirect support from a bead (11 N 157) from the city of Nippur. Numbers on this bead suggest that *Dodekatemoria* dates designate lunar positions at the end of each day, so that they serve as appropriate markers for the *last* complete day in the month when the moon stands within a zodiacal sign (see discussion below). Furthermore, as we will see, Tablets BRM IV, 19, BRM IV, 20, LBAT 1626, and SpTU V, 243 reveal efforts to synchronize solar and lunar movements based on the *Dodekatemoria* scheme, and the scenario described above would allow for the convenient conjunction of sun and moon at 0° of a zodiacal sign at the beginning of each month. I will later show that Calendar Texts likewise depict positions of a "virtual moon" at the end of the day, so that sun, moon, and "virtual moon" all come into conjunction at the beginning of every month.[17]

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15 As an alternative, the end of Tablet BM 47851 displays a shorthand method for working out Calendar Texts numbers, which I will explain in detail elsewhere.

16 The Babylonian day commences at nightfall, and Day 1 of each month is marked by the first appearance of the new moon crescent in the evening.

17 The alternative solution, where *Dodekatemoria* numbers describe the moon's location at the beginning of the Babylonian day, would result in the conjunction of sun, moon, and "virtual moon" at the beginning of Day 30 (= end of Day 29) of each month. This seems a less natural position to begin solar and lunar cycles, even in schematic depictions.

3 Reciprocals Through the Looking-Glass

Although the description of the relationship between *Dodekatemoria* and Calendar Texts as one of "swapped" headings may be more formal than practical, it highlights a crucial feature that has not been sufficiently noted. I propose that the Babylonians considered *Dodekatemoria* and Calendar Text schemes as reciprocals of each other, and that this reciprocal relationship extended meanings inherent in mathematical tablets, which were later articulated more explicitly in cuneiform commentaries of the late first millennium BCE.

To be sure, the numbers 13 and 277, which characterize *Dodekatemoria* and Calendar Text schemes, would not be found on standard cuneiform tables of reciprocals limited to regular sexagesimal numbers. Both 13 and 277 are irregular numbers, because the reciprocal of neither can be framed as a finite sexagesimal expression.[18] The number 13 was not an ideal candidate for reciprocal conversion and did not yield easy calculations in standard mathematical procedures, but we should remember the reason for its existence here, i.e., as a rough representation of the moon's average daily motion. In other words, while the number 13 was avoided in standard reciprocal paradigms and perhaps also in practical situations involving arithmetic because its calculations were awkward or troublesome, the use of 13 in the *Dodekatemoria* scheme was necessitated by actual celestial phenomena.

In modern mathematics, it would appear strange to consider 13 and 277 as reciprocals of each other, since they do not yield the product of 1. Given the relative place value notation used for cuneiform numbers, however, scholars have frequently defined Mesopotamian reciprocals as a pair of numbers whose product is any power of 60, including products such as $\frac{1}{60}$ (= 60^{-1}), 1 (= 60^{0}), and 3600 (= 60^{2}).[19] In fact, while most tables of reciprocals are written out using cuneiform numbers, a few that spell out the names of numbers in the Sumerian language reveal that even the ancients did not always have a fixed power of 60 in mind. When Tablet S.U. 52/5 is read very literally, for instance, it contains the reciprocal pair "three" (eš$_5$) and "one third" (šušana) whose product is 1 (obv. 4), as well as the pair "nine" (ilimmu) and "six and two thirds" (àš šanabi) whose

18 The reciprocal of 13 is 4;36 55 23 4 36 55 23 … (with 4 36 55 23 repeated indefinitely), while the reciprocal of 277 is 0;0 12 59 47 0 12 59 47 … (with 0 12 59 47 repeated indefinitely).

19 Neugebauer and Sachs (1945: 18), Friberg (2005: 290) and (2007: 67), and Robson (2008: 108). The numbers 277 (= 4×60^{1} + 37×60^{0}) and 4;37 (= 4×60^{0} + 37×60^{-1}), for example, were both written in exactly the same way, i.e., with four vertical wedges, followed by three *Winkelhaken*, followed by seven vertical wedges.

product is 60 (obv. 9).[20] Mesopotamian mathematicians probably regarded any power of 60 as a round number, and reciprocal numbers were considered as complementary to each other, since one completes the other in such a way as to result in a round number. Despite their status as irregular numbers, the product of 13 and 277 works out to 3601, which is a figure that very closely approximates 3600 (the 2nd power of 60).

If *Dodekatemoria* and Calendar Text schemes were indeed imagined as reciprocals, as I propose, they expressed ideas cogent to the mathematical notation IGI. The typical expression for reciprocity is igi-*n*-gál-bi $1/n$, which is usually translated idiomatically as "its *n*th part is $1/n$."[21] The logographic form IGI occurred so prominently in such expressions that loanwords *igû* and *igibû* came to refer to the two members of a reciprocal pair.[22] Early speculation that IGI (understood as "eye") alluded to "Horus Eye Fractions" has long been discredited, and Høyrup concluded that "the literal meaning of the expression is unclear."[23] Syllabic writing in several texts, however, shows that IGI could be translated as the Akkadian term *pāni* ("face (of)").[24] Friberg's description of "IGI *n*" as the "opposite" of the sexagesimal number *n* is attractive, since two objects "facing" each other may also be imagined as positioned "opposite" each other.[25] It should be emphasized, however, that this spatial metaphor depicts the two objects as complements rather than antagonists to each other.

In this essay, therefore, I have opted to translate "IGI *n*" as "complement of/to *n*." The employment of mathematical language in commentarial logic and rhetoric has not yet been fully explored, but I wish to demonstrate that the notation IGI performed functions in cuneiform commentaries reminiscent of its role linking reciprocal numbers, and that commentarial meanings of this term can shed light on the rationale behind *Dodekatemoria* and Calendar Texts. In the examples below, I have included cuneiform transcriptions for the commentaries, since several have been translated differently elsewhere without proper recognition of the notation IGI (Akkadian: *pān*(*i*)).

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20 The writing igi e-šá gál-bi šu-šá-an (obv. 4) stands for igi eš$_5$ gál-bi šušana ("three is complement to one third"), while the writing igi lam-mu u-šá-na-bi (obv. 9) stands for igi ilimmu àš šanabi ("nine is complement to six and two thirds"). Hulin (1963: 74–75).

21 For example, Høyrup (1990: 53–54), Robson (2002b: 339), Friberg (2007: 506).

22 Neugebauer and Sachs (1945: 130, 164–165) and CAD I/J, 39, 45.

23 Hilprecht (1906: 22) and Robson (2002a: 257); Høyrup (1990: 53).

24 IM 31210, iii 5 ff. in Bruins (1954: 58–59) and collated by Hunger in CAD P, 93; Al-Rawi and Roaf (1984: 180 ff.).

25 Friberg (2005: 290) and (2007: 68, 506).

Base Text #1 (Sa-gig Entry DPS *I, 22 =* TDP *1:24)*[26]

> If he sees a donkey mounting a jenny, death and that sick man are intertwined, he is critically ill, do not approach him.

*Commentary #1A (*AO *17661, obv. 26–27)*

26: *ik-tap-pi-lu* : *šá a-*⌜*ḫa-meš*⌝ x[… EME$_3$ *pa-an* GIG]
27: ANŠE *pa-an mu-tú šá-kin lì*[*b-bu-ú* …]
26: "… they are intertwined" *refers to* the case where together …
26–27: [The jenny is complement to (*pān*) the sick man.] The donkey is complement to (*pān*) death …

Commentary #1B (SpTU I, 27, rev. 9)

9: [*kit-pu-lu pa*]*-ni* ANŠE *šá-niš pa-ni* MUŠ …
9: ["To be intertwined"][27] is complement to (*pāni*) a donkey; secondly, it is complement to (*pāni*) a snake.[28] …

The two commentaries (#1A and #1B) above discuss an omen from the Diagnostic Series Sa-gig, which describes an event of divinatory significance that a healer encounters en route to his patient's house. According to this omen, the sight of donkey and jenny in the act of sexual intercourse was a negative portent that the patient was critically ill and about to die. The two commentators, Enlil-bēlšunu (#1A) and perhaps Anu-ikṣur (#1B), each focused on different aspects of the situation that might have given rise to this conclusion. To one, the animals pointed to deeper realities that transcended their surface identities, with the jenny representing the sick man and the donkey representing death. To the other, it was the act of being "intertwined" in sex that was revelatory, since the terminology was most commonly used for snakes that were an inauspicious symbol. Despite the evident subjectivity in rationalizing the omen, both commentators employed the notation IGI or *pān*(*i*) to express how everyday realia were "complement to" (i.e., corresponded to) deeper meanings beyond the obvious or observable. Furthermore, though we tend to think of

26 George (1991: 142–143, 148–149) and Labat (1951: 4–5).
27 This restoration is absent in Hunger (1976) and George (1991: 148–149), but proposed in Wee (2012: 516, 522), (forthcoming: Chapter 5).
28 *Contra* the translation "a donkey's face, alternatively, a snake's face" in George (1991: 149).

complementary reciprocals as an exclusive pair, Commentary #1B suggests the language of reciprocity could be flexible enough to take multiple referents.

Commentary #2 (*SpTU I, 30, obv. 11–12*)

11: … : SA[G.]KI-*šú šá* 15 G[U$_{7}$-*š*]*ú* ŠU ^{d}UTU TIN

12: [SAG.KI-*šú šá* 1]50 GU$_{7}$-*šú* ŠU ^{d}15 TIN : ⌜IGI⌝ 15 : ^{d}15 : IGI 150 : ^{d}UTU

11–12: … "His right temple hurts him; Hand of the god Šamaš, he will live." "His left [temple] hurts him; Hand of the goddess Ištar, he will live."

12: Complement to (IGI) the right is the goddess Ištar. Complement to (IGI) the left is the god Šamaš.

This next commentary includes a quotation of its base text, which ascribes pain on different sides of the head to different deities. Because terms for "the goddess Ištar" and the "right" side both could be written in cuneiform as the number 15, this goddess became associated with the sick man's right temple. Relying on the principle of *pars familiaris* versus *pars hostilis*, the commentator argued that Ištar would not harm her own side, and that her agency manifested itself instead as the hurting left temple.[29] Conversely, the god Šamaš was "complement to" or corresponded to the left side and therefore directed pain to the patient's right temple.[30] In this example, complementary entities imagined as "facing" (IGI) each other are clearly "opposite" in the sense of being mutually referential rather than antagonistic, since the deities indicated by one side of the head inflict harm on the other side.

Base Text #3 (*SpTU I, 46, obv. 6–15*)[31]

> If a man's face, neck, and lips keep becoming numb and burn him like fire, the *rābiṣu*-demon of the lavatory has seized that man. In order to

29 It should be noted that this commentator's rule was not uniformly followed elsewhere. In a Middle Assyrian diagnostic tablet from Assur (VAT 11122) that seems to focus on conditions attributable to the goddess Ištar, there are several descriptions involving the "right" (but not "left") side of the patient's body (obv. 2, 3, 4, 10).

30 Šamaš may have been assigned to the left side by default, i.e., because the right side was already taken by Ištar. Alternatively, one might note the assonance between the name *Šamaš* and the Akkadian word *šumēlu* ("left"), though these terms were not written out syllabically to emphasize any assonantal links.

31 For a recent edition and notes on this base text and its commentary, see Frahm (2011: 396–404).

heal him, crush together *mūṣu*-stone, *anzaḫḫu*-glass, black frit, (and other ingredients) … wrap in skin and place on his neck, and he will recover.

Commentary #3 (SpTU I, 47, obv. 13–14)

13: *ina* KUŠ ÙZ *šip-ki* : … : MAŠKIM KA LÚ *uṣ-ṣab-bi*[*t*]
14: MAŠKIM *pa-ni* ÙZ *ša-kin* : …
13–14: In a goat's *šipku*-skin … "The *rābiṣu*-demon has seized the man's mouth." The *rābiṣu*-demon is complement to (*pāni*) the goat.[32]

Our last example concerns therapeutic instructions for treating a man seized by the "*rābiṣu*-demon of the lavatory," which involves wrapping a variety of ingredients in skin and placing the skin pouch on the sick man's neck. While the base text does not specify the kind of skin to be used, the commentator defined the material as "a goat's *šipku*-skin." He went on to explain that the goat "is complement to" or represents the *rābiṣu*-demon, and that the healing procedure required ingredients to be wrapped up in a skin that symbolized the agent responsible for the sickness. Astrological applications of this healing principle may also be found in Tablets BM 76483 (and perhaps SpTU II, 49), BM 77971, BM 33535, and BM 56605.[33]

In any case, our examples vividly illustrate how experienced objects and events found their deeper significance in complements expressed by the notation IGI or *pān*(*i*), whose identities often lay beyond the realm of the senses. The mathematical language of reciprocity supplied the conceptual apparatus and rhetorical form for imagining real world entities with links to their true meanings beyond the looking-glass.

32 *Contra* the translation "the *rābiṣu*-demon has the face of a goat" in Frahm (2011: 400, 403). Frahm is correct to observe, however, that "elsewhere, the *rābiṣu*-demon is credited with lion-like features instead (see *RlA* 7, 455)."

33 Tablet BM 76483 is translated later in this essay. Note the following statements: "His left … hurts him, [place] grape(vine) in rooster-skin [on his neck]" (BM 77971, line 2′ in Heeßel (2005: 6)). "Wrap in donkey-skin with donkey-sinew, with a string of blue-purple wool (DUR SÍG ZA.GÌN.NA), and place on his neck" (BM 33535, obv. 14–15); "Wrap in horse-skin with horse-sinew, with a string of red wool (DUR SÍG SA_5), and place on his neck" (BM 33535, rev. 13–14). "If, while the sick man *ditto* (i.e., sleeps / travels ?), the Great One ((micro)-Aquarius) touches him, (and) his right thigh hurts him; place cypress in cat-skin on his neck, salve with oil, and he will recover" (BM 56605, obv. 48–50). Analogous statements with different constellations, body parts, woods, and animal skins occur in BM 56605, obv. 51–74.

4 Sun, Moon, and Virtual Moon in Synchronized Clockwork

We will first consider how the abstract scheme of Calendar Texts was concretized and articulated as the reciprocal counterpart of the *Dodekatemoria* moon, before we demonstrate, in the next section, how this reciprocal entity held the key to deeper meanings of calendar and celestial events. Let us turn to an important Calendar Text tablet (LBAT 1586+1587) from Babylon that includes a remarkable amount of non-numerical information, but which has not yet been fully understood.

Tablet LBAT 1586+1587

obv. 1–2:	12 7 3 1	The (virtual) moon stands in … with (/ (in) the region of)[34] the True Shepherd (micro-Gemini): …
3–4:	[9] 14 3 2	The (virtual) moon stands in the back of … [with] the Shepherd (micro-Gemini): La[gaš].
5–6:	6 21 3 3	The (virtual) moon stands in the waist of … [with] the Shepherd (micro-Gemini), …
	(*8 intervening entries*)	
rev. 3–4:	5 24 3 12	The (virtual) moon stands in the backbone of the Lion[35] (zodiacal sign 5) with the Shepherd (micro-Gemini): Temple of Bēlet-ṣēri.[36]
5–6:	3 1 3 13	The (virtual) moon stands in the shoulder of the Twin behind (zodiacal sign 3): Kutha.
7–8:	12 8 3 14	The (virtual) moon stands in the Swallow (zodiacal sign 12) with the Shepherd (micro-Gemini): Temple of Nanše.[37]
9–10:	9 15 3 15	The (virtual) moon stands in the back of Pabilsag (zodiacal sign 9) with the Shepherd (micro-Gemini): Lagaš.
11:	The third month …	

34 The logogram KI could mean either "with" (Akkadian: *itti*) or "(in) the region (of)" (Akkadian: *qaqqaru*). There is obviously much semantic overlap between the two terms. To avoid cumbersome English translations, however, I translate KI simply as "with" for the most part in this essay.

35 I agree with the emendation MÚL.⟨UR⟩.GU.LA (LBAT 1586+1587, rev. 3) proposed by Brack-Bernsen and Steele (2004: 100).

36 For possible referents to this Temple of Bēlet-ṣēri, see George (1993: nos. 192, 462, 648, 1289).

37 For possible referents to this Temple of Nanše, see George (1993: nos. 6, 250, 266, 719, 992, 1022, 1047, 1362).

A full cuneiform transcription and translation of this tablet has been provided by H. Hunger,[38] and my translation above covers only seven out of the fifteen entries in the tablet. As can be seen, each entry begins with a four-number sequence typical of Calendar Texts, and the explicit reference to "the third month" (rev. 11) confirms that the recurring number 3 in these sequences represents "Month 3." Following the numbers are statements that the "moon" stands in a portion of a zodiacal sign with the "Shepherd." This portion is given the name of a body part such as "back" (obv. 3, rev. 9), "waist" (obv. 5), "neck?" (obv. 9), "chest" (obv. 11), "backbone" (rev. 3), and "shoulder" (rev. 5).

One might imagine that a zodiacal sign's 30° was apportioned into sections each named after a body part, so that such a name became shorthand for a specific range of degrees within any zodiacal sign. When arranged in order of degrees, however, these body parts do not line up in a conclusive head-to-foot sequence.[39] Moreover, the concern to designate the "shoulder" (rev. 5) as belonging to "the Twin *behind*" (i.e., not the shoulder of the other Twin in front), suggests that degrees related to a body part vary from sign to sign, depending on how the ancients envisioned the outlined figure of each asterism. The same principle is evident in a Greek table entitled *On the Limbs of Zodiacal Signs* (περὶ μελῶν ζωδίων), which records the body parts of individual zodiacal figures that correspond to each micro-zodiac interval of 2° or 3° within their own zodiacal sign.[40] The bodily orientations of zodiacal figures there, however, do not always mirror those in our cuneiform tablet.[41]

Although the right edge of Tablet LBAT 1586+1587 is badly damaged, it is likely that the tablet connects Pabilsag (Sagittarius) to the city of Lagaš on two occasions (obv. 4, rev. 10),[42] and that the tablet as a whole describes the significance of the "moon's" zodiacal sign for certain cities (e.g., Kutha, Lagaš) or

38 Hunger (1975).

39 Arranging the body parts in order of degrees within their zodiacal sign while ignoring the identity of the sign, we get: "shoulder" (1°), "neck?" (5°), "chest" (12°), "back" (14°–15°), "waist/middle" (21°), "backbone" (24°).

40 Neugebauer (1959).

41 In Tablet LBAT 1586+1587, Sagittarius 14°–15° is its asterism's "back" (EGIR), Virgo 21° is its "waist/middle" (MURUB_4), Aries 5° is its "neck?" (G[Ú]), Capricorn 12° is its "chest" (GABA), Leo 24° is its "backbone" (GÚ.MURGU), and Gemini 1° is the "shoulder" (MAŠ.SÌL) of the Twin behind. In the Greek table of Cod. Vat. gr. 208 fol. 129^{v}, 130^{r} and Cod. Palat. gr. 137 fol. 83, these degree positions correspond respectively to Sagittarius' bow or hands, Virgo's left breast or abdomen, Aries' head, Capricorn's heart, Leo's knees or abdomen, and the head of the Twin to the north. See chart in Neugebauer (1959: 275).

42 I have restored ŠIR.[BUR.LA^{ki}] (obv. 4) and ŠIR.BUR.[LA^{ki}] (rev. 10).

temples (e.g., of Bēlet-ṣēri, of Nanše). Interestingly, the connections here partly agree with and partly deviate from the way stars and cities are correlated in another tablet BM 47494: In both tablets, Ur is linked to Taurus and Kutha to Gemini, but the zodiacal signs related to the cities of Marad, Babylon, and Lagaš differ.[43] On the other hand, the city of Lagaš is associated with micro-Gemini of Sagittarius not only here, but also in Tablet BM 33535.[44] All this illustrates a point I made at the beginning of this essay, i.e., that various attempts to integrate terrestrial features within fresh schemes of zodiacal astrology may, at times, result in inconsistent paradigms.

The most surprising thing about Tablet LBAT 1586+1587, however, is the fantastic motion it ascribes to what it calls the "moon."[45] This so-called "moon" travels at a constant velocity of 277° per day (as represented by the Calendar Text scheme), more than twenty times the speed of the real moon (i.e., around 13° per day, as represented by the *Dodekatemoria* scheme). We saw earlier that Calendar Texts were created by artificially manipulating *Dodekatemoria* numbers and did not express the movements of any known celestial body, so the "moon" described here is a purely theoretical construct with no basis in observed reality. In my translation above, I have dubbed this entity a "(virtual) moon." As a matter of fact, the ancient author could have just as easily given it another name, to avoid the possibility of confusing the real "moon" with the virtual "moon" in written or spoken description. The terminology here, however, served to emphasize the derivational relationship between real and virtual moons. Just as Calendar Text and *Dodekatemoria* schemes were consid-

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43 An edition of BM 47494 may be found in Hunger (2004). Note the correlations of Ur (ŠEŠ.UNUG^{ki}) with Taurus (LBAT 1586+1587, obv. 17–18 // BM 47494, obv. 2) and Kutha (GÚ.DU$_8$.A^{ki}) with Gemini (LBAT 1586+1587, rev. 5–6 // BM 47494, obv. 5). On the other hand, Marad (MARAD.DA^{ki}) is variously linked to Scorpio (LBAT 1586+1587, rev. 1–2) and Sagittarius (BM 47494, obv. 11), while Babylon (KÁ.DINGIR.RA^{ki}, TIN.TIR^{ki}) is linked to Capricorn (LBAT 1586+1587, obv. 11–12) as well as Leo's "breast," Sagittarius, and Pisces (BM 47494, obv. 7, 11, 14). Lagaš (ŠIR.BUR.LA^{ki}) appears with Sagittarius in LBAT 1586+1587 (obv. 3–4, rev. 9–10), but evidently not in BM 47494 (obv. 11). The possible referents to the temples of Bēlet-ṣēri and Nanše are too many to be certain which one is mentioned in LBAT 1586+1587, rev. 4 and 8 (see above). However, the Temple of Nammu associated with Cancer (LBAT 1586+1587, obv. 16), with possible referents at Babylon and Uruk listed in George (1993: nos. 641, 1360), does not seem to match up with the cities Sippar, Dilbat, and Girsu linked to Cancer in BM 47494, obv. 6.

44 "Twins (micro-Gemini) of Pabilsag (Sagittarius): Lagaš, …" (BM 33535, obv. 1).

45 The term "moon" in Tablet LBAT 1586+1587 is expressed by the cuneiform number "30," which is a very common expression for "moon" in cuneiform writing.

ered reciprocals of each other, the virtual moon was imagined as the reciprocal counterpart to the real *Dodekatemoria* moon.

Indeed, ancient astrologers recognized that the intricate links between virtual and real moons transcended the surface level of zodiacal signs and permeated their micro-zodiac structures. A key feature in Tablet LBAT 1586+1587 that has been misunderstood by scholars is the entity named "(True) Shepherd." Hunger argued that, since this "Shepherd" seems to follow the moon around and "changes its position relative to the other constellations," it must signify a planet like Saturn.[46] Brack-Bernsen and Steele noted that "True Shepherd of Anu" (múlSIPA.ZI.AN.NA) typically designates the constellation Orion, but acknowledged Hunger's concerns by allowing for the possibilities "Orion/Saturn."[47] I would argue that "Shepherd" here does in fact refer to Orion and, just as Orion represents the zodiacal sign Gemini elsewhere (e.g., SpTU III, 104, obv. 9 below),[48] "Shepherd" here is a label for the micro-zodiacal sign micro-Gemini. As a matter of fact, the language of Tablet LBAT 1586+1587 presents a contrast between the virtual moon's location "in" (*ina*) a zodiacal sign and its position "with / (in) the region (of)" (KI) a micro-zodiacal sign.[49] We will discover later that KI rather than *ina* also designates the sun's *micro*-zodiacal signs in the *GDBT* tablets and Tablets BRM IV, 20, LBAT 1626, and SpTU V, 243 (and per-

46 Hunger (1975: 41–42). For the "True Shepherd of Anu" (SIPA.ZI.AN.NA) as a possible *Deckname* for Saturn and perhaps other planets, see Gössmann (1950: 131 no. 348). Furthermore, in support of this idea, one might cite LBAT 1597, obv. 9′–10′ = line 6′ in Geller (2010: 68, 70): "If it is with the Bull of Heaven ((micro)-Taurus) and the Shepherd (Orion in (micro)-Gemini), *šaššaṭu*-sickness, vertigo—it is *maškadu*-sickness, AN.TA.ŠUB.BA-epilepsy, Daughter of Anu. 'True Shepherd of Anu' (*refers to*) 'Saturn.'" The last statement equating the Shepherd with Saturn is typical of the kinds of explanations found in cuneiform commentaries. As is true for commentaries in general, the commentator's explanations do not necessarily reflect authorial intentions of the original text commented on, but may include erudite ways of expanding on the meanings of the original. The original entries of LBAT 1597 most likely envisioned a certain (unnamed) celestial body in association with various (micro)-zodiacal signs. The commentator, however, argued that the same astrological meanings resulting from this body's association with (micro)-Gemini also came into effect when the body associated with "Saturn."

47 Brack-Bernsen and Steele (2004: 101).

48 Orion ("True Shepherd of Anu") is positioned between the constellations of the "Bull of Heaven" and the "Great Twins" in LBAT 1597, obv. 9′–10′, rev. 1 = lines 6′–7′ in Geller (2010: 68–71).

49 This is not to say that the common term KI always precedes a micro-zodiacal sign, but that, in specific contexts, KI may have been a way to signal that a following zodiacal name indicates a micro-zodiacal (not zodiacal) sign.

haps LBAT 1597 ?), as well as the virtual moon's *micro*-zodiacal signs in Tablet BM 76483 (and perhaps SpTU II, 49 and BM 77971).[50]

Scholars of Babylonian astrology have defined the micro-zodiac in two main ways, which correspond to the difference between "*Methods A and B*" and "*Methods C and D*" in W. Hübner's classification.[51] According to the former, the micro-zodiacal sign for a given position λ_1 (expressed as n degrees of zodiacal sign z) is related to and bears the same name as the zodiacal sign for position $\lambda_2 = 12n + \lambda_1$ (*Method A*) or $\lambda_2 = 13n + 0°$ of zodiacal sign z (*Method B*).[52] Though a zodiacal sign and its micro-zodiac counterpart are often described as being "associated" or "related" to each other or "correlating a point on the zodiac with another," we should be careful not to assume that zodiacal and micro-zodiacal signs sharing the same name also share exactly the same meanings.[53] It is evident that *Methods A and B* employ mutually reducible forms, but the formulation of *Method B* is actually preferable for comparison with *Method C* (see below). To give an example of how *Method B* works: The micro-zodiacal sign for Leo 16° (with longitude $\lambda_1 = 136°$) is micro-Aquarius, because it is related by formula to another longitude $\lambda_2 = 13 \times 16° + 120°$ (which is Leo 0°) $= 328°$ (which is Aquarius 28°). While scholars tend to present *Methods A and B* as one-step formulas, their explanations of *Method D* frequently take the form of a simple algorithm. According to *Method D*, a zodiacal sign of 30° is divided into twelve equal micro-zodiacal parts of 2½° each, whereby the first micro-zodiacal sign (range 0°–2½°) is related to and adopts the same name as the zodiacal sign from which it derives.[54] Using the same example

50 The term KI appears in BRM IV, 20 with the sun's micro-zodiacal signs, which are more fully expressed in plenary writing in BRM IV, 19. These tablets share similar contents with Tablets LBAT 1626 and SpTU V, 243, where zodiacal names preceded by KI likely also denote micro-zodiacal signs. On the other hand, Tablets BM 76483, SpTU II, 49, and BM 77971 are very similar in content and format, but KI is visible only in the better-preserved BM 76483. This term KI is not to be confused with the writing *ki-i* ("when") in LBAT 1598.

51 Hübner (2005: 200–202).

52 Bouché-Leclercq (1899: 300–301), Ungnad (1941–1944: 275–276), Sachs (1952: 73), Neugebauer and Sachs (1952–1953: 65), Rochberg (1988: 58 = 2010: 157–158), Koch-Westenholz (1995: 169). The method of calculation described in Scurlock (2005/2006: 127), in effect, expresses *Method B*.

53 This point becomes important later when I compare micro-zodiacal associations with materials (wood, plant, stone) and locations (city, temple) in the *GDBT* tablets and in Calendar Texts.

54 Sachs (1952: 71), Neugebauer (1959: 271), Weidner (1967: 13, 24), Rochberg (1988: 57 = 2010: 156), Reiner (1995: 115–116), Koch-Westenholz (1995: 165–166), Hunger and Pingree (1999:

as above, one would first figure out that Leo 16° stands in the seventh micro-zodiacal interval (range 15°–17½°) of Leo,[55] before counting forward from the first micro-zodiacal sign (micro-Leo) to this seventh micro-zodiacal sign (micro-Aquarius).

To make sense of the formulas and algorithm above, I suggest we think of micro-zodiacal signs not only as the *segmentation* of a zodiacal sign into parts, but also as the *compression* of the zodiac as a whole. In *Method D*, for instance, a micro-zodiacal sign represents the compression of a zodiacal sign by a factor of 12, so that a micro-zodiacal sign of n degrees retains the same name when it is expanded into a zodiacal sign of $12n$ degrees, provided it keeps to the same starting point at the beginning (0°) of any zodiacal sign z (see Fig. 6.2). This is the rationale for *Method C*, which states that the micro-zodiacal sign for a given position λ_1 (expressed as n degrees of zodiacal sign z) may be related to the zodiacal sign of another position $\lambda_2 = 12n + 0°$ of zodiacal sign z. When we compare the formula of *Method C* with that of *Method B* (i.e., $\lambda_2 = 13n + 0°$ of zodiacal sign z), it becomes clear that *Methods A and B* portray the micro-zodiac as the compression of the zodiac by a factor of 13, where each zodiacal sign consists of thirteen (not twelve) equal micro-zodiacal parts.[56] In this essay, it will be necessary to differentiate the 'micro-zodiac of (compression factor) 13' resulting from *Methods A and B* and the 'micro-zodiac of (compression factor) 12' resulting from *Methods C and D*.

It is easy to see why ancient astrologers were attracted to the 'micro-zodiac of 12,' since the twelve micro-zodiac divisions readily present themselves as a microcosm of the twelve zodiacal signs, and the simple algorithm of *Method D* (see above) may have involved less complicated calculations than the formulas of *Methods A and B*. Below is a list of tablets that employ a 'micro-zodiac of 12':

29), Heeßel (2000: 115–116), Hübner and Hunger (2002: 555), Rochberg (2004: 78–79 = 2010: 289–291), Scurlock (2005/2006: 144–145), Hunger (2007: 144–145), Popović (2007: 127), Geller (2010: 64, 74 n. 158); cf. Hübner (2005: 194–195).

55 Koch-Westenholz (1995: 168–169) thought this method might involve dividing zodiacal degree numbers by 2½ and wondered if the awkwardness of performing this operation might have led to the anticipation of later methods of multiplying by 12 and dividing by 30. Cf. Hübner (2005: 201–202). It may not have been too difficult a mental operation, however, to figure out which 2½° interval a number (between 1 and 30) came under.

56 See also the table in Neugebauer and van Hoesen (1987: 6) that also implies a thirteen-part division.

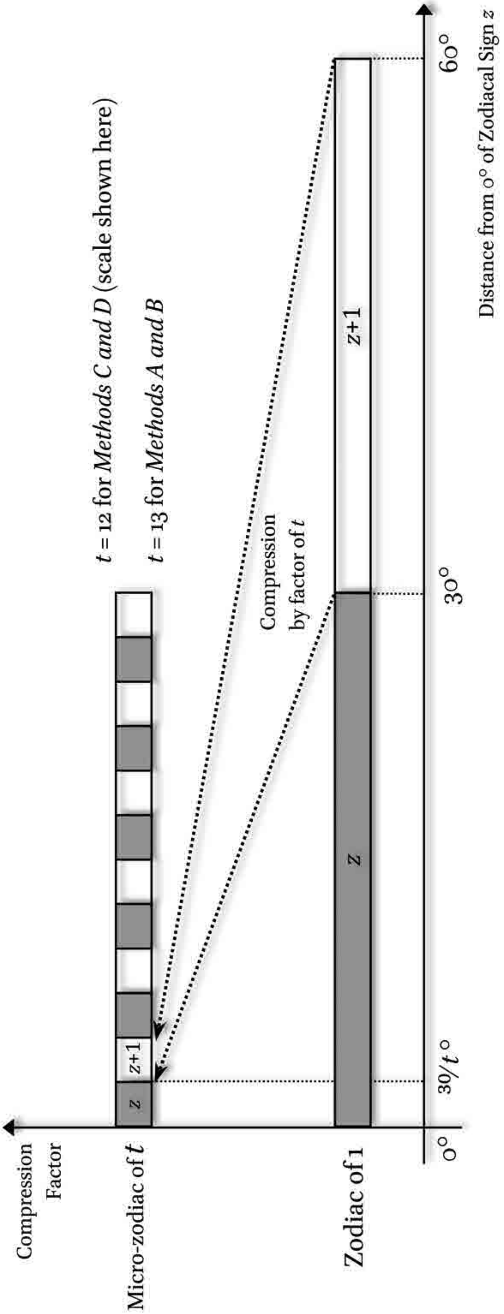

FIGURE 6.2 *The Micro-zodiac as Compression of the Zodiac*

Tablet no.	Publication	Description
AO 6483	TCL VI No. 14; Sachs (1952: 65–75)	Horoscopes
A 3427	Text A in Rochberg (2004)	Rising-Times Scheme
BM 34713	LBAT 1499 = Text B in Rochberg (2004)	Rising-Times Scheme
BM 34664	LBAT 1503 = Text C in Rochberg (2004)	Rising-Times Scheme
U 196	Text D in Rochberg (2004)	Rising-Times Scheme
BM 77242	Text E in Rochberg (2004)	Rising-Times Scheme
VAT 7851	Text 1 in Weidner (1967)	*GDBT* Tablet for Months 1 & 2
VAT 7847 + AO 6448	Text 2 in Weidner (1967)	*GDBT* Tablet for Months 5 & 6
BM 34572+	LBAT 1580 = Text 3 in Weidner (1967)	*GDBT* Tablet for Months 3 & 4[57]
BM 35784	LBAT 1578 = Text 4 in Weidner (1967)[58]	*GDBT* Tablet (mainly micro-Scorpio col.)
BM 41583	LBAT 1579 = Text 4 in Weidner (1967)	*GDBT* Tablet for Months 7 & 8[59]
K 11151	Landsberger (1915: 146–147); Weidner (1967: 39–40)	*GDBT* Tablet (micro-Leo to micro-Sagittarius cols.)[60]

57 From my examination of the original tablet LBAT 1580 (= BM 34572 (= Sp. II 44) + BM 78831 + Sp. II 253 + SH. 81-7-6, 705) at the British Museum, there is space for one more micro-zodiacal sign (i.e., micro-Gemini) at the right edge of the reverse, and the tablet therefore deals with Months 3 (obverse) and 4 (reverse). The "exaltation" (*hypsoma*) of Jupiter in Cancer (zodiacal sign 4) is marked by the label ^{d}SAG.ME.GAR above the horizontal bar of 1-day or 1° units on the tablet's reverse, which corresponds to the tablet's concern for Month 4.

58 Tablet A 3451 in the Oriental Institute of the University of Chicago includes contents with parallels in *GDBT* tablets: A 3451, obv. 0′–10′ // VAT 7847 + AO 6448 obv. cols. 9–12, 1–2 // VAT 7847 + AO 6448 rev. cols. 8–12, 1 // BM 34572+ obv. cols. 11–12 // BM 34572+ rev. cols. 10–11 // BM 41583 obv. cols. 10–12. Though Weidner (1967: 6 n. 4) claimed Tablet A 3451 belonged "zur gleichen Textgruppe" as LBAT 1578 and LBAT 1579 (cf. Sachs (1952: 72 n. 54)), these contents are not assigned to micro-zodiac columns typical of the *GDBT* tablets, and one wonders if the contents of Tablet A 3451 may have been applicable to *zodiacal* signs instead of (/ as well as) *micro-zodiacal* signs. I am currently preparing Tablet A 3451 for publication.

59 Although not well reflected in the hand copy of LBAT 1579, my study of the original tablet BM 41583 showed that parts of the micro-Leo and micro-Virgo columns preserved on the obverse are the rightmost columns abutting the right edge of the tablet, so that the tablet deals with Months 7 (obverse) and 8 (reverse).

60 The micro-zodiac labels are not preserved, but Weidner (1967: 39–40) noted that items in Tablet K 11151 correspond to those in columns for micro-Leo to micro-Sagittarius elsewhere, with the exception of ^{giš}*úr-an* (K 11151, line 6 // VAT 7847 + AO 6448, rev. micro-Pisces) in the micro-Virgo column.

(cont.)

Tablet no.	Publication	Description
W 22554/7a[61]	von Weiher (1993) = SpTU IV, 167; Hunger (2007: 149)	*GDBT* Tablet for Months 3 & 4[62]
BM 39680	Unpublished[63]	*GDBT* Tablet

In the tablet of horoscopes (AO 6483), we find instructions to "reckon 2½ days for one portion," so that the "first [portion] (of Aries) has the name (micro)-Aries."[64] For tablets displaying a "Babylonian Rising-Times Scheme," arc length intervals between *ziqpu* stars that culminate in sequence are related to risings of the twelve micro-zodiac divisions (2½° each) of a sign at the eastern horizon.[65] Such concerns for the rising of celestial bodies were also shared by procedural texts on constructing a sundial (LBAT 1494 and 1495+), which describe twelve divisions that "represent areas through which the shadow would pass as the day progressed" by the term *zittu* (logogram: ḪA.LA), a label that was used elsewhere for micro-zodiacal signs.[66]

61 Contrary to the usual practice in this essay, I refer to this *GDBT* tablet by its tablet number "W 22554/7a" rather than "SpTU IV, 167," since the interpretation and edition of this tablet by Hunger (2007: 149) greatly improves on the edition by von Weiher (1993) in his SpTU IV volume.

62 Note the restoration [… MUL].ALLA$^!$ KI$^!$ ISKIM$^!$ KUR.SU.BIR$_4$^{ki} EŠ.BAR-*šú-nu* M[E-*a* GAR] (SpTU IV, 167, rev. A x+2) by Hunger (2007: 149). The range of numbers 120–109 (only 114$^?$–111 preserved on SpTU IV, 167 obv.) and 110–199 (only 101–199 preserved on SpTU IV, 167 rev.) indicate the length of daylight in Months 3 and 4 (sun-signs Gemini and Cancer) respectively. These daylight numbers are coherent with the range 120–109 (only 113–⸢109⸣ preserved on LBAT 1580 obv.) for Month 3 (sun-sign Gemini), as well as 90–79 (only 90–82 preserved on VAT 7847 + AO 6448 rev.) for Month 6 (sun-sign Virgo). Elsewhere, I suggest why the numbers ⸢110⸣–99 for Month 4 on the obverse of Tablet VAT 7847 + AO 6448 correspond to micro-zodiac information and a drawing that mostly depicts the zodiacal sign Leo rather than Cancer.

63 This *GDBT* tablet (and perhaps others omitted in my preliminary list above) will be published by W. Monroe, who is currently writing his dissertation on the topic.

64 … 2½ *u*$_4$*-mu a-na* 1-*en* ḪA.LA ŠID-*ma* (AO 6483, obv. 10), [ḪA.LA] SAG-*ti* MÚL.LÚ.ḪUN.GÁ *šùm-šú* … (AO 6483, obv. 14) in Sachs (1952: 66, 68), cf. Rochberg (1988: 58 = 2010: 157).

65 Rochberg (2004: 56–94 = 2010: 271–302) builds on earlier work by Schaumberger (1955: 237–251).

66 Rochberg (1989: 164–165 = 2010: 185–186).

Perhaps the most striking exemplars of the 'micro-zodiac of 12,' however, are a group of Seleucid tablets published by E. Weidner in his 1967 book *Gestirn-Darstellungen auf babylonischen Tontafeln* (hence *GDBT*), which contain drawings of planetary "exaltations" (*hypsomata*) and display information pertaining to twelve micro-zodiacal signs in twelve equal columns. In a forthcoming publication, I describe how constellations and planets in such depictions were drawn to scale, as well as the close relationship between these drawings and the aforementioned "Rising-Times Scheme" and sundial texts.[67] For reasons I will shortly explain, my use of the label "*GDBT* tablet" includes exemplars of the genre that came to light after Weidner published his book (i.e., Tablets W 22554/7a and BM 39680), but excludes the Calendar Texts VAT 7816 and VAT 7815 discussed at the end of Weidner's book. In *GDBT* Tablet VAT 7851, the horizontal bar beneath a drawing of the moon's "exaltation" (*hypsoma*) is divided by vertical lines into many small units of equal size. Weidner mistakenly considered each small unit to be a "Mikro-Dekan" that is one-third of a micro-zodiacal sign,[68] but I have demonstrated that the bar is divided into a total of 30 equal units, that each such unit represents 1 day or 1° of the sun's ecliptic, and that each micro-zodiacal column immediately under this bar is marked by 2½ of these units.[69] The tablet therefore depicts the twelve-part division of the sun's zodiacal sign in a schematic month of 30 days, a period of time that approximates the moon's synodic month (~29½ days) but not its sidereal month (~27 days). In other words, while *GDBT* tablets are detailed in their portrayal of the sun's 'micro-zodiac of 12' in a 30-day schematic month, they seem less concerned about how these twelve micro-zodiacal signs of the sun relate temporally to the moon's 12 zodiacal signs in a sidereal month.[70] Sim-

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67 I presented an earlier version of my research in a lecture on "Measurements in Babylonian Drawings of Planets and Star Constellations" at the 24th International Congress of History of Science, Technology and Medicine (Manchester, 22–28 July 2013). I am grateful to Karine Chemla, Christine Proust, Agathe Keller, and the Mathematical Sciences in the Ancient World (SAW) group for their kind invitation to present this lecture, as well as for the funding provided by the European Research Council under the European Union's Seventh Framework Programme (FP7/2007–2013) / ERC Grant Agreement n. 269804.

68 Weidner (1967: 13).

69 Visible even in the photo of Tablet VAT 7851 but not accurately depicted in Weidner's hand copy are faint vertical lines that extend downwards from the top of the drawing and bisect several of these small (1-day or 1°) units at the 2½°-, 7½°-, and 12½°-mark. See Weidner (1967: Tafeln 1–2).

70 Contrary to the view that "the divisions in the 'Gestirn Darstellungen' texts comprise a sidereal month (the moon's return to the same fixed star)" in Jacobus (2014: 79 n. 142).

ilar schemes involving the sun's 'micro-zodiac of 12' were probably adopted as well in *GDBT* tablets that do not as explicitly depict a scale of 1-day or 1° units (Tablet VAT 7847 + AO 6448) or that do not have *hypsoma* drawings or labels fully preserved (Tablets LBAT 1580, LBAT 1578, LBAT 1579, K 11151, W 22554/7a, and BM 39680).

In addition to these remarkable drawings in *GDBT* tablets, the Greek term "*dodekatemorion*" (literally: "twelfth part") may have exerted its influence on modern interpretations of the cuneiform material.[71] By comparison, micro-zodiacal units are denoted in Akkadian simply by the term *zittu* (logogram: ḪA.LA) meaning "share" or "part" without any numerical qualifier, even though they clearly denote divisions of twelve parts in certain contexts like sundial texts above. By grouping together *GDBT* tablets and the Calendar Texts VAT 7816 and VAT 7815 in the same publication, however, Weidner may have contributed to the idea by Brack-Bernsen and Steele that *GDBT* tablets and their 'micro-zodiac of 12' were "a pictoral representation of the *Dodekatemoria*" in the context of *Dodekatemoria* and Calendar Text schemes.[72] Some disambiguation of terminology is needed. While *GDBT* tablets and Calendar Texts display similar astrological associations with deities, locations (cities and temples), materials (woods, plants, and stones), and propitious or unfavorable events, the "*Dodekatemoria*" of *GDBT* tablets depict the sun's 'micro-zodiac of 12,' but so-called "*Dodekatemoria*" (and Calendar Text) schemes actually work with a 'micro-zodiac of 13.' Also taking her starting-point from the twelve-part micro-zodiac in *GDBT* tablets, Rochberg spoke of "the Greek method of computing dodekatemoria [that] was based on the method reflected in the cuneiform material" and expressed by the formula "$\lambda_2 = 12n + n°$ of z," which is in fact *Method A*'s formula for a 'micro-zodiac of 13.'[73] Reiner showed the same confusion when she described how "the *dodekatemorion* of one position is found by adding to a particular degree of the sign … its twelve-fold multiple (i.e., *Method A* for a 'micro-zodiac of 13')," but then spoke of "Calendar texts" having "a micro-zodiac in which each sign is divided into twelve units

71 The definition of "*dodekatemorion*" as "twelfth (ordinal number) part" (not "twelve (cardinal number) parts") and its applications in classical contexts to "the twelfth part of the ecliptic" (30°), "the twelfth part of a zodiacal sign" (2½°), "the sixtieth part of a zodiacal sign" (½°), and "the twelfth part of the daily rotation" (30°) are discussed in Hübner (2005). The complex question how the Greek term "*dodekatemoria*" relates to a thirteen-part micro-zodiac is beyond the scope of this essay.

72 Brack-Bernsen and Steele (2004: 103–104).

73 Rochberg (1988: 58 = 2010: 157).

of 2½ degrees each."[74] Geller thought that a cuneiform tablet (BRM IV, 19) with *Dodekatemoria* numbers "divides each zodiac sign into a micro-zodiac of 2 ½ degrees" (as would be the case for a 'micro-zodiac of 12'), even though the actual micro-zodiacal signs named result instead from a 'micro-zodiac of 13' (see discussion later in this section).[75] In his relatively recent list of micro-zodiac tablets, Hunger described how "each sign of the zodiac is subdivided into twelve parts," but included in his description tablets like BM 33535 (and perhaps BM 56605) that relate the zodiac to time in ways characteristic of the Calendar Text System and its 'micro-zodiac of 13' (see appendix to this essay).[76]

Indeed, the practice of naming the first micro-zodiac division after the sign from which it derives (e.g., the first micro-zodiacal sign of Leo is "micro-Leo") may seem arbitrary in a 'micro-zodiac of 12,' but it makes perfect sense in a 'micro-zodiac of 13' where continuously repeating cycles of the twelve zodiac names are broken up into groups of thirteen. As we will discover at the end of this section, the 'micro-zodiac of 13' was instrumental in synchronizing sun, moon, and virtual moon in a single Calendar Text System. Indirect evidence for how the 'micro-zodiac of 13' was used may be found in a ceramic bead (11 N 157) excavated at Nippur (WB 1/4, Level IV Court, Floor 1) that displays a series of numbers on its outer edge:[77]

Nippur Bead (*11 N 157*)
[2] ⸢4⸣ 6 9 11 13 16 18 20!(21) 23 ⸢x⸣

The date of this bead is admittedly in question, and its findspot in Nippur differs from the usual locations (i.e., Babylon and Uruk) of existing Calendar Text and *Dodekatemoria* tablets.[78] D. Pingree, however, correctly observed that "the numbers may record the last 'full' day in a sidereal month that the moon

74 Reiner (1995: 110, 115–116).

75 Geller (2010: 74 n. 158).

76 Hunger (2007: 144–145).

77 I am grateful to Miguel Civil for alerting me to this bead, which is discussed in Gibson, et al. (1975: 106, 115, 119 (Fig. 87.4), 135–136, 142 no. 33). Traces of the sign ⸢x⸣ after 23 cannot be easily read as the number ⸢25⸣, so the ten numbers above (together with the implied starting number zero) define the boundaries for only eleven numerical intervals.

78 "Dr. Civil indicates that the numbers are written in a style not known as early as Old Babylonian and questions the validity of the findspot. It is possible that the bead is intrusive from above, but our field notes state the object came from Floor 1, under the sand lenses." Gibson, et al. (1975: 106).

is in each zodiacal sign."[79] Though Pingree's calculations employed the mean velocity of 13;10° per day for the moon, we arrive at the same conclusions by using the less precise figure of 13° in the *Dodekatemoria* scheme. As I intimated earlier, the choice of dates indicating the last time the moon occupies its current zodiacal sign (rather than the first time it enters a new zodiacal sign) would be more appropriate if the dates correspond to the moon's position at the end of the Babylonian day. This suggests that *Dodekatemoria* tablets and Calendar Texts record the zodiacal locations of the moon and virtual moon at the end (not beginning) of their respective days.

The Nippur bead indicates not only a way of dividing up the month into thirteen segments of 2 or 3 days each, but also the possibility of interpreting these divisions as micro-zodiacal signs of 2° or 3° each. Indeed, one wonders if the bead's main value lay not in its depiction of the moon's zodiacal times (which could otherwise also be ascertained by direct observation), but in its delineation of micro-zodiacal units (which were theoretical constructs). Although the integers 2 and 3 are very close to the 2½ figure characteristic of the 'micro-zodiac of 12,' it should be emphasized that they do not result from "rounding up" or "rounding down" of the ½ fraction, but represent the approximation of values from the 'micro-zodiac of 13.'[80] The bead suggests an easy way of calculating the 'micro-zodiac of 13,' which is akin to the simple algorithm of *Method D* for the 'micro-zodiac of 12.' Instead of working out formulas like $\lambda_2 = 12n + \lambda_1$ (*Method A*) or $\lambda_2 = 13n + 0°$ of zodiacal sign z (*Method B*), ancient astrologers could have simply committed to memory numbers like those on the Nippur bead, which would have quickly revealed the order of the micro-zodiacal interval of interest to them.

Informed by the numbers on the Nippur bead, Fig. 6.3 displays how boundaries are drawn in the 'micro-zodiac of 13,' as well as how the twelve iconic zodiacal names are distributed among its thirteen parts: The micro-zodiacal sign for days/degrees 1 and 2 shares the same relations and name as the one

79 Gibson, et al. (1975: 135). Similar (but not identical) accounts of the moon's journey through the zodiac may also be found in the Qumran text *4QZodiac Calendar*, where the last day the moon remains in a zodiacal sign occurs on Days 2, 4, 7, 9, 11, 14, 16, 18, 21, 23, 25, 28, and 30. Jacobus (2014: 45–51, Table 1.1.3).

80 Note, by contrast, how the zodiacal divisions at 2°, 5°, 7°, 10°, etc. were formed simply by "dropping in every second case the fraction ½ in an original sequence 2½, 5, 7½, 10, etc." Neugebauer (1959: 270–271). It is also inaccurate to describe micro-zodiac divisions of 2 or 3 days/degrees each as "unequal," in contrast to "equal" divisions of 2½ days/degrees each. The 2½ figure results from the division of 30 days/degrees into twelve equal parts, while the numbers 2 or 3 represent integer values from the division of 30 days/degrees into thirteen *equal* parts.

Micro-zodiacal interval order	Individual days or degrees
1st	1, 2
2nd	3, 4
3rd	5, 6
4th	7, 8, 9
5th	10, 11
6th	12, 13
7th	14, 15, 16
8th	17, 18
9th	19, 20
10th	21, 22, 23
11th	24, 25
12th	26, 27
1st	28, 29, 30

FIGURE 6.3 *The 'Micro-zodiac of 13'*

for days/degrees 28, 29, and 30.[81] Fig. 6.4 shows us two ways of working out the micro-zodiacal sign for the virtual moon's zodiacal sign (v_1) and degree (v_2) position in a given month (d_1) and day (d_2): (1) By using the simple algorithm, first figuring out the order of the micro-zodiacal interval (r) that corresponds to the degree position (v_2), then counting forward from the first micro-zodiacal sign (that shares the same name as its zodiacal sign v_1) to the micro-zodiacal sign of interest ($v_1 + r - 1$). (2) By using *Method B*, whereby this micro-zodiacal sign is related to the zodiacal sign for position $\lambda_2 = 13n + 0°$ of zodiacal sign z, which works out to $\lambda_2 = 13v_2 + 30(v_1 - 1)$.

Fig. 6.4 demonstrates that the virtual moon's micro-zodiacal sign consistently agrees in number with the month under consideration.[82] This confirms

81 I noted earlier that the calculations in Scurlock (2005/2006: 127) are reducible to the formula for *Method B* (i.e., $\lambda_2 = 13n + 0°$ of zodiacal sign z), which reflects a 'micro-zodiac of 13.' It comes as no surprise, therefore, that the intervals in Scurlock's chart resemble those of Fig. 6.3, except for her error in grouping Day 14 with Days 12–13 instead of with Days 15–16.

82 The application of *Method B* in Fig. 6.4 results in the zodiacal position $30(d_1 - 1) + p°$, where p is an integer from 1 to 30. Since $30(d_1 - 1)$ degrees of the zodiac corresponds to 0° of zodiacal sign d_1, *Method B* shows that the virtual moon's micro-zodiacal sign for each day of month d_1 takes the name of zodiacal sign d_1.

Day (d_2) in month (d_1)	Virtual moon's zodiacal sign (ν_1)	Virtual moon's zodiacal degree (ν_2)	Micro-zodiac of 13 interval order (r)th	Virtual moon's micro-zodiacal sign: $\nu_1 + r - 1$	Name of virtual moon's micro-zodiacal sign (*Method B*): $\lambda_2 = 13\nu_2 + 30(\nu_1 - 1)$
1	$d_1 + 9$	7°	4th	d_1	$30(d_1 - 1) + 1°$
2	$d_1 + 6$	14°	7th	d_1	$30(d_1 - 1) + 2°$
3	$d_1 + 3$	21°	10th	d_1	$30(d_1 - 1) + 3°$
4	d_1	28°	1st	d_1	$30(d_1 - 1) + 4°$
5	$d_1 + 10$	5°	3rd	d_1	$30(d_1 - 1) + 5°$
6	$d_1 + 7$	12°	6th	d_1	$30(d_1 - 1) + 6°$
7	$d_1 + 4$	19°	9th	d_1	$30(d_1 - 1) + 7°$
8	$d_1 + 1$	26°	12th	d_1	$30(d_1 - 1) + 8°$
9	$d_1 + 11$	3°	2nd	d_1	$30(d_1 - 1) + 9°$
10	$d_1 + 8$	10°	5th	d_1	$30(d_1 - 1) + 10°$
11	$d_1 + 5$	17°	8th	d_1	$30(d_1 - 1) + 11°$
12	$d_1 + 2$	24°	11th	d_1	$30(d_1 - 1) + 12°$
13	d_1	1°	1st	d_1	$30(d_1 - 1) + 13°$
14	$d_1 + 9$	8°	4th	d_1	$30(d_1 - 1) + 14°$
15	$d_1 + 6$	15°	7th	d_1	$30(d_1 - 1) + 15°$
16	$d_1 + 3$	22°	10th	d_1	$30(d_1 - 1) + 16°$
17	d_1	29°	1st	d_1	$30(d_1 - 1) + 17°$
18	$d_1 + 10$	6°	3rd	d_1	$30(d_1 - 1) + 18°$
19	$d_1 + 7$	13°	6th	d_1	$30(d_1 - 1) + 19°$
20	$d_1 + 4$	20°	9th	d_1	$30(d_1 - 1) + 20°$
21	$d_1 + 1$	27°	12th	d_1	$30(d_1 - 1) + 21°$
22	$d_1 + 11$	4°	2nd	d_1	$30(d_1 - 1) + 22°$
23	$d_1 + 8$	11°	5th	d_1	$30(d_1 - 1) + 23°$
24	$d_1 + 5$	18°	8th	d_1	$30(d_1 - 1) + 24°$
25	$d_1 + 2$	25°	11th	d_1	$30(d_1 - 1) + 25°$
26	d_1	2°	1st	d_1	$30(d_1 - 1) + 26°$
27	$d_1 + 9$	9°	4th	d_1	$30(d_1 - 1) + 27°$
28	$d_1 + 6$	16°	7th	d_1	$30(d_1 - 1) + 28°$
29	$d_1 + 3$	23°	10th	d_1	$30(d_1 - 1) + 29°$
30	d_1	30°	1st	d_1	$30(d_1 - 1) + 30°$

FIGURE 6.4 *Calendar Text Dates and Micro-Zodiacal Signs*

my proposal that, for Month 3 in Calendar Text LBAT 1586+1587, the virtual moon always stands in micro-Gemini (micro-zodiacal sign 3), which is denoted by the term "Shepherd." It also affirms that the virtual moon adopts a 'micro-zodiac of 13 (not 12)' in the Calendar Text scheme. We should not be surprised that micro-zodiac boundaries in Calendar Texts match up so nicely with time intervals in the *Dodekatemoria* scheme. After all, Calendar Texts formed by the "swapping" of *Dodekatemoria* headings only reinterpret the significance of existing numbers rather than alter their numerical values, so that agreement between month and micro-zodiac in Calendar Texts results merely as a mathematical byproduct. It is worth noting, however, the repeated emphasis in Tablet LBAT 1586+1587 that the "(virtual) moon" (despite moving in ways one does not expect for the moon) somehow always "stands with the Shepherd (micro-Gemini)." Such remarkable consistencies beneath the surface level of zodiacal signs served to highlight inner coherences in the deep structure of celestial time and movement.

The 'micro-zodiac of 13' is also evident in another tablet BRM IV, 19,[83] each entry of which prescribes magical spells or rituals for various purposes effective on a particular date (Month and Day), followed by the *Dodekatemoria* four-number sequence for that date,[84] and plenary writing of the name of a micro-

83 Earlier, I questioned the view that "BRM 4 19 … divides each zodiac sign into a micro-zodiac of 2 ½ degrees" (as would be the case for a 'micro-zodiac of 12') by Geller (2010: 74 n. 158). If Tablet BRM IV, 19 had adopted a 'micro-zodiac of 12' for the sun, we would find micro-Cancer instead of micro-Leo (obv. 2′–3′; rev. 24′–25′, 34′–37′), micro-Leo instead of micro-Virgo (obv. 5′–6′), micro-Virgo instead of micro-Libra (obv. 8′–9′; rev. 20′–21′), micro-Libra instead of micro-Scorpio (obv. 11′), micro-Capricorn instead of micro-Aquarius (obv. 12′), micro-Aquarius instead of micro-Pisces (obv. 13′, 14′–15′), micro-Sagittarius instead of micro-Capricorn (obv. 16′–19′), micro-Scorpio instead of micro-Sagittarius (rev. 22′–23′), micro-Gemini instead of micro-Cancer (rev. 26′–27′), and micro-Aries instead of micro-Taurus (rev. 38′) in the readings below, and possibly also micro-Aquarius instead of micro-Pisces (obv. 1′), micro-Pisces instead of micro-Aries (obv. 4′), micro-Aries instead of micro-Taurus (obv. 7′), and micro-Taurus instead of micro-Gemini (obv. 10′). The signs micro-Aquarius (rev. 28′), micro-Aries (rev. 29′–32′), micro-Gemini (rev. 33′), and micro-Taurus (rev. 39′–40′) would remain the same for either a 'micro-zodiac of 12' or a 'micro-zodiac of 13.'

84 Although the four-number sequences in BRM IV, 19 do not proceed in increments of 1 day, the numbers defined as Month and Day at the beginning of each entry correspond to those of the *Dodekatemoria* scheme (cf. Brack-Bernsen and Steele (2004: 103)). Scurlock (2005/2006: 125) suggested that "the pattern of dates chosen for the performance of sorcerous rites [in BRM IV, 19 and 20, and STT II, 300] is based on an underlying calendar dividing the month into weeks of 10 days (decans) which points specifically to ancient Egypt as the source of inspiration."

zodiacal sign (e.g., "Lion (micro-Leo) of Scorpion (Scorpio)"). Similar contents are repeated elsewhere without the *Dodekatemoria* numbers, with the micro-zodiac name either written in a concise way (e.g., micro-Leo written simply as "Lion" in Tablet BRM IV, 20) or omitted altogether (in Tablet STT II, 300). It is significant that the colophon of Tablet BRM IV, 20 ascribes it to "Iqīšāya, son of Ištar-šumu-īriš, descendent of Ekurzakir the magician,"[85] who also owned the Calendar Texts SpTU III, 104 and 105. There are several scribal errors in Tablet BRM IV, 19, so I have supplied below all (corrected) *Dodekatemoria* numbers and micro-zodiacal signs that are preserved.[86] In addition, I write out in detail the spells/rituals for selected ailments and sicknesses (BRM IV, 19, lines 5′–6′, 16′–32′, 38′–40′) that provide useful points of comparison with other tablets that we will examine in a later section.

Tablet BRM IV, 19 (= MS B in later discussion)

obv. 1′: [On Month 8 Day 10, (*spells/rituals*[87] *for …*)]
⸢8 10 12 10⸣ Field (micro-Pisces) of Scorpion (Scorpio) is the distance.[88]

2′–3′: ⸢On Month 8 Day 21, (*spells/rituals for …*)⸣
8 21 5 3 Lion (micro-Leo) of Scorpion (Scorpio) is the distance.

4′: On Month 9 Day 10, (*spells/rituals for …*)
9 10 1 10 Sheep (micro-Aries) of Pabilsag (Sagittarius) is the distance.

5′–6′: On Month 9 Day 21, (*spells/rituals for*) the one looking at you to point his finger [at you] for good (purposes).
9 21 6 3 Furrow (micro-Virgo) of Pabilsag (Sagittarius) [is the distance].

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85 [I]M ^{m}BA-*šá-a bu*$_{12}$*-kúr* ^{m}INNIN.MU.KAM ŠÀ.BAL.BAL ^{m}*É-kur-za-kir* ^{lú}MAŠ.MAŠ (BRM IV, 20, rev. 79).

86 There are some typos in the edition by Geller (2010: 43): "XII 24 XI 21" (obv. 23) should be "XII 27 XI 21"; "XII 19 XII 17" (obv. 25) should be "XII 29!(19) XII 17"; "II 22 … IV 22 VII 6" (rev. 27) should be "II 12 … II!(IV) 12 VII 6."

87 Though not explicitly stated here, Tablet STT II, 300, rev. 19 makes it clear that these contents involve "spells" (ÉN.MEŠ) or their use in rituals (see discussion in later section).

88 I have followed Rochberg's translation "(is) the distance" (ZI), which reflects the meaning of the term ZI as "traveled distance" or "velocity" in Seleucid astronomical texts. Rochberg (1988: 58 = 2010: 158); cf. Neugebauer and Sachs (1952–1953: 66) and Neugebauer (1955) = ACT 496–497.

7′:	…	10 10 2 10	Stars (Pleiades in micro-Taurus) of [Goat-fish (Capricorn) is the distance].
8′–9′:	…	10 21 7 3	Scales (micro-Libra) of Goat-fish (Capricorn) [is the distance].
10′:	…	11 10 3 10	Twins (micro-Gemini) of Great One (Aquarius) is the distance.
11′:	…	11 21 8 3	Scorpion (micro-Scorpio) of Great One (Aquarius) is the distance.
12′:	…	12 27 11 21	Great One (micro-Aquarius) of Field! (Pisces)[89] is the distance.
13′:	…	12 28 12 4	Field! (micro-Pisces)[90] of Field (Pisces) is the distance.
14′–15′:	…	12 29! 12 17	Field! (micro-Pisces)[91] of Field (Pisces) is the distance.

16′–19′: On Month 1 Day 21, in order to dispel the sorcerer that he may not approach the sick man, to heal the head, to expel his shivering, to heal the wound, to stanch the (menstrual) blood of a woman, that evil may not approach the man's house; make (*spells/rituals*), and it will be well.

1 21 10 3 — Goat-fish (micro-Capricorn) of Sheep (Aries) is the distance.

rev. 20′–21′: On Month 2 Day 12, in order to remove *lilû* and *ardat lilî* demons; make (*spells/rituals*), and it will be well.

2! 12 7 6 — Scales (micro-Libra) of Stars (Pleiades in Taurus) is the distance.[92]

22′–23′: On Month 4 Day 12, in order to remove *lilû* and *ardat lilî* demons; make (*spells/rituals*), and it will be well.

4 12 9 6 — Pabilsag (micro-Sagittarius) [of] Crab (Cancer) is the distance.

24′–25′: On Month ⸢5!⸣ Day 29, in order to remove AN.TA.ŠUB.BA-, *bennu*-, and ^{d}LUGAL.ÙR.RA- epilepsies, and Hand-of-God sickness; make (*spells/rituals*), and it will be well.

5 29 5 17 — Lion! (micro-Leo)[93] of Lion (Leo) is the distance.

89 Scribal error: GU *šá* IKU!(GU) ZI (BRM IV, 19, obv. 12′).

90 Scribal error: IKU!(GU) *šá* IKU ZI (BRM IV, 19, obv. 13′).

91 Scribal error: 12 29!(19) 12 17 GU.LA *šá* IKU ZI (BRM IV, 19, obv. 15′).

92 Scribal error: 2!(4) 12 7 6 RÍN *šá* MÚL.MÚL Z[I] (BRM IV, 19, rev. 21′).

93 Scribal error: UR!.A!(ABSIN) *šá* ⸢UR.A ZI⸣ (BRM IV, 19, rev. 25′).

26′–27′: On Month 6 Day 24, in order to seize a ghost to bind with a man,[94] to entrust a man's figurine to the dead, to make libation for a ghost, to expel guilt; make (*spells/rituals*), and it will be well.

6 24 4 12 — [Crab (micro-Cancer) of Furrow (Virgo)] is the distance.

28′: On Month 7 Day 11, in order that a woman may come; make (*spells/rituals*), and he will be without fault; make (*spells/rituals*), and it will be well.

7 11 11 ⸢23⸣ — [Great One (micro-Aquarius) of Scales (Libra) is the distance.]

29′–32′: On Month 7 Day 16, in order to invite the god, to invite the goddess, to heal *sagallu*-sickness, to purify the house, to confine the sick man,[95] to heal rectal sickness, to heal (kidney/bladder) stone, to hold diarrhea;[96] make (*spells/rituals*), and it will be [well].

7 16 1 28 — Sheep (micro-Aries) of Scales (Libra) is the distance.

33′: … 8 18 3 24 — Twins (micro-Gemini) of Scorpion (Scorpio) [is the distance].

34′–37′: … 8 21 5 3 — [Lion (micro-Leo) of Scorpion (Scorpio) is the distance ?][97]

38′: On Month [9] Day 12, (*for*) seized mouth; perform (*spells/rituals*), and it will be well.

9 12 2 6 — Stars (Pleiades in micro-Taurus) of Pabilsag (Sagittarius) is the distance.

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94 This rationale seems to be expressed by the commentary in BRM IV, 20, rev. 73′: *e-ṭím-mu ṣa-ba-tu it-ti* LÚ *a-na ra-k*[*a-su*] ("to seize a ghost to bind with a man").

95 The determinative in a parallel description lúGIG *ana e-se-ri* (STT II, 300, obv. 22) suggests that the "sick man" rather than "sickness" is the subject of confinement. Cf. Wiggermann (1992: 105–106).

96 KÚM ("fever") is omitted here but mentioned in the parallel entries of BRM IV, 20, obv. 37′ and STT II, 300, obv. 22.

97 Judging from the hand-drawn copy, there does not seem to be space at the damaged end of BRM IV, 19, rev. 37′ for the expected restoration [UR.A *šá* GÍR.TAB ZI] suggested by Ungnad (1941–1944: 275).

39′–40′: [On Month 10 Day 11,] in order that the god would look (favorably) and to appease divine wrath;[98] make (*spells/rituals*), and it will be [well].

[10 11] 2 23 Stars (Pleiades in micro-Taurus) of Goat-fish (Capricorn) [is the distance].

Tablet BRM IV, 19 clearly makes a valuable contribution to our understanding of Babylonian medical zodiology, and we will discuss it at greater length later in this essay along with the tablets BRM IV, 20, STT II, 300, LBAT 1626, and SpTU V, 243. For now, however, Tablet BRM IV, 19 raises an obvious question with important implications that needs to be addressed: Whose micro-zodiacal sign is it? Or, which celestial body is positioned in the micro-zodiacal signs corresponding to the dates listed above? Based on our earlier discussion of the *Dodekatemoria* scheme (Fig. 6.1(A)), we would expect the numbers for each date to indicate the real moon's zodiacal sign and degree position. In other words, the number sequence "8 10 12 10" expresses the fact that, on Month 8 Day 10, the moon is at zodiacal sign 12 (Pisces) 10°. Another way to frame our question, therefore, is to ask: Changes in whose micro-zodiacal positions coincide with changes in the moon's zodiacal positions?[99]

The answer is the sun, but only as imagined in certain schematic ways. For one, Tablet BRM IV, 19 assumes a schematic Babylonian year of 360 days that can be mapped exactly onto the sun's ecliptic of 360°, so that each month begins with the sun's movement into a new zodiacal sign, and the 30 days of a month correspond to the 30° of a zodiacal sign.[100] This synchronization of the calendar with solar motion led to an orthographic trait common in

98 *Contra* the interpretations "den (böse) blickenden Gott, den erzürnten Gott, versöhnen" in Ungnad (1941–1944: 281) and "annuling [*sic*] divine anger of watching gods" in Geller (2010: 35). The favorable character of the god's "look" is implied by the use of the Precative in the commentary: DINGIR IGI.BAR DINGIR.MEŠ *li-ip-pal-sa-a*[*n-ni*] ("DINGIR IGI.BAR (*means*) 'Would that the god(s) look at me!'") (BRM IV, 20, rev. 75′).

99 Early on, Ungnad (1941–1944: 283) recognized that "in unseren Texten [i.e., BRM IV, 19 and 20] legt der Nachdruck auf der Stellung des Mondes." Cf. Koch-Westenholz (1995: 170). The plenary writing of *micro*-zodiacal signs in Tablet BRM IV, 19, however, indicates that the subject directly addressed is not the moon's zodiacal signs.

100 This schematic year is noted in van der Waerden (1952–1953: 218), Weidner (1967: 51), Hunger, et al. (1985: 15), Hunger (1996: 194), Brack-Bernsen and Hunger (1999: 283), Brack-Bernsen and Steele (2004: 102), Roughton, et al. (2004: 551–552), and Steele (2011a: 336). This year was adopted also in the Qumran text *4QZodiac Calendar* (= 4Q318 cols. iv, vii–viii, lines 1–6a). Jacobus (2014: 83–91).

Calendar Text and *Dodekatemoria* tablets, i.e., the use of Babylonian month names to indicate zodiacal signs in cuneiform writing (see below). Secondly, the sun is assigned a 'micro-zodiac of 13' (in contrast to the sun's 'micro-zodiac of 12' in *GDBT* tablets), so that the real moon's thirteen zodiacal signs in a schematic month correspond to the thirteen micro-zodiac divisions of the sun's only zodiacal sign for that month. Two points are worthy of note here: In contrast to the largely theoretical twelvefold division of the sun's zodiacal sign in *GDBT* tablets, the sun's 'micro-zodiac of 13' in the *Dodekatemoria* scheme of Tablet BRM IV, 19 took its cue from actual celestial markers (i.e., changes in the real moon's zodiacal signs). Furthermore, as I intimated earlier, such endeavors to synchronize solar and lunar movements provide indirect evidence that *Dodekatemoria* dates indicate the moon's location at the end (not beginning) of the Babylonian day, so that sun and moon (and virtual moon) are all in conjunction at the start (0°) of a zodiacal sign at the beginning of each month.

Fig. 6.5 lays out the details of the sun's zodiacal parameters in Tablet BRM IV, 19, as well as calculations of its micro-zodiacal signs by simple algorithm ($s_1 + r - 1$) and *Method B* ($\lambda_2 = 13s_2 + 30(s_1 - 1)$). In Fig. 6.6, I suggest how such methods of synchronizing the calendar with movements of moon and sun can multiply the applicability of *Dodekatemoria* and Calendar Text schemes, so that they combine to form a comprehensive "Calendar Text System."

BRM IV, 19	**Sun's zodiacal sign (s_1)**	**Sun's zodiacal degree (s_2)**	**Sun's micro-zodiac interval order (r)th**	**Sun's micro-zodiacal sign: $s_1 + r - 1$**	**Name of sun's micro-zodiacal sign (*Method B*): $\lambda_2 = 13s_2 + 30(s_1 - 1)$**
obv. 1′	8 (Scorpio)	10°	5th	12 (micro-Pisces)	340° (Pisces 10°)
obv. 2′–3′	8 (Scorpio)	21°	10th	5 (micro-Leo)	483° (Leo 3°)
obv. 4′	9 (Sagittarius)	10°	5th	1 (micro-Aries)	370° (Aries 10°)
obv. 5′–6′	9 (Sagittarius)	21°	10th	6 (micro-Virgo)	513° (Virgo 3°)
obv. 7′	10 (Capricorn)	10°	5th	2 (micro-Taurus)	400° (Taurus 10°)
obv. 8′–9′	10 (Capricorn)	21°	10th	7 (micro-Libra)	543° (Libra 3°)
obv. 10′	11 (Aquarius)	10°	5th	3 (micro-Gemini)	430° (Gemini 10°)
obv. 11′	11 (Aquarius)	21°	10th	8 (micro-Scorpio)	573° (Scorpio 3°)
obv. 12′	12 (Pisces)	27°	12th	11 (micro-Aquarius)	681° (Aquarius 21°)
obv. 13′	12 (Pisces)	28°	1st	12 (micro-Pisces)	694° (Pisces 4°)
obv. 14′–15′	12 (Pisces)	29!°	1st	12 (micro-Pisces)	707° (Pisces 17°)
obv. 16′–19′	1 (Aries)	21°	10th	10 (micro-Capricorn)	273° (Capricorn 3°)

BRM IV, 19	Sun's zodiacal sign (s_1)	Sun's zodiacal degree (s_2)	Sun's micro-zodiac interval order (r)th	Sun's micro-zodiacal sign: $s_1 + r - 1$	Name of sun's micro-zodiacal sign (*Method B*): $\lambda_2 = 13s_2 + 30(s_1 - 1)$
rev. 20′–21′	2! (Taurus)	12°	6th	7 (micro-Libra)	186° (Libra 6°)
rev. 22′–23′	4 (Cancer)	12°	6th	9 (micro-Sagittarius)	246° (Sagittarius 6°)
rev. 24′–25′	5 (Leo)	29°	1st	5 (micro-Leo)	497° (Leo 17°)
rev. 26′–27′	6 (Virgo)	24°	11th	4 (micro-Cancer)	462° (Cancer 12°)
rev. 28′	7 (Libra)	11°	5th	11 (micro-Aquarius)	323° (Aquarius 23°)
rev. 29′–32′	7 (Libra)	16°	7th	1 (micro-Aries)	388° (Aries 28°)
rev. 33′	8 (Scorpio)	18°	8th	3 (micro-Gemini)	444° (Gemini 24°)
rev. 34′–37′	8 (Scorpio)	21°	10th	5 (micro-Leo)	483° (Leo 3°)
rev. 38′	9 (Sagittarius)	12°	6th	2 (micro-Taurus)	396° (Taurus 6°)
rev. 39′–40′	[10] (Capricorn)	[11°]	5th	2 (micro-Taurus)	413° (Taurus 23°)

FIGURE 6.5 *The Sun's 'Micro-Zodiac of 13' in Tablet BRM IV, 19*

While it is obvious from Fig. 6.6 that our concerns have extended beyond calendar dates and the real moon's movement, I have retained the conventional labels "Calendar Text scheme" and "*Dodekatemoria* scheme." Also, though I earlier remarked that Calendar Texts numbers do not necessarily appear in the order "(Sign)—(Date)," I have kept to the same four-number sequence (x_1 x_2 y_1 y_2) for both schemes in Fig. 6.6, so that Calendar Text numbers occur in the order "(Sign)—(Date)" and *Dodekatemoria* numbers in the order "(Date)—(Sign)." I must emphasize that, just because a scheme is possible does not mean that it was employed or preferred in ancient practice. In fact, as we see below, some of the schemes proposed in Fig. 6.6 are not unambiguously attested on cuneiform exemplars. On the other hand, our existing tablets often do not include enough non-numerical information to tell us exactly what the numbers meant, and it is possible that current definitions limited to lunar motion and calendar dates are overly restrictive.

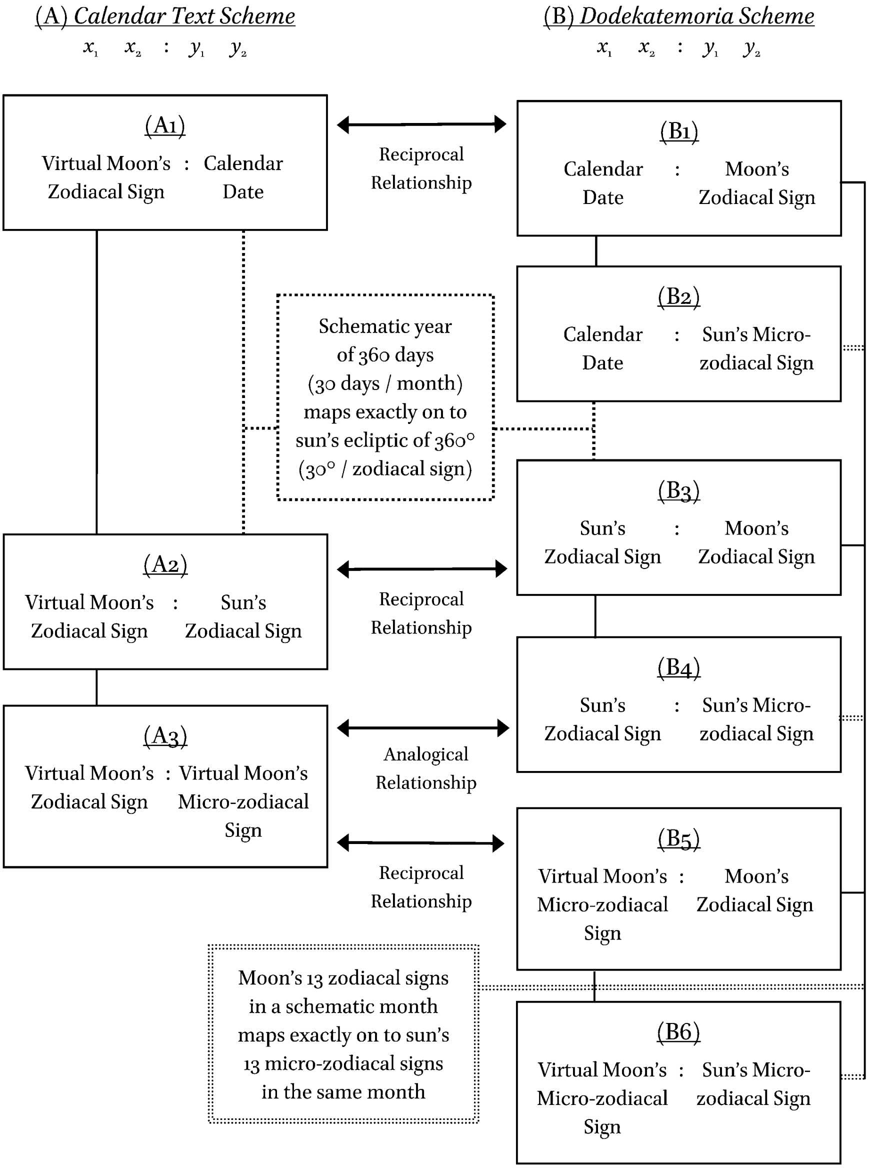

FIGURE 6.6 *The Calendar Text System*

Scheme	Clear attestations
(A) *Calendar Text scheme*	
(A1) Virtual Moon's Zodiacal Sign : Calendar Date	VAT 7816 and VAT 7815, BM 47851, LBAT 1586+1587, SpTU III, 104 and 105 (?)
(A2) Virtual Moon's Zodiacal Sign : Sun's Zodiacal Sign	–
(A3) Virtual Moon's Zodiacal Sign : Virtual Moon's Micro-zodiacal Sign	LBAT 1586+1587
(B) *Dodekatemoria scheme*	
(B1) Calendar Date : Moon's Zodiacal Sign	BM 47851 (?)
(B2) Calendar Date : Sun's Micro-zodiacal Sign	BRM IV, 19, etc.
(B3) Sun's Zodiacal Sign : Moon's Zodiacal Sign	–
(B4) Sun's Zodiacal Sign : Sun's Micro-zodiacal Sign	BRM IV, 19, etc.
(B5) Virtual Moon's Micro-zodiacal Sign : Moon's Zodiacal Sign	–
(B6) Virtual Moon's Micro-zodiacal Sign : Sun's Micro-zodiacal Sign	–

Colophons in Tablets VAT 7816 (rev. 17) and VAT 7815 (rev. 9) explicitly describe their contents as ranging "from Day 1 to Day 30," so the temporal significance of these tablets is clear.[101] Similarly, the writing U_4.*x*.KAM ("Day *x*") for Calendar Text and *Dodekatemoria* numbers on Tablet BM 47851 informs us that calendar dates are in view, even though this tablet employs Babylonian month names for zodiacal signs (e.g., the logogram NE, which is the usual writing for the 5th Babylonian month "Abu," also designates the 5th zodiacal sign Leo). For the most part, Tablets SpTU III, 104 and 105 distinguish month names like "Du'ūzu" (ŠU) and "Araḫsamna" (APIN) from zodiacal names like "Crab" ($KUŠU_2$) and "Scorpion" (GÍR), but some mixed writings such as ŠU for "Crab" (SpTU III, 104, obv. 4, etc.) present a confused picture. The same may be said for Tablet LBAT 1622 (obv. ii 1′–5′), which employs month names like "Nisannu" (BAR) and "Simanu" (SIG) for Aries and Gemini respectively, alongside Babylonian zodiacal names like "Furrow" (AB.SÍN) and "Goat-(fish)" (MÁŠ).

Although Tablet LBAT 1586+1587 clearly deals with the "third month" (rev. 11), the repeated mention of "Shepherd" (micro-Gemini) reveals the tablet's concern not just for calendar dates (Scheme A1) but also for the virtual moon's micro-zodiacal signs (Scheme A3). Moreover, there are other tablets that also

101 Weidner (1967: 42, 46).

assume the virtual moon's micro-zodiacal sign agrees with its month's number, even if they do not fully articulate a Calendar Text or *Dodekatemoria* scheme. While discussing the Calendar Text for Month 1, for instance, Tablet LBAT 1593 includes a reference to the "Old Man" ($^{\text{múl}}$ŠU.GI, obv. 17′), which may indicate the virtual moon's position in micro-Aries for that month. Tablet BM 33535 describes dream incubation in Months 3 and 4 with regards to micro-Gemini and micro-Cancer of Sagittarius, which could only represent micro-zodiacal signs 3 and 4 for the virtual moon in those months.[102]

By juxtaposing *Dodekatemoria* and Calendar Text schemes, Tablet BM 47851 literally fulfills the instructions to "take the 'animal of 13' (*Dodekatemoria* scheme) and the '(animal of) 4,37' (Calendar Text scheme) together" (Tablet LBAT 1593, obv. 18′), and it is therefore appealing to understand zodiacal divisions in Tablet BM 47851 as those of the real moon and its reciprocal counterpart (i.e., the virtual moon).[103] As we saw earlier, Tablet BRM IV, 19 (as well as Tablets BRM IV, 20 and STT 300) incorporates the sun into its *Dodekatemoria* scheme by adopting models of solar motion that synchronize the sun's zodiacal signs with calendar months and its micro-zodiacal signs with the moon's zodiacal signs. One might argue that *GDBT* tablets likewise apply labels such as KI ("region (of)"; Akkadian *qaqqaru*) and U_4 ("time," literally "day"; Akkadian *ūmu*) to each of their twelve micro-zodiacal divisions, which represent attempts to make spatial intervals in the sun's 360° ecliptic synonymous with temporal intervals in the schematic 360-day year.[104] The *GDBT* tablets, however, define the sun's twelve micro-zodiacal signs each month in ways that cannot be readily calibrated with the moon's thirteen zodiacal signs for the same month. Tablets exhibiting a 'micro-zodiac of 12' (listed above), therefore, cannot be easily integrated with the Calendar Text System and are omitted from the schemes of Fig. 6.6.

102 Only two entries are preserved in Tablet BM 33535 (see Hunger (2007: 141–144)). One begins with "Twins (micro-Gemini) of Pabilsag (Sagittarius)" (obv. 1) followed by the relevant time period "Simanu (Month 3), from Day 1 to Day 30" (obv. 7), while the other begins with "Crab (micro-Cancer) of Pabilsag (Sagittarius)" (rev. 1) followed by the time period "Du'ūzu (Month 4), from Day 1 to Day 30" (rev. 7). It is possible that other tablets (yet to be studied) include all other permutations of micro-zodiacal and zodiacal signs. On the other hand, perhaps the theme of dream incubation pertained specifically to Sagittarius, so that cities and plant and animal parts prescribed by the virtual moon-sign Sagittarius in any given month were applicable to that whole month.

103 A less intelligible alternative is to interpret the zodiacal names in Tablet BM 47851 as the sun's micro-zodiacal signs juxtaposed with the virtual moon's zodiacal signs in daily increments.

104 Weidner (1967: 21–26).

I wish to conclude this section by making a couple of observations about the complex relationships in the Calendar Text System. We should not forget that the construction of this system is a theoretical one that relies on artificial methods of calibrating celestial time and movement. We could think of *Dodekatemoria* and Calendar Text schemes, the dating of the Babylonian year, and the divisions of the sun's micro-zodiac as three separate wheels of clockwork that do not necessarily have to be synchronized with each other. Ancient astrologers did, in fact, conceptualize these processes in alternative ways. Contrary to the moon's zodiacal signs, for example, the sun's micro-zodiacal signs had no basis in observable reality, and the existence of tablets with a 'micro-zodiac of 12' indicates that the ancients did not always feel compelled to synchronize the two. Furthermore, the Calendar Text System implies that sun and moon coincide at Aries 0° at the beginning of the year. By contrast, we find a different model of intercalation in the so-called "*Pleiaden-Schaltregel*" scheme, which marks the beginning of the normal Mesopotamian year (i.e., not a leap year) by the moon's conjunction with the Pleiades (associated with Taurus).[105]

Furthermore, if I might extend the clockwork metaphor, the gears of celestial bodies in the Calendar Text System seem to mesh with each other as wheels within wheels: Just as each turn of the virtual moon's micro-zodiac corresponds to one cycle in the sun's zodiac, so do revolutions of the sun's micro-zodiac coincide with those of the real moon's zodiac. Meanwhile, the virtual moon's status as reciprocal counterpart to the real moon remains true not only with regards to calendar time (A1 versus B1), but also in relation to the sun's zodiacal sign (A2 versus B3) and the virtual moon's micro-zodiacal sign (A3 versus B5). Among all our cuneiform exemplars of Calendar Texts, Tablet LBAT 1586+1587 is the only source so far that explicitly names the "(virtual) moon."[106] It seems undeniable, however, that the idea of an entity reciprocal to the moon (which proclaims its affinity by sharing the same name "moon") has clear heuristic value for the explanation of the Calendar Text System.

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105 Hunger and Pingree (1989: 150–153) and Brown (2000: 118–119). In accordance with the *Pleiaden-Schaltregel* scheme, Stol (1992: 251–254) argued that an incantation describing "Vigil" (the half-moon) conceived by the Pleiades refers to the fact that "the moon begins his journey in this constellation."

106 See discussion in appendix for the possibility that the so-called "moon" (^{d}30) in Tablet LBAT 1598 is also a reference to the virtual moon.

5 Virtual Moon as Signifier in Medical Zodiology

The connection between a real world symbol and its deeper meaning, if we remember, was envisioned as a reciprocal relationship and described in cuneiform commentaries by the mathematical notation IGI or *pān*(*i*). We might therefore expect the astrological significance of the real moon's motion to be expressed by characteristics of its reciprocal complement, the virtual moon. This hypothesis is confirmed by a couple of Calendar Texts (SpTU III, 104 and 105) from the late Achaemenid library of Iqīšāya at Uruk.[107] I provide the translation for one of them below.

Tablet SpTU III, 104

obv. 1:	Month 4 Day 1, Aries[108] 7°	Smear with blood, fat, and hair of sheep.
2:	Month 4 Day 2, Goat-fish (Capricorn) 14°	Smear with blood, fat, and hair of goat.
3:	Month 4 Day 3, Scales (Libra) 21°	Smear with molted-skin of scorpion.[109]
4:	Month 4 Day 4, Cancer[110] 28°	Smear with blood and fat of crab.
5:	Month 4 Day 5, Stars (Taurus) 5°	Smear with blood or oil or hair of bull.

107 The fragmentary lines of LBAT 1622 obv. ii 1′–5′ may share the same format as SpTU III, 104 and 105, but too little is preserved to be certain.

108 Aries is written as BAR (either an abbreviation of BAR.SAG.SAG or BÁR.ZAG.GAR, logograms for the first Babylonian month *Nisannu*; cf. CAD N II, 265–266) at SpTU III, 104, lines 1, 14, 27; SpTU III, 105, lines 11, 24. In his cuneiform transcription, von Weiher understood the sign as MAŠ.

109 The cuneiform signs are read KI.KAL-*tim* by von Weiher (SpTU III, 104 and 105) and Reiner (1995: 116–117) and translated as "empty place" (perhaps the Akkadian *teriktim*, logogram KI.KAL) in Steele (2011a: 336; and forthcoming). I have understood these signs instead as *qí-líp* GÍR.TAB ("molted-skin of scorpion"), referring to the "peeled-off skin" (*qilpu*; CAD Q, 251–252) or exoskeleton shed by a scorpion as it grows beyond its original size. The same ingredient is written as BAR GÍR.TAB in SpTU II, 49, obv. 8′, 9′, and the syllabic writing in SpTU III, 104 and 105 may suggest that *qilpu* is a better rendition of the logogram than *quleptu* in Heeßel (2005: 8). A different term *šiḫṭu* (CAD Š2, 417–418) is used in Tablet YBC 9833, obv. 7–8 (// BM 56605, obv. 60, 62 // BM 47755, rev. [16, 18]) to describe the molted skins of scorpions and snakes in similar contexts of medical zodiology. The meaning of the verbal root *šaḫāṭu* B §2 as "to pull off the skin, to flay" (CAD Š1, 93) suggests a comparison between the natural process of molting and the human activity of flaying sacrificial animals and conquered enemies. In the case of medical zodiology, it would have been safer to collect molted remains than to capture living scorpions or snakes as ingredients.

110 Cancer is written as ŠU (logogram for *Du'ūzu*, Babylonian Month 4) at SpTU III, 104, lines 4, 17, 30, but as KUŠU$_2$ (logogram for *alluttu*, "crab") at SpTU III, 105, lines 10, 23.

6:	Month 4 Day 6, Great One (Aquarius) 12°	Smear with head, feather, and blood of eagle.
7:	Month 4 Day 7, Scorpion (Scorpio) 19°	Smear with molted-skin of scorpion.
8:	Month 4 Day 8, Lion (Leo) 26°	Smear with blood, fat, or hair of lion.
9:	Month 4 Day 9, Shepherd (Gemini) 3°	Smear with head, blood, and feather of rooster.
10:	Month 4 Day 10, Field (Pisces) 10°	Smear with head and blood of dove, head and blood of swallow.
11:	Month 4 Day 11, Pabilsag (Sagittarius) 17°	Smear with head, feather, and blood of *anzû*-bird.
12:	Month 4 Day 12, Furrow (Virgo) 24°	Smear with *šigūšu*-cereal flour, head and feather of raven.

For each day of Month 4, the tablet prescribes different ingredients for "smearing," presumably onto a sick person for purposes of healing. Cuneiform therapeutic tablets abound in instructions to "smear" (*pašāšu*) the patient with medicaments, often prepared beforehand by maceration and various methods of liquefaction, and it is likely that similar procedures are implied here.[111] The therapeutic function of the (mostly) animal materials here, as well as the wood, plant, and stone substances in other Calendar Texts (VAT 7816, VAT 7815, and W 20030/127), is not clearly stated in these texts, but becomes explicit when we later examine Tablet LBAT 1593. Focusing our attention on Tablet SpTU III, 104 for now, we find that the zodiacal positions above depict the virtual moon's movement of 277° per day. Zodiacal signs occupied by the virtual moon, not the observable real moon, determine the kinds of ingredients that become efficacious for healing on any given day.

Several of the Babylonian zodiacal names like "Crab" (Cancer), "Lion" (Leo), "Scorpion" (Scorpio), and "Goat-fish" (Capricorn) relate to their ingredients in very obvious ways. To be sure, substances like the "blood, fat, or hair of lion" were probably rarely available, and J.M. Steele has suggested that some of these terms may, in fact, be *Decknamen* ("hidden names") for more common medical ingredients.[112] In other cases, because the zodiacal name does not easily lend itself to viable ingredients, other constellations within the same sign dictate the choice of ingredients. Thus, the "Stars" (Pleiades) in the sign Taurus ("Bull") call for parts of the bull, the "Swallow" in the sign Pisces ("Field") designates swallows and doves,[113] while the "Ear of Grain" (Spica?) and the

111 Böck (2009: 110–116).

112 Steele (2011a: 337–338; and forthcoming).

113 For the "Swallow" as the western fish of Pisces (+ parts of Pegasus and Equuleus), see Gössmann (1950: 213–214, no. 389), Reiner and Pingree (1981: 14), Reiner (1995: 117), Hunger and Pingree (1999: 276), and Kolev (2013: 270).

"Raven" (Corvus+) in the sign Virgo ("Furrow") account for the use of *šigūšu*-cereal flour and the head and feather of the bird.[114]

As I mentioned earlier, "Shepherd" (the Babylonian name for the constellation Orion) can represent the zodiacal sign Gemini, and the "Rooster" constellation (Lepus?) in Gemini explains the efficacy of rooster body parts.[115] Because the "Scales" (Libra) have no animal component, and because of the large size of the Scorpius constellation and its very close proximity to Libra,[116] "molted-skin of scorpion" became the ingredient for both Scorpio and Libra. Particularly large (or northern) constellations may have been imagined as traversing zodiac boundaries and could, therefore, stand for more than one zodiacal sign.

Interestingly, the Babylonian constellation for Aries is the "Hired Man" ([múl]LÚ.ḪUN.GÁ), and its association here with sheep ingredients reflects the classical identity of Aries as a ram.[117] This recourse to the classical zodiac stemmed from the same motivations discussed above: Just as "Rooster" (Lepus?) rather than "Twins" (Gemini) became emblematic for its zodiacal sign because it was easier to obtain rooster parts, the interpretation of Aries as "Sheep" rather than "Hired Man" likewise reflects practical concerns in the gathering of ingredients. On the other hand, it is striking that the zodiacal sign "Pabilsag" (Sagittarius) is related here to parts of the *anzû*-bird, a mythological creature native to Mesopotamian belief and often associated with equids.[118]

114 The "Raven" was identified as Corvus in Gössmann (1950: 48, no. 132), Reiner and Pingree (1981: 15), Reiner (1995: 117), and Horowitz (1998: 398), but as Corvus and Crater in Hunger and Pingree (1999: 275) and Kolev (2013: 270). The drawing of Mercury's "exaltation" (*hypsoma*) in Virgo on the reverse of VAT 7847 + AO 6448 includes images of the Raven and the Furrow represented by the goddess Shala holding an Ear of Grain. Weidner (1967: 29, Tafel 10).

115 The "Rooster" constellation was identified as part of Canis Minor in Gössmann (1950: 215, no. 396), Reiner and Pingree (1981: 11), and Reiner (1995: 117), but as Lepus in Hunger and Pingree (1999: 275) and Kolev (2013: 268).

116 For example, the Arabic etymologies of *Zubenelgenubi* (α Librae) and *Zubeneschamali* (β Librae) as "southern claw" and "northern claw" respectively express the view that these stars were extensions of Scorpius.

117 The influence of the classical zodiac here has been noted by Reiner (1995: 117). Early on, Ungnad (1941–1944: 256 n. 37) suggested a possible relation between the sign LU (cuneiform sign for the logogram UDU, "sheep") and the sign LÚ of [múl]LÚ.ḪUN.GÁ ("Hired Man"), but more evidence is needed for this proposal to be persuasive.

118 Perhaps most familiar is the slaying of the *Anzû*-bird by the god Ninurta in the *Myth of Anzû*, edited in Vogelzang (1988). Note also the relief of the *Anzu*-bird and two stags from the temple of Ninhursag at Tell al-Ubaid (British Museum, W.A.1144308). In the narrative of *Lugalbanda and the Anzû-bird* in Vanstiphout (2003: 138–139, lines 63–66), equids appear

This association may explain why the "Star of *Anzû*" is equated in cuneiform texts with the "Star of the Horse,"[119] which in turn has been identified with various constellations in the neighborhood of Sagittarius.[120] Whatever its mythological origins, a couple of lexical texts compare the *anzû* to the *surinnakku*-bat, and the ingredients prescribed by Sagittarius here may come from a similar animal that existed in reality.[121]

Finally, the pairing of the "Great One" (Aquarius) and eagle ingredients can be problematic, since the "Eagle" constellation (typically identified as Aquila) seems to be positioned nearer Sagittarius instead.[122] The "eagle" (TI$_8$.MUŠEN), in fact, appears to be connected with Sagittarius in Tablet BM 56605 (rev. col. 9, row 3). In any case, zodiacal signs from Sagittarius to Pisces include several bird-constellations like "Eagle," "*Anzû*-bird," and "Swallow" (and perhaps "Dove"), and one wonders if they somehow relate to the classical constellations of Aquila and Cygnus (Latinized Greek: "Swan").[123]

It has been observed that *Dodekatemoria* tablets and Calendar Texts "seem to have had similar astrological uses" and that, by *adding* Calendar Text depictions of the virtual moon to *Dodekatemoria* representations of the real moon, one "doubles the amount of material that can be interpreted astrologically."[124] This observation and its inference, however, may raise questions about our model of reciprocals, since imagined reciprocal complements (more than their real

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as prey to the bird. In a Late Achaemenid Uruk commentary (SpTU I, 32, rev. 12–13), the magician Anu-ikṣur connects the *Anzû*-bird to the "donkey" (logogram ANŠE).

119 MUL ^{d}IM.DUGUD.MUŠEN = MUL ANŠE.KUR.RA in Koch-Westenholz (1995: 194–195, line 159); cf. Weidner (1959–1960: 107, line 21).

120 The "Horse" was identified as Lacerta or Equuleus in Gössmann (1950: 11, no. 32), as parts of Cassiopeia in Hunger and Pingree (1999: 273), and left undefined in Reiner and Pingree (1981: 10) and Kolev (2013: 268). One may be tempted to connect the "Horse" to the classical horse-constellations of Equuleus and Pegasus, even if their constellation boundaries and mythological backgrounds do not match up exactly. See Livingstone (1986: 147) and George (1991: 157 n. 22).

121 su.din.mìn musen = *še-u-ri-in-nak-ku* = [*pa-an*] *an-zi-i* (Hg. B IV, 258); su.din.mìn musen = *su-ri-nak-ku* = *pa-an an-zi-e* (Hg. D, 330) in Landsberger (1962 = MSL VIII/2: 168, 176).

122 For the "Eagle" as Aquila, see Gössmann (1950: 1–2, no. 2), Reiner and Pingree (1981: 10), Reiner (1995: 117), Hunger and Pingree (1999: 272), and Kolev (2013: 268).

123 It is uncertain if "dove" ingredients in Tablet SpTU III, 104, obv. 10 were indicative of an actual "Dove" constellation, or if they were only substitutes for ingredients prescribed by the constellation "Swallow" (western fish of Pisces+). Other bird-constellations in the vicinity like Pavo (Latin: "Peacock"), Grus (Latin: "Crane"), Tucana, and Phoenix were defined only in medieval times and later.

124 Brack-Bernsen and Steele (2004: 102–103).

world objects and events) appear to carry the weight of meaning in our earlier examples from cuneiform commentaries. No matter how tightly constructed the Calendar Text System may have been, though, it need not have precluded ancient astrologers from other schemes of medical zodiology, especially since Late Babylonian scholarship frequently encompassed a variety of traditions and interpretations, and since zodiacal astrology itself was not as standardized as other long-established branches of Mesopotamian divination. More importantly, when prescriptions by the Calendar Text System and other versions of medical zodiology are compared with each other, they reveal efforts at interpreting astrological meaning in such a way that the virtual moon becomes a signifier. All this will become clearer when we examine Calendar Texts VAT 7816, VAT 7815, and W 20030/127, the last of which I transcribe and translate below.

Tablet W 20030/127

obv. 1′:	[2] ⸢28⸣ 2 [4]	[...]
2′:		[...]
3′:	⸢12⸣ 5 2 5	${}^{\text{⸢giš⸣}}$x [...]
4′:		U$_4$-*u*[*m* ...]
5′:	[9] 12 2 6	${}^{\text{giš}}$x x [...]
6′:		${}^{\text{na4}}$AN.NA ${}^{\text{na}}$[${}^{\text{4?}}$ ... UR.SAG]
7′:		GAL-*ú* ${}^{\text{d}}$MAŠ *ana* SILA [NU È (?) ...]
8′:	[6] ⸢19⸣ 2 7	${}^{\text{giš}}$ESI ${}^{\text{ú}}$*kur-ka-nu-ú* ${}^{\text{na}}$[${}^{\text{4}}$ ... U$_4$-*um* DINGIR URU UR.SAG]
9′:		GAL-*u* ${}^{\text{d}}$MAŠ : BAD KÁ *ṣal-tu*[*m la i-ṣa-al* ...]
10′:	[3] 26 2 8	${}^{\text{giš}}$EREN ${}^{\text{ú}}$IGI.⸢NIŠ${}^{\text{?}}$⸣ x x[...]

obv. 1′–2′:	[2] ⸢28⸣ 2 [4]	...
3′–4′:	⸢12⸣ 5 2 5	... day of ...
5′–7′:	[9] 12 2 6	... tin ... the great [hero] Ninurta. [He must not go out (?)] to the street[125] ...
8′–9′:	[6] ⸢19⸣ 2 7	Ebony, *kurkānû*-plant, [tin/silver? ... Day of the city god], the great [hero] Ninurta. Opening of the gate. [He must not have a] quarrel ...
10′:	[3] 26 2 8	Cedar, *imḫur-ešrā*${}^{\text{?}}$-plant,[126] ...

125 Cf. *ana* SILA NU È (VAT 7847 + AO 6448, obv. micro-Sagittarius, micro-Aquarius; LBAT 1580, rev. micro-Aquarius) in Weidner (1967: 26–27, 37).

126 Based on the drawing in van Djik and Mayer (1980: no. 79), I have tentatively read ${}^{\text{ú}}$IGI.⸢NIŠ${}^{\text{?}}$⸣ for the plant *imḫur-ešrā* ("it cures twenty"), whose literal meaning reveals "wish-

Tablets VAT 7816, W 20030/127, and VAT 7815 are Calendar Texts that describe the virtual moon's motion in Months 1, 2, and 9 respectively. If we remember, the virtual moon's micro-zodiacal sign consistently agrees in number with its month (see Fig. 6.4), so these tablets also concern themselves with the virtual moon's micro-zodiacal signs 1, 2, and 9 (i.e., micro-Aries, micro-Taurus, and micro-Sagittarius). Earlier, I argued that the *GDBT* tablets do not belong to the Calendar Text System, because they adopt a 'micro-zodiac of 12' for the sun that does not fit with the moon's thirteen zodiacal signs in a month. That being the case, we find that the same deities, locations (cities and temples), materials (woods, plants, and stones), and events connected with the *sun*'s 12 micro-zodiacal signs in the *GDBT* tablets become associated instead with the *virtual moon*'s 13 micro-zodiacal signs in the Calendar Text System.

In my translation above, for example, ebony, *kurkānû*-plant, and perhaps tin are prescribed for the virtual moon-sign micro-Taurus of Virgo on Month 2 Day 7. These same substances are ascribed to the sun-sign micro-Taurus of Virgo (Month 6 Days 20–22½) in *GDBT* Tablet VAT 7847 + AO 6448 (rev. col. 9).[127] Furthermore, the same Calendar Text date comes with the instructions: "[Day of the city god], the great [hero] Ninurta; Opening of the gate; [He must not have a] quarrel." Roughly the same instructions appear for the sun-sign micro-Taurus of Leo (Month 5 Days 22½–25) in *GDBT* Tablet VAT 7847 + AO 6448 (obv. col. 10), as well as the sun-signs micro-Taurus of Gemini (Month 3 Days 27½–30) and micro-Taurus of Cancer (Month 4 Days 25–27½) on the obverse and reverse of *GDBT* Tablet SpTU IV, 167.[128]

To be sure, only a small fragment of Tablet W 20030/127 is available, and the picture quickly becomes less tidy in more fully preserved tablets. Calendar Text VAT 7816, which deals with Month 1 and micro-Aries of the virtual moon, includes materials and locations associated in *GDBT* tablets with the sun-signs micro-Leo, micro-Libra, micro-Scorpio, micro-Sagittarius, micro-Aquarius, and

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ful thinking" concerning its efficacy. See Reiner (1995: 33). This plant is assigned to Month 2 Day 8 (virtual moon's micro-Taurus of Gemini) here in Tablet W 20030/127. The writing ^{ú}IGI.⌜X⌝ for Months 1–2(?) (virtual moon's micro-Aries and micro-Taurus) in BM 56605 rev., col. 13 row 1 more likely designates the plant ^{ú}IGI(*imḫur*)-*lim*, which is associated with Month 1 (virtual's moon's micro-Aries) in LBAT 7816, obv. 23, rev. 3.

127 ^{giš}ESI ^{ú}*kur-ka-nu-u* ^{na4}AN.NA ^{na4}KÙ.BABBAR (VAT 7847 + AO 6448, rev. col. 9) in Weidner (1967: 31). One wonders if the damaged portion of Tablet W 20030/127 included other micro-Taurus materials described in the *GDBT* tablets like ^{giš}ŠE.GIŠ.Ì ^{ú}LI.L[I]$^{?}$ ^{na4}*èš-me-ku* (VAT 7847 + AO 6448, obv. col. 10 in Weidner (1967: 19)).

128 U$_4$-*um* DINGIR URU UR.SAG GAL-*ú* ^{d}*Nin-urta* : BAD KÁ *ṣal-tum* … (VAT 7847 + AO 6448, obv. Rows B–C, col. 10 in Weidner (1967: 25–26)); U$_4$-*um* DINGIR URU UR.SAG GAL-*u* ^{d}MAŠ : BAD KÁ *ṣal-tum la i-ṣa-al* (SpTU IV, 167, obv. and rev. in Hunger (2007: 149)).

micro-Pisces.[129] Similarly, though Calendar Text VAT 7815 focuses on Month 9 and micro-Sagittarius of the virtual moon, it contains entities assigned in *GDBT* tablets to the sun-signs micro-Scorpio, micro-Capricorn, and micro-Aquarius.[130] A careful look at these references, however, suggests that the variety of associations resulted in part from attempts to link materials (wood, plant, or stone) and cities to more than a single micro-zodiacal sign.[131] For example, entities in Tablet VAT 7816 such as almond-wood ($^{\text{giš}}$EŠ$_{22}$), *e'ru*-wood ($^{\text{giš}}$MA.NU), and the city of Nippur (NIBRU$^{\text{ki}}$), which are features of the virtual moon's micro-Aries, are connected in *GDBT* tablets with the sun's micro-Aries *in addition to* other micro-zodiacal signs. The discovery of more cuneiform sources and further analysis are needed to reconstruct the entire paradigm of relationships between terrestrial features and micro-zodiacal permutations of different celestial bodies (i.e., sun and virtual moon). Several prescriptions ascribed to the virtual moon's micro-Aries (VAT 7816) and micro-Sagittarius (VAT 7815), in fact, already have *GDBT* counterparts that relate to the sun's micro-Aries and micro-Sagittarius, even though the said Calendar Text dates and *GDBT* dates do not match up.[132] In Fig. 6.7, I highlight various prescriptions

129 $^{\text{giš}}$EŠ$_{22}$ (VAT 7816, obv. 1?, 20 // VAT 7815, obv. 1 // VAT 7847 + AO 6448, obv. micro-Aries, rev. micro-Sagittarius), $^{\text{giš}}$MA.NU (VAT 7816, obv. 7 // VAT 7847 + AO 6448, rev. micro-Pisces // LBAT 1580, rev. micro-Aries), $^{\text{giš/ú}}$*duprānu* (VAT 7816, obv. [10] // VAT 7847 + AO 6448, obv. micro-Scorpio, rev. micro-Leo // LBAT 1580, rev. micro-Aquarius), *É-an-na* (VAT 7816, obv. 17 // VAT 7847 + AO 6448, obv., micro-Leo, micro-Sagittarius), NIBRU$^{\text{ki}}$ (VAT 7816, obv. 20 // VAT 7847 + AO 6448, obv. micro-Aries, rev. micro-Libra).

130 $^{\text{giš}}$KÍN (VAT 7815, obv. 15 // VAT 7847 + AO 6448, obv. micro-Capricorn), $^{\text{giš}}$DÌḪ (VAT 7815, obv. 15 // VAT 7847 + AO 6448, rev. micro-Aquarius), ^{uru}*Eridu*$^{\text{(ki)}}$ (VAT 7815, obv. 18 // VAT 7847 + AO 6448, obv. micro-Capricorn, rev. micro-Scorpio).

131 Weidner (1967: 39–40) already hinted at this in his observation that the consecutive columns for micro-Leo to micro-Sagittarius in Tablet Tablet K 11151 assign $^{\text{giš}}$*úr-an* to micro-Virgo, even though this material is associated with micro-Pisces in Tablet VAT 7847 + AO 6448 (rev.).

132 In addition to the references of almond-wood ($^{\text{giš}}$EŠ$_{22}$), *e'ru*-wood ($^{\text{giš}}$MA.NU), and the city of Nippur (NIBRU$^{\text{ki}}$) in VAT 7816 noted earlier, see also $^{\text{ú}}$A.ZAL.LÁ and $^{\text{na4}}$AN.ZAḪ (VAT 7816, obv. 20 // VAT 7847 + AO 6448, obv. micro-Aries), $^{\text{giš}}$MES (VAT 7816, rev. 3 // VAT 7847 + AO 6448, rev. micro-Aries), Ú.NAM.TI.LA and $^{\text{na4.d}}$TIR.AN.NA (VAT 7816, rev. 11 // LBAT 1580, rev. micro-Aries). For Calendar Text VAT 7815, we find $^{\text{giš}}$*šūšu* (written syllabically here, but as $^{\text{giš}}$(ZA).MÙŠ.ŠÉŠ elsewhere), $^{\text{giš}}$EŠ$_{22}$, $^{\text{na4}}$ŠUBA(ZA.MÚŠ), $^{\text{na4}}$GIŠ.NU$_{11}$.GAL, and ZA.MÚŠ.ŠÉŠ$^{\text{ki}}$ (VAT 7815, obv. 1 // VAT 7847 + AO 6448, rev. micro-Sagittarius), $^{\text{giš.šim}}$GÍR (VAT 7815, obv. 13, 22 // VAT 7847 + AO 6448, obv. micro-Sagittarius), Ú.DÙG.GA (VAT 7815, obv. 15 // VAT 7847 + AO 6448, obv. micro-Sagittarius). Note also how the deity $^{\text{múl/d}}$Pabilsag (Sagittarius) appears for almost every day of Month 9 (i.e., the virtual moon's micro-Sagittarius) in Calendar Text VAT 7815. Weidner (1967: 45–46).

of Calendar Texts and *GDBT* tablets that reveal affinities, not only between the same micro-zodiacal signs of the virtual moon and sun, but also between their specific combinations of micro-zodiacal and zodiacal signs.

Because our sources are incomplete, we may not yet have a full appreciation how the zodiacal signs from which micro-zodiacal signs are derived (e.g., "micro-Taurus of Virgo" versus "micro-Taurus of Leo") can influence the kinds of prescriptions made. Fig. 6.7 suggests uneven efforts at fine-tuning the system, so that highly specific combinations of micro-zodiacal and zodiacal signs could be correlated with smaller groups of prescribed materials, locations, and events. Such combinations were not only symmetrically pleasing, but also helped to ease dissonances in medical zodiology between *GDBT* tablets and Calendar Texts. Indeed, the close similarities and often verbatim replication of prescriptions in *GDBT* tablets and Calendar Texts, as well as the fact that both *GDBT* Tablet VAT 7847 + AO 6448 and Calendar Text VAT 7815 (and probably VAT 7816) belonged to the same individual (Anu-bēlšunu of the Sîn-leqe-unnīnī family),[133] beg the question how different rationales for these prescriptions were reconciled with each other.

Problems could arise because, for any given month in the Calendar Text System, both the virtual moon's micro-zodiacal signs and the sun's zodiacal sign agree in number with the month. Thus, during the third Babylonian month Simanu, the sun remains continuously in the third zodiacal sign Gemini, while the virtual moon repeatedly returns to micro-Gemini at one-day intervals. By assigning specialized meanings to each of the sun's micro-zodiacal signs in a month, *GDBT* tablets imply that any of these meanings do not apply to the sun's zodiacal sign for that whole month. For instance, if a certain ingredient is ascribed to the *GDBT* sun-sign micro-Aries of Aries (Month 1 Days 0–2½), it means that this ingredient is not equally effective for the whole of Aries (Month 1 Days 0–30), and a sun's micro-zodiacal sign (micro-Aries) bears meaning that is not shared by its zodiacal sign of the same name (Aries). Earlier, I alluded to the importance of this distinction, in view of the tendency by scholars to describe zodiacal signs and their micro-zodiac counterparts as being "associated" or "related" to each other. By conflating the prescriptions

133 [*ṭu*]*p-pi* $^{\mathrm{m.d}}$60(*Anu*)-EN(*bēl*)-*šú-nu* $^{\mathrm{[l]ú}}$GALA $^{\mathrm{d}}$60 *ma-rum šá* $^{\mathrm{m}}$NÍG.SUM.MU(*Nidinti*)-$^{\mathrm{d}}$60 (*Anu*) *ma-rum* $^{\mathrm{m.d}}$30(*Sîn*)-TI(*leqe*)-ÉR(*unnīnī*) TIR.AN.NA$^{\mathrm{ki}}$-*ú qàt* $^{\mathrm{m.d}}$60(*Anu*)-AD(*abu*)-GUR(*utēr*) A-*šú* $^{\mathrm{lú}}$UMBISAG UD $^{\mathrm{d}}$60 $^{\mathrm{d+}}$*E*[*n-líl-lá* UNUG$^{\mathrm{ki}}$ ...] (VAT 7847 + AO 6448, rev.); *qàt* $^{\mathrm{m.d}}$60(*Anu*)-AD(*abu*)-[GUR(*utēr*) ...] (VAT 7816, rev. 23); ... IM $^{\mathrm{m.d}}$60(*Anu*)-UMUN(*bēl*)-*šú-nu* $^{\mathrm{lú}}$GALA $^{\mathrm{d}}$[60 A *šá*] $^{\mathrm{m}}$NÍG.SUM.MU(*Nidinti*)-$^{\mathrm{d}}$60(*Anu*) A $^{\mathrm{m.d}}$30(*Sîn*)-TI(*leqe*)-ÉR(*unnīnī*) *qàt* $^{\mathrm{m.d}}$60(*Anu*)-AD(*abu*)-GUR(*utēr*) A-*šú* $^{\mathrm{lú}}$UMBISAG UD $^{\mathrm{d}}$60 $^{\mathrm{d+}}$*En-líl-lá* UNUG$^{\mathrm{ki}}$-*ú* (VAT 7815, rev. 13–14); in Weidner (1967: 33, 42, 46).

Prescriptions	Calendar text tablet	Calendar text date	Virtual moon sign
Agreement of micro-zodiacal and zodiacal signs			
$^{\text{giš}}$MA.NU	VAT 7816, obv. 7	Month 1 Day 3	micro-Aries of Cancer
$^{\text{giš}}$EŠ$_{22}$, $^{\text{ú}}$A.ZAL.LÁ, $^{\text{na4}}$AN.ZAḪ, NIBRU$^{\text{ki}}$	VAT 7816, obv. 20	Month 1 Day 7	micro-Aries of Leo
Ú.NAM.TI.LA, $^{\text{na4.d}}$TIR.AN.NA	VAT 7816, rev. 11	Month 1 Day 29	micro-Aries of Cancer
$^{\text{giš}}$ESI, $^{\text{ú}}$*kurkānû*	W 20030/127, rev. 8′	Month 2 Day 7	micro-Taurus of Virgo
$^{\text{giš}}$*šūšu*, $^{\text{giš}}$EŠ$_{22}$, $^{\text{na4}}$ŠUBA, $^{\text{na4}}$GIŠ.NU$_{11}$.GAL, ZA.MÚŠ.ŠÉŠ$^{\text{ki}}$	VAT 7815, obv. 1	Month 9 Day 1	micro-Sagittarius of Virgo
$^{\text{giš.šim}}$GÍR	VAT 7815, obv. 22	Month 9 Day 10	micro-Sagittarius of Leo
Agreement of only micro-zodiacal signs			
$^{\text{giš}}$MES	VAT 7816, rev. 3	Month 1 Day 26	micro-Aries of Aries
$^{\text{na4}}$AN.NA	W 20030/127, rev. 6′	Month 2 Day 6	micro-Taurus of Sagittarius
U$_4$-*um* DINGIR URU UR.SAG GAL-*u* $^{\text{d}}$MAŠ : BAD KÁ *ṣaltum lā iṣâl*	W 20030/127, rev. 8′	Month 2 Day 7	micro-Taurus of Virgo
Ú.DÙG.GA	VAT 7815, obv. 15	Month 9 Day 7	micro-Sagittarius of Aries

FIGURE 6.7 *Prescriptions and Combinations of Micro-zodiacal and Zodiacal Signs*

GDBT tablet	*GDBT* tablet date	Sun sign
Agreement of micro-zodiacal and zodiacal signs		
LBAT 1580, rev.	Month 4 Days 22½–25	micro-Aries of Cancer
VAT 7847 + AO 6448, obv.	Month 5 Days 20–22½	micro-Aries of Leo
LBAT 1580, rev.	Month 4 Days 22½–25	micro-Aries of Cancer
VAT 7847 + AO 6448, rev.	Month 6 Days 20–22½	micro-Taurus of Virgo
VAT 7847 + AO 6448, rev.	Month 6 Days 7½–10	micro-Sagittarius of Virgo
VAT 7847 + AO 6448, obv.	Month 5 Days 10–12½	micro-Sagittarius of Leo
Agreement of only micro-zodiacal signs		
VAT 7847 + AO 6448, rev.	Month 6 Days 17½–20	micro-Aries of Virgo
VAT 7847 + AO 6448, rev.	Month 6 Days 20–22½	micro-Taurus of Virgo
VAT 7847 + AO 6448, obv.	Month 5 Days 22½–25	micro-Taurus of Leo
SpTU IV, 167, obv.	Month 3 Days 27½–30	micro-Taurus of Gemini
SpTU IV, 167, rev.	Month 4 Days 25–27½	micro-Taurus of Cancer
VAT 7847 + AO 6448, obv.	Month 5 Days 10–12½	micro-Sagittarius of Leo

of GDBT tablets and Calendar Texts, one might imply that ingredients for the GDBT sun-sign micro-Aries of Aries (Month 1 Days 0–2½) are also effective for the virtual moon-sign micro-Aries (Month 1 Days 0–30), which defeats the whole purpose of having micro-zodiac divisions of Month 1 in the first place.

On the other hand, if prescriptions are correlated with precise combinations of micro-zodiacal and zodiacal signs, the dates for the GDBT sun-sign micro-Aries of Aries (Month 1 Days 0–2½) and the virtual moon-sign micro-Aries of Aries (Month 1 Days 4, 13, 17, 26, and 30) do not combine to the extent that they render futile any micro-zodiac divisions in Month 1. In fact, dates for micro-zodiacal signs that differ in name from their zodiacal signs are even fewer and less likely to result in continuous durations of time. For example, the dates indicated by the GDBT sun-sign micro-Taurus of Aries (Month 1 Days 2½–5) and the virtual moon-sign micro-Taurus of Aries (Month 2 Days 9 and 22) are even farther apart from each other. The same can be said for the dates of the GDBT sun-sign micro-Aries of Taurus (Month 2 Days 27½–30) and the virtual moon-sign micro-Aries of Taurus (Month 1 Days 8 and 21).

There are other hints that prescriptions related to the sun's 'micro-zodiac of 12' were made applicable as well to the virtual moon's 'micro-zodiac of 13.' While several of the stone, wood, and plant ingredients in Tablets BM 76483 and SpTU II, 49 are not clearly attested in available GDBT and Calendar Text fragments, a couple of items are worthy of note.[134]

Tablet BM 76483, rev. 3′–6′, 11′–18′ (// SpTU II, 49, obv. 10′–12′, 16′–21′)

rev. 3′–6′: Kislīmu (Month 9), with Pabilsag (virtual moon's micro-Sagittarius): Green obsidian, *ašūḫu*-wood, [*ēdu*-plant, (and) dust from a ferry-boat]. Thread a piece of green obsidian in linen cloth with linen string as a poultice [(and) place on his neck]. Fumigate him with [*ašūḫu*-wood]. [Salve him] with *ēdu*-plant (and) dust from a ferry-boat (mixed) in *pūru*-oil. (This is) the salve for Day 1 to Day 7 of Kislīmu (Month 9). On Day 10+x, [...]

11′–14′: Šabāṭu (Month 11), with the Great One (virtual moon's micro-Aquarius): Hematite, *ildakku*-poplar, *aktam*-plant, (and) dust from the gate [of the god Enlil]. Wrap (the hematite) [in linen cloth] with linen string. Thread the piece of hematite as a poultice (and) [place] on his neck. [Fumigate him with *ildakku*-poplar]. [Salve him] with

134 Both tablets are edited in Heeßel (2005: 2–4, 7–10) and partially translated in Heeßel (2008: 10). My translation of the syntax above differs slightly from Heeßel's.

aktam-plant (and) dust from the gate of the god Enlil (mixed) in *pūru*-oil. (This is) the salve for Day 15 to Day 21 of Šabāṭu (Month 11). On Day 14+x, [...]

15′–18′: Addaru (Month 12), with the Tails (virtual moon's micro-Pisces): *luludānītu*-stone, *musukkannu*-wood, ... Thread ... in the skin of a female kid with (a string made of ?) the tanned skin *ditto* (i.e., of a female kid).[135] Thread a piece of *luludānītu*-stone as a poultice. Place (and) wear on his neck. Fumigate him with *musukkannu*-wood. Salve [with] ... (mixed) [in] *pūru*-oil. (This is) the salve for Day 22 to Day 28 of Addaru (Month 12). On Day ...

The zodiacal names "Pabilsag," "Great One," and "Tails" could refer either to the sun's zodiacal signs or to the virtual moon's micro-zodiacal signs for the months listed. I tentatively suggest that the latter is the correct interpretation, whereby these names designate the virtual moon-signs micro-Sagittarius, micro-Aquarius, and micro-Pisces respectively. To begin with, the term KI ("with / (in) the region (of)") is reminiscent of what we saw in Calendar Text LBAT 1586+1587, where the virtual moon is said to be located "in" (*ina*) a zodiacal sign, but positioned "with / (in) the region (of)" a *micro*-zodiacal sign. The following section will reveal several other examples of this term KI preceding micro-zodiacal signs. More decisively, the "*ēdu*-plant" (ᵘAŠ) prescribed for micro-Sagittarius (Month 9) here is assigned to the virtual moon's micro-Sagittarius (of Gemini) also in Calendar Text LBAT 7815 (Month 9 Days 2 and 28).[136] On the other hand, the "*aktam*-plant" for the virtual moon's micro-Aquarius (Month 11) appears instead as a feature of the *sun's* micro-Aquarius (but not the sun's zodiacal sign Aquarius) in *GDBT* tablet LBAT 1580.[137] While the "*ēdu*-plant" connects the prescriptions in Tablets BM 76483 and SpTU II, 49 to those of the virtual moon in Calendar Texts, the "*aktam*-plant" shows that such correlations between plant ingredients and the micro-zodiac were relevant also for the sun in *GDBT* tablets. Unfortunately, other ingredients in these

135 [*i*]*na* KUŠ MUNUS.ÁŠ.GÀR *ina* KUŠ *ri-ṣi-it* MIN È (BM 76483, rev. 16′ // SpTU II, 49, obv. 19′–21′). Note the parallel description [*ina* KUŠ *r*]*i-si-it-tu*$_4$ MUNUS.ÁŠ.GÀR in LBAT 1622, obv. 3′; tablet partially transcribed in Heeßel (2005: 8). By analogy with other entries in Tablets BM 76483 and SpTU II, 49, perhaps the "skin of a female kid" was used here in place of linen cloth as wrapping material, while a string made of more durable and flexible "tanned skin of a female kid" was used in place of linen string (or, elsewhere, the animal's sinew) to tie the poultice together.

136 LBAT 7815, obv. 3 and rev. 3 in Weidner (1967: 45–46).

137 LBAT 1580 rev., sun's micro-Aquarius in Weidner (1967: 37).

tablets do not show such straightforward correlations with preserved Calendar Texts and *GDBT* tablets, so the above connections remain only a hypothesis at this time.[138]

We cannot say for sure whether all these wood, plant, and stone prescriptions originated with *GDBT* tablets, Calendar Texts, or some earlier source, especially since they differ from the (mostly) animal materials in Calendar Texts SpTU III, 104 and 105. It is nonetheless revealing that, in Calendar Texts, the virtual moon as reciprocal complement once again takes on the role of signifier. While the virtual moon's zodiacal sign identified general animal parts (e.g., blood, fat, hair, head, etc.) for therapeutic use, its micro-zodiacal sign (or a specific combination of its micro-zodiac and zodiac) pointed to wood, plant, and stone ingredients. This neat categorization, however, is not without irregularities, since animal *skins* seem to be indicated by the virtual moon's micro-zodiacal (not zodiacal) signs. Tablet BM 76483 above, for example, links the virtual moon's micro-Pisces to "the skin of a female kid" (rev. 15′–18′), and the similar text BM 77971 probably prescribes "rooster-skin" (line 2′) for a micro-zodiacal sign of the virtual moon. In the appendix to this essay, we will learn that the same principle may apply also to Tablet BM 33535 and to the prescriptions and astrological table in Tablet BM 56605.

In contrast to clear-cut assignments of wood, plant, and stone ingredients to micro-zodiacal signs, therefore, it is possible that the relevance of animal materials for both micro-zodiacal and zodiacal signs once again reflects separate schemes of categorization brought together in the emerging science of medical zodiology. If we remember, Commentary #3 (SpTU I, 47, obv. 13–14) explained that therapeutic ingredients were to be wrapped up in the skin of an animal that represented the agent responsible for the sickness. Thus, for sickness caused by the *rābiṣu*-demon, ingredients were placed in a pouch of goatskin, since the goat represented this demon. It is conceivable that motivations like this contributed to the use of animal skins for micro-zodiacal signs (somehow perceived as the offending agent), in addition to traditions expressed by SpTU III, 104 and 105 that made zodiacal signs prescriptive for general animal parts.

138 For example, the *amīlānu*-plant is assigned to Arahsamna (Month 8 = virtual moon's micro-Scorpio) in BM 76483, rev. [1′] and SpTU II, 49, obv. 8′, 9′, but to LBAT 1580 obv., sun's micro-Capricorn in Weidner (1967: 35). Hematite (*šadânu*) appears with Šabāṭu (Month 11 = virtual moon's micro-Aquarius) in BM 76483, rev. 11′, 12′ and SpTU II, 49, obv. [16′], but with VAT 7847 + AO 6448 rev., sun's micro-Libra in Weidner (1967: 30). As discussed above, it would not be surprising if these and other ingredients were actually associated with more than a single micro-zodiacal sign.

Despite these discrepancies in the details, a rather enigmatic paragraph in Tablet LBAT 1593 seems to articulate the larger methodology for medical zodiology via Calendar Texts.[139] Because the phraseology, sentence breaks, and flow of logic in this difficult paragraph are ambiguous and may be contested, I include its cuneiform transcription before my translation below.

Tablet LBAT 1593

obv. 15′: *ú-ma-mu šá* 13 *ana* IGI-*ka* 1 1 1 13 *ú-ma-mu šá* NE *šá* BAR DAB-*bat* 1 2 1 26 *ú-ma-mu šá* ZÍZ *šá* BAR DAB-*bat*

16′: *ú-ma-mu šá iṣ-ṣi šá* GIŠ.GIŠIMMAR KUR.GI.MUŠEN GIŠ.GIŠIMMAR *ana ú-ma-mu šá* 13 DÙ-*uš* GIŠ.ZU *šá* DU$_6$ *šá* BAR *šá* AB

17′: *ana ú-ma-mu šá* 4,37 GIŠ.GIŠIMMAR KUR.GI.MUŠEN GIŠ.GIŠIMMAR TA$^?$ UGU $^{\text{múl}}$ŠU.GI TA x ŠE SAR NA$_4$ Ú *u* GIŠ

18′: *ú-ma-mu šá* 13 *ù* 4,37 KI *a-ḫa-miš* DAB-*bat* NA$_4$ Ú *u* GIŠ *ana* LÚ.GIG ŠÉŠ GU$_7$-*šú u tu-qat-tar-šú*

19′: *bi-ib-lu šá* BAR TA 1 EN 30 …

obv. 15′: The ‘animal of 13’ (*Dodekatemoria* scheme) is in front of you.

1 1 1 13 Take the animal of 5-of-1.
[13° corresponds to micro-sign 6 = 1 + 5]

1 2 1 26 Take the animal of 11-of-1.
[26° corresponds to micro-sign 12 = 1 + 11]

16′: Make the animal of wood,[140] of date palm, goose, date palm (Calendar Text ingredients) (as substitute) for the ‘animal of 13’ (*Dodekatemoria* scheme).

16′–17′: The writing-board[141] of 7-of-1 of 10 is for the ‘animal of 277’ (Calendar Text scheme), (namely, that of) date palm, goose, date palm, from$^?$ upon the Old Man (i.e., Perseus representing the virtual moon’s micro-Aries or Month 1) …

139 A transcription and workable translation of the whole tablet LBAT 1593 may be found in Reiner (2000).

140 Less likely is the reading *ú-ma-mu šá* GIŠ.ZÍ.⟨NA⟩ *šá* GIŠ.GIŠIMMAR … (LBAT 1593, obv. 16′), “animal of the frond(-midrib) (*zinû*) of the date palm …,” even though the term *zinû* does pertain specifically to the date palm. See also discussion in Landsberger (1980: 25–28) where ZÍ.NA is read as ZENA.

141 For (GIŠ).ZU as *lēʾu* (“writing-board”), see Mayer’s proposal in Deller, et al. (1989: 270–271). The colophon of Calendar Text VAT 7815 describes its origin “from an old writing-board” (TA UGU GIŠ.DA SUMUN^{bar}) (rev. 13).

17′: (For) stone, plant, and wood:[142]
18′: Take the 'animal of 13' (*Dodekatemoria* scheme) and the '(animal of) 277' (Calendar Text scheme) together.
18′: Salve, feed, and fumigate the sick person with the stone, plant, and wood.
19′: Almanac of Nisannu (Month 1) (Days) 1 to 30.[143] …

Four different "animal" designations may be discerned here: (I) The 'animal of 13.' (II) The 'animal of 277.' (III) The "animal (of wood,) of date palm, goose, date palm."[144] (IV) The "animal of 5-of-1" and the "animal of 11-of-1." It is obvious that the 'animal of 13' and the 'animal of 277' refer to the *Dodekatemoria* and Calendar Text schemes, which progress at a constant daily rate of 13° and 277° respectively.

In my understanding, the 'animal of 277' (Calendar Text scheme) is synonymous with the "animal (of wood,) of date palm, goose, date palm" (obv. 16′–17′), since it is the virtual moon's zodiacal and micro-zodiacal positions that determine the animal and plant materials prescribed for any given date. The "date palm" and "goose" seem to represent materials specific to a single Calendar Text entry, which appears here as a synecdoche for Calendar Texts in general. In all likelihood, this entry was the incipit of the first tablet of the Calendar Text scheme, which expressed the number sequence 10 7 1 1 relating Month 1 Day 1 to zodiacal sign 10 (Capricorn) 7°. Following the logic I explained earlier, the virtual moon's zodiacal sign (Capricorn) may have been responsible for the choice of "goose," while its micro-zodiacal sign (micro-Aries in Month 1) ascribed efficacy to the "date palm." To be sure, goat's blood, fat, and hair are prescribed for Capricorn in Calendar Texts SpTU III, 104 and 105, in accordance with the Babylonian conception of Capricorn as a "goat-fish" ($^{\text{mul}}$SUḪUR.MÁŠ$^{(\text{ku6})}$). However, perhaps as yet another example of influence by the classical zodiac, one wonders if the constellation Cygnus ("Swan") in Capricorn supplied the iden-

142 One is tempted to understand SAR (LBAT 1593, obv. 17′) as the logogram for "herb" that joins the list of "stone, plant, and wood" immediately following. However, the absence of SAR in the same list on the next line (obv. 18′) may argue against this interpretation.

143 It is uncertain whether this statement relates to what precedes it or to the badly damaged lines that follow it.

144 The syntax here is uncertain. It is possible that one should read instead "the animal of the wood of date palm (and) the goose (of) the date palm" (LBAT 1593, obv. 16′) and "animal of 4,37, (namely, that of) the date palm-(wood) and the goose (of) the date palm" (LBAT 1593, obv. 17′). Shared astrological connections between "goose" and "date palm" here do not necessarily indicate ecological associations between the bird and the tree.

tity for "goose" here.[145] The association of the "date palm" with micro-Aries, on the other hand, may be discerned by its connection with the constellation Nu-muš-da (in Pisces/Aries) in a list (BM 56605, obv. 48–74), following after the constellations "Great One" (Aquarius) and "Field" (Pisces) and preceding the constellations "Old Man" (Perseus in Aries), "Bull of Heaven" (Taurus), "Great Twins" (Gemini), etc.[146] Indeed, the "Old Man" constellation appears above in Tablet LBAT 1593 (obv. 17′) probably as a reference to the virtual moon's position in micro-Aries for each day of Month 1.[147]

The contents of Calendar Text Month 1 (i.e., the first tablet of the Calendar Text series) were recorded in the so-called "writing-board of 7-of-1 of 10," which makes reference to the tablet's incipit title and number sequence "10 7 1 1." One might suspect that the correct designation is "7 of 10" (= 7° of zodiacal sign 10), and that this was erroneously rendered as "7-of-1 of 10" (written in cuneiform as DU$_6$ *šá* BAR *šá* AB) by means of Babylonian month names representing numbers. The writing "7-of-1 of 10," however, seems to represent an attempt at solving a problem arising from such uses of Babylonian month names. On the one hand, by making month names interchangeable with labels for zodiacal units, the schematic Babylonian year of twelve 30-day months could be shown to map exactly onto the sun's ecliptic of twelve 30°-zodiacal signs, so that Month 1 corresponded precisely with zodiacal sign 1 (Aries). On the other hand, it was confusing to use month names for astrological units other than the twelve zodiacal signs, where the units do not recur in cycles of 12. For

145 Cygnus has been linked to the Babylonian constellation $^{\text{mul}}$UD.KA.DU$_8$.A, an epithet translated as "The Demon with the Gaping Mouth" in Gössmann (1950: 58–60, no. 144), Reiner and Pingree (1981: 15), and Reiner (1995: 3); and as "Panther" in Hunger and Pingree (1999: 274–275) and Kolev (2013: 270). Note also that the "Goose" (KUR.GI.MUŠEN) is the bird of the tenth recipe in a collection of twelve recipes that each requires the head of a different bird (BAM 473). Was the goose (from the classical conception of Cygnus) permitted as an alternative to the goat as an ingredient for Capricorn, because it was more accessible or cheaper to obtain?

146 See $^{\text{múl}}$GU.LA (obv. 48), AŠ.IKU (obv. 51), Nu-muš-da … $^{\text{[gi]š}}$GIŠIMMAR$^{?}$ (obv. 53), ŠU.GI (obv. 55), GÚ.AN (obv. 57), MAŠ.[TAB.BA GAL.GA]L (obv. 59), etc. in Tablet BM 56605. Note, however, that a parallel entry on another tablet has $^{\text{[gi]š}}$*šak-kul* (YBC 9833, obv. 4) instead of $^{\text{giš}}$GIŠIMMAR. The constellation $^{\text{mul}}$Nu-muš-da was identified with Piscis Austrinus and Grus(+Indus) in Gössmann (1950: 116–117, no. 305), with parts of Centaurus in Hunger and Pingree (1999: 274), and left undefined in Reiner and Pingree (1981: 14) and Kolev (2013: 270).

147 Also, the constellation $^{\text{múl}}$ŠU.GI ("Old Man" = Perseus) seems to represent (micro)-Aries as it stands at the beginning of a list of zodiacal signs in LBAT 1597, obv. 6′ = line 4′ in Geller (2010: 68, 70).

example, it would have been misleading to express Capricorn 7° (the incipit Calendar Text entry) as DU$_6$ *šá* AB ("7 of 10"), since 7° belongs to a cycle of 30° (not 12°)! I tentatively propose that the expression "{number}-of-1" refers to the status of that "{number}" as the sub-division of a single main unit, so that it is best translated as "{number} sub-units."[148] In the context of the writing board mentioned, "7-of-1 of 10" or "7 sub-units of 10" indicates "7° of zodiacal sign 10 (Capricorn)."

The same writing convention "{number}-of-1" appears also in the designations "animal of 5-of-1 (NE *šá* BAR)" and "animal of 11-of-1 (ZÍZ *šá* BAR)." Hunger seems to have identified these designations as references to the 'micro-zodiac of 12' of the real moon's position at Aries 13° and 26° on Days 1 and 2 of Month 1 (BAR).[149] In this view, 26° stands in the 11th twelfth-part division of Aries, while 13° is a rounding up of 12½° that stands in its 5th twelfth-part division. Besides the dubiousness of 13° as a rounded-up figure, we saw earlier that tablets of the Calendar Text System employ a 'micro-zodiac of 13 (not 12).' When we apply a 'micro-zodiac of 13' to these numbers, however, we find that 13° stands in the 6th micro-zodiacal sign of Aries, while 26° stands in its 12th micro-zodiacal sign. Perhaps we approach a solution by understanding "5-of-1" and "11-of-1" as "5 sub-units" and "11 sub-units" respectively. Whereas the sub-units in the "writing board of 7-of-1 of 10" refer to the degrees of a zodiacal sign (30 per cycle), those in the "animal of 5-of-1" and "animal of 11-of-1" refer to micro-zodiacal signs (13 per cycle). Thus, from the real moon's starting point of micro-Aries of Aries at the beginning of Month 1, it travels a distance of 5 sub-units (i.e., 5 micro-zodiacal signs) to micro-Virgo (the 6th micro-zodiacal sign of Aries) in one day, and it travels a distance of 11 sub-units (i.e., 11 micro-zodiacal signs) to micro-Pisces (the 12th micro-zodiacal sign of Aries) in two days.

To summarize the instructions in Tablet LBAT 1593, one should "take the 'animal of 13' (*Dodekatemoria* scheme) and the '(animal of) 277' (Calendar Text scheme) together" (obv. 18′), so that one might "make the animal of wood, of date palm, goose, date palm (Calendar Text ingredients) (as substitute) for the 'animal of 13' (*Dodekatemoria* scheme)" (obv. 16′). As a matter of fact, Tablet BM 47851 juxtaposes *Dodekatemoria* and Calendar Text entries for Days 1–30 of Month 5, providing concrete evidence that ancient astrologers did take the two schemes "together." After finding out the specific therapeutic ingredients

148 Even with this writing convention, it would have been difficult expressing sub-unit values of 13 or more by using only Babylonian month names for numbers.

149 Hunger's views are expressed in Reiner (2000: 424 n. 22).

for use, one could then "salve, feed, and fumigate the sick person with the stone, plant, and wood" (obv. 18′). In other words, while the real moon's position might reveal or confirm the Calendar Text date of relevance,[150] one needed to rely on the virtual moon's position for that Calendar Text date in order to discover the kinds of materials to be employed in medical zodiology, since the virtual moon was reciprocal complement to the real *Dodekatemoria* moon and signifier of its deeper meaning. Although Calendar Texts listing animal parts (SpTU III, 104 and 105) or wood, plant, and stone ingredients (VAT 7816, VAT 7815, and W 20030/127) may be reticent about the uses of these materials, Tablet LBAT 1593 provides incontrovertible evidence of their therapeutic function.

One final intriguing detail remains to be mentioned: While the *Dodekatemoria* scheme is described here as "in front of you" (*ana* IGI-*ka*), the Calendar Text scheme is obtained by consulting a "writing-board" (GIŠ.ZU). To be sure, the expression "in front of you" may at times refer to written texts or drawn illustrations set before a student or commentator.[151] In the rhetoric of Tablet LBAT 1593, however, one wonders if the author intended to present an epistemic contrast between the observable positions of the real moon in the *Dodekatemoria* scheme and the mathematically derived numbers of the virtual moon in the Calendar Text scheme.

150 One might argue that the *Dodekatemoria* scheme was not even necessary in such practices of medical zodiology, since the Calendar Text scheme already provides a correlation between dates and the virtual moon's positions (that signified therapeutic ingredients for use). Due to the schematic nature of the Calendar Text System, however, the real moon's positions anticipated by *Dodekatemoria* dates could have deviated from those occurring in ancient calendars that were currently in use. In such cases, the *Dodekatemoria* scheme could serve to indicate the Calendar Text date of relevance (that may have differed from the current calendar date) based on the observed position of the real moon, which could then be used to work out the corresponding virtual moon's position and its therapeutic significance.

151 Note the statement "you have their 'design' in front of you" (*uṣurtašunu ana pānīka*), which refers to a liver model or an illustrated tablet commentary before the student of extispicy. See *Manzāzu* Comm. 2 in Frahm (2011: 175); *Manzāzu* Comm. 1, § 69 in Koch-Westenholz (2000: 161). On the other hand, written texts may also be described as "in front of" the student: "If the (omen) entries, old versions, (and) (commentary)-exposition of the Presence are in front of you, if the Presence and the Path …" (BAD-*ma šu*-[*ma-a-ti*] *ši-bi mu-kal-lim-ti šá* NA *ana* IGI-*ka* BAD NA *u* GÍR GAR.MEŠ …). *Manzāzu* Comm. 1, lines A i 1–2 in Koch-Westenholz (2000: 132); cf. Frahm (2011: 174–175).

I already noted that the schematic year of 360 days (interchangeable with the zodiac of 360°) and the adoption of a 'micro-zodiac of 13' for the sun were artificial schemes that did not arise inevitably from astronomical observation, and that did not necessarily have to be synchronized with each other. My discussion of medical zodiology in this section provides further examples of how astrological meaning could be created by artificial ways of evaluating celestial variables. For instance, when ancient astrologers prescribed "blood, fat, and hair of sheep" for Month 4 Day 1 due to the virtual moon's position in Aries 7° on that day (SpTU III, 104, obv. 1), we might reasonably assume they expected these sheep ingredients to be efficacious for the whole day. As a matter of fact, since the virtual moon travels a distance of 277° per day, it actually moves through more than nine zodiacal signs during the first day of Month 4, including but not limited to the sign Aries. Astrologers made Aries and sheep ingredients relevant for the entire day by emblematizing the virtual moon's position at the end of the first day of Month 4 (i.e., Month 4 Day 1) when the virtual moon momentarily passes by the Aries 7° mark.[152]

The emblematic value of precise moments in time was even more critical for wood, plant, and stone prescriptions that relied on the virtual moon's micro-zodiacal sign, than for animal materials like sheep body parts that derived from the virtual moon's zodiacal sign. On any given day, the virtual moon remains in a zodiacal sign for a maximum of about 2½ hours (≈ 24 hours ÷ $^{277}/_{30}$°), whereas it remains in each micro-zodiacal sign for a maximum of about 12 minutes (≈ 24 × 60 minutes ÷ $^{277\times13}/_{30}$°). The actual durations are usually much shorter, since we typically do not find the virtual moon at the end of a zodiacal or micro-zodiacal sign at the end point of a day. To give an example: Almond-wood ($^{\text{giš}}$EŠ$_{22}$), *azallû*-plant ($^{\text{ú}}$A.ZAL.LÁ), and *anzaḫḫu*-glass ($^{\text{na4}}$AN.ZAḪ) prescribed for the sun-sign micro-Aries of Leo (Month 5 Days 20–22½) in *GDBT* tablets were associated instead with the virtual moon-sign micro-Aries of Leo (Month 1 Days 7 and 20) in Calendar Texts (see Fig. 6.7), in accordance with the virtual moon's role as signifier. At the end of the seventh day of Month 1 (i.e., Month 1 Day 7), the virtual moon is found at Leo 19°. In other words, on this day, the virtual moon remains in the zodiacal sign Leo for only about 99 minutes (i.e., time spent in Leo 0°–19°), and the ingredients of almond-wood, *azallû*-plant, and *anzaḫḫu*-glass reflect its location in micro-Aries of Leo for only about 5 minutes (i.e., time spent in Leo 18°–19°).

152 See earlier discussion on why dates in the Calendar Text System indicate positions of the moon and virtual moon at the end (not beginning) of the Babylonian day, which commences at nightfall.

I have worked out in detail the figures above for a couple of reasons. First, though our ancient texts seem to take their astrological emblems for granted, we should be aware that these could represent choices of convenience or imprecise features of schematic models. While apparently taking their cue from selected astrological elements or events, they do not necessarily reflect the whole range or extent of celestial phenomena. The significance of the virtual moon's position in the final moments of the day, or the therapeutic value ascribed to parts of a real "rooster" (instead of a "shepherd" or "twins") as an emblem of the zodiacal sign Gemini, constitute decisions and practices belonging to particular cultural or socio-professional contexts. Secondly, the emblematic nature of Calendar Text dates in medical zodiology and the poor correspondence between actual durations of time and prescribed ingredients becomes important in our discussion below. If the relationship between dates and animal, plant, and mineral materials was recognized as emblematic for only selected moments of time, it may have been easier to substitute calendar time for other variables more germane to the practice of medicine.

6 Variables of Time and Sickness

Calendar Texts like SpTU III, 104 and 105, VAT 7816, VAT 7815, and W 20030/127 seem to adopt principles similar to those in the *Babylonian Almanac* and other hemerological texts, which provide advice on activities and foods that were favorable and recommended or those to avoid on each day of the year.[153] Might prescriptions based on hemerology, then, serve to fulfill medical purposes? Cuneiform therapeutic texts do not typically describe medical signs in reference to their time of occurrence, but the Diagnostic Series Sa-gig distinguishes signs observed by the healer on the first day of the patient's sickness (Sa-gig Tablets 3–14) from signs that persist for several days or that manifest themselves at particular times of the day (Sa-gig Tablets 15–17).[154] In fact, the same medical signs could be ascribed to different divine agents, depending on the stage of their duration.[155] The following Sa-gig entry illustrates this principle partic-

153 See overview of the *Babylonian Almanac* in Waerzeggers (2012) and editions of hemerological cuneiform texts in Livingstone (2013).

154 Wee (2012: 111–122, 288–289).

155 For example, a condition initially attributed to "Hand of the god Šulpaea" (TDP 4, obv. 28 in Labat (1951: 36–37)) changes its identity to "Hand of the god Dapinu" (DPS 16, 22 in Heeßel (2000: 174, 182)) when it persists for at least two days.

ularly well: "If he (the sick man) is struck in his belly, Hand of the Twin Gods. If it is the second day, Hand of the god Adad. If it is the third day, Hand of the god Ea. If it is the fourth day, Hand of Dingirmah. If it is the fifth day, Hand of the god Papsukkal" (TDP 13, ii 17–18).[156] The extent to which Calendar Texts can omit all diagnoses and make therapeutic prescriptions dependent exclusively on dates, however, is unprecedented in the medical literature. Indeed, the idea of hemerology as medicine contradicts a fundamental tenet in medical practice, whereby methods and means of healing are specific to particular *kinds* of sicknesses (identified by diagnosis) or medical signs (in cases where treatment is symptomatic). Therapeutic recommendations in the Calendar Texts we have encountered so far, therefore, were at best only supplementary or auxiliary to other medical procedures and could never entirely take the place of the latter.

It is difficult to assess how ancient astrologers responded to this problem, but various tablets hint at efforts to incorporate sickness or the human body as variables in medical zodiology. Despite the fragmentary state of Tablet LBAT 1598, for instance, each line articulates some form of the following relationship: "When the moon is in {zodiacal name 1}, and the sickness / sick person is of {zodiacal name 2}, it … to {zodiacal name 3}."[157] The short excerpt from

156 DIŠ *ina* ŠÀ-*šú* SÌG-*iṣ* U4.9.KÁM ŠU [d]MAŠ.TAB.BA DIŠ 2-*i* ŠU [d]IŠKUR DIŠ *šal-šú* ŠU [d]*É-a* DIŠ 4 ŠU DINGIR.MAḪ DIŠ 5 ŠU [d]*Papsukkal* (TDP 13, ii 17–18) in Labat (1951: 118–119). Note that the forms 2-*i* and *šal-šú* clearly denote ordinal numbers (i.e., "second," "third") rather than cardinal numbers (i.e., "two," "three"). In addition, Sa-gig Tablet 28 shows the fluidity with which epileptic conditions such as AN.TA.ŠUB.BA, [d]LUGAL.ÙR.RA, and "Spawn of Šulpaea" can turn into the sicknesses "Hand-of-Goddess" and "Hand-of-Ghost," and vice versa. At other times, the commercial term *puquddû* ("deposit" or "entrusted goods"; CAD P, 515 §b) supplies the metaphor for the medical situation, whereby one deity apparently passes on the baton of responsibility for the sickness and "entrusts" it to another: TDP 3, 77; TDP 13, i 36′; TDP 14, iv 36′–37′ (= DPS XIV A iv 1–2) in Labat (1951: 26–27, 114–115, 144–145); DPS XIV C_2 iv 6 in Scurlock and Andersen (2005: 629, § 19.186); DPS 15, 92′ in Heeßel (2000: 155, 160). This usage of *puquddû* already appears in an Akkadian precursor of Sa-gig from 13th century BCE Ḫattuša: Tablet B, obv. 4′, 5′ in Wilhelm (1994: 34).

157 *ki-i* [d]30 *ina* {zodiacal name 1} *ù* GIG *šá* {zodiacal name 2} *šu-ú a-na* {zodiacal name 3} […]. Geller (2010: 60–62) seems to interpret all these names as zodiacal signs (as opposed to micro-zodiacal signs), while Rochberg (oral communication cited in Geller (2010: 62 n. 133)) wondered, "if gig here is the sick person, the text might be saying when the moon is in sign 1 and the sick person's (birth?) sign is sign 2, go to sign 3 (meaning 'treat' when the sun is in sign 3)?" It is not even clear whether "moon" ([d]30) in Tablet LBAT 1598 refers to the real moon or to the virtual moon (as in LBAT 1586+1587), but similar procedures of medical zodiology in Tablet BM 56605 may suggest that the virtual moon plays a role in such contexts (see appendix).

Tablet LBAT 1597 below, however, illustrates the challenges of interpreting such tablets.[158]

Tablet LBAT *1597*

obv. 9′–10′: If it is with the Bull of Heaven ((micro)-Taurus) and the Shepherd (Orion in (micro)-Gemini), *šaššaṭu*-sickness, vertigo—it is *maškadu*-sickness,[159] AN.TA.ŠUB.BA-epilepsy, Daughter of Anu.[160] "True Shepherd of Anu" (*refers to*) "Saturn."

rev. 1: If it is with the Great Twins ((micro)-Gemini), AN.TA.ŠUB.BA- and ^{d}LUGAL.ÙR.RA- epilepsies. "Great Twins" (*refers to*) "the stars ^{d}LUGAL.ÙR.RA and ^{d}MES.LAM.TA.È.A."[161]

2–3: If it is with the Crab ((micro)-Cancer), seized crown (of head), dribbling(?),[162] and shivering. "Crab" (or) "River"[163] (*refers to*) Ningirsu, Anu[164] : Adad.

4–5: If it is with the Lion ((micro)-Leo), *lamaštu*-, *labaṣu*-, *aḫḫāzu*-, ^{d}DIM$_{11}$.ME.TAB-, (and) ^{d}DIM$_{11}$.ME.TAB.GE$_{6}$.Ù.NA- demons, the

158 For editions and remarks on Tablet LBAT 1597 (= BM 34731), see Leibovici (1956: 275–280) and Geller (2010: 68–71).

159 The sicknesses *šaššaṭu* and *maškadu* are grouped together with other muscle ailments like *sagallu*, *kiṣṣatu*, and *kiṣṣat ṣēti* in Tablet 33 of the Mesopotamian Diagnostic Series Sa-gig (DPS 33:94–102) in Heeßel (2000: 357, 363). Here, the body's instability resulting from vertigo (*ṣidānu*) may have been perceived as a muscle condition and identified with *maškadu*-sickness. I am uncertain about Geller's (2010: 70) proposal of a "*šû*-disease" here.

160 The "Daughter of Anu" is identified with the *lamaštu*-demoness in the commentaries AO 17661, obv. 19, and SpTU I, 27, obv. 25′.

161 The eponymous stars of the "Great Twins" ((micro)-Gemini) were identified with the twin deities ^{d}LUGAL.ÙR.RA and ^{d}MES.LAM.TA.È.A. Cf. MUL.APIN I i 5 in Hunger and Pingree (1989: 19). Since the activities of ^{d}LUGAL.ÙR.RA in medical texts involve patient behaviors akin to epilepsy, (micro)-Gemini was therefore also linked to the more frequently named epileptic condition AN.TA.ŠUB.BA. Stol (1993: 7–14, 16–19).

162 Following Geller (2010: 70 n. 153), the writing *sil-ḫu* is interpreted as *sil'u* ("sprinking(?), dribbling(?)"; CAD S, 267).

163 Geller (2010: 70 n. 154) interpreted "river" here as a lunar halo; cf. CAD N I, 376 (*nāru* A § 3b). I prefer to understand this "river" in the context of Tablet AO 8196 (Source H): ^{mul}AL.LUL = ^{íd}IDIGNA ("The Crab = The Tigris River") and MUL.MEŠ IGI.MEŠ *šá* ^{mul}AL.LUL : ^{íd}IDIGNA ("Front stars of the Crab : The Tigris River") in Koch-Westenholz (1995: 192–193, lines 145 and 148); cf. Weidner (1959–1960: 107, lines 8 and 11).

164 Note the description "The Crab, the seat of Anu" (^{mul}AL.LUL *šu-bat* ^{d}*A-nim*) (MUL.APIN I i 7) in Hunger and Pingree (1989: 20).

> divine lion, belligerent[165] (oath by) the god's life,[166] Ištar, and Hand-of-Ghost sickness. (Alternatively,) Dilibat (Venus) and/in(?)[167] the Lion ((micro)-Leo).

For one, there is often insufficient information to determine whether zodiacal names indicate zodiacal or (concisely written) micro-zodiacal signs, or the identity of the celestial body that is said to occupy these positions.[168] Moreover, because it was convenient for ancient astrologers consulting these tablets to list zodiacal names and their astrological meanings in consecutive order (not in the order of *Dodekatemoria* or Calendar Text schemes), one is left in the dark as to whether these meanings were applicable to the Calendar Text System and its 'micro-zodiac of 13' or to some other zodiacal scheme. Finally, in tablets like LBAT 1598 and 1597, the precise relationship between sicknesses or sick body parts and the zodiac is phrased ambiguously. The connection between "Great Twins" ((micro)-Gemini) and "AN.TA.ŠUB.BA- and ^{d}LUGAL.ÙR.RA- epilepsies" (LBAT 1597, rev. 1), for example, does not tell us whether the former was imagined as an agent of the latter, or whether (micro)-Gemini merely corresponded to seasons when these sicknesses were espe-

165 Following Geller (2010: 69 n. 146), the logogram LIRI_8 (transcribed by Geller as "lirum") stands for *šitpuṣu*, "to grapple, wrestle" (CAD Š I, 449, *šapāṣu* § 2).

166 Geller (2010: 69, 71) understood the signs as "dingir *la-ab-ba* mu dingir lirum [*sic*]," which he translated as "the god is a lion related to a belligerent god." My translation above is based on the *lamaštu*-demoness's association with the "(oath by) the god's life" (MU.DINGIR.RA) in the commentary SpTU I, 27, obv. 28′–29′ (the reading is broken but restored from the lexical text Erimhuš VI, 80–83 = MSL XVII, 83). Cf. George (1991: 156). The association of the goddess Ištar and the demoness *lamaštu* (along with other similar demons) with (micro)-Leo reminds one of the ubiquitous appearances of these female beings on top of lions in the iconography of cylinder seals and plaque and wall reliefs (e.g., the well-known Burney or "Queen of the Night" relief (ME 2003-7-18, 1) at the British Museum).

167 Geller (2010: 69) transcribed the conjunction *u* at LBAT 1957, rev. 5 (= line 9′ in Geller), but the cuneiform writing seems to resemble the sign *ina* according to the tablet drawing in LBAT. The commentator seems to argue that the same astrological meanings resulting from the (unnamed) celestial body's association with (micro)-Leo would also occur if Venus (associated with the goddess Ištar) instead were with (micro)-Leo.

168 For instance, Geller (2010: 69 n. 148) understood this celestial body as the "moon" by analogy with Tablet LBAT 1586+1587, though it is unclear whether he realized this so-called "moon" in LBAT 1586+1587 is actually the virtual moon (not the real moon). On the other hand, if Tablet LBAT 1597 in fact correlates the zodiac with sickness in ways similar to Tablets BRM IV, 19, BRM IV, 20, LBAT 1626, and SpTU V, 243 (discussed below), the zodiacal names in LBAT 1597 would indicate the sun's micro-zodiacal signs.

cially likely to occur. Alternatively, it was also possible that such signs portended auspicious times for the healing of these sicknesses, indicating dates when prayers and rituals or therapeutic materials ought to be given for the patient.

Fortunately, we have been able to identify a group of tablets (BRM IV, 19, BRM IV, 20, LBAT 1626, and SpTU V, 243) that, not only incorporate types of ailments and other misfortunes as zodiacal variables, but also display an unambiguous connection to the *Dodekatemoria* scheme and its 'micro-zodiac of 13.'[169] Furthermore, a precursor of these tablets explicitly describes their subject matter as "spells" (STT II, 300, rev. 19) employed in rituals against various misfortunes, and expressions like "make (*spells/rituals*), and it will be well" (BRM IV, 19) confirm that zodiacal units were used as signifiers for the *remedy* of specific ailments. Admittedly, not all the misfortunes named in these tablets are as readily categorized as "medical," though, as will be shortly evident, a large number of entries address concerns in cuneiform medical texts, including the malicious activities of deities, demons, ghosts, and human sorcerers.[170] In contrast to the 'hemerology-based' Calendar Texts we have encountered so far, we might describe these texts as 'ailment-based.'

Among this group of ailment-based tablets, BRM IV, 19 is already cited earlier in this essay, so I provide translations of selected portions of the remaining tablets below. A couple of tablets reveal editorial efforts at arranging information in meaningful ways: The preserved fragment of LBAT 1626 seems to group together different entries dealing with the "Furrow" ((micro)-Virgo) in rev. 3′–4′, while the whole tablet SpTU V, 243 lists in consecutive order one (micro)-zodiacal sign per entry. Despite such differences in textual arrangement, it is obvious that these tablets address the same topics and themes with terminology that is strikingly similar.

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169 This group of tablets is the subject of considerable discussion in M. Geller's forthcoming book on *Melothesia in Babylonia* (= Geller (2014)), which is based on earlier research done in Geller (2010). The 2014 book was still in press and unavailable to me at the time of the writing of this essay, so my comments below on the way Geller reads these texts pertain to his 2010 publication.

170 Even when the purpose for a spell/ritual is framed in positive terms (e.g., "(*spells/rituals for*) the one looking at you to point his finger [at you] for good (purposes)" in BRM IV, 20, obv. 18), it is not impossible to imagine what the implied misfortune might be (i.e., sinister finger-pointing, perhaps as a magical gesture of wicked sorcery).

Tablet STT II, 300 (= MS A)

obv. 4–6: [If on Month 1] …; on Day 21, (*for*) dispelling sorcery that it may not approach the sick man, to heal the head, to expel his shivering, to heal the wound, to stanch the (menstrual) blood of a woman, that evil may not approach the man's house; make (*spells/rituals*), and it will be well.

9–10: If on Month 3 …; on Day 4, (*for*) ⸢a pure river (?)⸣;[171] … make (*spells/rituals*), and it will be well.

12–13: If on Month 4 …; on Day 12, in order to remove *lilû* (and) *ardat lilî* demons; … make (*spells/rituals*), and it will be well.

14–15: If on Month 5 Day 10, (*for*) ⸢'cutting off the breath'⸣; … on Day 28, in order to remove AN.TA.ŠUB.BA-, *bennu*-, and ᵈLUGAL.GÌR.RA-epilepsies, and Hand-of-God and Hand-of-Ghost sicknesses; make (*spells/rituals*), and it will be well.

16–18: If on Month 6 Day 1, (*for*) a pure river (i.e., a river unpolluted by the guilt of one tested);[172] … on Day 24, in order to seize a ghost to bind with a man, to entrust(?)[173] a man's figurine to the dead, to make libation for a ghost, to expel guilt; make (*spells/rituals*), and it will be well.

20–23: If on Month 7 …; Day 11, in order that a woman may come; from Day 16 to Day 20, (*for*) 'cutting off the breath' …; on Day 16 and Day 17, in order to invite the god, *ditto* (i.e., to invite) the goddess, to heal *sagallu*-sickness, to purify the house, to confine the sick man, to heal rectal sickness, to heal (kidney/bladder) stone, to hold diarrhea, to remove fever; on Day 7, to confine the sick man; … make (*spells/rituals*), and it will be well.

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171 This restoration of the damaged reading is suggested by Geller (2010: 45), who admits that "this phrase looks out of place here."

172 Note the commentarial interpretation: ᵈÍD KÙ.GA = *a-me-lu ina ḫur-šá-nu zu-uk-ku-ú* ("'A pure river' (*refers to*) a man acquitted in the river ordeal") (BRM IV, 20, rev. 59 = line 52 in Geller (2010: 31, 36)). I have interpreted this to mean that the river is unpolluted and does not harm the man tested in the river ordeal, rather than the view that the man experiences "cleansing (of guilt) by river" in Geller (2010: 33, 55, 56).

173 This tentative reading NU LÚ *ana* ÚŠ ⟪NU⟫ *pa-qá-*⟨*di*⟩ (STT II, 300, obv. 17) follows those of later parallel entries. See discussion in Scurlock (2005/2006: 133) and Geller (2010: 46 n. 110).

rev. 5–6: If on Month 9 …; on Day 21, (for) the one looking at you to point [his] finger (at you) for good (purposes) … make (*spells/rituals*), and it will be well.

9–11: If on Month [10] …; on Day 12, (*for*) 'cutting off the breath' and in order to remove *lilû* (and) *ardat lilî* demons; make (*spells/rituals*), and it will be well …

12: If on Month 11 …; on Day 21, (*for*) overturning a judgment; *ditto* (i.e., make (*spells/rituals*), and it will be well).

13–14: If on Month 12 Day 26, (*for*) dispelling sorcery; … *ditto* (i.e., make (*spells/rituals*), and it will be well).

15: If on Months 10 and 11 Day 21, (*for*) a man's slave not to run away; …

16: If on Months 11 and 12 Day 27, (*for*) dispelling sorcery; make (*spells/rituals*), and [it will be well].

19: Spells (are) knowledge from cuneiform wedge(s) of the scribal school. Let the knowledgeable reveal (them) to the knowledgeable, but conceal (them) from the unlearned.[174]

Tablet BRM IV, 20 (= MS C)

obv. 2: (*Spells/rituals for*) overturning a judgment; with the Great One ((micro)-Aquarius).

9: (*Spells/rituals for*) 'cutting off the breath'; with Pabilsag ((micro)-Sagittarius) or with the Twins ((micro)-Gemini).

11: (*Spells/rituals for*) a pure river or waterhole; with the Goat-fish ((micro)-Capricorn).

12: (*Spells/rituals for*) entering the palace; with the Crab ((micro)-Cancer).

18: (*Spells/rituals for*) the one looking at you to point his finger [at you] for good (purposes); with the Furrow ((micro)-Virgo).

174 I have understood the cuneiform as ÉN.MEŠ *mu-du*$_{11}$*-tu sam-tak-ki* É. ⸢DUB⸣ *mu-du-ú mu-da-a li-k*[*al-lim an*]*a*(?) *la mu-du-u* ⟪NU⟫ DUL (STT II, 300, rev. 19). Geller (2010: 48, line 46) interpreted the end of this line as NU ⸢PÀ!⸣ instead, i.e., as an injunction not to "mention" (*zakāru*) secret knowledge to the unlearned. The typical verbs call for the knowledgeable not to "reveal" (*kullumu*) to the unlearned, or for the unlearned not to "see" (*amāru*). Cf. CAD K, 524 (*kullumu* § 4b); CAD M II, 168 (*mudû*, § 1). Notice the erudite orthography *mu-du*$_{11}$(KA)*-tu* in contrast to *mu-du-ú* and *mu-du-u* later in the same line, which underscores the oral (KA) character of spell-knowledge even if it partly depends on writing ("cuneiform wedges") for its transmission.

23: (*Spells/rituals for*) sorcery; with the Great One ((micro)-Aquarius) or with the Tails ((micro)-Pisces).

26–28: (*Spells/rituals*) in order to dispel the sorcerer that he may not approach the sick man, to heal the head, to expel his shivering, to heal the wound, to stanch the (menstrual) blood of a woman, that evil may not approach the man's house; with the Goat-fish ((micro)-Capricorn).

29: (*Spells/rituals for*) the *lilû* demon; with the Stars (Pleiades in (micro)-Taurus) or with the Scales ((micro)-Libra)

30: (*Spells/rituals for*) the *ardat lilî* demon; with the Stars (Pleiades in (micro)-Taurus), or with the Twins ((micro)-Gemini), or with ⌜Pabilsag⌝ ((micro)-Sagittarius).

31: (*Spells/rituals for*) *lilû* (and) *ardat lilî* demons; with ⌜Pabilsag⌝ ((micro)-Sagittarius).

32–34: (*Spells/rituals for*) AN.TA.ŠUB.BA- and ^{d}LUGAL.ÙR.RA- epilepsies, Hand-of-God (and) Hand-of-Ghost sicknesses; with … (*Spells/rituals*) in order to seize a ghost ⟨to⟩ bind with a man, to entrust a man's figurine to the dead, to make libation for a ghost, to expel guilt; with …

47: (*Spells/rituals for*) a man's slave not to run away; with the Scorpion ((micro)-Scorpio).

Tablet LBAT *1626* (= MS D)

rev. 3′: [… KI ^{m}]^{ul}ABSIN ÍD KÙ.GA KI ^{mul}[ABSIN]

4′: [*a-mi*]*r-ka*(?) ŠU.SI SIG$_5$-*tim* EGIR.NA LA[L ^{mul}ABSIN]

rev. 3′: [(*Spells/rituals for*) …; with] the Furrow ((micro)-Virgo). (*Spells/rituals for*) a pure river (i.e., a river unpolluted by the guilt of one tested); with the [Furrow ((micro)-Virgo)].

4′: (*Spells/rituals in order that*) [the one looking at] you (?)[175] points a good finger behind (you); [with the Furrow ((micro)-Virgo)].

175 Here, I have followed the restoration [*a-mi*]*r-ka* ŠU.SI SIG$_5$-*tim* EGIR NA lá-[…] in Geller (2010: 54–55), though the sign transcribed *ka* is depicted as the sign MUL in the hand-copy of LBAT 1626, rev. 4′.

Tablet SpTU V*, 243* (= MS E)

obv. 1–2:	(*Entry here addresses the sign* (*micro*)*-Aries*)
3–4:	[(*Spells/rituals for*) *lilû* and] *ardat lilî* demons; with …[176] (*or*) with the Stars (Pleiades in (micro)-Taurus).
5–9+:	(*Entries here address the signs* (*micro*)*-Gemini to* (*micro*)*-Libra*)
rev. 2′–3′:	[…] (*Spells/rituals for*) a man or woman's slave not to run away; with the Scorpion ((micro)-Scorpio).
4′–5′:	(*Spells/rituals for*) sorcery, 'cutting off the breath,' *lilû* and *ardat lilî* demons; with Pabilsag ((micro)-Sagittarius).
6′–7′:	(*Spells/rituals for*) a pure river or waterhole; with the Goat-fish ((micro)-Capricorn).
8′–9′:	(*Spells/rituals for*) overturning a judgment, entering the palace; with the Great One ((micro)-Aquarius).
10′–11′:	(*Entry here addresses the sign* (*micro*)*-Pisces*)

Earlier, I examined Tablet BRM IV, 19 together with the Calendar Text LBAT 1586+1587 in a rather synchronistic manner, in order to demonstrate how the Calendar Text System and its 'micro-zodiac of 13' encompassed not only the moon and its reciprocal complement (i.e., the virtual moon), but also the sun. It is well worth considering, however, the significance of Tablet BRM IV, 19 as part of a diachronic development of ideas that predated Calendar Texts and even the invention of the zodiac itself. Tablet STT II, 300 comes from the Neo-Assyrian city of Ḫuzirīna (Sultantepe), and its colophon mentions the palace overseer Bēl-aḫu-uṣur, who was eponym for the year 621 or 616 BCE during the reign of King Sîn-šarru-iškun.[177] Geller has correctly pointed out the significance of this Neo-Assyrian tablet, which reveals how "a traditional hemerology-based system of favourable and unfavourable days of the month has been replaced by [a] zodiac-based system which assumes astral influences over the same spells and rituals."[178]

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176 Understood as múl.⟨šu.gi⟩ ("Old Man," i.e., Perseus) in von Weiher's SpTU edition and Geller (2010: 55).

177 mEN-PAB-PAB *šá* ⸢IGI-KUR⸣ (STT II, 300, rev. 25 = bottom edge line 2), cf. Hunger (1968: 362). The eponym Bēl-aḫu-uṣur was assigned to the year 621 BCE by Reade (1998: 256, 259), but to the year 616 BCE by E. Frahm in Radner (1999: 284, § 8b).

178 Reiner (1995: 111 ff.); Geller (2005: 4) and (2010: 56). Dates recommended for individual spells appear also in other kinds of ritual texts. To give an example: Wiggermann (1992: 105–106) observed how "the almanac prescribes the same days for profitable performance (*STT* 300:23, Tašrîtu 7, 26, Araḫsamna 12, or rather ⸢22⸣) as the ritual tablet of *bīt mēseri* I/vi

As I mentioned before, Tablet BRM IV, 19 clearly refers to the sun's micro-zodiacal signs as evident from plenary writings like "Lion (micro-Leo) of Scorpion (Scorpio)" (obv. 3′). Since Tablet BRM IV, 20 closely follows the sequence of entries in BRM IV, 19, it is very probable that zodiacal names like "Lion" (BRM IV, 20, obv. 16) in the former are concise writings of the same micro-zodiacal signs of the sun (i.e., micro-Leo). If we extend this line of reasoning, it is possible to interpret zodiacal references in Tablets LBAT 1626 and SpTU V, 243 also as the sun's micro-zodiacal signs on account of similarities in their content and language, despite the fact that these tablets are a further step removed from Tablet BRM IV, 19. Additional suggestion for identifying these as *micro*-zodiacal signs comes from the use of the term KI ("with / (in) the region (of)") in Tablets BRM IV, 20, LBAT 1626, and SpTU V, 243 (as well as Tablets BM 76483, SpTU II, 49, and perhaps LBAT 1597), which resonates with the way the Calendar Text LBAT 1586+1587 distinguishes the virtual moon's location "in" (*ina*) a zodiacal sign and its position "with / (in) the region (of)" (KI) a *micro*-zodiacal sign. In short, what began in typical almanac fashion as a record of auspicious dates for performing various spells and rituals (STT II, 300) later became a key for correlating these magical practices (and the ailments and misfortunes addressed) with the sun's micro-zodiacal signs (BRM IV, 19 and 20, LBAT 1626, and SpTU V, 243).

In making this shift, it is interesting that astrologers decided to employ a 'micro-zodiac of 13.'[179] While the sun's zodiacal signs could be determined roughly by direct observation, its micro-zodiacal signs were theoretical constructs that depended on how astrologers imagined the partitioning of celestial space and time. Moreover, the attractiveness of a 'micro-zodiac of 12' may be inferred from the *GDBT* tablets and others concerned with a Rising-Times Scheme (see above), which neatly conceived of the micro-zodiac as a miniature representation of the twelve zodiacal signs. One might rightly question

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7 (correct here Araḫsamna 12 to 22?)." Unfortunately, the entries in our group of tablets cannot be easily related to those in hemerological texts edited in Livingstone (2013).

179 By employing a 'micro-zodiac of 13' for the sun, the sun's micro-zodiacal signs in a month could be calibrated with the real moon's zodiacal signs for that month. On the basis of Tablet BRM IV, 19 and the use of the term KI ("with / (in) the region (of)"), I argued that the zodiacal names above originally referred to the sun's micro-zodiac, but my indeterminate translation of these names (e.g., "(micro)-Virgo") allows for the possibility that astrologers conveniently used these labels for the real moon's zodiac as well. As noted earlier, Ungnad (1941–1944: 283) and Koch-Westenholz (1995: 170) entertained the thought that the real moon's zodiacal signs were addressed in these texts, which would have been plausible if not for the fact that Tablet BRM IV, 19 displays plenary writing of *micro*-zodiacal signs.

whether the 'micro-zodiac of 13' belonged exclusively to the Calendar Text System or could also be a feature of other non-Calendar Text schemes. However, the presence of four-number sequences of the *Dodekatemoria* scheme in Tablet BRM IV, 19 is highly suggestive, and it is plausible that the shift from a "hemerology-based system" to a "zodiac-based system" was motivated by the desire to incorporate variables of ailments and misfortunes into an existing Calendar Text System. Indeed, these variables were assigned to the *sun*'s micro-zodiacal signs even though it is the *virtual moon* that plays the role of signifier in the Calendar Texts we have seen so far, and one wonders whether this assignment was necessary because zodiacal and micro-zodiacal signs of the virtual moon were already engaged as prescribers for therapeutic materials.

The fact that zodiacal connections to ailments were rooted in almanac precursors explains why such connections could be inconsistent. For purposes of convenient notation, I refer to Tablets STT II, 300, BRM IV, 19, BRM IV, 20, LBAT 1626, and SpTU V, 243 as manuscripts (MSS) A, B, C, D, and E respectively in the following paragraphs. In several cases, hemerological dates clearly supply the rationale for linking spells and rituals against misfortunes to particular micro-zodiacal signs. Dates "to seize a ghost to bind with a man, to entrust(?) a man's figurine to the dead, etc." (Month 6 Day 24) and that "a woman may come" (Month 7 Day 11) are identical in MSS A and B, but the latter takes the additional step of converting these dates to the signs micro-Cancer and micro-Aquarius respectively. Moreover, even though the relationships between micro-Capricorn and spells "to heal the head, to expel his shivering, etc." (MS C) and between micro-Virgo and pointing the finger (MSS C and D) are left unexplained in some manuscripts, others (MSS A and B) reveal their origins in special days for performing these rituals (Month 1 Day 21 and Month 9 Day 21 respectively).

The priority of dates to micro-zodiacal signs shows up especially clearly when periods of ritual efficacy extended beyond the duration of a single day. Sometimes, this resulted in the same micro-zodiacal sign, in the case where the two days for remedies against "AN.TA.ŠUB.BA-, *bennu*-, and [d]LUGAL.GÌR.RA-epilepsies, etc." (Month 5 Day 28 in MS A and Day 29 in MS B) could be both ascribed to micro-Leo. At other times, the conversion to micro-zodiacal signs was less straightforward. Procedures to "invite the god (and goddess), to heal *sagallu*-sickness, to purify the house, etc." on Month 7 Days 16 and 17 (MS A) correspond to both micro-Aries and micro-Taurus, but only micro-Aries (for Month 7 Day 16) was acknowledged in MS B. It is difficult to say for certain if astrologers were deliberately selective with dates, or if they just worked with whatever dates were mentioned in their written sources or current in local practice. Furthermore, our manuscripts include records of different special days for the same purpose, and one wonders whether this really reflected customs of performing the same spells repeatedly throughout the year, or whether the manuscripts represent a conflation of various local ritual calendars.

We find here the recurring theme of a cacophony of ideas resulting from unsettled attempts at incorporating past ideas within new paradigms of zodiacal astrology. Our Sultantepe tablet (MS A), for example, prescribes spells against 'cutting off the breath' on Month 5 Day 10 (micro-Sagittarius), Month 7 Days 16–20 (micro-Aries—micro-Gemini), and Month 10 Day 12 (micro-Gemini), but only micro-Sagittarius (MSS C and E) and micro-Gemini (MS C) find their way into later tablets. The twenty-first day appears to have been particularly propitious for spells preventing run-away slaves, and both Month 10 Day 21 (micro-Libra) and Month 11 Day 21 (micro-Scorpio) were recommended for the purpose in MS A, but only micro-Scorpio appears in MSS C and E. Similarly, the twelfth day was a favorable time to ward off *lilû* and *ardat lilî* demons, especially on Month 2 Day 12 (micro-Libra in MS B), Month 4 Day 12 (micro-Sagittarius in MSS A and B), and Month 10 Day 12 (micro-Gemini in MS A). All three micro-zodiacal sun-signs are recorded in MS C, but only micro-Sagittarius of these occurs in MS E. In addition, micro-Taurus (MSS C and E) is mentioned as an auspicious sign against *lilû* and *ardat lilî* demons, even though our tablets preserve no date (e.g., Month 9 Day 12)[180] corresponding to this micro-zodiacal sign. We get the same impression that our sources portray an incomplete picture in the case of spells for a "pure river," which are prescribed for Month 6 Day 1 (micro-Virgo) in MS A and assigned to micro-Virgo in MS D, but attributed to an entirely different sign (micro-Capricorn) in MSS C and E.[181]

Many more examples may be cited, but those above will suffice to demonstrate my arguments. The big question still remains: How were correlations between spells for specific ailments and the sun's micro-zodiacal signs actually applied to the practice of medical zodiology using Calendar Texts? There is, unfortunately, a paucity of explicit statements concerning such procedures, and any proposal at this stage must only be tentative.

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180 Perhaps we should restore DIŠ *ina* [iti]GA[N U$_4$.12.K]ÁM LÍL.LÁ.EN.NA KI.SIKIL.LÍL.LÁ.EN.NA ZI-*ḫi* ... ("If on Month 9 [Day 12] (i.e., sun-sign micro-Taurus), in order to remove *lilû* (and) *ardat lilî* demons ...") for STT II, 300, rev. 8.

181 In other cases, not all dates are preserved on our available tablets, but disparities in micro-zodiacal signs may derive from a plurality of special days. For example, spells for "overturning a judgment" on Month 11 Day 21 (micro-Scorpio in MS A) occur also for micro-Aquarius (MSS C and E), while spells for "entering the palace" are attested for both micro-Cancer (MS C) and micro-Aquarius (MS E).

It is, of course, possible to treat ailment-based texts like MSS B to E as a separate genre that were used in isolation from hemerology-based Calendar Texts (e.g., SpTU III, 104 and 105, VAT 7816, VAT 7815, and W 20030/127). Both groups of texts, however, display inadequacies that might be better resolved in cooperation with each other: Hemerological recommendations of therapeutic ingredients that disregard the nature or identity of sickness violate basic tenets of medical practice, while spell- or ritual-type remedies implied in MSS B to E give no indication of specific ritual materials to be used or healing ingredients of wood, plant, and stone that were typical for cuneiform therapeutic texts. Furthermore, we saw how texts based on different systems of medical zodiology could be associated with the same professional. One needs to apply caution here, of course, since it is possible that ancient scholars collected, copied, or even authored texts of assorted theories without necessarily subscribing to each theory with the same extent of belief or commitment. Not only did Anu-bēlšunu of the Sîn-leqe-unnīnī family own the Calendar Text VAT 7815 and *GDBT* tablet VAT 7847 + AO 6448, however, the same correlations between prescriptions and micro-zodiacal signs for the sun's 'micro-zodiac of 12' in *GDBT* tablets were also preserved for the virtual moon's 'micro-zodiac of 13' in Calendar Texts, suggesting that efforts were made to relate and perhaps to reconcile two disparate astrological systems. In similar fashion, the hemerology-based Calendar Texts SpTU III, 104 and 105 and ailment-based Tablet BRM IV, 20 (= MS C) both belonged to Iqīšāya of the Ekurzakir family, and one wonders whether variables of sickness linked to the sun's 'micro-zodiac of 13' in the latter were, in some way, connected to prescriptions by the virtual moon's 'micro-zodiac of 13' in the former.

While definite answers remain elusive, I hope at least to point the way forward by making a couple of observations. First, despite the plenary writing of specific combinations of micro-zodiacal and zodiacal signs in MS B (e.g., "Lion (micro-Leo) of Lion (Leo)"), the sufficiency of only the sun's micro-zodiacal signs in MSS C to E likely suggests that their astrological meanings were applicable no matter which zodiacal sign they belonged to. Fragmentary evidence for this practice comes from the fact that, as I noted earlier, editors intended Tablet LBAT 1626, rev. 3′–4′ (= MS D) to be a collection of entries involving the "Furrow" (the sun-sign micro-Virgo) and the whole tablet SpTU V, 243 (= MS E) to be a systematic listing of each of the sun's micro-zodiacal signs. In both cases, individual entries were arranged or grouped together in ways that seem to disregard the sun's zodiacal signs. In MS D, for instance, spells for "a pure river" (sun's micro-Virgo of Virgo = Month 6 Day 1 in MS A) appear together with spells pertaining to one who "points a good finger" (sun's micro-Virgo of Sagittarius = Month 9 Day 21 in MS B). Likewise, MS E enumerates spells against "[*lilû* and] *ardat lilî* demons" (perhaps sun's micro-Taurus of Sagittarius = Month 9 Day 12 in MS A),[182] various spells for sun-signs micro-Gemini to micro-Libra (not well-preserved on tablet), followed by spells for a "slave not to run away" (sun's micro-Scorpio of Aquarius = Month 11 Day 21 in MS A) and spells against "sorcery, 'cutting off the breath,' etc." (sun's micro-Sagittarius of Leo = Month 5 Day 10 in MS A).[183]

In other words, in MSS C to E (and perhaps also MS B), the astrological meaning of micro-Leo of Leo was also shared by micro-Leo of Virgo, micro-Leo of Libra, etc. This disregard for specific combinations of micro-zodiacal and zodiacal signs runs contrary to what we saw earlier in efforts to harmonize *GDBT* and Calendar Text prescriptions, and it is worth asking what was achieved by this maneuver. Let us consider the spells against "AN.TA.ŠUB.BA-, *bennu*-, and ᵈLUGAL.GÌR.RA- epilepsies" on Month 5 Day 28 (MS A) or 29 (MS B). The conversion of these dates to micro-Leo of Leo would extend the applicability of these spells by only a few more days within the same month (i.e., Month 5 Days 1–2, 28–30). On the other hand, by disregarding the zodiacal sign in which a micro-zodiacal sign occurs, the remedy of a given ailment could be made applicable to a micro-zodiacal sign (and its corresponding dates) in every single month, i.e., micro-Leo of Virgo in Month 6 Days 26–27, micro-Leo of Libra in Month 7 Days 24–25, etc. While the Sultantepe tablet (MS A) shows us that spells against different ailments and misfortunes were scheduled on specific dates of a ritual calendar (perhaps for preventive purposes?), the above strategy to extend the applicability of these spells likely reflects pressures to make such measures a more timely remedy for sickness.

This brings me to my second point: Ancient patients surely experienced sicknesses of various kinds at unpredictable times, even taking into account cases of epidemics and contagion. Indeed, the need for diagnosis implied by the voluminous Diagnostic Series Sa-gig and its precursors underscores the unpredictability of sickness as a general rule. Hemerology-based Calendar Texts might supply recommendations of therapeutic materials for any date that a patient happened to fall ill, but could not respond to diversities in the types

182 If the correct restoration is indeed DIŠ *ina* ⁱᵗⁱGA[N U$_4$.12.K]ÁM LÍL.LÁ.EN.NA KI.SIKIL.LÍL.LÁ.EN.NA ZI-*ḫi* … ("If on Month 9 [Day 12] (i.e., sun-sign micro-Taurus), in order to remove *lilû* (and) *ardat lilî* demons …") in STT II, 300 (= MS A), rev. 8. See my remarks above on the twelfth day as an auspicious time to ward off these demons.

183 Spells for a "pure river" linked to the sun-sign micro-Capricorn, as well as spells for "overturning a judgment" linked to the sun-sign micro-Aquarius, are preserved only in MSS C and E. Neither of these manuscripts gives us enough information about original ritual dates or the sun's zodiacal sign(s) associated with the said purposes.

and features of sickness. On the other hand, ailment-based tablets like MSS B to E could indicate the sun's zodiacal positions associated with the remedy of particular misfortunes, but these positions were linked to specific dates of ritual origin and were not quite flexible enough to deal with the unpredictable times that sickness could occur. By disregarding the sun's zodiacal signs and focusing exclusively on its micro-zodiacal signs, MSS B to E extended the dates applicable for the remedy of particular ailments, increasing the likelihood that actual cases of sickness would coincide with such dates stipulated for their healing. On their own, however, tablets like MSS B to E could still not adequately cover all possible times that sickness could occur, and they remained silent where ritual materials or healing ingredients were concerned.

One wonders, therefore, if ailment-based tablets like MSS B to E could have been employed in tandem with hemerology-based Calendar Texts, in order to provide a more holistic solution to the problem of sickness. In fact, such methods are implied by other tablets of medical zodiology like LBAT 1598, which expresses the relationship: "When the moon is in {zodiacal name 1}, and the sickness / sick person is of {zodiacal name 2}, it … to {zodiacal name 3}." In my discussion of Tablet BM 56605 in the appendix, I suggest how the "moon" in LBAT 1598 may actually be the virtual moon. Whether or not this is so, Tablet LBAT 1598 seems to take into consideration two variables: (1) the (micro)-zodiacal position of a real or virtual "moon," and (2) the (micro)-zodiacal position implied by the identity or nature of sickness or the sick person.[184] The specific combination of these two variables results in a third (micro)-zodiacal position, whose significance is unfortunately not preserved in the broken tablet, but which very likely determines how the sickness is treated.

It is suggestive that, within the Calendar Text System, the same two variables are represented: (1) by hemerology-based Calendar Texts that relate the virtual moon's zodiacal and micro-zodiacal signs on particular dates to therapeutic materials from animals, woods, plants, and stones, and (2) by ailment-based tablets like MSS B to E that relate the sun's micro-zodiacal signs for any given month to the remedy of particular sicknesses. Moreover, it may not have appeared too radical to modify the significance of calendar time by zodiacal variables of sickness and the body, since the relationship between dates and ingredients in hemerology-based Calendar Texts were, after all, emblematic for

184 The prescriptions in Tablet BM 56605 (obv. 48–74) are apparently determined by the same two variables. See discussion in appendix.

only selected moments of time, i.e., at the end of the day when the virtual moon stays in its emblematic zodiacal sign (for a maximum of about 2½ hours) or micro-zodiacal sign (for a maximum of about 12 minutes). In the absence of clear procedural descriptions, such analogies with Tablet LBAT 1598 (and Tablet BM 56605) may present a working model for the practice of medical zodiology based on the Calendar Text System and its 'micro-zodiac of 13.'

7 Conclusion

In closing, we return to the theme of this volume concerning the circulation of astronomical knowledge. Without making too much of the word "circulation," perhaps the imagery of an unimpeded flow and assimilation of knowledge does not quite describe the complex ways that ideas in Calendar Texts and related cuneiform astrological tablets interacted with each other, their strategies for harmonizing essentially different but co-existing systems, as well as their piecemeal efforts to emblematize and incorporate selected astrological and medical features.[185] In fact, assumptions of standardization and consensus we have come to expect of scientific theory and practice may be brought into question here, since the same ancient astrologers seem to include in their repertoire fundamentally varied ways of imagining the heavens, and their tablets display a level of tolerance for dissonant astrological ideas.

GDBT tablets assigned prescriptions of wood, plant, and stone ingredients to the sun's 'micro-zodiac of 12' in ways that could not be readily calibrated with the 13 zodiacal signs of the moon in a month. Hemerology-based Calendar Texts, however, preserved such relationships between ingredient and micro-zodiacal sign by applying them instead to the virtual moon's 'micro-zodiac of 13,' even though *GDBT* tablets divide up the micro-zodiac in a manner irreconcilable with that of the Calendar Text System. While attempting to harmonize

185 Here, I avoid the notion of "accommodation" as articulated by Posner et al. (1982: 211–227) and the subject of much subsequent discussion, which inappropriately compares Piaget's definition of "accommodation" in individual pedagogy to Kuhn's notion of a "scientific revolution" involving significant social consensus and change. Pertinent to our study of Calendar Texts and related tablets, we find the adoption of only selected astrological features from varied systems rather than the wholesale replacement of an existing paradigm, and we get the impression that ancient astrologers could be tolerant of diverse schemata and did not always feel the need to explain or reconcile the discrepancies to themselves or to others.

GDBT tablets and Calendar Texts, it became important to consider specific combinations of zodiacal and micro-zodiacal signs, since the exclusivity of the meaning assigned to, say, the sun's micro-Aries of Aries in *GDBT* tablets (i.e., Month 1 Day 0–2½, not the whole of Month 1) might become nullified if the same astrological meaning were simultaneously valid for any zodiacal sign of the virtual moon's micro-Aries (i.e., whole of Month 1). On the other hand, it was strategic to disregard the sun's zodiacal signs and to utilize only its 'micro-zodiac of 13' in ailment-based texts of the Calendar Text System like MSS B to E, so that any one of these micro-zodiacal signs could be made applicable to dates in every single month, providing a more timely response to unpredictable occurrences of sickness.

Along with the tendency to underestimate the diversity of ideas (and tolerance for this diversity) in local and native contexts, it is easy to attribute innovation mainly to external sources or stimuli. While cosmopolitan culture and society in the final centuries BCE likely influenced Babylonian astrology, our study suggests that Calendar Texts were "Babylonian" not only because of their archaeological provenance in the cities of Babylon and Uruk or association with professionals like Iqīšāya and Anu-bēlšunu, but also because they display continuities with concepts and practices that were deeply rooted in the Babylonian and Mesopotamian past, even if the wine of old ideas now appeared in new wineskins. The notion that reciprocals were complements or completers of each other (expressed by the mathematical notation IGI) came to fruition in the rhetoric of cuneiform commentaries, where experienced objects and events were portrayed as only one half of reality, while their counterparts and deeper meanings (indicated by IGI) lay on the other side of the looking-glass beyond the realm of the senses. As the reciprocal of the real moon in the *Dodekatemoria* scheme, the virtual moon in the Calendar Text scheme therefore performed the part of signifier, even displacing the *GDBT* sun from this role in correlations made between micro-zodiacal signs and prescriptions of wood, plant, and stone.

Similar roots may be traced also for astrological schemes that presented alternatives to hemerology-based Calendar Texts. Though deviating from the 'micro-zodiac of 13' of the Calendar Text System, the 'micro-zodiac of 12' in *GDBT* tablets and those of the "Rising-Times Scheme" share analogous concerns for the rising of constellations and zodiacal signs at the eastern horizon, and it is not surprising that the twelve intervals of seasonal hours in sundial texts (marking shadow lengths formed by the rising sun) were each indicated by the term (*zittu*) used in other texts for a micro-zodiacal unit. Elsewhere, I discuss how drawings of constellations and planets in *GDBT* tablets reflect also dates of heliacal rising in older works like Mul-apin, as well as Tablet

LBAT 1591 (obv. 5–7).[186] On the other hand, ailment-based tablets related to the Calendar Text System (MSS B to E) were developed from older ritual calendar traditions exemplified in the Sultantepe tablet STT II, 300 (= MS A), by converting each ritual date into a corresponding micro-zodiacal sign of the sun. Such correspondences, however, could be inconsistent, because authors or copyists may not have had accurate access to older sources, because editorial choices may have prioritized one date over another (for whatever reasons), or because idiosyncrasies in local ritual calendars may have introduced variations to the dates. Furthermore, one wonders why correlations between ailments and micro-zodiacal signs did not follow what seems to be the more straightforward scheme in Tablet LBAT 1597 (see above), where, for example, micro-Gemini indicated "^{d}LUGAL.ÙR.RA-epilepsy" (rev. 1) because the eponymous deity (i.e., ^{d}LUGAL.ÙR.RA) was identified as one of the twin stars of the constellation Gemini.

We may never be entirely certain why some traditions and not others became precursors to later astrological and zodiacal schemes, but the evidence so far repeatedly depicts the Calendar Text System and its meanings as outgrowths of Babylonian intellectual and cultural history. By contrast, it is telling how seldom we are obliged to look to uniquely Greek or Roman ideas in order to find explanations for features in cuneiform Calendar Texts. Recourse to the classical conception of Aries as a ram in Calendar Texts SpTU III, 104 and 105, for example, is easily explained by the convenience of having the virtual moon-sign Aries prescribe "sheep" parts for therapeutic use. After all, the corresponding Babylonian name for Aries ("Hired Man") did not readily suggest an available ingredient.[187] But then again, Calendar Texts SpTU III, 104 and 105 prescribe "rooster" parts for the virtual moon's Gemini, alluding to the Babylonian constellation of the "Rooster" (Lepus?) in the zodiacal sign Gemini. The preferment of classical constellations in one instance and Babylonian constellations in another might strike one as whimsical, but such choices were driven by the same motivation of identifying (animal) materials that were readily (and perhaps cheaply) accessible for therapeutic purposes. The piecemeal fashion in which foreign elements were incorporated into cuneiform Calendar Texts certainly reveals openness by Babylonian astrologers to ideas from outside, but

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186 See my forthcoming publication and the acknowledgements mentioned in footnote 67.

187 The "goose" in Tablet LBAT 1593 (obv. 16′) may also be an allusion to the classical constellation Cygnus ("Swan") in the zodiacal sign Capricorn. Perhaps "goose" ingredients were more easily obtainable than "goat" ingredients, which the Calendar Texts SpTU III, 104 and 105 prescribe for the virtual moon-sign Capricorn.

FIGURE 6.8 *Photo of Reverse Side of Tablet BM 56605*
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also indirectly affirms their confidence in the larger framework, principles, and categories of the Babylonian Calendar Text System.

8 Appendix: The Cat and Its Zodiac Man

My discovery of the "Zodiac Man" (*Homo signorum*) in a cuneiform astrological table (BM 56605) has been entrusted to an Assyriological publication (*Journal of Cuneiform Studies*, 2015 issue), since my interpretation relies heavily on the ways cuneiform signs are read and would benefit from review and critique by other Assyriologists. In this appendix, however, I give a brief description of the context of this Zodiac Man, partly in answer to interest expressed by non-Assyriologists, partly because of suggestive connections between the astrological table and features of the Calendar Text System. This astrological table occurs on the reverse side of the British Museum tablet BM 56605, and a photo and schematic diagram of it may be found in Figs. 6.8 and 6.9.

♈	♉	♊	♋	♌	♍	♎	♏	♐	♑	♒	♓	
1	2	3	4	5	6	7	8	9	10	11	12	
2	3	4	5	6	7	8	9	10	11	12	1	
3	4	5	6	7	8	9	10	11	12	1	2	
4	5	6	7	8	9	10	11	12	1	2	3	
5	6	7	8	9	10	11	12	1	2	3	4	
6	7	8	9	10	11	12	1	2	3	4	5	
7	8	9	10	11	12	1	2	3	4	5	6	
8	9	10	11	12	1	2	3	4	5	6	7	
9	10	11	12	1	2	3	4	5	6	7	8	
10	11	12	1	2	3	4	5	6	7	8	9	
11	12	1	2	3	4	5	6	7	8	9	10	

FIGURE 6.9 *Diagram of Astrological Table on Tablet BM 56605, Reverse*

As early as 1988, British Museum curator I. Finkel remarked on this "mysterious table of astrological significance."[188] N. Heeßel published an edition of Tablet BM 56605 in 2000 and later revisited the material in shorter articles (2005 and 2008) without changing his interpretation of it.[189] Heeßel thought it problematic that only eleven (not twelve) rows are numbered (i.e., Rows 3–13), since each row seems to be concerned with a division of a 'micro-zodiac of 12,' and he therefore speculated that Row 2 (unnumbered and shaded uniformly in Fig. 6.9) was initially omitted by mistake and inserted in its present location only later.[190] In Fig. 6.10, I have reinterpreted the cuneiform signs read by Heeßel and affirmed that Row 2 does in fact belong at the top of the astrological table, as a kind of heading that correlates zodiacal names with parts of the human body. The pattern of correlation echoes descriptions of the Zodiac Man in numerous classical and medieval sources,[191] and it is pos-

188 Finkel (1988: 147 n. 29).

189 Heeßel (2000: 112–130, 468–469, Tafeln I and II), (2005: 8), and (2008: 11–14). Minor changes to Heeßel's readings were later proposed by Geller (2010: 74–77).

190 Heeßel (2000: 114–116) and (2008: 12 n. 37).

191 The earliest description of the Zodiac Man is often ascribed to Marcus Manilius (*c.* 10–30 CE), *Astronomica* II, 453–465; cf. IV, 701–710: "The Ram is allotted the head as Princeps of all, and the handsome neck is given by census to the Bull. To the Twins are inscribed the arms joined to shoulders. The breast is allocated to the Crab. The reign over sides and shoulder blades belongs to the Lion. As her individual lot, the lower abdomen

Column	Zodiacal Name (Row 1)	Heeßel's Reading of Constellations, etc. (Row 2)	My Reading of the Zodiac Man (Row 2)	My Translation (Row 2)
1	Aries	⸢KA⸣	⸢SAG⸣	Head
2	Taurus	⸢X⸣.GÚ	⸢X⸣ GÚ	… Neck
3	Gemini	TI$_8$.⸢MUŠEN⸣	Á ⸢MAŠ.SÌL⸣	Arm, Shoulder
4	Cancer	⸢X⸣	⸢GABA⸣	Chest
5	Leo	ŠÀ⸣.BI	⸢*lìb*⸣-*bi*	Belly / Heart
6	Virgo	GU$_4$.MURUB$_4$	GU$_4$.MURUB$_4$	Waist
7	Libra	GU	ḪAR(?)	Insides(?)
8	Scorpio	ŠÀ.A	PEŠ$_4$	Female Genitalia
9	Sagittarius	ALLA.BI	TUGUL	Hip / Upper thigh
10	Capricorn	X X	*kim-ṣa*	Knees / Shins
11	Aquarius	ÚR?	ÚR	Leg
12	Pisces	⸢X"⸣	⸢GÌR⸣.2	Feet

FIGURE 6.10 *Reinterpreting the Cuneiform in Astrological Table* (BM *56605, Reverse*) *Row 2*

sible that Tablet BM 56605 represents our earliest account of the Zodiac Man so far.[192]

Because of damage to the tablet's surface and the cursive nature of the script, readings for several other cuneiform signs in the astrological table remain uncertain. On the whole, however, each numbered square seems to include the name of an animal (e.g., "cat," "wolf," "bull"), perhaps similar to the kinds of animals whose skins appear in prescriptions on the obverse side of Tablet

falls to the Maiden. The Scales rule over the buttocks, and the Scorpion delights in the groin. The thighs assent to the Centaur. Capricorn commands both knees. The pouring Waterman arbitrates the lower legs, and the Fishes adjudicate the feet." My translation of this passage relies on the Latin in Scarcia, Flores, and Feraboli (1996: I, 140; II, 144). For post-classical attestations of the Zodiac Man, see the dissertation by Clark (1979), along with shorter surveys with bibliography in Bober (1948), Clark (1982), and Winiarczyk (2013).

192 Tablet BM 56605 includes no explicit date and names no datable person, but it has been vaguely described as Late Babylonian by Finkel (1988: 147 n. 29) and Geller (2010: 74) or Hellenistic / early Parthian by Heeßel (2000: 112) and (2008: 11). Note, however, the view by Popović (2007: 170) that "although the concept of *dodecatemoria* is Babylonian, the specific idea of *melothesia* lacks any decisive evidence for a Babylonian origin."

BM 56605 (obv. 48–74) (see discussion below).[193] A clue to interpreting the table may be supplied by another tablet dealing with dream incubation (BM 33535), based on positions of the virtual moon in the Calendar Text System.[194]

Tablet BM 33535

obv. 1–4: Twins (micro-Gemini) of Pabilsag (Sagittarius): Lagaš … -wood, white *kiškanû*-wood, black *kiškanû*-wood, red *kiškanû*-wood, *elpetu*-plant,[195] *amīlānu*-plant, *engisû*-stone, *anzaḫḫu*-glass, …,[196] … -stone. (Skin of ?) cat (SA.A).[197]

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193 The information in BM 56605, obv. 48–74 is duplicated (with minor differences) in Tablet BM 47755 and closely related to that of Tablet YBC 9833. See Heeßel (2000: 124–125) and Geller (2010: 74–77). Though it is easy to focus on BM 56605 due to its better state of preservation and its astrological table, there are indications that its readings may be corrupted and inferior to those of the other tablets. Note, for example, the body parts transcribed by Heeßel and Geller as ku-a-mu-u *u* MAŠ.SÌL (BM 56605, obv. 65). Heeßel (2000: 120, 122) did not translate the signs ku-a-mu-u (BM 56605, obv. 65), while Geller (2010: 76, 77 n. 161) considered them a scribal error for *qumāru* ("upper shoulder"). The cuneiform here, however, could be a corruption of the signs [ŠU] 150-*šú šá-niš* MAŠ.S[ÌL], "his left hand or shoulder" (BM 47755, rev. 21), with ŠU possibly mistaken for KU, 120(two vertical wedges) for A, and *niš* for U+U. The expression [ŠU] 150-*šú šá-niš* MAŠ.S[ÌL], "his left hand or shoulder" (rev. 21) is, moreover, analogous to ⌜ŠU⌝.2 15-*šú u* MAŠ, "his right hand and shoulder" (obv. 13) on the same tablet BM 47755. Furthermore, what is presented as the body part *pu-qut-ta-šú* (BM 56605, obv. 71) appears elsewhere more plausibly as the ingredient $^{\text{giš}}$*pu-qut-tú*, "thorn(bush)" (YBC 9833, rev. 13). Heeßel (2000: 120, 123) translated *pu-qut-ta-šú* (BM 56605, obv. 71) as "seine Eingeweide," perhaps because the intestines were compared to the thornbush in extispicy (BRM IV, 13:49 in CAD P, 515). Geller (2010: 76, 77 n. 162) understood the signs instead as *bu-bat-ta-šú* ("his boils"), but this interpretation deviates from the usual pattern in BM 56605, obv. 48–74 that describes how a normally healthy *body part* hurts the sick man, rather than how a *medical sign or symptom* inflicts the pain. Finally, though the writing *giš da a* (BM 56605, obv. 71) has been related to *is lê* ("Jaw of the Bull (Taurus)," i.e., the Hyades) in Heeßel (2000: 123, 127) and Geller (2010: 76 n. 160), the sequence of constellations named in Tablet BM 56605 (obv. 48–74) suggests that it should be identified instead as a constellation in the vicinity of Sagittarius and Capricorn.

194 For the full edition and translation of BM 33535, see Hunger (2007: 141–144).

195 Instead of Ú.NI[R]$^{?}$ (BM 33535, obv. 2) in Hunger (2007: 141), I have read the signs as $^{\text{ú}}$NU[MUN$_2$] ("*elpetu*-plant").

196 Here, Hunger (2007: 141–142, 144) has *šá 2-i eṣ-pu* (BM 33535, obv. 4), "which is multiplied by$^{?}$ two." The meaning of this is obscure, and it is possible the signs mean something else.

197 Hunger (2007: 141–142) transcribed the signs NA$_4$ ḫe-e$^{?}$-en-zu : SA.A (BM 33535, obv. 4) and translated them as "… -stone. SA.A." I have understood SA.A as a reference to the "cat."

5–6: Twins (micro-Gemini) of Pabilsag (Sagittarius): Day of the city god, the twins, Sîn (and) Šamaš, (and) Nergal. Feast of Ninurta.[198]

7–13: In Simanu (Month 3), from Day 1 to Day 30, let the man wash himself, … let him sleep on the roof … the gods of the night will speak with him.

14–15: Wrap in donkey-skin with donkey-sinew, with a string of blue-purple wool,[199] and place on his neck.

16: Twins ((micro?)-Gemini): *Ḫaluppu*-wood, … -bird.

rev. 1–4: Crab (micro-Cancer) of Pabilsag (Sagittarius): Mutabal. *Ḫaluppu*-wood, *šaššūgu*-wood, … -plant, seed of *urṭû*-plant, iron ore, copper ore, *mūṣu*-stone. Skin(?) of cat (SA.A).[200]

5–6: Crab (micro-Cancer) of Pabilsag (Sagittarius): Day of the city god, Šamaš judge of the land, and Šulpa'e. Opening of the gate.

7–12: In Du'ūzu (Month 4), from Day 1 to Day 30, let the man wash himself, … let him lie on a bed and sleep, his goddess will speak with him.

13–14: Wrap in horse-skin with horse-sinew, with a string of red wool, and place on his neck.

15: Crab ((micro?)-Cancer): *qaqû*-bird, apple$^{?}$-wood.

The texts grouped together in sections above are each demarcated on the tablet by horizontal lines. Along with the unnecessary repetition of titles like "Twins of Pabilsag" (obv. 1 and 5) and the disjointed way that sections are linked

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If the animal "cat" (*šurānu*, logogram SA.A) here and in Tablets BM 56605 // BM 47755 // YBC 9833 reflects an actual "Cat" constellation, it predates and probably differs from the constellation Felis. For the interpretation that the skin of this animal is in view, see my comments on BM 33535, rev. 4 below. Because of the identity of the stone (NA$_4$) is uncertain, it is unclear whether *en-zu* might refer to the "she-goat" or whether the sign transcribed ZU is actually KUŠ ("skin"; cf. BM 33535, rev. 4).

198 Here, the micro-zodiacal sign "Twins" ($^{\text{múl}}$MAŠ.MAŠ) evokes the divine "twins" (written here as *māšū*, perhaps for $^{\text{d}}$MAŠ.TAB.BA), the twin-like complementarity of sun (Šamaš) and moon (Sîn) deities, the god Nergal (written here as $^{\text{d}}$U.GUR but elsewhere as $^{\text{d}}$MAŠ.MAŠ), and the god Ninurta ($^{\text{d}}$MAŠ).

199 DUR SÍG ZA.GÌN.NA ("string of blue-purple wool") at BM 33535, obv. 14, and DUR SÍG SA$_5$ ("string of red wool") at BM 33535, rev. 14, are not differentiated in the translation by Hunger (2007: 143).

200 Hunger (2007: 142) transcribed the signs GIŠ$^{?}$ SA.A (BM 33535, rev. 4) and translated them as "… SA.A." The reading may be KUŠ$^{?}$ SA.A ("cat-skin"), which is also mentioned in BM 56605 obv. 49 // [BM 47755, rev. 6] // YBC 9833, obv. 1. On the other hand, it is uncertain if KUŠ ("skin") appears at the analogous position in BM 33535, obv. 4.

together, they suggest that Tablet BM 33535 represents a collection and presentation of (micro)-zodiacal or hemerological information from various sources. As I pointed out earlier, the micro-zodiacal signs "Twins (micro-Gemini) of Pabilsag (Sagittarius)" for Month 3 and "Crab (micro-Cancer) of Pabilsag (Sagittarius)" for Month 4 must belong to the virtual moon, since the virtual moon repeatedly (in one-day intervals) returns to the micro-zodiacal sign that agrees in number with its month. Furthermore, we are fortunate that Calendar Text LBAT 1586+1587 (obv. 3–4, rev. 9–10) preserves the same combination of micro-zodiacal and zodiacal signs as Tablet BM 33535 (obv. 1), so that, in both tablets, the virtual moon-sign "micro-Gemini of Sagittarius" displays the same relationship to the city of Lagaš.

Despite some ambiguities in the cuneiform readings, the unmistakable pattern of signs SA.A ("cat") may be discerned at the end of sections (BM 33535, obv. 1–4 and rev. 1–4) that correlate the virtual moon's micro-Gemini of Sagittarius (i.e., micro-sign 3 of sign 9) and micro-Cancer of Sagittarius (i.e., micro-sign 4 of sign 9) with cities, woods, plants, and stones. Significantly, in the astrological table of BM 56605, the same label SA.A ("cat") appears in two squares inscribed with the number "9" in Columns 3 and 4 (both squares shaded with diagonal lines in Fig. 6.9). If we were to assume that the astrological table (BM 56605) expresses the same relationships as BM 33535, then the first twelve columns of the table would correspond to the twelve months, and the zodiacal name at the top of each column would indicate the virtual moon's micro-zodiacal sign for that month, while numbers inscribed in the squares below would refer to the virtual moon's zodiacal sign for the given month.[201] Note that the consecutive ordering of the virtual moon's zodiacal signs in each month column means that the *days* corresponding to these signs do not appear in consecutive order.[202]

201 One also wonders if the skin of "a female kid" (MUNUS.ÁŠ.GÀR) for the virtual moon's micro-Pisces in BM 76483 (rev. 15′–16′) relates in any way to "she-goat" (ÙZ) in Col. 12 Row 7 (square with number "4") of the astrological table (BM 56605, rev.). See my hypothesis earlier why zodiacal names of Tablet BM 76483 (along with SpTU II, 49 and perhaps BM 77971) refer to the virtual moon's micro-zodiacal signs.

202 The pattern of numbers in the astrological table (BM 56605) closely resembles the pattern of the (real) moon's zodiacal signs in numerous medieval exemplars of a Moon-sign Chart (a kind of lunar ephemeris), where the columns indicate consecutive months and the rows indicate consecutive days during which the moon occupies each zodiacal sign. To give but one prominent and accessible example, note the crescent moon pictured at the top left corner of the chart beside the image of a Zodiac Man in the Catalan Atlas. If the astrological table in BM 56605 originally depicted zodiacal and micro-zodiacal signs of the *virtual* moon, then the days of each month column obviously do not run consecutively as

According to this interpretation, the astrological table functions as an instrument for figuring out animal materials (perhaps skins?) prescribed by different permutations of micro-zodiacal and zodiacal signs of the virtual moon. Its relationship with the animal-skin prescriptions on the obverse side of Tablet BM 56605 (obv. 48–74) is still the subject of ongoing research. In fact, these latter prescriptions (e.g., "place cypress in cat-skin on his neck" in BM 56605, obv. 49) appear more similar to statements like "wrap in donkey/horse-skin with donkey/horse-sinew … and place on his neck" (obv. 14–15; rev. 13–14) rather than itemizations like "(skin of ?) cat" (obv. 4; rev. 4) in Tablet BM 33535 (see above). It is possible that, in both tablets BM 33535 and BM 56605, information collected together from diverse sources do not always relate to each other in clear-cut ways. In contrast to the transparent reasons for connecting zodiacal signs to general animal parts (e.g., blood, fat, hair) in Calendar Texts SpTU III, 104 and 105, it is less evident how specific combinations of the micro-zodiac and zodiac (in BM 33535 and the astrological table of BM 56605) were linked to materials from particular animals.

In any case, it is worth thinking about the zodiacal variables implied by both the astrological table on the reverse of BM 56605, as well as the prescriptions on its obverse side. While permutations of the virtual moon's zodiacal and micro-zodiacal signs in the astrological table could be a function of Calendar Text dates, the presence of the Zodiac Man in Row 2 (see Fig. 6.9) strongly suggests that these permutations were influenced by variables of human body parts, perhaps those parts that experienced pain or sickness. The prescriptions on the obverse of Tablet BM 56605 (obv. 48–74) confirm this impression, and they all exhibit the pattern below:

> If, while the sick man *ditto* (i.e., sleeps / travels ?),[203] {constellation, perhaps representing a (micro)-zodiacal sign} touches him, (and) his {body part} hurts him; place {wood} in {animal skin} on his neck, salve with oil, and he will recover.

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they do in medieval Moon-sign Charts. However, as I consider below, relationships in the astrological table (BM 56605) may not have been originally or exclusively applied to the virtual moon, and perhaps it was Tablet BM 33535 that expressed such relationships in ways that made the virtual moon a signifier (in accordance with practices elsewhere).

203 Heeßel (2000: 126) considered "*ditto*" (MIN) here to designate "eine Zeit-, Orts- oder Tätigkeitsbeschreibung des Patienten," and the term is used without explanation in Geller (2010: 76–77). The nearest antecedent for *ina* MIN (BM 56605, obv. 48) that makes good sense is *ina a-lak gi-ru* (obv. 44), "during a journey," but another good alternative may be *ina ṣa-la-li-šú* (obv. 42), "while he sleeps."

In other words, based on variables of (1) the {constellation or (micro)-zodiacal sign} that touches the sick person and (2) the specific {body part} that hurts him, the astrologer would be able to figure out therapeutic materials (a kind of {wood} in a kind of {animal skin}) that are needed to heal the patient. Though it is not completely clear how information on the obverse and reverse sides of Tablet BM 56605 relate to each other, the astrological table would answer to the two variables above if (1) the micro-zodiacal and zodiacal signs that "touch" the sick person are those of the virtual moon, and (2) the body part that "hurts" the patient somehow modifies the first variable according to correlations indicated by the Zodiac Man. If this interpretation is correct, another way of phrasing it may be evident in Tablet LBAT 1598:

> When the (virtual) moon is in {zodiacal name 1}, and the sickness / sick person is of {zodiacal name 2}, it … to {zodiacal name 3}.

Incidentally, if the so-called "moon" in Tablet LBAT 1598 is, in fact, the virtual moon (as the interpretation above requires), this would constitute one more example (in addition to Tablet 1586+1587) where the derivational relationship between real and virtual moons is emphasized by their use of the common label "moon." Furthermore, repeated emphasis of the same two variables in different texts may lend some support to our suggestion earlier that (1) hemerology-based Calendar Texts expressing the virtual moon's (micro)-zodiacal position and (2) ailment-based tablets of the Calendar Text System like MSS B to E could have been employed together.

I offer the above explanation as one possible interpretation of Tablet BM 56605, being fully aware that various points of my argument are based on conjecture. It is my hope that further study of these tablets and others may bring more clarity to the fascinating practices of medical zodiology, whether or not these relate to the Calendar Text System. As a matter of fact, it is not incontrovertible that Tablet BM 56605 and its astrological table must be included within the Calendar Text System. As we saw earlier, ingredients ascribed to the sun's micro-zodiacal signs in *GDBT* tablets could be made features of the virtual moon's micro-zodiacal signs in Calendar Texts, in acknowledgement of the virtual moon's role as the reciprocal complement of the real moon and signifier of its deeper meaning. It is possible, therefore, that connections between zodiacal permutations and animal materials preserved in the astrological table (BM 56605) did not originally concern the virtual moon, but were made to do so in Tablet BM 33535, out of similar motivations to depict the virtual moon as a signifier of meaning.

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CHAPTER 7

On the Concomitancy of the Seemingly Incommensurable, or Why Egyptian Astral Tradition Needs to be Analyzed within Its Cultural Context

Joachim Friedrich Quack

As it is well known, the famous historian of astronomy Otto Neugebauer held a very low opinion of Egyptian astronomy. More precisely, he coined the (in)famous statement "Egypt has no place in a work on the history of mathematical astronomy".[1] How did he arrive at such a harsh judgment and to which degree is it justified? Neugebauer's dictum was, obviously, a counterpoise to the high renown which the Egyptians enjoyed in Greek and Latin texts as far as astronomy was concerned. It went hand in hand with his high esteem of Mesopotamian astronomy.

For the evaluation of Egyptian astronomical knowledge, much was decided at the time when Neugebauer early in his career, in the late 1930s, collaborated in the edition and commentary of two papyri with astronomical content, namely papyrus Carlsberg 1 with a text on celestial matters, especially the decans,[2] which partially reproduced textual material already attested in the Osireion of Abydos under king Seti I, and pCarlsberg 9, a schematic calculation of lunar months.[3] In resuming what sort of astronomy he got out of them and the already known demotic Egyptian planetary tables, he commented on their primitive state which could in no way match the contemporary Mesopotamian testimonies of highly developed mathematical astronomy.[4]

Perhaps even harsher, but also less well known than Neugebauer, is a remark by Bartel Leendert van der Waerden. He remarked that the whole decan astron-

1 Neugebauer (1975: 559).

2 First edition Lange and Neugebauer (1940), see below for more recent editions and discussions.

3 First edition Volten and Neugebauer (1938); later Neugebauer and Parker (1969: 220–225); additional fragments in Zauzich (1974); Hoffmann (1997). For the interpretation of the text, see lastly Depuydt (1998), Krauss (2012: 27 f.).

4 Lange and Neugebauer (1940: 73.75).

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omy was a product of the Middle Kingdom and later was simply copied down without updating. The Egyptian scholars were supposed to have nothing more advanced than long surpassed theories on the decans at hand, or else they would have provided something better for the mighty king Seti I.[5]

Perhaps the most noticeable point about Neugebauer's and van der Waerden's statements is what remains unstated because it was considered as self-evident, namely that the only possible reason an Egyptian at Tebtunis in the Roman period could have studied a text on the decans was to gain astronomical knowledge. This is far from self-evident. For example, nobody would argue that Otto Neugebauer or Bartel L. van der Waerden must have had a very low competence in astronomy because they studied a very simple and schematic way of dealing with the decans in an ancient Egyptian papyrus.

As a matter of fact, by now, including unpublished texts whose existence is known to me, there is clear evidence for an enormous amount of quite different texts relating to astral lore which were in circulation in Graeco-Roman Egypt. I will try to present them in a typological order, because a purely chronological arrangement according to the date of the preserved manuscripts does little justice to the chronology of the real historical development—too much is distorted by the chances of preservation.[6] At the outset, I can already state that Egyptian temples play an important role as far as astrology in Graeco-Roman Egypt is concerned,[7] and material from temple libraries will be at the core of this paper, especially from Tebtunis in the south of the Fayum area.

At Tebtunis, we have remnants of two papyrus copies of hieroglyphic inscriptions which originally were engraved in some tombs of the Early Middle Kingdom in Assiut, Middle Egypt. They preserve, among other texts, a version of the so-called "classical sky image" comprising also the decans, Egyptian stellar entities corresponding roughly to a third of a zodiacal sign.[8] This is a complex image with text which dominated our record of preserved astronomical decoration of monuments for many centuries. However, the latest safely dated attestations are from about the third century BCE.[9] Afterwards, private mon-

5 Van der Waerden (1968: 24).

6 For overviews of unpublished material see Ryholt (2005: 152 f.); Winkler (2009); I am basing myself on direct knowledge of the manuscripts.

7 Jones (1994: 39–46). See also Evans (2004: 24–36), who tries to link astrology mainly to the Serapis temples, although this is hardly warranted by the evidence. See also Dieleman (2003).

8 Osing and Rosati (1998: 22–24).

9 The coffin of Harendotes can be dated quite precisely to the reign of Ptolemy III because the owner has titles linking him to the dynastic cult of the Ptolemaic kings, see Quaegebeur (1995:

uments tended to abandon the decans altogether (in the Roman period they often have recourse to the "modern" concept of the zodiac), whereas in public monuments, only the Seti I B- and the Tanis-family of the decans with their special, and quite different, iconographies remained in use. So, we have to pose the question what purpose these papyrus copies served. The most likely explanation is that they formed part of the cultural memory which continued to be copied. We have to take into account, for this question, that the astronomical decoration only forms part of a substantially larger body of copies of the decoration of several tombs in Assiut of the early Middle Kingdom. Somehow they entered a stream of tradition and became a canonical item of the culture.[10]

Somewhat similar are attestations of some constellations as well as the decans in a fundamental work compiling religious knowledge which normally goes under the only partially justified title of "geographical papyrus".[11] By now, we have attestations in one hieroglyphic papyrus from Tanis,[12] as well as one hieroglyphic[13] and two hieratic papyri from Tebtunis.[14] It is likely to have originally comprised, in the astronomical section, the decans according to the Tanis- as well as the Seti I B-family. It should be stressed that this is a fundamental text assembling traditional Egyptian knowledge, with a strong religious background.[15]

The religious background is equally strong in a badly preserved semi-demotic text from Roman period Tebtynis which discursively treats the decans and other astral phenomena by linking them with mythological background.[16]

I would also like to mention a very substantial composition which is stylized as a dialog between Imhotep, the well-known sage who was divinized in Egypt, and a king.[17] It concerns the temple, and more particularly, the correct times for festivals as well as the symbolic meaning of certain parts of the temple. A substantial part is given to astral phenomena. The text speaks of sun, moon and the five planets, mentions seven places of rising (obviously linked to them)

142–144); Verhoeven (2001: 82). The tomb of Petosiris at Atfih which is quite schematically dated to 150 BCE by Neugebauer and Parker does not really allow a close dating.

10 For other material from this batch, it can also be demonstrated how the Assiut inscriptions became a cultural model, see Kahl (1999).

11 Lastly studied by Leitz (2014).

12 Petrie and Griffith (1889: pl. IX).

13 Osing and Rosati (1998: 25 f.; pl. I).

14 Osing (1998: 221–224, pl. 23).

15 Stricker (1944); Yoyotte (1960); Osing (1999).

16 Quack (2004).

17 Quack (2014: 54–57).

and gods appearing in the sky. It is obvious that this important role of celestial phenomena accords with the substantial role of astral motives on the ceilings of Egyptian temples especially of the Late Period, but at the current state of analysis of this composition, I would prefer to decline delving more in the details.

In order to develop this point a bit further, I would like to say a bit about astral motives in the actual archaeological record. On the public monuments (i.e. mostly temples), planets are normally shown either in their astrologically determined "places", or in their equally astrologically determined hypsomata. Private objects (mostly coffin lids or tomb ceilings) usually display the planets and constellations at the moment of the birth of the owner. There is less difference between those two decoration concepts than it seems at first, because the position of the planets in their "places" is actually nothing other than their position at the moment of the birth of the world.[18] Public monuments, being connected with the world as a whole and not merely with a specific person, obviously chose that positioning.

There is also an evident religious background in the composition which served as starting point for Neugebauer's position. By now we have a substantially better knowledge of what is actually attested. The text, called "fundamentals of the course of the stars",[19] is a composition aiming originally at giving a religious background to all phenomena of the sky, not only the stars, but also the sun, the moon with its phases, probably the planets,[20] and in one section even the migratory birds. It is, in its core parts, a very old text, probably going back to the Old Kingdom (third millennium BCE).[21] It combines pictures with accompanying texts. At the time of its oldest preserved copy, in the Osireion at Abydos under Seti I, the text already had suffered considerably in transmission, with garbled writings, errors in the calendar dates, and major lacunae in some sections. At Tebtunis, the text appears in several quite different forms. There are fragments of a version with drawing and hieroglyphic text of which only small parts survive. Then there are three different papyri transmitting the text in hieratic writing without images. Finally there are two different papyri which give parts of the text with a demotic translation and a commentary, drawing on quite a number of Egyptian books which are explicitly cited. One of those

18 For a more detailed argumentation, see Quack (in preparation).

19 New edition von Lieven (2007), see there 125 f. for the question of the title. A substantial discussion of this text will appear in Quack (in preparation). The proposals by Klotz (2011) are quite completely erroneous.

20 This has been disputed by Leitz (2008/2009), but see von Lieven (2012).

21 Disputed by Werning (2013). A detailed reply will be published elsewhere.

two papyri is pCarlsberg 1 which was used by Neugebauer as a principal witness for his negative judgment of Egyptian astronomy. The text can be better understood if we situate it as a case where the Egyptians struggled to make sense of their old cultural traditions.[22]

Perhaps this is the right point to discuss also in more detail pCarlsberg 9 which was the second Egyptian text which considerably influenced Neugebauer's position. By now, it should be clear that the practical application of this papyrus is about the service of priests in the temple.[23] There are not only some comparable texts in Greek language[24] but also good evidence that the phyles of priests on duty in the temples rotated according to a schematic calendar which could be off for some days as far as astronomical accuracy is concerned but had the great advantage of allowing an easy advance planning. A good point of comparison might be modern calculations of the Easter day which are also quite schematic and not infrequently actually violate what is astronomically defined as the Sunday after the first full moon in spring. Nevertheless they continue to be used in our culture without in any way constituting proof of low astronomical competence. We can be fairly certain that this method of schematic lunar dates was developed in Egypt itself because it functions only with the Egyptian year of 365 days, but no leap-day.[25]

We have documentation for several astronomical Tables in demotic Egyptian, planetary as well as lunar positions.[26] Normally, they show the application of mathematical methods and are thus comparable in structure to the astronomical cuneiform texts from Mesopotamia.[27] Indeed it is not unlikely that they came about under Mesopotamian influence, but regardless of the

22 To some extent, this can be compared with the situation in Mesopotamia where the old Omen Series *Enūma Anu Enlil* received new commentaries even in the Seleucid Period, see Frahm (2011: 129–166 and 332–338), when it was by no means the most up-to-date collection of astral knowledge.

23 Lippert (2009); Bennet (2008); Krauss (2012: 23–43).

24 Neugebauer and Turner (1949–1950) (pRylands 666).

25 Turner and Neugebauer (1949–1950: 83). A different opinion (derivation from Mesopotamia) is held by Spalinger (1994a: 57 note 15 und 59 note 42); Spalinger (1994b: 11–13).

26 Neugebauer and Parker (1969: 220–252 u. 254f., pl. 65–79); for the planetary table of pBerlin 8279 see the additional fragment published by Hoffmann (1999); for a lunar ephemeris see Hoffmann and Jones (2006/2007). Unpublished fragments of astronomical nature can be found in the papyrus collection of the EES in Oxford, especially a primary lunar table (Edition together with A. Jones in preparation). An overview mainly of the Greek-language material but including the demotic Egyptian tables and with further references is given in Jones (1999).

27 For those see Neugebauer (1955); Ossendrijver (2012).

"copyright", the important point I would like to make is that in Egypt in the Roman period, up-to-date mathematical astronomical tools were available. In turn, the remark by Alexander Jones that Egypt was likely the place where the Greeks encountered the mathematical astronomical methods derived from Mesopotamia,[28] gains in probability from the ongoing exploration of the demotic sources. In that perspective, Graeco-Roman Egypt should no longer be seen as a backwater, but as a hotbed of technological transfer.

Tables are based on procedure texts indicating how to calculate the positions of the planets. There actually are at least a few demotic papyri of this nature. One of them, badly preserved and from Roman period Tebtunis (now in Florence), has already been published by Neugebauer and Parker.[29] Another one, about the way of calculating the rising of Venus, has been found during the recent excavations of the Franco-Italian team at Tebtunis and is still unpublished.

Demotic Egyptian Horoscopes in rather substantial quantities are known by now.[30] They cover the time from about the end of the Ptolemaic period till the late second/early third century CE. I do not intend to make a formal statistical analysis of them because the documentation is strongly distorted by a few exceptional find-spots like Narmouthis. Still, it can be noted that in the earlier phases, demotic horoscopes can rival in number with the Greek ones but drop out after the early third century CE while the documentation in Greek language continues much longer. This goes hand in hand with the

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28 Jones (1994: 46–48).

29 Neugebauer and Parker (1969: 250–252). The number "44" they give it does not correspond to the actual numbering system. Their decipherment and translation can be improved in a few places. Most notably, l. 4 at the beginning read [*ḥr*] *ḫpr ỉp* 'the number of days comes about', in l. 6 and 7, *ỉ:ỉry* can only be the imperative 'make' (the interpretation as participle advocated by Neugebauer and Parker is excluded because no main verb is following).

30 The ones then known are assembled in Neugebauer (1943); new editions are Neugebauer and Parker (1968); Nur el-Din (1974: 264f. T. 25) (Nr. 333, see for that Quack (1994) and Goebs (1995)); Parker (1984); Devauchelle (1987: 137f.); Ross (2006a); Ross (2006b); Ross (2009a); Ross (2009b); Ross (2011); Quack (2008/2009); an unpublished one from Elephantine will be published by F. Hoffmann. See also the list of birth dates in Hoffmann (1995); Gallo (1997: 89 Nr. 84); similar Greek ones in Baccani (1989); Baccani (1995); Bastianini and Gallazzi (1995); Pintaudi (2011–2012); in oMM 1229, see Menchetti and Pintaudi (2007: 234–241 and 265–269). Raw data as well as documentation of the life of astrologers is presented in Menchetti (2009) with some problematic translations; for example, OMM 1198 understand l. 6f. rather "which are worthy to get the impious one in distress" and l. 10f. rather "his time of life is (written) below it"; OMM 1545, l. 3 read *ḫftỉ* "enemy" instead of *ll*, as demonstrated by Quack (2006/7: 178).

increasing abandonment of demotic Egyptian writing from the third century CE onwards in general.[31] Another point worthy of notice is that all demotic Egyptian horoscopes published so far are written on ostraca while the Greek ones typically are written on papyrus, in a few cases as graffiti on walls.[32] That might be an indication that there was a difference in wealth between clients preferring demotic Egyptian and those preferring Greek. This divide does not necessarily have to be based on ethnicity; it is likely that the Egyptian elite in the Roman period was largely bilingual.

Of course, tables as well as procedure texts constitute nothing more than the tools an astrologer needs to establish the horoscopes as such. For interpreting them, other manuals are needed which provided what the position of a planet in a zodiacal sign or in a house etc. really means.

The number of demotic astrological treatises[33] is remarkably large, but up to now has been little known because most of the important manuscripts are still unpublished, and they have rarely been the favorite choice of editors. Given that there is a special paper by Andreas Winkler in this volume, I will not go into too many details. Globally, there are several different types. The first category of astrological texts includes those concerned with universal (judicial) astrology—predictions for the king and the country. They might announce things such as military success of one kingdom against the other, the death of rulers, the positive or negative things happening to their children and their courtiers, drought or high Nile inundations and other meteorological phenomena (e.g. wind or rain), good or bad economic prospects, even the prospect of wild beasts, birds, crocodiles etc.[34] Among these, by far the most typical are predictions based on the heliacal rising of Sirius. One published specimen with the preserved title *nꜣ sḫn.w n spṭ.t* "the prognoses of Sirius" is the demotic papyrus Cairo CG 31222,[35] dating to Roman Imperial times (about 2nd century CE). The preserved part treats the position of the planets in different zodiacal signs at the time of the heliacal rising of Sirius. There are probably at least 11 additional unpublished manuscripts of this type in Copenhagen, Florence, Ann Arbor, New Haven, London and Oxford.

Other texts of universal astrology include a treatise in the Vienna collection which derives prognoses from eclipses and other events of the moon, dating to

31 Zauzich 1983; Yiftach-Firanko (2008).

32 See the material in Neugebauer and van Hoesen (1959) and Baccani (1992).

33 For Demotic astronomical and astrological texts, see the general overview in Hoffmann (2000). See also the (incomplete) enumeration of demotic astrological texts in Ross (2007).

34 For an overview see Quack (in press a).

35 Hughes (1950), improved translation in Quack (in press a).

about the late first century CE and coming from Soknopaiou Nesos.[36] This treatise, or at least the first part of it, is quite certainly derived from Mesopotamian models. In view of the specific correlation between the Egyptian calendar and the Babylonian month names, the archetype is likely to date to the time from about 625–482 BCE. Potentially helpful is also that Kim Ryholt could identify a partially destroyed royal name in the text as that of king Nekhepsos of the Saïtic period,[37] whose rule from 610–595 falls squarely into the time-frame set by the astronomical dates for the correlation of the months. Also a specific linguistic feature in the formation of the conditional clause is in accord with an early date of the composition.[38] All told, we can with some degree of confidence say that this is a case of the transfer of astral knowledge which took place probably during the final years of the Neo-Assyrian Empire, or perhaps just its aftermath when it was exactly king Nekhao II (Nekhepsos) who came to the aid of the last Assyrian throne pretenders.

Another category of astrological treatises are decanologies, specifying the destiny of children born under the influence of one of the 36 decans of Egyptian tradition. It should be stressed that the demotic treatises known to me never are zodiologies, and that shows a certain tenancy in keeping to Egyptian traditions. A small fragment of one such text (PSI Inv. D 39) has, rather inadvertently, already been published by Neugebauer and Parker,[39] several more are completely unpublished.

There are Demotic Egyptian texts operating with the position of the planets in either the zodiacal signs—in this case without differentiating according to decan—or the 12 'places' of the so-called *dodecatropos*. Two manuscripts of the latter type have been published. The first is P. Berlin 8345, dating as a manuscript probably to the first or early second century CE.[40] Much less reliable is the edition of the second astrological treatise, papyrus Vienna D 6614,

36 Edited by Parker (1959). Some useful corrections can be found in the review by Williams (1966); an improved translation of the better preserved passages will be given in Quack (in press a). For the date, see Quack (2000: 85 n. 10) as well as Stadler (2004: 28 f.). The date in the late second or third century CE given in the original edition is certainly too late.

37 Ryholt (2011: 62).

38 Quack (2000).

39 Neugebauer and Parker (1969: 252 f., pl. 80 C). In principle, Neugebauer and Parker defined that astrological treatises were outside the limits they had set themselves (1969: 217). I could add several new pieces directly joining to the fragment they published, and there are numerous further fragments of the manuscript mainly at Florence but also at Copenhagen and Berlin.

40 Photograph published (without detailed commentary or translation) in Spiegelberg (1902: 97); English translation and philological discussion by Hughes (1986), for one detail, see

also of the Roman period, which was not even recognized as such in its first edition.[41] One point, however, should already be obvious. In phraseology and terminology, the Demotic astrological treatises are very close to the Greek and Latin ones; much closer than e.g. the cuneiform "proto-horoscopes". Most importantly, this concerns the *dodecatropos* which is of fundamental importance for Hellenistic and later astrology but completely unknown in cuneiform texts. Evidently, decisive steps towards shaping ancient astrology into what we know as typical came about on Egyptian soil, and this is reflected in Demotic as well as Greek texts.[42]

While the birth-astrology treatises known so far in Demotic Egyptian date to the Roman period, especially the second century CE, according to information I owe to Kim Ryholt, recently during the Franco-Italian excavations at Tebtunis, fragments have turned up from a Ptolemaic-period manuscript which is also remarkable by giving fairly specific case-studies about the factual destiny of men borne under certain constellations.

Concerning the relation between tables and astrological manuals, there is a very important point to be made. Most of the tables are in Greek language and script, and this fact concerns Oxyrhynchus[43] as well as (to a smaller degree) Tebtunis (from where we have one very substantial astronomical almanac).[44] By contrast, astrological manuals are quite a bit better attested in demotic Egyptian. At Tebtunis, where we have dozens of them, that is immediately obvious. Even at Oxyrhynchus, the number of published astrological treatises in Greek is not very high,[45] while I know of a number of unpublished ones in demotic Egyptian. Even more importantly, it would be a grave mistake to differentiate between the languages (and scripts) in a way which attributes everything Greek to a "Greek" culture distinct from the Egyptian one, and

Quack (1999: 41). German translation with further improvements in Quack (2008: 368–370). An unpublished small fragment of the manuscript is kept in the Heidelberg papyrus collection.

41 Reymond (1977: 143–157, pl. VI); identified as an astrological text by M. Smith in Hughes (1986: 69); several important improvements in reading by Smith (1985: 111–114); a proposal for the reading of the title can be found in Quack (2002: 90 f.). Additional unpublished fragments of the same manuscript are at Aberdeen (inv. 191).

42 See also the discussion by Greenbaum and Ross (2010).

43 For information about Egyptian-language manuscripts from Oxyrhynchus, see Quack (in press b).

44 Manfredi and Neugebauer (1973); Jones (1998); Jones (2001).

45 See Haslam, Jones, Maltomini and West et al. (1998: 130–175). Still, according to oral information by Alexander Jones, there is a substantial body of unpublished Greek papyri of this type.

perhaps even constructs an opposition between a more "scientific" Greek and a more "superstitious" Egyptian tradition. The fallacy of such an approach can be highlighted by looking in more detail at the manuscripts themselves: One of the demotic Egyptian astrological manuals from Oxyrhynchus is written on the back of a Greek commentary to a philosophical treatise of Aristotle. The large Greek astronomical almanac from Tebtunis has demotic religious texts on the back, and even on the recto, there is a short hieratic Egyptian pen trial which remained unidentified in the *Editio princeps*[46] but which I could identify as the beginning of a fundamental Egyptian manual on the ideal temple. Thus, it should be obvious that there is no great divide, but that Greek astronomical treatises could be in the hands of Egyptian priests, and those making use of demotic Egyptian astrological manuals were steeped in Greek philosophical thinking.

So, in order to conclude my paper, I would like to present some results. We can by now demonstrate that during the Roman period, especially at Tebtunis which, due to its exceptional preservation of texts, can serve as a case study, there was a wealth of texts in Egyptian language concerning astral lore available. They range thematically all the way from the more culturally and religiously significant to the then cutting edge of mathematical calculation of planetary positions. It is only by carefully situating each single one of them in its place of relevance that we can ever hope to gain an adequate picture of what celestial phenomena and their interpretation meant to the ancient Egyptians. To focus exclusively on the supposedly 'astronomical' nature of texts in decontextualizing them is not an appropriate way to deal with them.

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46 Manfredi and Neugebauer (1973: 101).

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CHAPTER 8

Some Astrologers and Their Handbooks in Demotic Egyptian*

Andreas Winkler

1 Introduction

The astrological papyri from Roman-period Tebtunis are one of the best sources for the study of such practices in Graeco-Roman Egypt. Though other localities have produced important material,[1] basically only the crocodile priests at Tebtunis have left behind a more varied set of writings, nearly four-dozen different astrological manuals and a handful of texts of a more astronomical nature.[2] These papyri are mainly written in Demotic, but there are also a number of Greek texts, both astrological (e.g. *P.Tebt.* II 276, 277, and 676)[3] and astronomical treatises.[4] At least one Greek astronomical text was written on the same manuscript as a Demotic astrological manual, i.e. P.Carlsb. 104.[5] The Greek text, an astronomical almanac, is written on the verso (against the fibres), while the Demotic treatise is found on the recto (along the fibres), indicating that the Egyptian text was the first to be inscribed. It is unclear whether the two compositions have anything to do with each other directly,

* I wish to express my gratitude to John Steele for inviting me to the conference and giving me the opportunity to publish this paper in this volume; Guido Bastianini, Simona Russo, and Kim Ryholt for allowing me to access and quote the still unpublished Tebtunis material; Joachim Quack for having discussed with me some of the issues addressed; Todd Hickey and Michael Zellmann-Rohrer for their advice regarding the Greek papyri. Any error or misunderstanding is my responsibility alone.

1 See e.g. Neugebauer and van Hoesen (1959). Comprehensive lists of references to works treating Demotic astronomical and astrological texts are provided by Bohleke (1996); Quack (2002a: 169, n. 43); Ross (2007a). Other important publications include: Hoffmann (1995); Menchetti (2009); Menchetti and Pintaudi (2007: 227–242); Neugebauer and Parker (1968); Quack (2008/2009); Ross (2006); Ross (2007b); Ross (2009a); Ross (2009b). See also the article by Quack in the present volume.

2 Chauveau (1992); Jones (1998); Ryholt (2005: 152–153); Ryholt (2013: 33–34); Winkler (2009).

3 The latter text is republished by Fleming and Hanson (2009).

4 E.g. Jones (1998); Jones (2001); Jones and Perale (2011).

5 Jones and Perale (2012) 311–319.

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but the texts at least confirm a practicable level of bilingualism. The astrologers in Roman Tebtunis, similarly to those active in contemporary Narmuthis, could engage with documents in both Greek and Egyptian when dealing with the astral arts. This does not mean, however, that the two languages were entirely exchangeable, or that everyone could handle texts in either langue with similar ease.

Like most papyri from the find, the astrological texts are fragmentary. Yet enough survives to show that various astrological traditions coexisted and that the priests engaged in different kinds of astrology. This art can generally be divided into two main categories. The first concerns universal omina, mostly so-called Sothis texts,[6] while the second type is best described as natal astrology. In the former kind of astrology, the annual heliacal rising of Sothis (Sirius) and constellations of planets in relation to the zodiacal signs, or the decans as 10° segments of these, were used for establishing the predictions. These treat mainly the welfare of the land, international politics, and the life of kings and rulers.[7] The second type of astrology concerns most commonly an individual and his or her personal life. These texts produce forecasts based on the constellations at the moment of birth and can be classified as either decanal or planetary. The former type bases mainly the predictions on the appearance of the 36 decans and their relation to the two luminaries, the Sun and the Moon, though the planets are also mentioned.[8] In the planetary astrological texts, on the other hand, the position of the seven planets known in antiquity, including the two luminaries, and their conjunctions with one another and other celestial bodies or spheres in heaven are considered. There are several diverse traditions here as well. Though the handbooks to a greater or lesser degree considered the same parameters for establishing a forecast, the texts were slightly differently organised and thus transferred astrological knowledge to their reader in diverse ways.

6 Fos such texts, see e.g. Hughes (1951); Jones (1998).

7 The priests were also to some extent engaged in making predictions based on omina connected with the two luminaries, the Sun and the Moon, such as eclipses (Ryholt 2005: 162). See Parker (1959) for an example of such a treatise from Soknopaiou Nesos and more recently Ross (2007a: 5–13). Cf. also Moyer (2011: 241); Ryholt (2011).

8 See Chauveau (1992: 104).

2 Conveying Astrological Knowledge from Manuscript to Practitioner

A particularly interesting astrological tradition is preserved in P.Carlsb. 81 and 89 and PSI inv. D 34,[9] three manuscripts of the same text, which were probably written by three different scribes. The text preserved on these papyri may be regarded as part of the same branch of astrology as represented by P.Berl. 8345 from Soknopaiou Nesos.[10] Yet the Tebtunis text is more sophisticated and slightly differently organised. Just as in the Berlin treatise, the main point of reference for establishing a forecast is the relation between planets and the loci (mundane houses).[11] While P.Berl. 8345 stops there, the other text adds a number of parameters for establishing a prediction. It also considers the time of the birth, i.e. whether it was a diurnal or nocturnal birth, and takes account of the zodiacal signs. That the text of the Berlin papyrus is less sophisticated than the one from Tebtunis may indicate that it represents a less developed stage of astrology. Since the loci are of Egyptian origin,[12] however, it is possible that the text stems from a time when the zodiacal signs were not yet part of this art. Nevertheless, since the planetary order found in this text is the younger, this fact could argue against such an assumption. Yet it is possible that the arrangement was adjusted in later times.[13] An alternative suggestion, which is explored below, is that it belonged to a less skilled astrologer; it was easier to use than the more advanced treatise.

Given that the remains of three columns are preserved in the astrological text from Soknopaiou Nesos, we do not know how extensive the text once was or what additional sequences were present. P.Carlsb. 81 and the related manuscripts, on the other hand, contain the remains of a text that would account for all aspects of an individual's life as well as guidelines for the astrologer on how to establish a complete nativity. That is, it includes calculations for the lifetime and a fairly extensive treatment of the general principles of astrology in addition to a lengthy sequence with general forecas.

9 These texts are briefly described in Winkler (2009: 366–372). I only provide the numbers for the main pieces of each manuscript. Fragments of these papyri are primarily found in Berkeley, Berlin, Copenhagen, and Florence.

10 Cf. Hughes (1986). An improved translation is provided by Quack (2008: 368–370). See also Quack in the present volume.

11 Bouché-Leclercq (1899: 257–259 and 280–288).

12 This is already pointed out by several classical authors, see e.g. Barton (1994a: 98); Bouché-Leclercq (1899: 257); von Lieven (1999: 100–101); von Lieven (2007: 146–147).

13 See Neugebauer and Parker (1969: 175) for the planetary sequences.

Since several astrological treatises appear to have been introduced by a framing story, the same can be expected for the text found in P.Carlsb. 81 and 89 and PSI inv. D 34, even if it is not preserved in any of the extant manuscripts. A framing story explains the text by describing the content of the text, how it was discovered and copied onto a papyrus, and who its author was. Most likely the imagined author would have been one of the ancient sages known to the Egyptians, for instance, Imhotep.[14] A framing story connects the text with other areas of Egyptian knowledge and places it into a longstanding intellectual tradition; as an indigenous text it gained authority.[15] The majority of these introductory stories are preserved in decanal treatises, but there is one exception, namely P.Yale CtYBR inv. 422vo.[16] This text is not a complete manual, but what seems to be a copy of such an introductory story. The manuscript also includes a brief instructional sequence, which seems to presuppose that the reader was already familiar with at least the basics of astrology.[17] The papyrus could be indicative of the structure of an astrological manuscript, suggesting that an instructional part or at least a listing of the relevant celestial bodies follows the introduction. But the decanal astrological text of PSI inv. D 39ro, part of which is published as P.Flor. 8ro,[18] commences with forecasts directly after the introduction.[19] The instructions or at least a list of decans and their corresponding zodiacal signs are therefore jotted down after these. Also in PSI inv. D 35vo, another text of similar kind,[20] the forecast begin directly after the introduction. These instances indicate that instructions were not always inserted after the framing story. It was probably up to the compiler where and if such a textual device would be inserted.

14 E.g. Quack (2014a: 48–51 and 56–57); Ryholt (2009: 305 and 313); Ryholt (2011: 71); Winkler (2009: 373).

15 See e.g. Dieleman (2005: 261–274); Moyer (2011: 248).

16 See Ryholt (2012: 13) with further references.

17 We are informed that the astrologer had to observe, *inter alia*, the relation between zodiacal signs and planets (*šꜥ-ir⸗w pꜣ šny* (*n*) *pꜣ twtw nty-iw nṯr ẖn⸗f*: “One always inspects the zodiacal sign (see n. 48 below) in which a planet (lit. god) is”).

18 Neugebauer and Parker (1969: 252–254).

19 The frame story is mentioned by Ryholt (2009: 313 n. 30); Winkler (2009: 373).

20 Quack (2014a: 57); Ryholt (2009: 313 n. 30).

3 The Structure of P.Carlsb. 81 and the Related Manuscripts

In the text preserved on P.Carlsb. 81 and the related manuscripts, the introduction is followed by more or less detailed instructions (see below), then forecasts about the important events in the native's life are found, and finally the most important section, instructions for establishing the lifetime of the individual for whom a horoscope was cast, are written down.[21] While the division between the different sections, at least the three last ones, may be somewhat artificial, such a partition is useful for understanding the structure and nature of an astrological treatise of this kind.

Since the material is rather poorly preserved, the extent of these introductory instructions is hard to determine. A sequence of P.Carlsb. 81, which most probably followed the predictive section,[22] contains rules for how to calculate the lifetime of the native as well as astrological instructions of a general nature. Because the introductory instructions are fragmentary, it cannot be determined presently whether the instructions in the end of the manuscript, which complement the procedures for establishing the lifetime, repeat the information that would be found in the beginning of the manual, or whether they in fact develop these.

That the introduction was followed by more or less elaborate instructions with listings of celestial bodies relevant for astrology, connections between them, and calculations can be deduced from the fact that there are fragments where the first sequences are instructional, and these are then followed by predictions. Fragment 1 of P.Carlsb. 81 preserves the upper part of two columns, the end of the first column (right) and the beginning of the second one (left). The right one contains instructions; there is a list of loci and planetary houses. Not much more can be said about it.[23] The left column, on the other hand, contains forecasts of one of the superior planets, probably Saturn (*Ḥr-pꜣ-kꜣ*); only the first element (*Ḥr-*) of the planet's name is preserved before the papyrus breaks off. A similar phenomenon can be observed in a fragment (P.Carlsb. 107) belonging to P.Carlsb. 89. It is also poorly preserved, but the first lines

21 Claudius Ptolemy is one of the ancient authors who promote this idea (Ptol.*Tetr*.3.10), claiming that this was the position of one of the ancient ones, that is, one of the ancient Egyptian founding fathers of astrology, Petosiris and Nechepsos.

22 The placement of this section has already been discussed in Winkler (2009: 374). Notice, however, that this section was there understood as purely "instructional". The fact that it does not contain any red ink to indicate new sections (see below) further enhances the interpretation made there.

23 The exaltation of Saturn and the houses of Mars and Jupiter are mentioned.

contain instructions, listings, and explanations, followed by a blank space, which occupies roughly three lines. After this graphic maker, forecasts begin. Although no name of a planet is preserved, they arguably belong to Saturn, the first planet in the planetary sequence in use at this time.[24]

It must be questioned, however, whether this is a general rule valid for all astrological handbooks. Doubts arise from the fact that there are manuals beginning with forecast after the introduction (see above). There also seems to have existed texts of purely an instructional character, such as P.Carlsb. 104.

P.Berl. 8345 and P.Carlsb. 81 reveal that the predictive part was divided into chapters, one for each planet.[25] While the Berlin treatise makes use of explicit headlines for each such section, introduced with the words *nꜣ sḫnw n* PLANET, "The omina (occurrences) of PLANET",[26] there are no traces of such a literary device in the other texts under discussion, save for PSI inv. D 39ro.[27] But these two are not singular in this respect. Also, for instance, P.Carlsb. 420vo, another planetary astrological manual,[28] indicates new sections but in a slightly different way. The section treating Venus is headed as follows: *nꜣ md.wt n pꜣ Ntr-tꜣy*: "The Things/Matters of Venus".[29] *Ipso facto* it can be deduced that a similar caption must have introduced each new planetary chapter with forecasts.

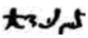
P.Cair. III 50143 also suggests that brief instructions could be inserted in the beginning of each chapter. The papyrus preserves the bottom part of two

24 Neugebauer and Parker (1969: 175).

25 P.Vindob. D 6614 [see Hughes (1986: 69); Quack (2002b: 90–91); Smith (1985: 113)] appears to be structured according to the loci instead, a system that is hitherto unattested elsewhere. The astrological system seems otherwise to be equally simple as that of P.Berl. 8345.

26 Erichsen (1954: 455–456); Hughes (1951: 259); Hughes (1986: 58); Quack (2004a: 491); Quack (2010: 73); Thompson (1912: 230).

27 ***nꜣ sḫnw** n pꜣ Rꜥ iw=f ꜥḥꜥ irm wꜥ **ẖn pꜣ 36 sw wnwn** …*: "*The omina* of the Sun as it culminates with one *of the 36 decans* (lit. running stars) …".

28 It is possible that this particular text reflects the same astrological system as found in the horoscopes *O.Neugebauer* 1–5 [Neugebauer (1943)]. The ostraca make reference to two obscure points, the eastern and western *twr* and the eastern, western, and middle *swšp*. The latter term might perhaps correspond to the ἀποκλίματα. The manual brings up at least the eastern and western *ṯꜣw-lꜣ*  and the same points are recorded for something referred to as the *sḏpꜣ*. *ṯꜣw-lꜣ* may be the Fayumic rendering of *twr*. To reconcile *sḏpꜣ* with *swšp* is phonetically more difficult, however. See Ross (2008) for a speculative discussion of the two terms *twr* and *swšp*.

29 It may be observed that PSI inv. D 35vo, col. I.3 describes the content of the text as treating: … *tꜣ nfr.t*] ⸢*šy*⸣ *irm* ⸢*tꜣ*⸣ *bꜣn*(.*t*) *šy irm* ***nꜣ md.wt*** *nty ḫpr* (*n*) *nꜣ s-ḥm.wt* …: "… the good] ⸢fate⸣, ⸢the⸣ evil fate, and **the things/matters** that happen to women …" [cf. Quack (2014a: 57)].

columns. The first lines of the first column (right) contain forecast.[30] And the same seems to be the case with the second and left one. Yet, the penultimate line in the first column contains a kind of heading, which makes clear that what follows are predictions based on Mercury. The planet is referred to as the sixth god (*nṯr mḥ-6 Swgꜣ pꜣy*) and the subsequent line mentions its triplicity (... *nꜣ ḥtry*] *tꜣ ꜣḫ.t pꜣ mw*: "... Gemini], Libra, and Aquarius").[31] Perhaps these instructions served as a kind of reminder of basic astrological information.

From the statement that Mercury is the sixth planet, it can be deduced that the predictive part of the manual would have been arranged into chapters with the following order: Saturn, Jupiter, Mars, the Sun, Venus, Mercury, and the Moon. That is, the planets were arranged from the slowest to the fastest moving one, a system attested firstly in the fourth century BC.[32] Other texts seem to have the same arrangement of the planets, whilst the two luminaries were set apart and probably placed in the beginning of the sequence. This appears to be the case with P.Carlsb. 420vo as well as P.Carlsb. 81.[33] The former text ends with forecast relating to Mercury,[34] and it is probable that this was also the last planet to be mentioned in the predictive section of the text preserved in P.Carlsb. 81 and 89 and PSI inv. D 34.

Each planetary chapter in P.Carlsb. 81 and the related manuscripts is parted into sections corresponding to a constellation, a planet in conjunction with a locus. Unlike P.Berl. 8345, which only has one section per constellation beginning with the Ascendant (*rꜥ-ḫꜥ*), followed by the House of Provisions (*ꜥ.wy n sḥn ꜥnḫ*), and ending with the twelfth locus, the House of the Demon (*ꜥ.wy n sšr*), the text from Tebtunis separates the four cardinal loci from the remaining eight. The loci do not follow the given order: Ascendant, Lake of the Netherworld (*šy n dwꜣ.t*), the Descendant (*rꜥ-ḥtp*), and the Lake of the Sky (*šy n p.t*). These are instead arranged according to the principle of opposition. First comes the Ascendant and the Descendant followed by the Lake of the Netherworld and finally the Lake of the Sky. Each such constellation appears at least twice, one for a nocturnal birth and one for the diurnal one, in that order. Each such constellation is furthermore doubled. In one the planet stands in conjunction with

30 The antepenultimate line reads as follows: ...] *nkt nfr iw⸗f ḫpr ḫn* ...: "...] a good thing. He/It will appear in ...". In the line before, I can read: ...] *iw⸗f r di.t* ⸢... ...⸣: "...] He will give/cause ⸢... ...⸣". In the following column, only the word *pr-ꜥꜣ*[ꜥ.w.s.]. "pharaoh[L.P.H.]" is preserved. The right collum therefore contains forecasts.

31 See Neugebauer (1943: 124 n. 53).

32 Bouché-Leclercq (1899: 107–108).

33 Cf. Winkler (2009: 367).

34 Cf. Hughes (1951: 256); Jones (1998: 131) for the planetary order in *P.Cair.* II 31222.

the locus in question and in the other the Moon is also included. Thus there is as a minimum sixteen entries for the four cardinal loci, at least ideally.

Consequently each planetary chapter begins with the four cardinal loci with the planet together with the Moon in each section, and these are in turn divided into nocturnal and diurnal births. These are then followed by the same constellation but without the Moon. Thereafter the eight remaining loci are charted. These are also ideally divided into nocturnal and diurnal births and therefore each complete planetary section should contain at least thirty-two entries, if complete.

4 The Entries

Instead of introducing each entry with a conditional statement, as many other types divinatory treatises do, the text employs a nominal phrase followed by forecast written in the conjunctive or future tense.[35] An example from the chapter treating omina produced by Venus from P.Carlsb. 81 reads as follows:

> ***pꜣy-ms⸗w r Nṯr-tꜣy irm Iꜥḥ*** *ḥr rꜥ-ḫꜥ n ms grḥ h̠n pꜣy⸗f qnḥy*(*.t*) …
>
> *He who was born when Venus was with the Moon* in the Ascendant during a nocturnal birth in its zodiacal sign[36] …

or

> [***pꜣy-ms⸗w r***] ***Nṯr-tꜣy*** *irm Iꜥḥ n rꜥ-ḫꜥ* ⸢*h̠n*⸣ *tꜣy⸗f qnḥy*(*.t*) *n* [*ms*] ⸢*mtry*⸣[…
>
> [*He who was born when*] *Venus* was with the Moon in the Ascendant in its zodiacal sign during a ⸢diurnal⸣ [birth] …

The underlined words are written in red ink, a common visual technique in Egyptian texts, used to indicate an important passage or a new section.[37] Such marks are a significant feature of texts, which were supposed to be used and read.[38] Scribes could also use other methods to introduce new sections, for instance, by leaving a blank space before an entry, a technique that the

35 See Quack (2010: 77); Winkler (2009: 368).

36 See Chauveau (1992: 102) for the translation of the term *qnḥy.t* (see also sect. 5 below).

37 Chauveau (1992: 104).

38 See e.g. Parkinson and Quirke (1995: 44–45); Posener (1951).

scribe of this particular papyrus also used. He apparently employed rubrics to indicate new sections throughout the text until the Venus section. There he seemingly ran out of red ink because he begun to indicate new sections with a *vacat* instead. The main fragment treating Venus forecasts in P.Carlsb. 81 has four poorly preserved columns. In the first two, the scribe employed rubrics, but in third one he left a space before the formula indicating the constellation. It is possible that he meant to fill in the empty space later. He left enough room to write *pꜣy-ms=w* before the remaining part of the formula (*r Nṯr-tꜣy n* ...) for which he used black ink. He might, however, have thought of using an elliptic version of the formula instead; *pꜣy-ms=w* does not convey any new or necessary information for establishing a forecast, not to someone who is familiar with the manual in question. Such a procedure is found in other astrological manuscripts, e.g. P.Carlsb. 89. While the elliptic form possibly could be confusing for a first-time user, an astrologer having only a slight familiarity with the workings of a text of this kind would know that the section which followed concerned forecasts for someone born under the constellation described.

Nevertheless, the scribe of P.Carlsb. 81 did not pursue this method of indicating new sections for the remaining part of the text. In column four and the remaining ones, he refrained from using the elliptic formula but not from *spatia*. At a later stage he, or someone else, filled in the empty space before each entry with a faint red stroke, possibly to enhance the visual effect of the *spatium*.

Though considerably less is preserved of PSI inv. D 34, it seems that the scribe of this manuscript chose to write out the complete formula but instead of demarcating each new entry with red ink he chose to employ *spatia*, occasionally filled in with a thin red stroke.

This indicates that the scribes, when copying a manuscript, had the choice to alter or leave out the non-essential information, passages that merely state the obvious. Even if our copyist meticulously copied his source, then the scribe of that manuscript had the option to do so.

That the scribes had the liberty to alter such information is further indicated by the parallel manuscripts. The individual copying the text onto P.Carlsb. 89 never made use of the initial words *pꜣy-ms=w* in the birth formulae and also refrained from using red ink throughout the manuscript. Each new section was instead distinguished with a blank space.[39] But this is not all; he could also

39 Another option is that the scribe intended to fill in all these blank spaces with red ink after having copied the text but never got around to do so. Yet, even if this were the case, it

rearrange some components of each entry. This is shown in the example that follows (P.Carlsb. 107):

> [⟨*pꜣy-ms⸗w*⟩ *r Ḥr-pꜣ-kꜣ irm Iꜥḥ ḥr rꜥ-ḫꜥ*] *ẖn tꜣy⸗f qṇhy*(*.t*) *n ms.t grḥ* …

> [⟨He who was born⟩ when Saturn and the Moon were in the ascendant][40] being in its zodiacal sign during a nocturnal birth …

Comparing the first formula quoted from P.Carlsb. 81 we can see that the scribe swapped places between the time of the birth and the notion that the constellation occurred in conjunction with the zodiacal sign connected with it. But, as seen above, also the scribe of P.Carlsb. 81 occasionally swapped the position between these two elements. The reason for this may depend on the fact that exactly the same information is conveyed by the two formulae no matter which element comes first. Also the scribe of PSI inv. D 34 swapped the order of the two parameters in one and the same column:

> *pꜣy-ms⸗w r Ḥr-pꜣ-⸢šty⸣ n ꜥ.wy n ḫ̂pšy ẖn tꜣy⸗f qnḥy*(*.t*) *n ms grḥ* …

> He who was born when Jupiter was in the house of fortune, being in its zodiacal sign during a nocturnal birth …

or

> *pꜣy-ms⸗w r Ḥr-pꜣ-šty n ⸢ꜥ.wy⸣ n ššl n ms mtry ẖn tꜣy*[*⸗f qnḥy*(*.t*) …]

> He who was born when Jupiter was in the ⸢House⸣ of the Demon during a diurnal birth, being in it[s zodiacal sign …]

The time of birth was an important parameter for the astrologer and could not be negotiated away when establishing a forecast; it affected the forecasts. But what about the zodiacal sign? Though the scribes of P.Carlsb. 81 and PSI inv.

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does not change the fact that the insertion of these words would not have been necessary for conveying new information to the practitioner using the manual and therefore never filled in.

40 The reconstruction is based on the fact that the present forecast is the first one occurring in the section. Since the manuscript contains the same text as P.Carlsb. 81, which seemingly begins each section with the appearance of a planet together with the Moon in the four cardinal loci, the same must logically apply to this manuscript.

D 34 were careful to spell out the connection in the formula, the copyist of P.Carlsb. 89 was not. In the chapter, which treats the forecast produced by Mars, the formula describing the planetary position reads as follows:

> ⟨*pꜣy-ms=w*⟩ *r Ḥr-tšy n šy n dwꜣ.t* [*n*] *ms grḥ* …
>
> ⟨He who was born⟩ when Mars was in the Lake of the Netherworld [during] a nocturnal birth …

The formula is followed by forecasts. Even though the astrologer omitted the connection between the zodiacal sign and the planet in the formula, he still established the native's future by considering a possible relation between these entities.

The chain of forecasts that follows is generally complemented with parameters that could alter the predictions. There are usually two factors that can do this. One is the presence of another planet (*sw*, lit. "star")[41] in the same locus. That is, whether the planet was in aspect with another one (see below). The other condition that can change the course of the forecasts is when the constellation does not correlate with any zodiacal sign connected with the planet in question. After a sequence of various projections about the native's future, often the following formula can be read: *iw=f ḫpr r bn-iw tꜣy=f qnḥy*(*.t*) *in tꜣy*, "If it is not its (the planet's) zodiacal sign". It is commonly followed by a terse statement, which indicates that it is either half a fortune (*gs md.t-nfr.t*) or half a misfortune (*gs md.t-bꜣn.t*). The "fortune" and "misfortune" refer to the predictions and indicate that prosperous prophecies will not turn out as beneficial or that calamitous ones become less dismal.

The negated protasis indicates that the prognoses were originally constructed for an ideal constellation between planet, locus, and zodiacal sign. And when this was not the case, an alternative future was provided. Having knowledge of the workings of the manual in question, the astrologer would know that each single forecast following the description of the constellation was established on the basis of these parameters. The mention of the correlation between a planet and a zodiacal sign can therefore also be regarded as formulaic and non-essential information in the introductory formula.

41 Erichsen (1954: 413).

5 The *qnḥy*(*.t*)

The predictive section of the manual does not explain what a *qnḥy.t*, literally "shrine",[42] designates in an astrological context. That it refers to zodiacal signs can be inferred from P.Carlsb. 66, which refers to "12 *qnḥy.t* in the sky", which Chauveau explains as the twelve zodiacal signs.[43] A section, which contains instructions for how to calculate the lifetime of the native (see above), includes basic lists of the essential celestial bodies relevant for the astrologer, and in these more information on the *qnḥy.t* is available:

> *wpy tꜣ qnḥy.t n pꜣ Rꜥ Iꜥḥ pꜣ 5* ⟨*sw*⟩ *ꜥnḫ nꜣ ꜥ.wy.w nty* ⌜*mr*⌝[*=w n.im=w*][44] ⌜*nꜣy=w ꜥ.wy.w*⌝ *n ṯsy tꜣ qnḥy.t n pꜣ* | [*pꜣ*] *Rꜥ* [*pꜣ*] *Mꜣy pꜣy=f ꜥ.wy n ṯsy pꜣ Isw n s*[*wsw*] *19* ⌜*mr*⌝[*=f Mꜣy Pꜣ-nty-ꜣtḥ*]^Arrow. det.^ *pꜣ I*⌜*sw*⌝ …
>
> Dividing the zodiacs of the Sun, the Moon, and the five living ⟨stars⟩ (planets), the houses [in which they] prefer [to be], and ⌜their exaltations⌝: The zodiacal signs of | [the] Sun: Leo; its exaltation: Aries in 19⌜°⌝.[45] [It] ⌜prefers⌝ [Leo], ⌜Sagittarius⌝, and ⌜Aries⌝ …

This passage shows that the zodiacal signs were labelled as *qnḥy*(*.t*), more specifically the planetary houses. Probably, the term refers to the diurnal and nocturnal houses of the planets. Other locutions for various zodiacal positions are *ꜥ.wy n ṯsy*, literally "house of lifting", which refer to the exaltation (ὕψωμα).[46] We are further informed that the triplicities are called "houses in which they prefer to be" (*ꜥ.wy nty mr=w n.im=w*).[47]

Nonetheless, the definitions provided above are complicated by the fact that the text also gives other terms for some of these constellations. The triplicities seem also to be referred to as "the houses of beneficence" (*nꜣ ꜥ.wy n ir md.t-nfr.t*), while the term *qnḥy.t* can also designate a zodiacal sign in general.[48] The locution is used for a zodiacal sign that is qualified as one in which Jupiter exalts:

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42 Erichsen (1954: 541). See also Gallo (1987: 38–39); Vittmann (1998: 422 and 526–527).

43 Chauveau (1992: 102).

44 It is possible, however, that the reconstruction shall read *nꜣ ꜥ.wy nty mr=w-st* "houses, which they prefer" instead.

45 For the translation of *swsw* as "degree", see Winkler (2009: 368 n. 38).

46 Bouché-Leclercq (1899: 192–199); Neugebauer and van Hoesen (1959: 2).

47 Cf. n. 44 above.

48 Another term for a zodiacal sign in general is *twtw* (Winkler 2009: 370 n. 49). This can be seen in, for instance, P.Carlsb. 9, col. 1.6. Cf. also *P.Zauzich* 50 [Quack (2006)].

> …] *⸢tꜣ⸣ qnḥy.t nty iw≠f ⸢ṯsy⸣ ẖn≠s* | *pꜣ gnḥḏ n swsw* [*1*]*5 pꜣy≠f ꜥ.wy n hby pꜣ Ḥr-ꜥnḫ* [*n swsw 15* …
>
> …] ⸢the⸣ zodiacal sign in which it (Jupiter) exalts: | Cancer in [1]5°, its depression: Capricorn [in 15° …

Another passage found in the same column reads as follows: *tꜣ qnḥy*(*.t*) *n iꜥḥ Pꜣ-kꜣ n swsw 3 ⸢ẖn⸣*[*≠f* …, "the zodiacal sign of the Moon is Taurus in 3° ⸢in⸣[it (the Moon) …".

These instances show that the standard constellation observed by the astrologer was the correlation between a planet, locus, time of birth, and whether the planet in question was under the influence of its diurnal or nocturnal houses or exaltation.

6 Aspect in the Demotic Manuals

Another parameter brought up in connection with almost every constellation and which could affect the forecasts is the aspect (Lat. *adspectus*; Gr. ὄψις),[49] to which the expression "If a beneficent/maleficent planet (lit. star) looks at it" (*iw≠f ḫpr r wn sw nfr/bꜣn nw r-r≠f*) or similar must refer. The third person singular pronoun *≠f* signifies the planet, which produces the forecasts. Though this phrase describes the aspect, it does not specify the angles, whether it was in trine or sextile etc. and the planet is rarely specified. Only its qualities as either beneficent (*sw nfr*) or maleficent (*sw bꜣn*) are mentioned.[50] This indicates that both the beneficent planets produced the same alterations. Also the maleficent planets were treated in a similar manner, both—no matter which one—had the same affect on the forecasts. There are some modifications of this formula, however. For instance, a planet may be in aspect with two other planets etc. In

49 Bouché-Leclercq (1899: 165–179); Neugebauer and van Hoesen (1959: 2). Briefly mentioned in Winkler (2009: 371).

50 *P.Lond.* 98ro, better known as the Old Coptic Horoscope [Černý, Kahle, and Parker (1957); Neugebauer and van Hoesen (1959: 28–38); *ed.princ.*: Griffith (1900)], refers to the planets in the same way, namely as ⲥⲟⲩⲛⲟⲩϥⲉ or ⲥⲟⲩⲃⲱⲛ. This is not surprising; the Old Coptic Horoscope is *de facto* nothing but a Demotic text written with the Greek alphabet enhanced with a number of Demotic signs [Quack (2004b: 118)]. See Barton (1994b: 86–90) for a detailed although partially erroneous discussion on the astrological content of this text [cf. also Komorowska (2004: 405–407)]. My former student Edward Love is preparing a much-needed new edition of this text.

most cases, this aspect is followed by further predictions. These are usually not modifications of previous ones but additions.

It should be pointed out that the scribe of PSI inv. D 34 seems to have refrained from using the aspects when establishing forecasts. This manual thus represents a simplification of the text, alternatively, a less developed stage.

Which planets were regarded as beneficent and maleficent concurs mostly with the Hellenistic concepts or their qualities. Nevertheless, the Tebtunis text under discussion departs from the common notions. In a similar fashion as it described the zodiacal signs as planetary houses or as parts of other constellations, the planets and their qualities are listed:

> [*wpy*]Book-roll and Abstract det. *nꜣ sw.w bꜣn.w* | *irm nꜣ sw.w nfr.w Ḥr-pꜣ-kꜣ Ḥr-tšy pꜣ Rꜥ nꜣ sw.w* ⸢*bꜣn.w*⸣ *nꜣy Ḥr-pꜣ-št*[*y Nṯr-tꜣ*]*y Sbkꜣ nꜣ sw.w* | *nfr.w nꜣy …*
>
> [Dividing] the maleficent stars | and the beneficent stars: Saturn, Mars, and the Sun are the ⸢maleficent⸣ stars; Jupi[ter, Venu]s, and Mercury are the | beneficent stars.

That Saturn and Mars are maleficent (κακοποιοί) and Jupiter and Venus are beneficent (ἀγαθοποιοί) is not surprising. But it is noteworthy that the Sun joins the two first mentioned; it was usually regarded as neutral. It is likewise striking that Mercury, usually also regarded as a neutral planet (κοινός), being to equal parts beneficent and maleficent,[51] is connected with the beneficial ones. That these two planets were assigned such qualities is curious and a concept basically alien to Hellenistic astrology. The beneficent qualities ascribed to Mercury may, however, be influenced by Seleucid astrological theories. There the planet occasionally seems to have possessed beneficial qualities.[52]

The Moon is not part of this enumeration, but the luminary is mentioned adjacent to the list:

> *i.ir Iꜥḥ ḫpr iwṯ=w pꜣ nty ir md.t-nfr šꜥ-ir=f* ⸢*irm*⸣*=f pꜣ nty ir md.t-bꜣn.t šꜥ-ir=f* [*irm=f* …
>
> When the Moon is between them (i.e. the planets); the one which is beneficial, it always acts ⸢with⸣ it; the one which is maleficent, it always acts [with it …

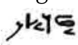
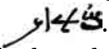
51 See e.g. Ptol.*Tetr.*1.4–5.

52 Rochberg-Halton (1988: 325).

The implication seems to be that the Moon takes over the qualities of the planet with which it is in conjunction, and perhaps even enhances its influence on the native. That is probably the reason why there seem to have been separate entries for a planet together with the Moon, at least in the cardinal loci.

These instructions equipped the astrologer with the basic knowledge for decoding the constellations and the future that they produced. It seems that the manual to a large extent is a self-contained system. It comprises all the necessary systematic knowledge an astrologer needs to have in order to establish the native's future. Having the required birth data at hand, the manual has only to be completed with an astrological almanac pinpointing the relevant positions of the celestial bodies needed to create a complete horoscope.[53]

7 Orthographical Discrepancies

The copyists were not only free to make textual alternations as long as the essential non-formulaic information was retained. They were also allowed to decide about the textual layout and how to spell certain words. In a section of the manual, which concerns the planetary periods and what lifetime the celestial bodies bestow the native, the scribes of the different manuscripts used diverse spellings for the same words in the different manuscripts. The text states that the Moon provides the native with 25 years and that the Sun gives 19 years (the Metonic cycle). Writing out this information the scribe of P.Carlsb. 81 employed the aorist *ḫr-tw⸗f* , "it (the planet) always gives" followed by the number of years, while the copyist of P.Carlsb. 89 chose another graphical solution for the same verbal form, *šꜥ-di⸗f* . These instances demonstrate what kind of liberty the scribes had when they were copying a text of this sort. They could make orthographical changes as long as the content of the text was unaffected. It might further be suggested that the scribe of the latter papyrus seems to be the one who departs from the source to a greater extent than the one who copied P.Carlsb. 81. The reason for this assumption is that both manuscripts contain the aorist-base *ḫr* elsewhere. The fact that the scribe of P.Carlsb. 89 generally abbreviated the birth formula (see above) compared with both P.Carlsb. 81 and PSI inv. D 34 also contributes to this impression. Thus the astrological knowledge in the texts was not codified in terms of form, orthography, or formulaic expressions, but ostensibly only in terms of content. Yet, as seen above, there seems to have been some leeway in this respect as well;

53 See Evans (2004) for the astrologer's tools. Cf. also Barton (1994b: 86).

some elements could either be added or subtracted. How this knowledge was conveyed between manuscript and user is briefly outlined below.

8 The Structure of an Astrological Manual

The structure assumed for the astrological manual under discussion can be summarised as follows: a) introduction, b) instructions, c) forecasts, and d) calculations for establishing the lifetime. One reason behind this conclusion is the fact that the fragments of the first part of the manual consist of instructions, which are followed by forecasts. Though there are fragments with the opposite order, they do not contradict this interpretation. It is probable that the astrologer or copyist could insert sporadic explanations among the forecast. Perhaps these originated as marginal notes, which subsequently became incorporated into the main text. If they were part of the original composition, they must have functioned as reminders or similar; the information would be difficult to locate if it was only found hidden among forecast.

Another indication favouring the suggested structure of P.Carlsb. 81 is the use of rubrics. There is no trace of them in the final section. If this sequence had been inserted before the forecasts relating to Venus, one would expect the scribe to indicated new sections or headings with red ink there as well. The fact that this part contains a table of terms,[54] which according to the second century AD author Claudius Ptolemy was a feature found in the end of an Egyptian astrological manual, further supports this arrangement.[55]

Yet not all manuals follow the same structure or contain the same sequences. As mentioned above, some astrological handbooks, including P.Carlsb. 104, only contain instructions, while other texts may have had the predictive part as the final element. This is the case with P.Carlsb. 420vo. There the concluding column is preserved in part. The left and last edge was clearly cut in antiquity. It contains forecasts relating to Mercury, the last planet to be enumerated, and closes with a colophon. The astrological text is on the verso (written against the fibres) and the recto (with the fibres) contains at least two administrative records written in Greek.[56] Either these records were pasted together into a longer roll or the astrologer used at least two distinct papyri

54 E.g. Bouché-Leclercq (1899: 206–215); Heilen (2004: 131–133).

55 Winkler (2009: 374).

56 Such features are occasionally taken as an indication that the text was a "use text"; the assumption is that the finish of a practical text would be of lesser importance than that of a fine "library copy", so e.g. Moyer (2011: 236). But cf. Quack (2014b).

to write one astrological text. And perhaps he therefore kept the text on separate rolls; there is no trace of any *kollesis* in any of the extant fragments and such procedures seem to be rather rare, but the papyrus is poorly preserved and therefore it is possible that any joining of separate pieces is lost to us today.

Keeping a longer text on several rolls could possibly make it more manageable. However, if this indeed were the case with P.Carlsb. 420vo, the scribe did not separate between different sections of the text, which would have been the practical solution. The chapter treating predictions produced by Mercury is written on the back of two different Greek texts. Therefore, if it indeed was kept on separate rolls or sheets of papyrus, it is more plausible that he would have done this out of necessity rather than for any practical reasons. This view is further enhanced by the fact that he reused papyrus. Possibly the scribe lacked a roll of appropriate length and had to supplement it with at least one additional piece.

P.Yale CtYBR 1132vo[57] is also part of an astrological treatise, written by the same scribe who wrote P.Carlsb. 420vo (see table 8.1).[58] The Demotic text on the papyrus is written on the verso, while the recto is inscribed with an account in Greek, which appears to be the same document on the back of which the end of P.Carlsb. 420vo is written. This may indicate that the scribe wrote the instructional sequence of the text after the forecasts were produced. The Demotic text of P.Yale CtYBR 1132vo is a table of terms written in tabular form, and this format was surely handier to use than one in which the numbers are written in the running text as is the case with the other texts discussed.[59]

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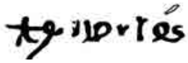
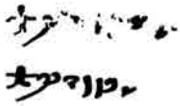
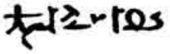
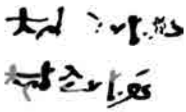
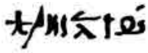
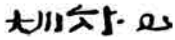
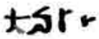
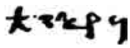
57 The text has been published twice; the *ed.princ.* is provided by Depuydt (1994) and thereafter Bohleke (1996) republished the text.

58 There are slight variants in the orthography in the two manuscripts, however. The difference between some of the spellings may depend on separate sources; the astrologer would have copied two manuscripts written by two scribes and chose to follow the spelling found in each text. Notice that the hand of *P.Tebt.Tait* 15, a wisdom text, is very similar, and therefore it is plausible that the same individual penned all of these manuscripts. Tait (1977: ix) notes the similarity between this text and some other ones, which probably were written by the same scribe. Nevertheless, he does not suggest that the same individual wrote these texts but merely makes a note suggesting that they belong to the same type of scribal hand.

59 Knowing the disposition of a table, the reader of the manual could easier find the information sought than in a text where visual markers do not separate the units of information. Bohleke (1996: 39) argues that the table was a graphic mnemonic device.

TABLE 8.1

	P.Yale CtYBR 1132 vo	**P.Carlsb. 420 vo**
Ḥr-pꜣ-kꜣ / Saturn		
Ḥr-pꜣ-št / Jupiter		
Ḥr-tšy / Mars		
Pꜣ-nṯr-tꜣy / Venus		
Swgꜣ / Mercury		

Above the table there are traces of a heading written in red ink, which clearly indicates that it was considered the beginning of a new section or similar. Furthermore, the right margin of the papyrus is rather broad, which suggests that it was not an intercolumnium dividing two sections of the text, but the beginning of a separate roll or sheet of papyrus. To begin an instructional text with a table of terms would be awkward, however. Several other instructions surely preceded this part, at least if one is to believe the structure of a similar sequence in P.Carlsb. 81 and 89. This therefore could imply that the astrologer kept the instructional text on a number of separate sheets.

That the two astrological "texts"—the forecast and the instructions—are written on the back of what appears to be the same Greek manuscript could suggest that they were once considered to be the same text; they would logically have been produced in the same time. But perhaps a more cautious and plausible proposal would be that the scribe produced an aid for the manual, which perhaps did not contain any instructions, a suggestion supported by the fact that the forecasts in P.Carlsb. 420vo are terminated by a colophon and, as already pointed out, there seems to exist texts that only contain instructions.

It would be easy to argue that the astrologer kept the "texts" on separate rolls; two shorter rolls are easier to handle than a longer one. And if the instructions are regarded as a separate text, it may have had the same status as the other tools employed by an astrologer for casting a complete horoscope, such as an astronomical almanac. These were also usually kept on separate rolls of papyrus or similar.[60]

An astrologer who intended to use the manual may deliberately have placed the text on several rolls so as to make the text more accessible. Employing this technique, he would be able to check the instructions while scrutinising the forecasts. A diviner, who kept the instructions on the same roll as the forecasts, on the other hand, would not as easily be able to educe this information while checking the predictive part.[61]

The separation of the various elements suggests a fluid model for the constituents of an astrological manual. That is, such texts may not have had fixed components or a static order of these. It is plausible that the manuals were put together from the needs of the users. And some astrologers were more knowledgeable or practical than others. The presence of these two section also seems to settle the question of whether the astrologer possessed enough knowledge to construct a horoscope or not; it was beyond doubt the same person, though the person who produced the astronomical almanacs may have been a different individual.[62]

9 Similar Forecasts, Different Texts

Having access to a manual such as P.Carlsb. 81 an astrologer would have been able to construct a rudimentary horoscope or a more sumptuous one, such as the so-called Old Coptic Horoscope.[63] This text contains rather elaborate astrological calculations in Greek and also some predictions are jotted down in this language, while the greater part of the forecasts is written in Egyptian. Such a procedure again reminds us of the bilingual environment of the Egyptian astrologers.

60 See n. 53 above.

61 This implies that the astrologer indeed used the whole array of writings when constructing a horoscope. That the astrologers made use of certain (written) tools is inferred by a number of texts describing such procedures (e.g. OMM 65 and 423 [Menchetti (2009)] and *O.Narm.Dem.* II 82). In most instances, these implements seem to be almanacs, boards, and annotations rather than an actual astrologer's manual containing forecasts. The astrological consultation described in the Greek *Alexander Romance* is also devoid of any mention of such a handbook, but not other astrological tools, such as a *pinax* and gems representing the seven planets including the two luminaries [cf. e.g. Packman (1988); Packman (1990)].

62 So Jones (2007: 311).

63 See n. 50 above.

Much of the technical terminology is shared between the two texts under discussion, but the parameters considered in the bilingual one are partially different from those in P.Carlsb. 81. Both texts plot the planets, their relation to the loci, and the zodiacal signs, but the Old Coptic text also makes use of decans, a reference point not attested in the Demotic papyrus. Some of the forecasts found in the Old Coptic Horoscope are furthermore visibly extracted from a text containing the same or similar predictions as P.Carlsb. 81 and 89 and PSI inv. D 34. An instructive example is:

> (140)| … ⲟⲩⲛ̄ ⲛⲉ⸢ⲧ⸣ (141)|ϫⲓ ⲕⲗⲙ ⲙⲛ ⲛⲟⲩⲃ ⲁϫⲱⲟⲩ ϧⲛⲛ ⲣⲙⲡⲉ̅ⲣ̅ⲓⲛⲟⲩ ¬ⲧⲉϥϫⲱ ¬ⲧⲟⲩ ⲉⲓⲣⲉ ⲁϧⲣⲁϥ
>
> (140)| … (And) there are those who (141)| wear a wreath of gold on their heads in the years concerned and he (the native) will speak and one will act according to his command.[64]

64 The readings proposed here follow mainly those of the the *ed.princ.* (Griffith 1900: 82), which differ marginally from the interpretation of Černý, Kahle, and Parker (1957: 88, 92, and 98). The second edition divides the word in another way. It understands the beginning of ⲟⲩⲛ̄ as the third person plural suffix pronoun ⲟⲩ. In the interpretation of the second editors, it serves as an object to the preceding verb, which is read as follows: … ⲉϥϫⲁⲉⲓⲟⲩ: "… [while] he cause[s] them to appear", but the text is not written in scriptura continua and ⲟⲩⲛ̄ is clearly separated from ϫⲁⲉⲓ. Furthermore, the last letter ⲓ is elongated, a common feature in final position in connection with ⲉ, but not in a medial one. ϫⲁⲉⲓ is possibly the qualitative of "disgraced" (ⲧϭⲁ(ⲉ)ⲓⲟ) with the ending lost in a haplography. Černý, Kahle, and Parker take what stands thereafter as ⲛ̄ⲛⲉ., which they translate as "as those who". Yet to read ⲛ̄ as a preposition would be an anomaly; the word is always written as ¬ elsewhere in the text. Their suggestion on ⲛⲉ. as the nominalised relative converter ⲛⲉⲧ where the final ⲧ has elided with the following ϫ is plausible, but the scribble after ⲛⲉ, represented as a dot, may in fact be the remains of this sign. Another reason for the suggested reading is that the construction *wn nꜣ nty sḏm*, "there are those who listen", is a common in the astrological handbooks (cf. n. 69 below). An example from P.Berl. 8345 col. III.9–10 illustrates this phenomenon: *wn nꜣ nty-iw bw-ir s-ḥm.t* ⸢*di.t*⸣-[*ḫpr*] *n⸗w šw:* "(And) there are those for whom a woman is never profitable" [reading follows Quack (2008: 369 n. 228)]. By turning from a sentence pattern that indicates the future in this type of text [cf. Winkler (2009: 371)] to one that signalises existence, it is implied that the forecast may occur, or is typical for the constellation in question, but not all natives will experience the described consequences. There are also a number of examples of the construction *wn pꜣ nty sḏm*, which seems to have a very similar function, such as the following instance from P.Carlsb. 81: *mtw s-ḥm.t bꜣn imꜣ.t ḫpr n⸗f wn pꜣ nty di.t-ḫpr šr irm s-ḥm.t 2.t*: "and a woman of evil character will be with him, (but) there is (also) he who obtains a son and two women". The same predictions may by and large be found in either construction. Compare *wn nꜣ nty ḥms irm tꜣy⸗f sn.t n*

The passage echoes the following one in P.Carlsb. 81:

> *iw⸗f r ṯꜣy qlm* [*ḥr*] *ḏꜣḏꜣ⸗f ḥbs šs-nsw ḥr-ꜣ.ṯ⸗f iw⸗f r* ⸢*ḏd*⸣ *iw⸗w r ir* (*r*)*-ḫrw⸗f*
>
> He (the native) will wear a wreath [on] his head and a byssus cloak on his back. He will ⸢speak⸣. One will act according to his command.[65]

Another telling instance is the following one, which exists in a number of minor variants:

> (123)| … ⲁϥⲁϫⲏ ⲁ ϳ-ⲧⲁϩ ⲁⲥ ⲡⲣⲱ (124)| ⲕⲉ ⲡⲛⲟⲩⲧⲉ
>
> (123)| … He will go to the detention of the king (124)| or (that of) the god.[66]

Both P. Carlsb. 81 and 89 contain forecasts about the native going to the detention of a god (*iw⸗f šm r ḏtḥ n nṯr*: "He will go to the detention of a god"; alt. *iw⸗w ṯꜣy.ṯ⸗f r ḏtḥ n nṯr*: "He will be taken to the detention of a god"). The latter manuscript also mentions that the native may be held in a state prison ([*iw⸗f r šm r*] ⸢*ḏtḥ*⸣ *n pr-ꜥꜣ*ꜥ.ws.: "[He will go to] ⸢the detention⸣ of the kingL.P.H."").[67] In all instances, the forecast is connected with experiencing further misfortunes, *inter alia* such which pertain to illness, death, or a bad rumour.[68]

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mhꜣw.t: "And there are those who marry their relative" with *iw⸗f r ṯꜣy n⸗f sn.t* (*n*) *mhꜣw.t n ḥm.t*: "He will take for himself a relative as a wife" in P.Carlsb. 420vo. Similar forecast are also present in, for instance, P.Carlsb. 66 [Chauveau (1992: 104)]. In col. II.5 of that text, we can read: *iw⸗f r ṯꜣy ḥm.t r sn.t mtw⸗f tꜣy*: "He will take a wife who is his sister". See Cumont (1937: 137–138) for consanguine marriage in the astrological texts. I am grateful to James P. Allen and Edward Love for having discussed with me the passage from the Old Coptic Horoscope.

65 It can be observed that the two forecast are also found separate from each other. Notice also *P.Lond.Leid.Mag.* col. XVIII.14.

66 See Quack (2004b: 118) for the present translation, which departs from that of Černý, Kahle, and Parker (1957: 87).

67 The reconstruction is based on the parallel in the Old Coptic Horoscope.

68 Greek astrological texts also contain references to being detained by a god. There the native can be referred to as a ἱεροῦ ἐγκάτοχος [e.g. Kroll (1906: 146–147)] and often this condition is, similarly to the Demotic writings, associated with a weakened mental health. Already Sethe (1913: 68–71) could identify the Greek expression with an Egyptian term, namely *ḏtḥ n rpy nṯr*: "detained of the temple of a god", which is often found in texts containing rules of cultic association [e.g. Cenival (1972)]. Being in the temple detention is described as a condition under which members could not participate ordinarily [see

Also the following negated conditional found in the predictive part of P.Carlsb. 89 demonstrates close ties between the two texts:

> *iw=f ḫpr r bn-iw sw nfr di.t n=f šm n* ꜥ[*nḫ* (?)]
>
> If a beneficent planet did not give him (the native) a sign of l[ife (?)].

A similar phrasing occurs in the Old Coptic Horoscope:

> (133)| … ⲁϥϭⲱⲡⲉ[69] ⲟⲩⲛ̄ ⲥⲟⲩⲛⲟⲩϥⲉ ⲧⲓ ⲛⲉϥ ϣⲉⲙ …
>
> (133)| If a beneficent planet gave him (the native) a sign …[70]

These examples render it plausible that the two texts at some point in time were compiled from a common source. That there is a discrepancy in the two astrological systems either means that the original planetary astrological text—most likely the one found in P.Carlsb. 81—was amended with further parameters, decans in this case, and thus a new system was created. Alternatively forecasts were lifted out from one text and combined with another astrological system. No matter how the procedure is described, the two texts display flexibility in how astrological texts were used; prognoses were not bound rigidly to a particular astrological system.

Some forecasts found in the astrological text P.Berl. 8345 are more or less identical to predictions found in the text of P.Carlsb. 81. The Berlin text also contains a number of forecasts, which are more or less replicated in the dream

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e.g. Legras (2011: 13–21); Ray (2005: 29–30)]. See e.g. Cumont (1937) and Kroll (1923) for an overview of the Egyptian background to many of the forecasts found in the Greek and Latin astrological writings.

69 Barton (1994b: 87–88), referring back to Griffith (1900), suggests that this form should be read as the perfect (Sah. ⲁϥⲥⲱⲧⲙ); the clauses are understood as describing observed or calculated positions. Such an interpretation could in theory make sense, but the astrologer did not compose the Old Coptic text. Instead he "mindlessly" copied clauses found in a Demotic manual and the conditionals were thus transferred to the horoscope. That conditional clauses are present in the sequence with Greek forecast further enhances the suggestion that ⲁϥϭⲱⲡⲉ indeed corresponds to the Demotic conditional *iw=f ḫpr* [cf. Černý, Kahle, and Parker (1957: 90)] despite the fact that the form ⲉϭⲱⲡⲉ appears once in line 142.

70 It might be noticed that the same phrase is encountered in P.Carlsb. 98vo (+ P.Yale CtYBR inv. 1168vo), a planetary astrological manual. Even if this text belongs to another astrological tradition, the occurrence shows that there existed a shared technical vocabulary.

interpreter's manual P.Berl. 8769.[71] It has therefore been suggested that there might have existed a catalogue of stereotypical forecasts that could be used in many different kinds of divinatory works.[72] Yet many of the next to identical forecasts found in various contexts are more likely common modes of expression, which were used when forecasts were constructed for different texts.[73]

10 How to Establish a Forecast

To what extent an astrologer had to make use of an astrological manual may have depended on how advanced such a handbook was and how many parameters he wanted to use. It is possible that the more factors an astrologer had to consider, the greater the need to consult a manual would have been. An astrologer, who would foretell the future using a simple system, such as the one represented by P.Berl. 8345, would probably not need to consult the manual to any greater extent, at least if he had learned the predictions by heart.

The forecasts produced by each constellation were not something that the astrologers haphazardly put together as the manual was composed. That the qualities to the planets and the loci would influence the forecast produced by each constellation is a logical assumption. In addition to these associations, the predictions seem to follow principles, which are similar to those found in many other divinatory writings from the ancient world. Generally two main rules for establishing a forecast are observed in the oldest extant Egyptian divinatory manuals. One rule is that of association, either symbolical, cultural, or that of opposition,[74] while the other one is based on wordplays and puns.[75] The latter aspect can be observed in the astrological writings as well. One example from P.Berl. 8345 (col. IV.1–5) follows below:

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71 Prada (2012).

72 Prada (2012: 320–321).

73 This is the case with the forecast found in, for instance, P.Berl. 8345 col. II.16–17 and IV.16 (*šny iw⸗f ḥp* (*r*) *ḫpr n.im⸗f/ḫn⸗f*: "A hidden disease will happen to/in him" [cf. Ps.Manetho.2.365–367]); col. IV.19 (*tꜣy⸗f ḫꜥy.t r ꜥny m-šs*: "His end will be exceedingly beautiful"); col. IV.20 (*iw⸗f r pḫl ḥꜣṯ* (*n*) *rmt* "He will enchant the heart(s) of men"). These are repeated in several instances in P.Carlsb. 81 and 89 and PSI inv. D. 34.

74 Most examples discussing divinatory deductive techniques concern oneiromancy. See e.g. Leitz (2000: 226); Prada (2013: 90–93); Szpakowska (2003: 70–73); Volten (1942).

75 See e.g. von Lieven (1999: 107–108); Quack (2010: 79). A comprehensive list of references to various kinds of wordplays is found in Noegel and Szpakowska (2006: 193, n. 1 and 194, n. 4). Nevertheless, Quack observes that punning is relatively rare in the Demotic oneiromantic material.

pꜣy-ms⸗w r Swge mtw⸗f n ꜥ.wy n sn r pꜣ rmt n rn⸗f r ḥs.t ꜥꜣ.t r ḫpr n⸗f (*n*)-*ḥwꜣ*-(*r*) *nꜣy⸗f sn.w nꜣy⸗f iry.w nꜣy⸗f ẖne.w mtw⸗w sḏm n⸗f ḏr⸗w mtw⸗f ḫpr irm nꜣ nty wꜥt r-r⸗f mtw⸗f ṯs.ṱ* (*n*)-*ḥwꜣ*-(*r*) *nꜣy⸗f ꜥꜣ.w r rn nfr r ḫpr n⸗f r rmt ꜥšꜣ* (*r*) *swn⸗f ḏr⸗w*

He who was born when Mercury was in the House of the Brother, concerning this man, great praise will occur for him, more than his brethren, companions, and friends, and all of them will listen to him, and he will be with those who are better than he is, and he will become more elevated than his superiors. A good name will occur for him and all common men will know him.

The example shows that the overall beneficent qualities of the planet and locus affect the predictions of the constellation. The locus is associated with the native's family and friends among classical astrologers[76] and this is also by and large the topic of the forecast produced by this particular constellation. This indicates that the qualities ascribed to these in the Greek and Latin writings were also applicable to Egyptian concepts, which enhances the link between the Demotic and classical astrological writings. A striking feature in the Egyptian text is that there is a simple pun between the name of the locus, a key element in the description of the constellation, and the first prediction. The word "brother" is repeated (*sn*/ⲥⲟⲛ—*sn.w*/ⲥⲛⲏⲩ).

The similarity between the forecasts produced by Venus in the same locus in the same text is striking. Though the section is badly preserved, it is apparent that the first forecasts in both sets of predictions are next to identical:

pꜣy-ms⸗w r pꜣ Nṯr-tꜣy mtw⸗f n ꜥ.wy n sn r pꜣ rmt n rn⸗f r ḥs.t ꜥꜣ.t r ḫpr n⸗f (*n*)-*ḥwꜣ*-(*r*) *nꜣy⸗f sn.w nꜣy⸗f iry.w …*

He who was born when Venus was in the House of the Brother, concerning this man, great praise will occur for him, more than his brethren and companions …

The forecast also contains a reference to people listening to the native (*mtw mšꜥ sḏm n⸗f*), echoing the prediction in the Mercury section, which mentions that the native's entourage will listen to him.

76 Cf. the list compiled of the various qualities ascribed to the loci by Bouché-Leclercq (1899: 280–285); von Lieven (1999: 123–124); Neugebauer and van Hoesen (1959: 9). See also e.g. Firm.*Mathesis*.2.19–20; Valens.*Anth*.9.3.6–18.

The forecasts produced when Mercury is in conjunction with the House of the Brother can be divided into two strands. One concerns the praise that the native enjoys and the consequences thereof, while in the other he becomes the active subject and the results of his actions, being with people better than he is, are listed. The first set of predictions concludes with a statement that everybody will listen to the native (*stm **n=f ḏr=w***), while the second ends with an assertion that everybody will know him (*sw**n=f ḏr=w***). There is also a repetition of the word *ꜥ3(.t)* "great" or "great ones/superiors" in both sets of forecasts. The compound preposition *n-ḥw3-r* "more than" is also found in both sequences. The two strands are thematically connected and can be understood as consecutive in nature. In the first set, the native is praised and outdoes his peers. In the second one, he surpasses his superiors, receiving good reputation and fame.[77]

The repetition of words and consecutive nature of the forecasts suggests that they could be learned by heart; such a structure aids memorisation of the verses.[78] It is therefore possible that the diviner using the astrological system represented by P.Berl. 8345, at least if he was a better-versed one, did not need to employ a manual to establish the future. Nonetheless, a less experienced astrologer would probably be in need of such a text. It is feasible that an astrologer using a more elaborate system, however, such as that represented by the P.Carlsb. 81, would require an astrological handbook. It is likely that there are too many parameters to be considered in the latter system to allow an easy memorisation of its entire content, although this cannot be excluded.

11 An Astrologer Identified

It is possible that the educational level of the astrologers determined who had access to the manuals and who needed to consult such a document, assuming that the more well-versed practitioners would know most of the content by heart.

Though there might have existed freelance astrologers, it is commonly assumed that many were attached to an institution, a temple. The majority of the astrologers would have been priests or at least belonged to the temple personnel. Yet there is not much information available on what type of priests were astrologers or how restricted such arts indeed were. If one believes the

77 I hope to be able to publish a fuller account of the deductive techniques employed by the Egyptian astrologers elsewhere.

78 Cf. Bohleke (1996: 39).

"Book of the Temple", a treatise on the organisation of the temple that also outlines the different areas of responsibility expertise of the priesthood,[79] such knowledge was reserved to the upper clerical echelons. Following the text, priests of higher rank, described as the children of the prophets and the superior priests (*wꜥb.w ꜥꜣ.w*), had to go through various steps in their sacerdotal education, and only in the fourth and last stage they became acquainted with what seems to be celestial divination.[80]

Administrative documents and everyday texts provide more tangible evidence for astral competence among the priests, however. The purely administrative records from Tebtunis attest to the existence of astronomers (ὡρολόγος),[81] who probably are to be identified with the ὡροσκόπος mentioned by Clemens of Alexandria.[82] The Greek title corresponds to the Egyptian *imy-wnw.t* (*wnw.ty*)[83] meaning "hour watcher" but commonly rendered as "astronomer".[84]

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79 E.g. Quack (2000); Quack (2003a); Quack (2004c).

80 Quack (2002a: 168–169). The text states that the priests were supposed to learn *sẖn.w iby*(*.t*), which Quack translates as "eclipse omina", while Ryholt (2005: 162 n. 97) suggests tentatively "omina and eclipses". Regardless which rendering is correct, the passage shows that astral, and thus also divinatory, knowledge belonged to the latter stages of the sacerdotal education. The eclipses arguably function as a kind of *pars pro toto* for most kinds of celestial divination practiced by the temple personnel at this time; probably the observation and interpretation of eclipses was the first kind of such mantic practices known in ancient Egypt. The oldest specific attestation of a lunar eclipse portending upcoming events can be found in the 8th century BC so-called Chronicle of Prince Osorkon [e.g. Caminos (1958: 88–90); Jansen-Winkeln (2007: 186–196 esp. 188); von Lieven (1999: 103 n. 157 and 122); Ritner (2009: 363); Thijs (2010: 181–182)]. Krauss (2007) provides an extensive bibliography, but his reinterpretation of the passage in question is not convincing. There are also earlier Ramesside references to celestial divination, namely in the so-called Israel Stela of Merenptah (KRI IV, 16.5) [e.g. Brunner (1973); Jambon (2013: 158–161); Quack (2002a: 168–169)].

81 E.g. *P.Tebt.* II 599; *SB* XVIII 13118 (= *P.Tebt.* II 598); *SB* XXVI 16459 (= *PSI* X 1151). There are also Demotic texts that attest such functionaries in the temple (e.g. *P.Cair.* II 30607–30609). Greek attestations of the title ἀστρολόγος in administrative and other everyday texts are listed by Papathomas (2006: 21–22).

82 Cf. Dieleman (2003: 278); Jones (1994: 42–43). Sauneron (1960: 66) distinguishes between these two titles and regards them as separate functionaries; one would be a timekeeper (*horologos*), while the other one (*horoscopos*) would be the astrologer, a mantic specialist. Such a division seems unfounded, however.

83 E.g. Birk (2014: 83–84); Dieleman (2003: 278); Osing (1985: 100–101); Vittmann (1998: 323–324).

84 Erichsen (1954: 30 and 90).

We are told by the church father (Clem.*Strom*.6.4.35–36), who observed a procession of Egyptian priests among whom the present functionary participated, that the *horoskopos* was equipped with astronomical insignia, a *horologion* and a palm rod.[85] He was also required to know by heart four books, which pertain to the celestial sciences and were written by Hermes, the Egyptian god Thoth.[86] Then follows a brief description of three books in Clemens's text. The first one was about the order of the bright fixed stars (περὶ τοῦ διακόσμου τῶν ἀπλανῶν φαινομένων ἄστρων), the next book treated conjunctions and the luminous appearances of the Sun and the Moon (τὸ δὲ περὶ τῶν συνόδων καὶ φωτισμῶν ἡλίου καὶ σελήνης), and the last one concerned the rising-times (τὸ δὲ λοιπὸν περὶ τῶν ἀνατολῶν).

One book is obviously missing in this account. The text is corrupt and this is not the only instance of textual haziness; the work is only completely preserved in one imperfect manuscript. There is a general agreement among commentators that the description of the missing book, probably the second in number in the account, lurks elsewhere in the text. It is apparent that it can be found inserted among the descriptions of the writings that were in the hands of the Scribe of the Sacred Books (ἱερογραμματεύς).[87] This sacred functionary is said to have knowledge of the movements of the two luminaries and the five planets.[88] Most editions of the text therefore lift out the passage from

85 The ὡρολόγιον is equated with the Egyptian *mrḫ.t*-instrument [e.g. Birk (2014: 84); Lull (2004: 76–78); Menchetti and Pintaudi (2010)], whilst the palm rod (φοῖνιξ) has the equivalent in *bꜥ n imy-wnw.t*, "palm rod of the astronomer" [e.g. Birk (2014: 84); Dieleman (2003: 278); Jansen-Winkeln (2007: 355–357); Lull (2004: 75–77) with further references].

86 The content of these is discussed by Neugebauer (1942: 238–239), who is able to identify corresponding Egyptian book titles. These works all seem to pertain to astronomy rather than astrology, however.

87 See most recently: Altenmüller, El-Masry, and Thissen (2012: 79–80 and 187).

88 According to the text, this priest was supposed to have knowledge about what is called hieroglyphic writings (τὰ ἱερογλυφικὰ καλούμενα), cosmography, and geography (περί τε τῆς κοσμογραφίας καὶ γεωγραφίας). Thereafter the symmetry of the text is broken by the insertion of τῆς τάξεως τοῦ ἡλίου καὶ τῆς σελήνης καὶ περὶ τῶν πέντε πλανωμένων, which is followed by a statement that the priest should be acquainted with the description of Egypt and the Nile chart (χωρογραφίας τε τῆς Αἰγύπτου καὶ τῆς τοῦ Νείλου διαγραφῆς). The statement about the planets fits the context badly, and the text must be amended to align grammatically; it lacks a coordinating conjunction (e.g. καί … τε). As it stands in the manuscript, τῆς τάξεως κτλ. connects with γεωγραφίας, which is nonsensical. Most editors of the text, therefore, move the phrase up to the section treating the duties of the astronomer, adding τὸ δὲ περί in front of τῆς τάξεως so as to make it fit the grammatical structure. See also n. 89 below.

the description of the *hierogrammateus* and insert it in the section describing the astronomer. This editorial improvement of the text accords well with the remaining duties of that priest, completes the number of astrological works, and seems to remove an ill-fitted passage from the description of the duties of the *hierogrammateus*. Though, other sources indicate that the Scribe of Sacred Books also possessed knowledge of the astral arts, a fact which may have contributed to the textual conflation.[89]

It has been suggested that the titles ἀστρολόγος, ἀστρονόμος, μαθηματικός, and ὡρολόγος etc. in the Greek sources from Egypt designate by and large the same kind of profession;[90] they refer to astronomers, i.e. people who gazed at the stars for primarily other purposes than to cast a nativity or the like. It is not implausible, however, that some may also have been involved in casting nativities.[91] Several biographical inscriptions belonging to astronomers indicate their area of competence, which seems mainly to have been to establish the time for performing the cultic acts properly.[92] Some individuals, however, appear also to have engaged in celestial divination, though it is notable that few of these diviners in fact carry explicitly the title of an astronomer.[93]

89 The phrase is not always removed from its placement, however; scholars believe that both the *hierogrammetus* and the astronomer had knowledge of the planetary movements, so e.g. Derchain (1951: 270–271); Neugebauer (1942: 237); Otto (1905: 89–90); Ryholt (2005: 160). Both *P.Hib.* I 27 and *P.Par.* 1 ascribe the same type of astral knowledge to the astronomer/astrologer and the *hierogrammetus* [see e.g. Jones (1994: 43); Moyer (2011: 238–239)]. The latter priest is also mentioned in relation to such arts in other texts (e.g. *PSI* VII 760) and traditions. Both Chaeremon [van der Horst (1984)] and Melampus [e.g. Lippold (1931)] were regarded as Scribes of Sacred Books and are said to have authored treatises on the stellar arts. The connection between this priest and the astral arts is further enhanced by the mention of the alleged author of the astrological treatise P.Vindob. D 6614 (see n. 25 above), who was both a priest (*wʿb*) and a *hierogrammetus* (*sẖ pr-ʿnẖ*) in the temple of Amun [Quack (2002b: 90–91)], but cf. von Lieven (2007: 297–298). It needs to be pointed out, however, that even if one lets the phrase stand (see n. 88 above), it cannot possibly be the only area of astral wisdom with which the *hierogrammetus* was acquainted.

90 E.g. Jones (1994: 43).

91 Török (2009: 459–460). Cumont (1937: 124), Dieleman (2003: 278–279), and Sauneron (1960: 66) suggest that the astronomers were also the temple functionaries responsible for keeping track of good and bad days, as known from the hemerologies (e.g. Leitz 1994), an activity which in a way comes close to later astrological practices.

92 Birk (2014: 83 and 86); Sauneron (1959).

93 Most notable among these individuals are Harkhebis [e.g. Brunner (1973: 29 n. 32); Derchain (1989); Dieleman (2003: 280–282); Gorre (2009: 369–372); Graefe (1971: 120–121); Jansen-Winkeln (1998: 9–10); von Känel (1984: 201–203); Legras (2002: 985–986); Moyer

The evidence from Tebtunis is not particularly informative as to the duties of the astronomer. In the Ptolemaic period, a village scribe held the title "Astronomer of the Temple of Tebtunis" (*imy-wnw.t* (*n*) *ḥw.t-nṯr* (*n*) *Tꜣ-nb-tꜣ-tny*) for a number of years in his early scribal career, but for unknown reasons he at some point stopped using the title.[94] Perhaps he sold the office. The Roman-era *P.Tebt.* II 599 (2nd century AD) attests that an individual who acquired the office of the prophet also obtained the duties of the astronomer. These attestations may suggest that the astronomer indeed belonged to the higher echelons of the sacerdotal hierarchy, but the evidence is inconclusive.

The astronomer is also attested in some priestly accounts in which costs for his activities, viz. processions, are enumerated.[95] The expenses for him are

(2011: 239–241); Neugebauer and Parker (1969: 214–216); Ritner (1993: 36 n. 167); Traunecker (1995: 89)] and members of the Nubian Waykye-family attested in *Graf.Dak.*30, *Graf.Phil.*410 and 421 [e.g. Burkhardt (1985: 100); Griffith (1935: 27–28); Pope (2008/9: 89); Török (2009: 461–462)], and *REM* 89 [Griffith (1916: 26–27); Leclant (2000: 89–90); Peust (2003: 51)]. Other examples of such practitioners may include: Ashaihy [Depauw (2001)] and perhaps The Dattari Statue [e.g. Guermeur (2005: 304–306)]. Some of these and further individuals with astral competences are surveyed in Birk (2014: 81–87); Fissolo (2001); Lull (2004). The "Astronomer of the Domain of Souchos" (*wnwn n pr Sbk*), Senty, son of Pensobek [Birk (2014: 87); Clagett (1995: 489–490); Daressy (1919: 276–278)], is another individual from the Ptolemaic Fayum with astral competences. Although his biography is poorly edited and requires a new treatment, it informs us that Senty participated in processions of the god (*mꜣꜣ nṯr m ḥb=f*), was not partial in judging between two rivals (*wp rḥ.wy sn.wy nn nmꜥ*), divided the hours according to the will of the god (*wp wnw.t mtry ib nṯr*), knew how to divide the year; month; day; hour; minute, and the orbits of the stars by observing their movements (*wp rnp.t ꜣbd hrw wnw.t ꜣ.t sby sbꜣ nb r.mꜣꜣ nmt.t=sn*), and foretold what was coming (*sr iy.t*), i.e. the future. I am grateful to David Klotz for having discussed some of these readings with me.

94 At Tebtunis, the village scribe between 128 to 106 BC, Haryotes, son of Harmysis (see Arlt 2008: 20; Muhs 2005: 94), was also an astronomer in the early years of his career. In the oldest notary deeds which he wrote (*P.Cair.* II 30607–30609), he signed the contracts using this title, while he only wrote his name in the later ones. Though astronomers are attested elsewhere as temple affiliated notaries, notably at Hawara (*P.OI.Hawara* 1, 7, and 8), where they are referred to as "Astronomer of Souchos" (*imy-wnw.t n Sbk*), it is improbable that the stargazers had any particular connection to the scribal office. Instead these occurrences indicate that certain individuals held several different responsibilities within the temple, and consequently they were using additional titles when they could. It is plausible that Haryotes moonlighted as an astronomer in the early years of his career, rather than vice versa. If the latter were the case, one would expect him to have used the title in some of the later deeds as well.

95 See n. 81 above.

mentioned in connection with those for the *pastophoros*, "porter". This individual was commonly a low-ranking temple functionary.[96] That the astronomer is enumerated together with the *pastophoroi* may suggest that stargazing was not reserved for the higher strata of the priesthood.[97] There are furthermore several documents from other parts of Egypt, showing that a *pastophoros* was also the temple astronomer.[98]

The Memphite poll tax receipt *SB* XXII 15390 (second century AD) evokes a similar impression.[99] The text attests that an astrologer had to pay the tax. Even though the name of the payer is lost, the matronymic is not, and his mother has an Egyptian name. If the payer indeed belonged to the indigenous temple hierarchy, he was not one of the tax-exempted priests, that is, he would not have been a person belonging to the higher tiers of the priesthood.

This is not the place to discuss the astronomer in closer details, save for the remarks made. Namely, that people who had accesses to some degree of astronomical knowledge and *ipso facto* could practice astrology can be found on most levels of the temple hierarchy. Such knowledge was not therefore confined to only a select few of the upper echelons of the sacerdotal ladder. This observation accords well with Quack's suggestion that it seems to have been a common duty of the priests at Narmuthis to perform astrological consultations.[100] It is possible that the different levels of sacerdotal education was also reflected in the general astrological competence, temple servants of lower status were perhaps in general less well versed in this art, whilst those of a higher education were potentially also more technically skilled.[101] Though such an assumption is by no means sure or provable.

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96 E.g. Hoffmann and Quack (2014). See also Vittmann (1998: 322–324).

97 Cf. Otto (1905: 89–91); Vittmann (1998: 324).

98 E.g. *P.Eleph.Porten* C 30 (= P.Mosc. 135); P.Louvre N 2409; *P.Tor.Botti* 2 (a/b). For the latter text, see Hoffmann and Quack (2014: 145). The astronomer in the Elephantine papyrus has also the title "Measurer of the Granary" (*ẖy n tꜣ šnʿ.t*). See e.g. *Edfou* VI.346.2–347.5; Alliot (1949: 27–29); Birk (2014: 83 n. 15 and 86); Sauneron (1959: 37) for such responsibilities of the temple astronomers.

99 See Nelson (1995).

100 Quack (1999: 193); Quack (2002a: 169). A similar notion seems to be implied by Dieleman (2003: 282 n. 36). One obvious incentive to provide astrological consultations must have been that the diviner could make a profit from such operations, as indicated by, for instance, *O.Narm.Dem.* I 27, see e.g. Dieleman (2003: 277).

101 Cf. Jones (2007: 309–311), who also suggested that there must have been different levels of expertise among people versed in the astral arts. It is tempting to make a comparison with the experiences of less skilled practitioners, which, for instance, Thessalos, the author of *De virtutibus herbarum* [cf. Moyer (2004: 253)], and Vettius Valens [Komorowska (2004:

P.Carlsb. 420vo presents an interesting case study about an astrologer. A palaeographical comparison shows that the scribe of this text was the same man who also wrote the letters *P.Cair.* II 31220 and *P.Tebt.Tait* 22 (see table 8.2).[102] These two texts were written by a certain Panesis, son of Pakebkis, and are addressed to an individual, going by the name Psenkebkis, who was both a "sage" or a "*hierogrammetus*" (*rḫ-iḫ̑y*) and prophet (*ḥm-nṯr*). Although the exact nature of these two poorly preserved documents is unclear, they inform us of the title of the scribe; he was a *m-nṯry* priest.[103] At Tebtunis the Egyptian title seems to be translated with the Greek term ἱερεύς. The reason for this may depend on the fact that the title, which seems to be particularly connected with the town, is described in a religious treatise, the so-called Book of the Fayum,[104] as the local variant of the *wʿb*-priest.[105] The title means "clean" and designates an ordinary priest attached to a sanctuary, that is, a person who did not enjoy a particularly high rank in the temple hierarchy, though by no means being at its bottom.[106] This observation accords well with the evidence discussed above and Otto's idea that the astronomers were not necessarily priests of the highest order. They may often have been "ordinary" clerics.[107]

Hickey has suggested that one of the lessors of some temple lands attested in the Greek lease contract *PSI* X 1143 from AD 164 may be the same individual.[108] If this identification is correct, it means that the Demotic texts are also to be dated to the middle of the second half of the second century AD and not the third as proposed by the editor of *P.Tebt.Tait*. 22. The date suggested by Hickey seems to

248–259)] had when they came to Egypt in search for arcane knowledge. Both report that they met several priests, who purported true wisdom in such arts but *de facto* proved to be merely charlatans.

102 There are unfortunately few good diagnostic signs. The table contains most words that occur in both the letters and the astrological text. The occasionally different appearance of the signs depends on, *inter alia*, the fact that the scribe employed different brushes. The writing utensil used to write *P.Cair.* II 31220 is considerably thicker than any of the brushes used for any of the other texts.

103 Depauw (2006: 361); Quack (2013: 112).

104 Beinlich (1991); Beinlich (2014).

105 See recently Quack (2013: 111–116). Also Wegner (2011: 117) and Winkler (2010: 164) provide references to earlier discussions of this sacerdotal title.

106 Otto (1905: 75–77); Sauneron (1960: 70–72); cf. Török (2009: 459).

107 Otto (1905: 89–91).

108 Hickey (2009: 77). Though Hickey is cautious in making this identification. But the fact that the texts are by and large contemporary, Panesis is identified as a priest in both cases, and that there are no other attestations of this combination of name and patronymic in the 2nd century AD, enhances the suggestion.

TABLE 8.2

	P.Cair. II 31220 and *P.Tebt.Tait* 22	P.Carlsb. 420
iẖy		
wꜥb		
wḏꜣ		Cf. Jupiter
pꜣy		
md.t		
rḫ		
ḥꜣṯ		
ḥms		
ḥḏ		
ḫꜣꜥ		
ḫpr		
šm		
gm		
di.t		
Book roll det.		
House det.		
Man det.		
ꜣ		
w		
l		
ẖ		

be confirmed by the administrative records on the recto side of P.Carlsb. 420; the latest date attested in the Greek text on the recto is year seven of Antoninus Pius (AD 143/144). Assuming that the papyrus was recycled to be inscribed with the Demotic text roughly twenty to thirty years after the Greek account was written, the astrological treatise on the verso would have been penned approximately in the same time as *PSI* X 1143 was drawn up and therefore probably not chronologically distant from the time of composition of the two Demotic letters.

In the Greek lease contract, Panesis is also described as a priest (ἱερεύς). But, more interestingly, he subscribed the document. The *hypographê* shows that the person in question was capable of not only speaking Greek but also had a limited competence writing in that language. While his Demotic is of excellent quality, the Greek is not. It can be described as written in a typical slow hand; Panesis wrote Greek like a "still unformed schoolboy".[109] *Ipso facto* he was probably not used to writing anything lengthier in that language and surely was not one of the Greek scribes attached to the sanctuary.[110] If this had been the case a more trained hand would be expected. That Panesis had limited skills in Greek is not necessarily a reflection of his priestly rank, access to "sacerdotal wisdom",[111] or astral competence; some priests with the same title seem to have been completely incapable of writing in that language, whilst others apparently preferred it for their business. A parallel to Panesis can perhaps be seen in the fictional character Pancrates, the master magician, who spoke "bad" Greek.[112]

Whatever this information is worth, it provides a peek into the life of one of the astrologers at Tebtunis and shows that not all scribes who composed

109 Youtie (1971: 244). It can be pointed out that Panesis' brother, Psyphis, also a priest, and probably of similar rank, wrote considerably better Greek.

110 Cf. Hickey (2009: 76).

111 The fact that Panesis also copied a wisdom text, *P.Tebt.Tait* 15 (see n. 58 above), reminds us that also priests outside the highest sacerdotal echelons accessed various kinds of Demotic literature. It may furthermore be pointed out that the scribe of P.Carlsb. 81 can be identified as having written other texts from Tebtunis. He, for instance, probably copied the Sothis text *P.Cair.* II 31222 [Hughes (1951)]. That the same person wrote two distinct astrological texts suggests that these individuals were engaged in both making forecasts about nativities and prophecies about the welfare of the country, at least if the latter kind of text indeed was used for such purposes. PSI inv. D 39 (see nn. 19 and 20 above) evokes the same impression; the verso contains a Sothis-text, while the recto is inscribed with a text for casting nativities. The two sides appear, however, to be written by two different individuals. See Quack (2014b: 122) for another prolific scribe in the crocodile sanctuary.

112 Lucian.*Philops*.34–36 and perhaps *PGM* IV.2446–2455; see Moyer (2011: 224 n. 53) for references.

lengthy astrological treatises in Demotic would be able to do the same in Greek. The Greek astrological texts were surely compiled by priests and astrologers of the Soknebtunis sanctuary, and in most cases these texts were written by scribes who were well versed in that language. This fact underlines the variety of competence among astrologers at Tebtunis, they had different capacities in Greek and it is possible, as suggested above, that the same diversity can be found in relation to their astral proficiency, though these two skills are by no means causally or directly related.

The difference in their astral expertise may have been reflected in the astrological writings, both in relation to their structure and level of complexity. Simpler manuals may have been used by less well-versed diviners, or possibly, as suggested above, they could structure their writings in a more convenient manner.

12 Conclusion

This paper has discussed the structure of some astrological manuals and what information they contain in helping the astrologer to produce a complete set of forecasts. It has been shown that various manuals follow different structures and that the astrologers had a certain degree of autonomy when they copied the texts; they could choose freely how to arrange the information contained by such a treatise. The scribal agency also influences the way "obvious information" was incorporated or excluded. It has further been suggested that the way certain texts were compiled may partially reflect the competence of the practitioner. The texts were thus by no means codified into a rigid structure and likely therefore represent a creative process, the shaping of a science, rather than epitomising a merely reproductive tradition.

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CHAPTER 9

The *Anaphoricus* of Hypsicles of Alexandria

Clemency Montelle

Rising times and related patterns have thus become an excellent indicator of cultural contacts, ultimately originating in Mesopotamia.

NEUGEBAUER (1975: 371)

1 Introduction

While historians of ancient mathematical astronomy frequently acclaim Ptolemy's great *Mathematical Syntaxis* as a triumph for the discipline, they also readily admit that its widespread success has had some serious consequences for our understanding of astronomical activity that preceded it. As a result of the overwhelming popularity and superiority of the *Syntaxis*, many prior Greek astronomical endeavors ceased to be copied, deemed outdated and obsolete, and thus their contents remain permanently out of reach to the historian. It is often lamented that our knowledge of early Greek astronomy is thus all the poorer, and in order to sketch an impression of the environment that fostered the publication of such a masterpiece, modern scholars at best cobble together a picture from scattered texts, references, testimonia, material from related disciplines, scientific inference, and the like, even drawing from material outside the Greek tradition altogether.

Whilst our picture of the development of early Greek astronomy may be sketchy, there do exist sources which give some direct insight. One of these is the work of Alexandrian scholar Hypsicles, who flourished in the first half of the second century BCE (see section 1.1). Hypsicles wrote several works, two of which have survived. One of these, the so-called *Book 14 of Euclid's Elements*, is a mathematical work in the style of Euclid which explores the relations between an icosahedron and a dodecahedron inscribed in the same sphere.[1] The other is a work on mathematical astronomy called *Anaphoricus*,

1 See Vitrac and Djebbar (2011), Vitrac and Djebbar (2012), Heath (1956), Heiberg (1988).

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or 'Little (work) on Rising-Times' and describes a procedure to compute a set of rising times or oblique ascensions, along with a mathematical justification of the procedure, as well as a partially worked example for the latitude of Alexandria.

This work is of key interest for two main reasons: firstly, because of its exceptional and seemingly precarious trajectory through time as a text, and secondly because of its inspiration from earlier, foreign, sources and in turn, its influence on successive generations of practitioners from diverse cultures of inquiry. The *Anaphoricus* appears to have been inspired by the arithmetical modeling techniques of ancient near eastern scholars, but the underlying scheme was thoroughly modified and reshaped to suit the Greek context. It is also our earliest Greek source which explicitly uses sexagesimal notation and conventions, also transmitted from the ancient near east, and it is the first extant text in the Greek corpus to define and use 'degrees' as a 360th part of the ecliptic.

Somewhat ironically, linear approaches to rising times were technically made redundant with the advent soon after the publication of the *Anaphoricus* of more correct trigonometrical approaches. They did not cease to be used however. In fact, quite the contrary: linear schemes for rising times became hugely popular particularly amongst astrological practitioners and this work seemed to inspire many authors to adopt similar schemes for centuries after its composition.

The *Anaphoricus* was included at some point as part of the *Little Astronomy*[2] which ensured its survival to the present day, and was eventually translated several times into Arabic, as well as into Latin and Hebrew. I present here an English translation of this work with an accompanying technical commentary,[3] and discuss the significance of this work and its circulation and reception by later scholars.

1.1 *Date of Hypsicles*

Hypsicles' dates have been variously reckoned,[4] but his *floruit* can be confirmed from his own work. There are three ancient authorities who refer to

2 Modern scholars, including Neugebauer, have questioned the cohesiveness of this collection. This issue will be addressed more fully in a later section of this paper.

3 This work has already been critically edited and translated into German. In the process, de Falco et al. consulted the various scholia as well as the Arabic versions. The English translation has been based on this critical edition. See de Falco et al. (1966), along with reviews by Pingree (1968) and Toomer (1970).

4 For example, Bulmer-Thomas (2008) suggests the date of 175, making the assumption that Hypsicles' father was an older contemporary of Apollonius who died in the early second century BCE, thus placing Hypsicles.

Hypsicles, but none of them provide more than a rough *terminus ante quem*. Diophantus of Alexandria (insecurely dated; fl. ca. 250 CE?) explicitly attributes to Hypsicles a mathematical definition in *De polygonis numeris*.[5] According to Achilles Tatius (date insecure, second or third century CE?), Hypsicles also wrote a book on the harmony of the spheres which is lost.[6]

Hypsicles himself however refers to several individuals throughout *Book 14 of Euclid's Elements* and through this his date can be established more precisely. He addresses this work to Protarchus who may be the Epicurean Protarchus mentioned by Strabo, a contemporary of Philonides who lived it is supposed from roughly 200 to 120 BCE.[7] Hypsicles reveals that Protarchus is on close terms with his father and friendly with Hypsicles himself. However, Protarchus is a common name in antiquity and thus this attribution must be treated with caution. Hypsicles also refers several times to Apollonius of Perga (262–190 BCE)[8] and Aristaeus (fl. ca. 350–330 BCE). Euclid, however, is never mentioned by name, nor is the *Elements* explicitly cited, although a proposition from book XIII is mentioned. But the key source for securing Hypsicles' date is the reference Hypsicles makes to the individual who worked in collaboration with his father, Basilides of Tyre. Basilides is a well-known figure in antiquity and can be dated securely to the beginning of the second century BCE.[9] Taking into account a lapse of one generation then, one can place Hypsicles' *floruit* tentatively to about 190 BCE. Therefore, it is possible he may have been a contemporary of Hipparchus or that there was a little overlap in their careers; it is possible that Hypsicles began working slightly earlier.

1.2 *What are Rising Times and Why are They Important?*

Rising times,[10] or oblique ascensions, are intervals of the time it takes for a given zodiacal sign (or parts thereof) to rise above the horizon. Rising times appear to have been first investigated because they were a convenient way to determine the time at night. For instance, in his *Phaenomena*, Aratus (3rd century BCE)

5 Tannery (1993).

6 Maass (1898: 43.9).

7 Mueller (1982: 94).

8 These are traditional dates of Apollonius however Evans (2014: 149–151) makes a resume of the dates including a plausible reevaluation of Apollonius' dates to be two decades earlier. This, however, does not affect the proposed dates of Hypsicles.

9 Basilides of Tyre was the fourth successor of Epicurus, as the head of the Epicurean school. He succeeded Dionysius of Lamptrai in the year 205/4 as scholarch. See Algra (1999: 44). Mueller (1982: 93) also mentions DL X 24–25.

10 See Evans (1998: 95–125), Montelle (forthcoming).

notes that the time can be determined by observing which zodiacal constellation is rising over the horizon. This rudimentary scheme was improved soon after by more sophisticated approaches.

From the vantage point of an observer located somewhere on the earth, once a day the celestial sphere with all its contents makes a complete rotation westwards about the North (celestial) pole. One complete rotation is equivalent to 24 hours or 360 degrees. As well as all the stars and planets, the sun is carried around too, making a compete rotation in a day. The sun can also be imagined to have an annual motion and this apparent path is known as the ecliptic. The ecliptic is often divided up in to twelve 30-degree intervals, each of which have associated with them a constellation, known as a sign of the zodiac. The ecliptic is offset with respect to the (celestial) equator by a little under 24 degrees, an amount which is called the obliquity of the ecliptic. Thus as part of the daily rotation of the celestial sphere, the sun and also the ecliptic will make a complete rotation. Therefore, every day, the twelve zodiacal signs will rise (obliquely) above the horizon and set on the other side. An observer, of course, will only be able to observe those zodiacal signs which rise when the sun is below the horizon, that is, at night. During the day of course, it is largely impossible to observe stars with the naked eye.

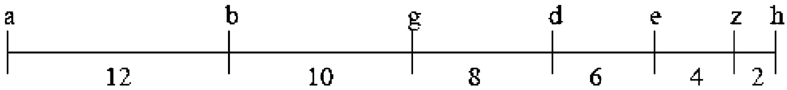
The rising time of a zodiacal sign then is the time it takes for that particular sign to rise, that is, for the entire 30 degrees of that sign to rise completely above the horizon. Rising times can also be computed for individual degrees of zodiacal signs. From sunrise to sunset 180 degrees of the ecliptic are swept across the horizon, or six consecutive zodiacal signs. The length of time between sunrise and sunset therefore is equal to the rising time of six consecutive signs. The same is true of the length of time between sunset and sunrise. The length of the day (or night) determines how quickly each of these zodiacal signs rise. Furthermore, because of the obliquity of the ecliptic, each of these zodiacal signs will rise in different times. Thus the astronomical problem becomes to find, for a given zodiacal sign, the arc of the equator which is crossing the horizon in the same time, as time is measured along the equator. As the length of daylight is dependent on geographical latitude, the problem raised by rising times connects with geographical latitude and length of daylight and thus is a fundamental element of astronomy.

Indeed, rising times were not only useful for time reckoning but crucial for carrying out certain astrological procedures. For instance, casting a horoscope required the degree of the ecliptic that was rising above the horizon at the time in question, usually to a precision of hours and minutes. Thus tables of rising times were essential for astrologers.

2 The Text

2.1 *Translation*

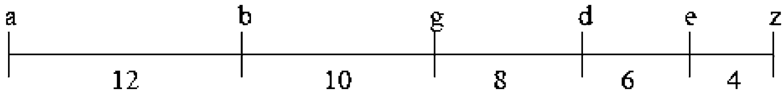
If there should be as many terms as we please, with a common difference, lying one after another, their number being even, the difference, by which the sum of half of the number (of terms) beginning from the greatest exceeds (the sum of) the remaining (terms), is the product of the common difference and the square of the (amount) of half of the number of terms (originally) set out.



Let there be as many terms as we please, ab, bg, gd, de, ez, zh, with a common difference, lying one after another, their number being even, beginning from the greatest, ab, and let half of the number be ad. I say that the difference by which the sum of half of the number (of terms) exceeds (the sum of) the remaining (terms), that is the difference by which ad exceeds dh, is the product of the common difference and the square of half of the number (of terms).

For since the difference (between) ab (and) bg is equal to the difference between de (and) ez, therefore, 'alternately' (*enallax*), the difference (between) ab (and) de is equal to the difference (between) bg (and) ez. Again, since the difference (between) bg (and) gd is equal to the difference (between) ez (and) zh, 'alternately', the difference (between) bg (and) ez is equal to the difference (between) gd (and) zh. Consequently, the difference (between) ab (and) de and the difference (between) bg (and) ez and the difference (between) gd (and) zh, that is the difference (between) ad (and) dh is the product of the difference (between) ab (and) de and the number ab, bg (and) gd. And the difference (between) ab (and) de is the product of the difference (between) ab (and) bg and the number (of terms) ab, bg (and) gd. Consequently, the difference (between) ad (and) dh is the product of the difference (between) ab (and) bg and the square of the number (of terms), ab, bg and gd, that is, the square of half the number of terms (originally) set out.

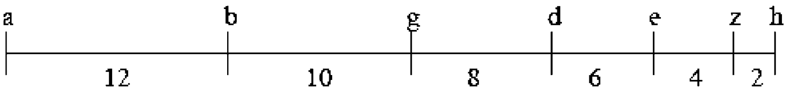
If there be as many terms as we please with common difference, lying one after another, their number being odd, beginning from the greatest, the sum of all (of the terms) is the product of the middle (term) with the number of terms (originally) set out.



Let there be as many terms as we please ab, bg, gd, de, ez, with common difference, lying one after another, beginning from the greatest, ab, and let the number of them be odd. I say that the sum of them all, az, is the product of the middle (term) gd and their number.

For since ab, bg, gd, de, ez have a common difference and the number of (terms) ab, bg, gd are equal to the number (of terms) gd, de, ez, therefore because of equality, the difference (between) ab (and) gd will be equal to the difference (between) gd (and) ez. Therefore ab and ez together is double gd, so that ab and ez together is the product of gd and the number (of terms) ab, ez. Through the same (reasonings), bg and de together is the product of gd with the number (of terms) bg de, and gd is equal to itself; so that az is the product of gd and the number (of terms) ab bg gd de ez.

If there should be as many terms as we please, with common difference, lying one after another, their number being even, beginning from the greatest, the sum of them all is the product of the two at the extremities and half the number of terms (originally) set out.



I call 'syzygies of one another' the two terms at the ends and, in turn, the two adjoining them, and the two next, and so on, up to the middle.

Let there be as many terms as we please ab bg gd de ez zh, with common difference, lying one after the other, beginning from the greatest, ab, and let their number be even. I say that the sum of them all, ah, is the product of the two (terms) at the extremities ['syzygies'] and half the number of terms set out.

For, since the difference (between) ab (and) bg is equal to the difference (between) ez (and) zh, therefore ab and zh together is equal to bg and ez together. Through the same (reasonings), indeed bg and ez together is equal to gd and de together. Therefore abzh, bgez, (and) gdde together are as many as to ah, as so many as is the number (of terms) ab, bg, and gd, that is, as many as is half the number of terms set out; consequently, ah is the product of the two (terms) at the extremes and half the number terms set out.

With the circle of zodiacal (signs) being divided into 360 equal arcs, let each of the arcs be called spatial degrees. Indeed, in the same way, with the time, in which the zodiacal circle returns from a point to the same point, being divided into 360 equal time-intervals, let each of these (time intervals) be called time degrees. With these things having been established, we will demonstrate, using the afore-ascribed theorems, that for a given locality, when the ratio of the longest day to the shortest is known, the time degrees in which each of the zodiacal (signs) rises will be known.

Let the klime through Alexandria in Egypt be assumed, where the longest day to the shortest day has a ratio of 7 to 5; for that it is thus, we demonstrated using the solsticial midday shadows taken from gnomons.

Let the circle of zodiacal (signs) be laid out, in which the diameter (of this circle intersecting with) the 'celestial equator' is ah. And let the circle be divided into the zodiacal (signs) at a b g d e z h q k l m n. And let the point a be the beginning of Aries, the (point) b the beginning of Taurus, g the beginning of Gemini, and let the successive points be understood (as the beginnings) of the successive zodiacal (signs). Since the longest day with respect to the shortest day has a ratio of 7 to 5, and the time of the longest day is that in which the semicircle beginning with Cancer rises, that to say dhl, and the time of the shortest day is that in which the semicircle beginning from Capricorn rises, (that is) lad, therefore the rising time of the semicircle dhl with respect to the rising time of the semicircle lad has a ratio of 7 to 5. Now, the whole circle rises in 360 time degrees: therefore the semicircle dhl rises in 210 time degrees and the semicircle lad in 150 time degrees. And the quadrant dh rises in the same time as the quadrant hl, and the quadrant la rises (in the same time) as ad. For (each) is offset an equal amount from the celestial equator. Therefore the quadrant dh will have risen in 105 time degrees, and the quadrant da will have risen in 75 time degrees. Therefore the rising time of the quadrant hz ed will exceed the rising time of the quadrant dg ba by 30 time degrees.

Since the six terms are the rising (times) of the arcs hz ze ed dg gb ba, with common difference, lying one after another, beginning from the greatest, the one with respect to h, for this was proposed by the (original) assumptions concerning rising times, the difference, by which the sum of half of the number of (terms) beginning from the greatest exceeds (the sum) of the remaining (terms), is the product of the difference of each (term) and the square of half of the number (of terms). And the difference of rising times, by which the sum of half of the number of remaining terms exceeds (the sum) of the remaining, is 30 time degrees, the square of half (of the number of terms) is 9: 30 (divided by) 9 is 3;20 time degrees. Therefore, the difference of the rising times for the "twelfth parts" [henceforth zodiacal signs] hz ze ed dg gb ba is 3;20.

Again, since as many terms as we please are the rising times of the arcs hz ze ed, with common difference, lying one after another, their number being odd, beginning from the greatest, the sum of all of them is the product of the middle (term) and the number of them. Now, the rising time of the sum of them all is 105, the number (of terms), hz, ze, ed is three, a third of 105 is 35. Therefore the arc ez, which is Leo, will have risen in 35 time degrees. Through the same (reasonings), indeed the (arc) bg, which is Taurus, will have risen in 25 time degrees.

And the rising times of the successive arcs will exceed each other by 3;20 time degrees. Therefore, Aries will rise in 21;40, Taurus in 25, Gemini in 28;20, Cancer in 31;40, Leo in 35, Virgo in 38;20, and zh in a time-interval equal to qh, and ez to qk. And those offset an equal (distance from the celestial equator) rise in an equal time-interval. Therefore, Libra will rise in 38;20, Scorpio in 35, Sagittarius 31; 40, Capricorn in 28;20, Aquarius in 25, Pisces in 21;40.

The setting times of the zodiacal (signs) will be obvious, as the rising time of any one zodiacal (sign) is equal to the setting time of the zodiacal (sign) diametrically opposite.

When the difference by which the rising times of successive twelfth parts of the zodiac exceeds each other is known, the rising times of thirtieth parts of the twelfth-parts, lying one after another, will be known also, in which there is a difference.

Let there be laid out (two successive) twelfth-parts of the circle of zodiacal signs, one after the other, ab bg, and let ab rise in a time greater than bg. Let the beginning of the rising time be the point a. Therefore, the rising time of the zodiacal sign ab exceeds the rising time of the zodiacal sign bg by 3;20 time degrees. Indeed, I say that the rising times of the thirtieth-parts of the zodiacal signs ab (and) bg lying one after another, will be known, in which there is a difference, beginning from the greatest.

For since the rising times of the thirtieth parts of the zodiacal signs ab bg have a common difference, beginning from the greatest at a, the difference, by which the sum of half of the number (of terms) exceeds the remaining terms, is the product of the difference of each of them and the square of half of the number of terms. And the difference (between) ab (and) bg is 3;20 time degrees, the square of half the number (of terms) is 900. 3;20 (divided by) 900 is 0;0,13,20. Therefore, the sought after rising-time difference of the thirtieth-parts of the zodiacal signs lying one after another is 0;0,13,20.

What with in how many times degrees one twelfth part whatsoever of the zodiacal circle rises being known and what with the difference of the rising time being known, by which the risings times of successive thirtieth parts of the zodiacal signs exceed, the time degrees in which each thirtieth part rises will be known.

Let there be laid out the zodiacal sign of Aries ab. Nothing will be different, if we should suppose otherwise. Therefore ab the zodiacal sign rises in 21;40 time degrees. Indeed it is necessary to find in how much time each of the thirtieth parts of the zodiacal sign ab rises.

Let the first thirtieth part be ag and the last db. Since as many terms as we please are the rising times of the thirtieth parts in the zodiacal sign ab, lying one after the other, with common difference, their number being even, beginning from the greatest ag, the sum of all of them as established is the product of the two at the extremities and half of the number of the terms. And the (sum) from everything that was established is 21;40, and half of the number (of terms) is 15. 21;40 (divided by) 15 is 1;26,40. Therefore ag and db together will have risen in 1;26,40 time degrees.

Again since the rising times of the arcs of the thirtieth parts of the zodiacal sign ab have a common difference, beginning from the greatest ag (and the first is ag, the last db), ag exceeds db by a difference of 29 times 0;0,13,20. So many differences times 0;0,13,20 produce 0;6,26,40. Consequently, the difference of the rising time ag with respect to db is 0;6,26,40. And ag and db together rises in 1;26,40 time degrees. Therefore, ag rises in 0;46,33,20 (time degrees) and db in 0;40,6,40.

What with these things having been found and the difference of successive rising time arcs being known, which is 0,0,13,20, in how much time the remaining (rising times) rise will be known also.

3 Commentary

Hypsicles' text contains several distinct sections. The first contains three mathematical propositions with their 'demonstrations', each with an accompanying diagram. The second section covers various important data and astronomical conventions. The third section applies the mathematical propositions and works through examples to determine the rising times of select zodiacal signs. The results of these worked examples are displayed on a large diagram (see figure 9.1 for a reconstruction of this diagram based upon how as it appears in one of the manuscripts).

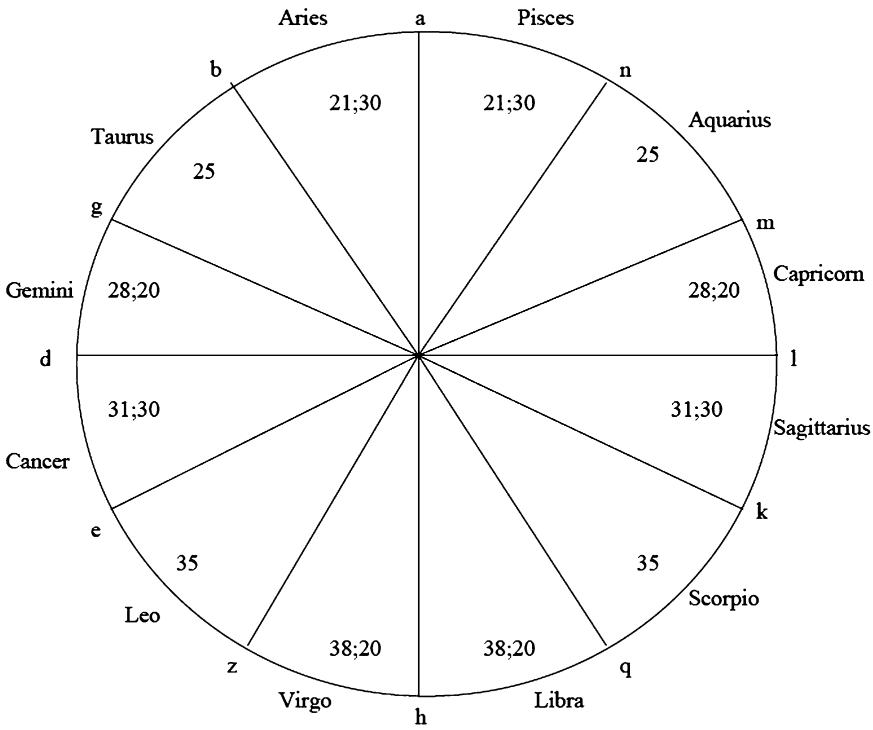


FIGURE 9.1 *Circular diagram depicting the rising times in each zodiacal sign (redrawn from the diagram in Vat. Gr. 204 f. 135ᵛ).*

3.1 *Mathematical Discussion*

The emphasis on giving mathematical foundation to astronomical results is firmly established as Hypsicles' treatise opens with the enunciation, description, and demonstration of three abstract mathematical results which give certain relations between the individual terms of an arithmetical sequence and the sums of these terms. Rising times are not mentioned until well into the work. His entire approach to the computation of rising times rests upon these three propositions and they are invoked multiple times throughout the rest of the work.

Each result is set out in a distinctive manner: the relation is stated, then illustrated more specifically, that is, the result is demonstrated by means of a 'non-specific' but fixed example, and then lastly the relation is 'demonstrated' or 'proven'. Each result is accompanied by a diagram for clarification. The language Hypsicles employs is unmistakably Euclidean in style, however notably absent is the Euclidean rhetorical formal structure with its characteristic phrases such as 'thus it was to be demonstrated' at the end of a demonstration.

Hypsicles invokes an arbitrary number of terms, each of which differ from the previous by a common difference, arranged in decreasing order starting from the largest. More formally, what Hypsicles is working with is what is nowadays known as an arithmetical sequence or progression. There is no single term in Greek that means ‘sequence’ but rather Hypsicles conveys the concept by means of the phrase ‘however-so-many terms with common difference lying one after the other’.

The results Hypsicles presents involve the sums of sequences. In modern symbolic notation, the sum of a sequence of terms can be captured as follows:

$$\begin{aligned} S_n &= a_1 + a_2 \qquad + a_3 \qquad + \ldots + a_{n-1} \qquad\qquad + a_n \\ &= a_1 + a_1 + d + a_1 + 2d + \ldots + a_1 + (n-2)d + a_1 + (n-1)d \end{aligned}$$

and can be written as follows in closed form:

$$S_n = \frac{n\,(a_1+a_n)}{2}$$

$$S_n = \frac{n\,(2a_1+(n-1)d)}{2}$$

Even without the aid of such notational reasoning, the sum of an arithmetical sequence of terms can be derived somewhat intuitively: the sum of the first and the last terms in a sequence is the same as the second and the second-to-last term, the third and the third to last term, and so on, until one runs out of terms in the middle. There will be $\frac{n}{2}$ such sums if there are an even number of terms. In the absence of modern symbolic manipulation, it seems likely that it was through this sort of reasoning that Hypsicles derived these results.

The three results he presents are all articulated rhetorically. They are, in order of exposition, as follows:

Proposition One

Let there be a decreasing arithmetical sequence with an even number of terms. Given the total number of terms ($2n$) and the common difference (d) between them, one can find the difference between the sum of the first half of the terms and the sum of the latter half of the terms. The mathematical relation is, in modern notation:

$$\sum_{k=1}^{n} a_k - \sum_{k=n+1}^{2n} a_k = n^2 d$$

Proposition Two

Let there be a decreasing arithmetical sequence with an odd number of terms. Given the middle term (a_n) and the total number of terms ($2n-1$), one can find the sum of all of the terms. Their relation is, in modern notation:

$$\sum_{k=1}^{2n-1} a_k = (2n-1)a_n$$

Proposition Three

Let there be a decreasing sequence with an even number of terms. Given the first term (a_1) and the last term (a_{2n}) and the total number of terms ($2n$), one can find the sum of them all. Their relation is, in modern notation:

$$\sum_{k=1}^{2n} a_k = n(a_1+a_{2n})$$

Proposition one is demonstrated in the following way. Hypsicles says 'let there be as many terms as we please' but for his demonstration lists an exact number, in this case 6, calling them *ab bg gd de ez zh*. For convenience's sake and ease of interpretation let us call these a_1,a_2, etc., to a_6.

Hypsicles proceeds in the following manner by carefully selecting pairs of contiguous terms and noting that they differ by the common difference. He notes

$$a_1 - a_2 = a_4 - a_5$$

which is d, so he can conclude

$$a_1 - a_4 = a_2 - a_5$$

which is $3d$. He does not generalise this further for other appropriate pairs of terms, or the general case. Similarly:

$$a_2 - a_3 = a_5 - a_6$$

implies

$$a_2 - a_5 = a_3 - a_6$$

So that

$$
\begin{aligned}
\sum_{k=1}^{3} a_k - \sum_{k=4}^{6} a_k &= (a_1 - a_4) + (a_2 - a_5) + (a_3 - a_6) \\
&= 3(a_1 - a_4) \\
&= 3(3d) \\
&= 3^2 d
\end{aligned}
$$

For the next result, Hypsicles considers a descending arithmetic sequence with an odd number of terms, 5 in this case, represented by *ab, bg*, etc. Again let us use a_1 to a_5 for convenience. Hypsicles notes

$$a_1 - a_3 = a_3 - a_5$$

which is $2d$, so he can conclude

$$a_1 + a_5 = 2a_3$$

and in a similar way he notes

$$a_2 + a_4 = 2a_3$$

so that

$$
\begin{aligned}
\sum_{k=1}^{5} a_k &= (a_1 + a_5) + (a_2 + a_4) + a_3 \\
&= 2a_3 + 2a_3 + a_3 \\
&= 5 \times a_3
\end{aligned}
$$

For the third and final result, Hypsicles is careful to gloss the term *syzygy* as terms at the extremes. Again, he sets out an even number of terms and notes

$$a_1 - a_2 = a_5 - a_6$$

implies

$$a_1 - a_6 = a_2 - a_5$$

and also

$$a_2 - a_5 = a_3 - a_4$$

so that:

$$\begin{aligned}\sum_{k=1}^{6} a_k &= (a_1+a_6) + (a_2+a_5) + (a_3+a_4)\\ &= (a_1+a_6) + (a_1+a_6) + (a_1+a_6)\\ &= 3(a_1+a_6)\end{aligned}$$

Noticeably, these three results are not arranged in a strictly deductive order, that is not in order of increasing complexity as is the tradition for Euclidean style. For instance, Hypsicles invokes the notion of the sums of sequences which are not treated until the subsequent two results. Proposition one might sit more naturally in a deductive sequence *after* propositions two and three. Furthermore the two results which are applicable for sequences with an even number of terms are not presented side by side, but rather split by the result for the sum of a series with an odd number of terms.

Evaluated in this way strictly mathematically, the exposition may seem a little strange. However, on closer scrutiny, it appears that this ordering is rather a reflection of the order in which Hypsicles draws upon them later on in the text. This further supports the idea that what is foremost on his mind is mathematics in application of another aim. Hypsicles' primary motivation was not to present a polished mathematical treatise progressing in a strictly deductive logical order, but rather give some mathematical results relevant to an applied problem at hand.

The other noticeable feature is that the results are not articulated in a form that he can use immediately, but require subsequent (although fairly trivial) mathematical manipulation. For example, the empirical result his whole work rests on is the ratio of longest to shortest length of daylight, which provides information for the first proposition about the difference between the first half of the terms and the second. He combines this with the total number of terms to find the common difference. However, the relation given in proposition one produces the difference of the sums of the first half and second half of the sequence as being equal to the product of the square of the number of terms multiplied by the difference. Thus division needs to occur to make this expression produce the difference.

Another feature is the inclusion of diagrams within the text. In the diagram accompanying proposition 3, for instance, the line segments have been given numerical values, starting at 12, and decrease by the common difference of 2, to produce the decreasing arithmetical sequence 12, 10, 8, 6, 4, 2. This has been done in several manuscripts and is not particular to one scribe. Quantifying the line segment portions in this way is not mentioned in the text.

More work needs to be done on the role and scope of the diagrams, however what is immediately clear is that the diagrams are a vital component of the work. Without them it would not always be clear what the text is referring to. For example, at the end of the work, two intervals *ag* and *bd* are invoked in the text. Contrary to all previous usages in this text (in say, proposition one), these intervals are *not* adjacent to one another, but are the extreme terms of the interval. The diagram is the only place in which this detail is revealed.

The diagrams also may give insight into how exactly these mathematical objects, the terms of the sequence, were visualised. Here, as is in keeping with the Euclidean exposition, these terms are not seen as discrete units, but rather line segments. This way of presentation has advantages; along this line is two different ways for expressing the sum of several terms of the sequence: can say *ad* to equally mean $ab + bg + bd$. Both are used in the text seemingly interchangeably. It also perfectly connects with the fact that these abstract mathematical propositions are in fact going to be applied to arcs along the ecliptic perhaps, which can themselves be imagined to be line segments.

More generally, this text is at the intersection between pure mathematics and applied astronomy. Its approach, therefore, epitomises mathematical astronomy in ancient Greece, even at this early stage.

3.2 *Astronomical Discussion*

Following the three mathematical propositions, Hypsicles includes a passage which outlines the foundation for the following computation of rising times. He invokes the ecliptic and its division into 360 equal arcs. This is the first time in the Greek tradition that degrees are explicitly invoked and defined. He names each of these arcs 'spatial degrees', literally *moira topike*. He then considers the time it takes for the ecliptic to make one complete rotation, this time period is to be divided into 360 equal time intervals. He names each of these arcs 'time degrees', literally *moira chronike*. Rising times thus become the time interval for various arcs of the ecliptic to rise.

This is also the earliest extant Greek text to use sexagesimal notation and compute in a sexagesimal framework.[11] The impact of this mode of reckoning on Greek astronomy was profound, most notably as it provided practitioners with a place-value system of numeration which was more suitable to arithmetical operations. However, as Hypsicles' text reveals, modifications to this system of reckoning were made to adapt it to the existing Greek system of numeration. Unlike the system of numeration in the ancient near east (namely two distinct symbols for 1 and 10 which could then be repeated and combined to represent numbers between 1 and 59), the symbols used to express these sexa-

11 Jones (1991: 442, fn. 5).

gesimal numbers are the so-called Ionian numbers, in which the letters of the old Ionic alphabet are assigned numbers (one to nine are the given the first nine letters, 10 the next letter, 20 the following, and so on). The system is not a place-value one, and fractional parts of numbers had different symbols again. What is notable is that these letters of the Greek alphabet had been used already on the diagrams of this text to indicate the lettered points. The resulting ambiguity was not helped by the practice of putting overbars over these expressions: overbars were used both over a line segment indicated by the letters on the extremities, or a number that might be made up of two or more letters. Hypsicles also notes at this point that the rising times are computed for a specific local latitude. He states that his will be computed for Alexandra in Egypt. The one (and only) piece of empirical information he requires for his computations is, as he notes, the ratio of the longest day to the shortest day. He also explains how this is determined: from the noon shadow at each of the solstices which can be measured using a gnomon.

Hypsicles then instructs the reader to construct a diagram. One is to start with a circle, draw in the diameter, divide the circle into 12 equal portions and label these with the first 12 letters of the Greek alphabet. The celestial equator is set as *ah*. He carefully describes how to place the letters and how they relate to zodiacal signs.

In the reasoning that follows, he relies on the following assumptions:

(1) The rising times of signs offset an equal distance from the equator will be equal
(2) In the Northern Hemisphere, Cancer through to Sagittarius take longer to rise than Capricorn to Gemini.
(3) Ratio of longest to shortest day is 7:5 in Alexandria.
(4) Rising times form a decreasing linear arithmetical sequence with unknown constant difference.

Firstly, the ratio of longest to shortest day, namely 7:5, is converted into total rising times for the two appropriate halves of the ecliptic:

$$7:5 \text{ for } 360^\circ \text{ gives } 210:150$$

He then observes that, from assumption (1):

$$R_{dh} = R_{hl}$$

$$R_{la} = R_{ad}$$

and proceeds to calculate the individual rising times as follows (see figure 1 for the appropriate arcs):

As $R_{dh} + R_{hl} = 210°$ and $R_{dh} = R_{hl}$, then

$$R_{dh} = R_{hl} = 105°$$

Similarly, as $R_{la} + R_{ad} = 150°$ and $R_{la} = R_{ad}$ then

$$R_{laa} = R_{ad} = 75°$$

and thus can show that the difference of the two sums:

$$R_{hzed} - R_{dgba} = 30°$$

Now Hypsicles uses proposition one, as he has the total number of terms, the difference of the first and last sums, and uses this to find the common difference sign-by-sign.

$$\begin{aligned} \sum_{k=1}^{n} a_k - \sum_{k=n+1}^{2n} a_k &= n^2 d \\ 30 &= 3^2 d \\ \Rightarrow d &= \tfrac{30}{9} \\ &= 3;20° \end{aligned}$$

so that 3;20 time degrees is the common difference from zodiacal sign to zodiacal sign. He now considers the quadrant that is made up from three zodiacal signs, namely from *e* to *d* to determine the rising times of the individual zodiacal signs. To do this he uses proposition 2. As the total number of terms are known as well as the sum, Hypsicles finds the middle term:

$$\begin{aligned} \sum_{k=1}^{2n-1} a_k &= (2n-1)a_n \\ 105 &= (3)a_2 \\ \Rightarrow a_2 &= \tfrac{105}{3} \\ &= 35 \end{aligned}$$

so that the rising time R_{ze} is 35 time degrees. Using the identical procedure, Hypsicles calculates the rising time of R_{gb}:

$$\begin{aligned}\sum_{k=1}^{2n-1} a_k &= (2n-1)a_n\\ 75 &= (3)a_2\\ \Rightarrow a_2 &= \tfrac{75}{3}\\ &= 25\end{aligned}$$

so that R_{gb} is 25 time degrees. In fact this second calculation was unnecessary as given that Hypsicles has already calculated the difference in rising times between each sign, he can compute all the others by simple addition of 3;20 and using the symmetry of the fact that signs offset an equal distance from the equator have equal rising times—precisely the technique he proposes to compute the others. The calculation of the other rising times is suggested by Hypsicles, but not completed in the treatise. The full list of rising times implied by Hypsicles' method is:

Sign	**Rising-time**	**Sign**
1	21;40	12
2	25	11
3	28;20	10
4	31;40	9
5	35	8
6	38;20	7

Hypsicles now seeks to ascertain the rising times of individual degrees. A new diagram is invoked (see figure 2.1) labelled with *a b g d*. These are to be imagined as single degrees of a zodiacal sign. In Hypsicles' diagram, *ab* is the sign of Aries, *ag* is the first degree and *db* is the last.

He proceeds by considering two adjacent zodiacal signs, and invokes proposition one, given that he knows the difference of the first and last sums (R_{gb}–R_{ba}=3;20), and the total number of terms (the number of degrees in two zodiacal signs, i.e., 60), thus the common difference for the individual degrees is:

$$\begin{aligned}\sum_{k=1}^{n} a_k - \sum_{k=n+1}^{2n} a_k &= n^2 d\\ 3;20 &= (30)^2 d\\ \Rightarrow d &= \tfrac{3;20}{900}\\ &= 0;0,13,20\end{aligned}$$

Now, just as with the zodiacal signs he seeks the amount of one individual degree so he can apply the constant difference to it to generate all the others. For this, he considers the Rising time of $R_{\beta\alpha}$ (Aries) and applies proposition 3, as this time he has an even number of terms (30) and its total rising time is 21;40 time degrees:

$$\begin{aligned}\sum_{k=1}^{2n} a_k &= n(a_1+a_{2n})\\ \tfrac{21;40}{15} &= a_1 + a_{30}\\ 1;26,40 &= a_1 + a_{30}\end{aligned}$$

In order to solve this, Hypsicles recognises that

$$a_{30} = a_1 - 29d$$

so that:

$$\begin{aligned}1;26,40 &= a_1 + (a_1 - 29d)\\ &= 2a_1 - 29 \times 0;0,13,20\\ 2a_1 &= 1;26,40 + 0;6,26,40\\ a_1 &= \tfrac{1;26,40\,+\,0;6,26,40}{2}\\ &= 0;46,33,20\end{aligned}$$

and thus:

$$\begin{aligned}a_{30} &= a_1 - 29d\\ &= 0;46,33,20 - 0;6,26,40\\ &= 0;40,6,40\end{aligned}$$

and indeed, one can determine the rest by subsequent addition and subtraction by 0;0,13,20. Again, having set out the means to be able to calculate the individual rising times, Hypsicles is satisfied and does not compute any more of these, and the work finishes.

One notable characteristic of Hypsicles' text is the absence of any astronomical tables, despite the fact this work deals with the particular feature of rising times for not just zodiacal signs (of which there are 12) but individual degrees (of which there are 360). In order to be of any use to the practicing astronomer or astrologer, each of these needs to be calculated and for facility of use put in a table. The fact that this has not been done implies that the intended recipients of this work are competent mathematicians and not necessarily practitioners who want a work for reference.

Therefore, the immediate practicality of this work is questionable. Firstly, one must be in Alexandria, secondly, one must compile the table and the 360 entries oneself. This further reinforces the idea that this was meant to be an example treatise from which one could compute one's own set of tables for whatever ratio of daylight was appropriate.

4 Circulation of Ancient Knowledge

The *Anaphoricus* is an important text for many reasons. It is the earliest surviving work that testifies to the significant influence ancient near eastern astronomy had on Greek scholars. Pingree (1968) notes that the version we have today is a "Byzantine redaction of an original Hellenistic text". The text was also translated, multiple times, into Arabic, Latin, and Hebrew at various points in time. The circulation of this text in early times is thus well documented, and its technical content was obviously of interest to many different groups of practitioners.

Despite its eventual wide circulation among later cultures of inquiry, the early passage of this text was somewhat precarious. Attributed to "chance" and "antiquarianism", perhaps "an overzealous scribe" and at some point to its "inexplicable inclusion in a Byzantine pedagogical program",[12] the fate of this text was secured by its incorporation at some point in time in the so-called *Little Astronomy*, a popular and ever changing corpus of works on mathematical astronomy from antiquity. Indeed, scholars have often observed that from a technical point of view, Hypsicles' rising time scheme was in principle 'obsolete' almost immediately after its publication. That is, it was not long after that more technically correct trigonometric methods were developed to model rising times.

However, the survival of this text testifies to a key point when considering the circulation of scientific knowledge in early times. It is not necessarily the most up-to-date or technically precise approach to a phenomenon that will guarantee the popularity of a text; other factors made a work appealing when it came to copying and disseminating. In this particular case, Hypsicles' *Anaphoricus* was short and self contained. It offered a rubric for computing rising times for one's own particular geographical circumstances which required no more mathematics than basic arithmetical operations. Furthermore, it gave guidelines on how to establish the empirical data needed to account for one's own

12 Observations all offered by Pingree (1968).

locality in the computations, and provided a set of worked examples to show how rising times could be generated step by step.

The content of the *Anaphoricus* also raises some interesting questions about the audience it was designed for. It may have been 'outdated' as far as the astronomical elite were concerned, but its intended focus appears to have been mathematicians, at least initially. The three abstract propositions and their demonstrations that open the work would have had immediate appeal to a mathematical audience. The intention to underscore astronomical phenomena with abstract mathematical relations would have no doubt been of substantial interest to mathematicians. Hypsicles offered a simple, elegant way to model a real-world problem. In addition, these propositions presumably gave the scheme, and indeed the work a certain intellectual prestige.

Beyond the mathematical community, linear modelling of rising times appears to have been a popular approach amongst working astrologers, as they were quick to compute and produced a unique set of values for one's own circumstances. Having a customized set of numerical parameters often gave astrologers a demonstrable professional advantage which may also explain the attraction of the 'how-to' aspect of this work. Works on rising times computed thus appear (sometimes with notable variations to the basic scheme and for contrasting localities including Babylon, Rome) in Vettius Valens, Maillius, Porphyry, Paulus Alexandrinus, Frimicus Maternus, Bardesanes of Edessa, to name a few. They were even transmitted to Indian sources where they were hugely popular. The earliest instance of them is in the *Yavanajātaka* (269/270 CE) of Sphujidhvaja (Chapter 1 v. 63; Pingree (1978: II 228–229)) where a simple linear scheme is used to determine their time intervals:

> "The measure of the rising-times of the first and last signs is demonstrated with certainty to be two muhūrtas each; know that the measure of the rising-times (of the rest of the signs) in the two halves of the zodiac, taken (respectively) in direct and reverse order, is (two muhūrtas) with a fifth (of that measure) added (successively to each)."

where one fifth[13] has been used as the constant difference between successive signs. Varahamihira (fl. ca. 550 CE) included a list of rising times in his astrological work, the *Bṛhatjātaka* (I, 19). These are, from Aries for the first two

13 There is some question as to how the "with a fifth" should be interpreted. See Pingree (1978: 228) for the two alternatives. The second alternative produces the rising times of the signs given in Varahamihira listed next.

quadrants, given as 20, 24, 28, 32, 36, and 40; Manilius gives these exact numbers, supposedly for Alexandria.[14] Ironically enough, in this particular case the parameters are unchanged from their Greek originals, which of course renders them completely useless for most latitudes on the Indian subcontinent. This particular allocation was also included by other Sanskrit scholars, including the authors Satya, Guṇākara, and Vaidyanātha who wrote astrological texts.

4.1 *Circulation: From the Ancient Near East*

A significant impact that occurred no doubt because of the influence of the Babylonian astronomical tradition is a decisive shift in attention by Greek astronomers away from the speculative geometrical approaches towards more numerical and predictive-capable procedures.[15] Indeed, if any generalization can be made to characterise the distinction between early Greek and Babylonian astronomical practice, it is frequently noted that Babylonian astronomy is distinctly arithmetical, with seemingly little attention given to the related cosmology (to the exclusion of any geometrical considerations). In contrast, early Greek astronomy was substantially geometrical; the apparently irregular motions of celestial phenomena could be reproduced by the intricacies of geometrical models and the cumulative effects of combining two or more contrasting geometrical manipulations. In the early stages these models had no predictive capacities. Thus, when Babylonian arithmetical techniques were introduced to the primarily geometrical apparatus of the early Greeks, it unleashed new capability for mathematical astronomy, more powerful than either culture on their own was capable of.

Indeed, Hypsicles' computation of rising times has been clearly influenced by Babylonian arithmetic techniques. Many Babylonian astronomical schemes use the assumption that periodic phenomena can be modeled by linear zig zag functions: a scheme with values that increase and decrease strictly linearly with constant difference around extremal values. Hypsicles' scheme reveals an incorporation of such numerical patterns into a more proposition-based mathematical context of the Greek tradition.

More particularly though there is ample evidence which suggests that Babylonian scholars were interested in the phenomenon of rising times. There exist a variety of distinct sources which either directly or indirectly testify to various approaches that practitioners were exploring. Neugebauer, for instance, believed that he had found a text (ACT 200 Section 15) which "contains an

14 See Neugebauer (1975: 718–719).

15 Evans (1998), Goldstein and Bowen (1983), Neugebauer (1975: 571), Jones (1991).

explicit proof for the correct astronomical use of rising times" (Neugebauer 1953). This text was a lunar procedure text to compute the first visibility of the lunar crescent. It specifically concerned determining the elongation between sunset and moonset, or equivalently, the time it takes the distance between the longitudes of the moon and the sun, i.e., arc of the ecliptic, to set. However, a reference to rising times *per se* nor the numbers themselves are nowhere made explicit. The numbers in the text still require a certain manipulation to be converted into rising times, and are clearly only understood in this specific context, and not as a distinct topic. It is difficult to know whether or not these were an inspiration to Greek practitioners in this context.

However, more direct evidence of the concept of rising times and the arithmetical modeling of this phenomenon do appear in a group of late Babylonian non-tabular astronomical texts. These texts, referred to as the "Micro Zodiac Texts" (three examples of which are called A, B, and C in Rochberg (2004)), contain explicit evidence of rising time schemes reckoned arithmetically.[16] Unfortunately these texts are incomplete, but they contain enough data in them to reconstruct the scheme with confidence.[17] There is evidence of the reckoning of the rising times of complete zodiacal signs, as well as for smaller divisions: twelfth parts of each of the twelve zodiacal signs (i.e., $2\,\frac{1}{2}^{\circ}$ portions), called HA.LA (= *zittu*). The fundamental reckoning tool used in these texts to gauge the rising times appear to have been the *ziqpu* stars and their meridian transits, a measure which was commonly used in astronomy in other contexts. The *ziqpu* stars were a group of 25 stars which were used to the determine the time intervals during the night by noting their meridian crossings.[18] In these micro-zodiac texts, intervals between *ziqpu* star transits (measured in time degrees) were matched to the rising times of the twelfth parts of a zodiacal sign. So, for each zodiacal sign, there were associated 12 'distances' (ZI = *nishu*) which were measured in time degrees (with reference to the equator). This scheme then is clear evidence of Babylonian practitioners considering arcs of the ecliptic and a corresponding time interval in which they rose (or set).

Text A reveals for Scorpius the following (cumulative) rising times reckoned for each 2 1/2° of the zodical sign: 1;40, 5, 8;20, 11;40, 15, 18;20, 21;40, 25, 28;20 31;40, 35.[19] These all have a constant difference of 3;20. Sagittarius is incomplete but appears to follow the same parameters. Text B gives the parameters for the

16 These were first published by Schaumberger (1955).

17 Rochberg (2004) notes complete data exists for Aries and Scorpius, and parts of Taurus, Libra, Sagittarius and Pisces.

18 For further details on the *ziqpu* stars see Steele (2014).

19 The final 40 given by Rochberg (2004: 87–88) is in fact the total for the whole sign.

second half of Aries: 1;40, 3;20, 5, 6;40, 8;20, 10. In summary, Scorpio rises in 40 degrees, and each 2 1/2 portion differs from the last by 3;20. Aries rises in 20 degrees (or rather half of Aries rises in 10 degrees) and each 2 1/2 portion differs from the last by 1;40. Both of these are arithmetical sequences with a constant difference.[20]

Furthermore, the scheme on these tablets appears to divide the zodiacal belt into two halves with respect to the rising times of signs: a fast half, in which the zodiacal signs take 20° to rise and a slow half in which the zodiacal signs take 40° to rise. Six signs of 20° (Capricorn to Cancer) and six signs of 40° (Cancer to Capricorn) makes 360° in total. One can then infer that rising times imply a very simple ratio of length of daylight: 2:1. It is important to note that this ratio, and the concept of length of daylight is not explicit in this text but can be derived in this way. Furthermore, this is a very crude approximation to the ratio of longest to shortest day, and appears to be a theoretical approximation rather than derived from observation. In fact, the ratio of 2:1 is rather a 'schematic' ratio used to generate numerical patterns rather than an attempt to reflect the actual circumstances,[21] in the same spirit as, for instance, an adoption of an ideal calendar of 360 days composed of 30 day months.

As Rochberg shows, the schemes in these micro-zodiac texts A–C are different from those schemes that underlie ACT system A which can be derived from column C and the length of daylight-models which are based on the fundamental assumption that the length of daylight is function of the position of the sun with respect to the zodiacal belt. For one, these ACT texts assume that the ratio of length of daylight is 3:2 which mean that the allocation of rising times for the two halves of the ecliptic will be different. Perhaps, she argues, the scheme in the micro-zodiac texts was a precursor; it could have also been a simpler tradition continued in tandem with the other mathematical astronomical approaches to related problems. Notwithstanding, despite the fact that this scheme is very crude, it is the only direct evidence that we have that gives explicit evidence of rising times in late Babylonian mathematical astronomy.

Indeed, these texts attest explicitly to the notion of considering arcs of the ecliptic and a corresponding time interval in which they rise (or set):[22]

20 For the texts in which these numbers appear, as well as a deeper analysis see Rochberg (2004: 78–91).

21 The phenomenon of 'schematic astronomy' is convincingly argued by Steele (2013) in the context of shadow-length procedures.

22 As communicated to me by John Steele from research in progress. The text is LBAT 1499, the so-called Text B in Rochberg (2004).

> The distance a total of 10 UŠ from the Shoulder of the Panther to the Bright Star of its Chest; Aries [from it]s loins to its end rises. The first portion (of this part of the equator) 1 UŠ 40 NINDA culminates and 2 UŠ 30 NINDA the first portion [of Aries] rises …
>
> LBAT 1499, rev. lines 27′–29′

There are many similarities with these schemes and that presented by Hypsicles; however there are some notable differences. Firstly, Hypsicles gives his rising times for complete signs and single degrees, not the $2\frac{1}{2}°$ equivalents as given in the micro-zodiac texts. Secondly, Hypsicles' rising times are not cumulative, but rather intended to be computed separately for each unit in question. He models the problem using a decreasing (linear) sequence, and the ratio of longest to shortest day is explicitly made the basis of scheme, plus other explicit symmetry considerations. Furthermore, there is the stated understanding that rising times are latitudinally specific. This, if it was realised at all by the micro-zodiac texts, is not made clear.

In addition, Hypsicles has contextualised the scheme using three abstract mathematical propositions to facilitate an elegant solution to this non-trivial astronomical problem for, presumably, an audience of Greek mathematicians. In terms of circulation and development of astronomy therefore, this is a fascinating example of the circulation from one 'audience' to another.

4.2 *Circulation: The "Little" Astronomy*

The survival of the *Anaphoricus* was due largely to one factor, that is, its inclusion as part of the so-called *Little Astronomy*, an ever changing corpus of astronomical and mathematical works deemed useful to be studied before undertaking the 'Great' or 'Greatest astronomy', namely Ptolemy's *Almagest*.[23] The trajectory of this suite of works is extremely complex and its composition was ever changing.

The *Little Astronomy* was first mentioned by Pappus (ca. 290–ca. 350 CE) in the sixth book of his collection. He notes that it included the six works: Theodosius' *Spherics*, Autolycus' *On the Moving Sphere*, Theodosius' *On Days and Nights*, Aristarchus' *On the Sizes and Distances of the Sun and the Moon*, Euclid's *Optics* and his *Phaenomena*. Hypsicles' work was not included in them at this

23 See Pingree (1968) who provides an erudite overview of the evolution of this corpus. There is some disagreement about whether or not this was recognized as a corpus. Neugebauer takes a critical view on this. He comments that the title *Little Astronomy* and its status as a precursor to Ptolemy is "… a story invented by Vossius in the early 17th century … to be repeated ever since" Neugebauer (1975: 768–769).

early stage. A later scholion at the start of this book refers to solutions 'of difficulties in the little astronomy' (*en tōi mikeōi astronomoumenōi*) which suggests a collection of works was recognized as a body. In the ensuing centuries, the composition of this collection of works expanded and was reordered and by the tenth century it contained eleven works; Hypsicles' *Anaphoricus* was now among them. Heiberg posits that this collection was probably compiled no earlier than the middle of the ninth century.

Parallel to this, these texts were translated into Arabic in the mid-ninth century as part of the large scale translation movement, although it is not certain that they were translated as a corpus. The first Arabic translation to have produced an (incomplete) group of these works as a collection is dated in 1230 (Topkapi Seray 3464) but this does not contain Hypsicles' work. From Arabic sources, Gerhard of Cremona (ca. 1114–1187) translated a selection of these works into Latin. Hypsicles' work was included in this suite of works.

Another Arabic version of the *Little Astronomy*, now renamed 'The Middle' or 'The Intermediate' was produced by Naṣīr al-Dīn al -Ṭūṣī in 1255 and contained translations based on those produced by Isḥāq ibn Ḥunayn (d. 910/911) Quṣṭā ibn Lūqā (d. 912) and Thābit ibn Qurra (834–901). His version now included 16 books; Hypsicles' work was Quṣṭā's Arabic translation which had been corrected by al-Kindī.

It has been observed that while some works that formed part of the *Little Astronomy* were copied and circulated independently of the collection, Hypsicles' *Anaphoricus* never existed apart from it.[24] Furthermore, scholars have noted that to their knowledge no reference to it exists prior to its appearance in Arabic. The audience of the *Little Astronomy* appears to have been mathematicians (and not astrologers). It is therefore interesting that the scheme included in the text appears to have appealed to the astrological community as well.

5 Concluding Remarks

Hypsicles' little work on rising times is the earliest source in existence which reveals the significant impact Babylonian mathematical astronomy had on Greek authors. Beyond the concept this work embodies, the scheme for rising times that Hypsicles presents has many particular conventions imported directly from earlier sources, such as sexagesimal notation and arithmetical schemes to model periodic phenomena. Despite the fact that more sophisti-

24 Pingree (1968: 16).

cated approaches emerged soon after in Greek astronomy, the *Anaphoricus* proved to be popular, largely, it seems, because of its length and its simplicity, and the basic, reproducible scheme it presented. The reliance only on basic arithmetical operations to reproduce rising times for any latitude appears to have been popular amongst the astrological community in particular. Furthermore, the work appears to have been of interest, both technically and pedagogically to later thinkers, in Byzantine, Arabic, and the Latin-West cultures of inquiry and was included in the *Little Astronomy* which ensured its survival. As Neugebauer insinuated in the epigram opening this chapter, rising times prove to be emblematic of the many and diverse scientific exchanges that occurred in early cultures of inquiry. Indeed, this work highlights many pertinent aspects when considering transmission more broadly. The *Anaphoricus* is found in various translations and transformations, and circulated to different audiences at different times, all who found their own engagement with the text.

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CHAPTER 10

Interpolated Observations and Historical Observational Records in Ptolemy's Astronomy

Alexander Jones

1 Introduction

This paper considers two subsets of the dated observation reports in Ptolemy's *Almagest*: reports that describe a phenomenon or celestial configuration supposedly in effect at the stated date, but that were derived from an underlying series of actual observations made over a span of time ("interpolated observations"), and reports of observations made more than a century before Ptolemy's time ("historical observations"). Where these subsets intersected, Ptolemy was confronted with interesting problems arising from transitions in observational practice and losses of information through the processes of transmission from the original observers.

2 Interpolated Observations and Their Place in Ptolemy's Astronomical Deductions

Ptolemy's *Mathematical Composition*, better known as the *Almagest*, presents a systematic deduction and quantification of models (ὑποθέσεις, "hypotheses") based on uniform circular motions to explain the motions and phenomena of the heavenly bodies, based on and in agreement with empirical data. The book's methodology is extremely complex and sophisticated, and the empirical or observational elements enter into its arguments in diverse ways. In the broadest terms, Ptolemy summarizes what he regards as a satisfactory deduction of a model in *Almagest* 9.2 as involving three stages:

(1) demonstration of the periodicities and sizes of the various geometrical components of the model from manifest and agreed-upon "phenomena";
(2) demonstration of how these elements are to be combined in the model; and
(3) demonstration that the model accounts for practically all the phenomena (not just the phenomena used in the first stage).

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In practice he does not go through these stages in a straightforward linear order. For example his treatment of the planet Mars has the following structure:

(1a) assumption of periodicities obtained in the first instance from the research of a predecessor (Hipparchos) but subject to confirmation and correction that will come at a later stage (*Almagest* 9.3);
(2a) assumption of an unquantified model structure (epicycle and eccenter model with equant and sidereally precessing apsidal line), some elements of which—the epicycle to account for the synodic anomaly and the eccenter for the zodiacal anomaly—are justified at this stage on the basis of generalized phenomena whereas the justification of the others is deferred (*Almagest* 9.5–6);
(2b) demonstration of the precession of the apsidal line of Mercury, based on analysis of dated observations, and extended to the other four planets on the basis of an unspecific assertion that "the phenomena of the other planets individually fit" (*Almagest* 9.7);
(2c) demonstration of the equant and its location from generalized phenomena (*Almagest* 10.6);
(1b) quantification of the eccentricity, epicycle radius, corrected periodicities, and epoch from dated observations (*Almagest* 10.7–10);
(2d) representation of the quantified model in predictive form using trigonometry or a table of anomaly, allowing computation of the planet's longitude for a given date (*Almagest* 11.9–12);
(3a) demonstration of retrogradations predicted by the quantified model (*Almagest* 12.4 and 12.7–8);
(2e) demonstration of the unquantified latitudinal inclinations of the model's geometrical components from generalized phenomena (*Almagest* 13.1–2);
(1c) quantification of the inclinations from undated observations (*Almagest* 13.3);
(2f) representation of the quantified model in predictive form using a table of latitude, allowing computation of the planet's latitude for a given date (*Almagest* 13.4–6); and
(3b) demonstration of first and last visibilities predicted by the quantified model (*Almagest* 13.7 and 13.9–10).

Thus we encounter explicit empirical input in all the stages except those that merely work out the predicted behavior of the model as it has been deduced so far. (Stages 3a and 3b implicitly invite comparison with the observable behavior of the planet, but Ptolemy does not adduce any empirical confirmation of his results in so many words.) The empirical evidence comes in several varieties:

generalized phenomena, i.e. empirical claims such as "the time from least speed to mean (of a planet in its synodic cycle) is always greater than the time from mean speed to greatest".[1]

Almagest 9.5, H2.251

dateless measurements, such as "at the oppositions near the apogee (Mars) is 4 1/3 ° to the north of the ecliptic".

Almagest 13.3, H2.539

dated records of immediate observations, such as "in the second year of Antoninus, Epiphi 15/16 in the Egyptian calendar, 3 equinoctial hours before midnight, … Mars was seen to have a longitude of Sagittarius 1 3/5 °".

Almagest 10.8, H2.347

dated statements of events that depend on interpolating between observations made before and after, such as "(Mars was in opposition to the mean Sun) in the fifteenth year of Hadrian, Tybi 26/27 in the Egyptian calendar, 1 equinoctial hour after midnight, at about Gemini 21°".

Almagest 10.7, H2.322

The distinction between an immediate observation and an interpolated observation is this: in an immediate observation, either the time for observing a desired configuration of the heavenly bodies could be chosen by the observer, or the timing of the configuration was directly manifest; in an interpolated observation, either the direct observations by autopsy could only be made at certain times that would not normally coincide with the desired configuration, or the timing of the configuration was not straightforwardly observable, or the configuration can be recognized only in relation to observations at other times, or the configuration could not in any case be directly observed.

Among the dated observations cited in the *Almagest*, the following types are immediate:

1 Translations of brief passages in the *Almagest* are adapted from Toomer (1984), with some minor stylistic modifications; parentheses enclose supplements and glosses to Ptolemy's wording. Page references in the form "H2.322" are to the volume and page number in Heiberg's edition, which are also provided in the margins of Toomer's translation. For a general discussion of the empiricism of the *Almagest* and the respective roles of generalized phenomena and specific observations see Swerdlow (2004).

> elongations of the Moon from the Sun (date and time may be chosen at the observer's convenience so long as both luminaries are visible)
>
> positions of Moon or a planet in relation to fixed stars (date and time may be chosen at the observer's convenience)
>
> lunar eclipses (times of beginning and end of obscuration and totality are directly observable)[2]

whereas the following types are interpolated:

> solstices (direct observations made only at noon, requires comparison with observations on other dates)
>
> equinoxes (direct observations made only at noon)
>
> oppositions of a superior planet with mean Sun (timing of event not straightforwardly observable, frequently occurring at time when direct observation is not possible)
>
> greatest elongations of an inferior planet from the mean Sun (requires comparison with observations on other dates, direct observations made only in first or last part of night)

The basic principle of an interpolated observation is that the assertion that such-and-such a configuration or phenomenon occurred at such-and-such a date and time is an inference based on a series of direct observations made over span of time, say, at the same time on several successive days, which are not individually reported. In some kinds of observation, one is trying to determine the date when some extreme value is reached in the middle of an interval during which the value is changing very slowly. Ptolemy's extremal observations include solstices and greatest elongations; dated observations of planets' stations, which Ptolemy does not cite in the *Almagest*, would also be extremal. In other kinds, one is looking for the date when a more rapidly and monotonically changing quantity crosses a threshold value. In the *Almagest*,

2 Since Ptolemy generally requires the time of mid-eclipse, these observations are in a trivial sense interpolated, slightly less trivial in cases where the time of beginning or end was not observable or not recorded.

observations of equinoxes and planetary oppositions are of this type, as would be observations of planetary conjunctions if Ptolemy had made use of them. When applying interpolated observations for theoretical work, one always requires the date of the desired configuration; in the case of the planetary observations one also needs the planet's longitude on that date.

The fact that Ptolemy never gives us the series of actual observations from which the interpolated observations were obtained limits what we can know about the methods of interpolation that he or his sources used. Nevertheless one can at least distinguish some basic approaches. In some cases, it appears that someone has simply selected from the series of direct observations the one that most closely corresponds to the desired configuration. In others, the date evidently falls between direct observations, so that it and the associated longitude (if the configuration involves a planet) must have been obtained by some kind of computation.

A third category arises with respect to greatest elongations of Mercury and Venus. Ptolemy uses these as surrogates for observations of the invisible points where a tangent line from the observer touches the planet's epicycle. If he requires such an observation in a situation where no greatest elongation has taken place within the range of available observations, one solution available to him is to interpolate a fictitious observation between actual greatest elongations observed in nearby situations, simulating what would have been observed if the planet had been at a point near the point of tangency instead of some other point on its epicycle. These constitute a kind of second-order interpolated observation.

3 Historical Observations and Their Place in Ptolemy's Deductions

The dated observations reported in the *Almagest*, other than those that Ptolemy identifies as his own, were made by many disparate individuals and groups:[3]

> *Babylonians*: ten lunar eclipses (721–382 BC), three observations of positions of planets (Mercury and Saturn) relative to stars (245–229 BC).

> *Those around* (*οἱ περί*) *Meton and Euktemon*:[4] summer solstice (432 BC).

3 The reports can be located by means of Toomer's index, by the observer, the heavenly body, or the kind of event.

4 In Ptolemy's usage, the expression "those around" seems to indicate a degree of vagueness or uncertainty adhering to observations ascribed to chronologically remote individuals.

Timocharis: four observations of positions of Moon relative to stars (295–283 BC), two observations of Venus relative to stars (272 BC), and some lunar eclipse observations (dates not given in the *Almagest*).

Those around Aristarchos: summer solstice (280 BC).

Unnamed observers using the calendar of Dionysios, in Alexandria (?):[5] ten observations (henceforth "Dionysian observations") of positions of the planets Mercury, Mars, and Jupiter relative to stars (272–241 BC).

Archimedes: solstice observations (dates not given in the *Almagest*).

Unnamed observers in Alexandria: four lunar eclipses (201–174 BC), vernal equinox (146 BC).

Hipparchos: autumnal and vernal equinoxes (162–128 BC), summer solstice (135 BC), three lunar eclipses (146–135 BC), three lunar elongations (128–127 BC).

Agrippa: observation of position of Moon relative to stars (AD 92).

Menelaos of Alexandria: two observations of positions of Moon relative to stars (AD 98).

Theon the Mathematician: four observations of positions of planets (Venus and Mercury) relative to stars (AD 127–132)

A significant chronological divide is apparent between the observations up to Hipparchos's time, which for convenience we will call "historical," and those dating from the late first and second centuries of our era, which we will call "recent." As a rule, Ptolemy bases his deductions and quantifications of models on his own observations or other recent observations (Agrippa, Menelaos, Theon) except when he wishes to demonstrate a long-term periodicity or rate of motion. For such demonstrations, he generally employs historical observations dating from the remotest period from which he possessed reports of the right kind and of suitable quality. Exceptions to this rule include several histor-

5 For the evidence situating these observers in Alexandria, or at least in Ptolemaic Egypt, see Jones (2006:257).

ical lunar eclipse reports that satisfy special constraints that perhaps were not satisfied by any recent report available to Ptolemy, and observations by Hipparchos of lunar elongations which Ptolemy adduces in his deduction of the eccenter-and-epicycle model for the Moon (*Almagest* 5.3 and 5.5), ostensibly to back up his claim that he discovered the necessity of this model through studying Hipparchos's observations. In the context of discussing aspects of Hipparchos's researches Ptolemy also cites various historical observations used by Hipparchos but that play no role in Ptolemy's own deductions.

With the probable exceptions of the summer solstices associated with Meton and Euktemon and with Aristarchos, which both appear to have been inaugural dates for calendrical cycles,[6] all the historical and recent observations in the *Almagest* were probably selections from larger sets compiled by the various individuals or groups. How were these sets presented by their authors, and did Ptolemy have access to them in their original context or only through intermediaries? There existed essentially two modes of presentation for observation reports: corpora collecting reports as a resource for reference or research, and theoretical or didactic texts (such as the *Almagest* itself) in which selected reports were embedded. We can identify three of the corpora from which some of Ptolemy's reports derived, and interestingly, they illustrate diverse paths by which reports passed from the original observers to their ultimate user, Ptolemy:

> Theon the Mathematician:[7] Ptolemy speaks of "an observation recorded among those given to us by the mathematician Theon" (ἐν … ταῖς παρὰ Θέωνος τοῦ μαθηματικοῦ δοθείσαις ἡμῖν εὕρομεν ἀναγεγραμμένην τήρησιν, *Almagest* 10.1, H2.296), and again another "among the observations we got from Theon" (ἐν ταῖς παρὰ Θέωνος εἰλημμέναις τηρήσεσιν, *Almagest* 9.9, H2.275). This was evidently a corpus compiled by the observer and communicated personally to Ptolemy.

> Babylonians: Ptolemy's Babylonian eclipse reports probably, and his three Babylonian planetary observations almost certainly, derive from cunei-

6 The Meton-Euktemon solstice date is cited as an inaugural date for a 19-year calendrical cycle by Diodoros 12.36 and *IMilet inv.* 84, for which see Diels & Rehm (1904:93–97), Dessau (1904), Lehoux (2005), and Jones (forthcoming). The Aristarchos date is exactly eight 19-year cycles later, as noted by Dessau.

7 Theon the Mathematician is not known from any source independent of the *Almagest*; he is not to be identified with the contemporary Platonist philosopher Theon of Smyrna, whose grasp of planetary theory was inaccurate and out of date by the standards of Ptolemy's time.

form tablets in the astronomical archive of Babylon, substantial portions of which are extant in the British Museum and other modern collections. The source documents would have been corpora, either the Astronomical Diaries, which were the original form of record in which observations of a wide range of astronomical phenomena were organized chronologically over spans of several months, or various types of excerpt tablets that listed observations of a single kind in chronological order over longer spans. The first presentations of these reports in Greek are likely also to have been corpora. Several of the Babylonian eclipses in the *Almagest* are known to have been cited by Hipparchos in works to which Ptolemy had access; it is likely, though not certain, that Ptolemy was also able to draw on corpora containing Greek versions of eclipse and planetary observations.

Hipparchos: Ptolemy writes (*Almagest* 9.2, 2.210) that Hipparchos's only contribution to planetary theory, to his knowledge, was "to make a compilation of the planetary observations arranged in a more useful way, and to show by means of these that the phenomena were not in agreement with the hypotheses of the astronomers of that time." This might have been two separate books or a single one in two parts, but the "compilation" was clearly a corpus that collected planetary observation reports by earlier astronomers as well, perhaps, as by Hipparchos himself. That Ptolemy had access to it, or to some derivative of it, is confirmed by one of the Dionysian observations cited in *Almagest* 9.7, where he gives Hipparchos's reduction of the report (Mercury "was a little more than 3° in advance of Spica, according to Hipparchos's reckoning", H2.267) rather than the original wording.

Let us now turn to the evidence for theoretical treatises by Ptolemy's predecessors that contained reports subsequently cited by Ptolemy:

Hipparchos's *On the Displacement of the Solstitial and Equinoctial Points*, according to Ptolemy's discussion of it in *Almagest* 3.1, cited lunar eclipse observations by Timocharis, solstice observations by Archimedes, Hipparchos's own observations of solstices and equinoxes and of two lunar eclipses, and at least one observation of an equinox made by a contemporary at Alexandria (likely obtained by personal communication). Among these, Ptolemy reused for his own theoretical deductions one of Hipparchos's vernal equinoxes and one of his autumnal equinoxes.

Almagest 3.1 (H1.206–207) cites Hipparchos's *On the Length of the Year* as having made use of the Aristarchos solstice and of his own summer solstice observation of 135 BC. It is likely that the Meton-Euktemon solstice was also discussed in this work (as implied by a quotation from it in *Almagest* 7.2, H2.15–16).[8] Of these, Ptolemy reused the Meton-Euktemon solstice.

Almagest 4.11 discusses what may have been either one treatise or two by Hipparchos on the measurement of the Moon's anomaly, in which he cited three Babylonian eclipse observations from 383–382 BC and three Alexandrian lunar eclipse observations from 201–200 BC. Ptolemy does not use these observations in his own deductions, though he appeals to their agreement with his own solar and lunar theory as a verification of its validity.

Almagest 6.9 summarizes part of the argument of a work of Hipparchos's (possibly the book *On the Moon's Monthly Motion in Latitude* mentioned by the *Suda s.v.* Ἵππαρχος Νικαεύς) in which he used a Babylonian lunar eclipse observation from 720 BC together with one of his own from 141 BC to establish the Moon's periodicity in latitude. Both observations were used by Ptolemy for different purposes (*Almagest* 4.6, 4.9, and 6.5).

Almagest 4.9, in citing a Babylonian eclipse observation from 502 BC, adds that Hipparchos "used" it (συνεχρήσατο, H1.332), without explaining how or in what context.

In *Almagest* 11.3 (H2.386), Ptolemy makes use of a Dionysian observation of Jupiter from 241 BC that he very probably found in an early 2nd century AD theoretical treatise of which a fragment is extant in the papyrus *POxy astron.* 4133.[9] This treatise may have been by Menelaos of Alexandria. The part preserved in the papyrus cites a different observation of Jupiter made in 241 BC, just four months after the one in the *Almagest*, as well as one made by the author in AD 104.

Beyond this evidence we can only speculate. For the recent observations other than those of Theon, it seems at least plausible that Ptolemy's sources were

8 See Toomer (1974:328 note 53).

9 Jones (1999).

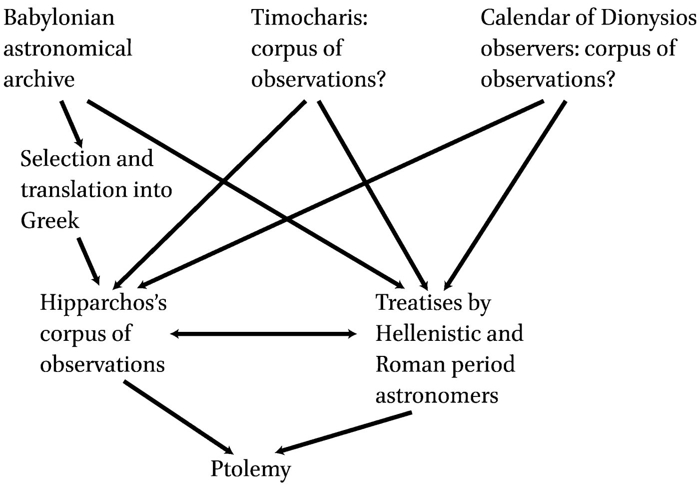

FIGURE 10.1 *A conjectural scheme for Ptolemy's reception of historical planetary observations*

treatises by Agrippa (concerning whom we know nothing besides the single report in *Almagest* 7.3, H2.27) and Menelaos. I would guess that the original presentation of the historical observations of Timocharis and the unknown astronomers who employed the calendar of Dionysios took the form of corpora, but we have no evidence that Ptolemy had direct access to these corpora or indeed to any text from before Hipparchos's time that contained observation reports. It is worth noting that Ptolemy seems to have had at least two indirect channels transmitting Dionysian observations, namely Hipparchos's corpus and the early second century AD treatise on Jupiter. Fig. 10.1 shows a schematic reconstruction of the routes by which the historical observations of the planets could have reached Ptolemy without presumption that he consulted sources older than Hipparchos.

While Ptolemy appears to have regarded even his historical eclipse reports, including even the oldest ones from the eighth century BC, as satisfactory for his analytic purposes, he is more critical of the pre-Hipparchian solar and planetary observations. He writes that the summer solstice reports associated with Meton and Euktemon (432 BC) and with Aristarchos (280 BC) "were conducted rather crudely, as Hipparchos too seems to think" (*Almagest* 3.1, H1.203), though he nevertheless makes use of the earlier of them "because of its antiquity" (H1.205). As for the early observations of the planets, he has several complaints (*Almagest* 9.2, H2.209–210):

they do not extend as far back in time as one would like;

the "more continuous series of observations" (συνεχέστερα) consist of first and last visibilities and stations, which cannot be observed accurately and unambiguously; and

observations of the locations of planets relative to fixed stars, unless the distances are small, are hard to calculate and hit-or-miss (στοχαστικήν)—a judgment that seems to presume that such observations were carried out without instruments, which may well have been true.

In practice Ptolemy makes no use of observations of stations and visibility phenomena. His historical observations of positions of planets relative to stars are spread over the interval 272–229 BC, from which we can infer that his sources provided few if any satisfactory observations of this kind from before the early third century BC.[10] The ones that he selects are by no means limited to situations where the planet is very close to a star; in one instance, a Dionysian observation of Mercury from 257 BC (*Almagest* 9.7, H2.265), the reported distance of the planet from the nearer of the two stars mentioned is more than 9° according to Ptolemy's reckoning.

At this point we can turn to consideration of those among Ptolemy's historical observations that are also interpolated observations. These turn out to be of just two kinds: solar observations of solstices and equinoxes, and observations of an inferior planet (Mercury) at greatest elongation from the mean Sun. In both cases, the materials that Ptolemy had to work with set severe limits on the usefulness of the observations, though for different reasons.

4 Historical Observations of Solstices and Equinoxes

As we noted above, all the historical solstice and equinox observations mentioned in the *Almagest* were cited in Hipparchos's *On the Displacement of the Solstitial and Equinoctial Points*, and it is possible that this work was effectively Ptolemy's sole source for them. Dated reports of solstice observations from before Hipparchos's time seem in fact to have been quite rare and dated reports of pre-Hipparchian equinoxes practically nonexistent. The 432 BC date associated with Meton and Euktemon was in fact famous enough in antiquity to be

10 On these observations see Jones (2006).

cited by a public inscription at Miletos (*IMilet inv*. 84, dating after 109 BC), as well as by the first century BC historian Diodoros,[11] though Diodoros does not identify the date as a summer solstice and neither source assigns a time of day to it as Ptolemy does. Without Ptolemy we would not even know of the existence of the Aristarchos solstice report of 280 BC or the series of solstices of unknown date observed by Archimedes.

The crucial question with respect to the solstices of 432 and 280 BC is why Ptolemy says that they were crudely made (ὁλοσχερέστερον εἰλημμένας, H1.203) or crudely recorded (ὁλοσχερέστερον ἀναγεγραμμένην, H1.205). Unfortunately Ptolemy does not provide us with much of a basis for deciding what he (or Hipparchos before him) would have regarded as a crude or an accurate solstice report. The specific solstices mentioned in the *Almagest*, all of them in 3.1 and all of them summer solstices, are the following (giving the proleptic Julian calendar equivalents of Ptolemy's Egyptian calendar dates):

432 BC June 27, at daybreak (πρωίας), observed "crudely" by "those around Meton and Euktemon" (H1.205–206)

280 BC, date and time not given, observed "crudely" by "those around Aristarchos" (H1.203 and 206–207)

135 BC, date and time not given, observed "accurately" (ἀκριβῶς εἰλημμένη) by Hipparchos (H1.207)

AD 140 June 25, about 2 hours after midnight, "computed securely" (ἀσφαλῶς ἐπελογισάμεθα) by Ptolemy (H1.206)

The only information provided in the two more detailed reports is the date and time. Ptolemy gives only the years for the 280 and 135 BC solstices, but he quotes Hipparchos as saying that the time interval between them was 52960 1/2 days. Moreover an indirect argument from a year length attested in a Babylonian astronomical tablet, BM 55555, indicates with high plausibility that Hipparchos calculated the time interval between the 432 and 135 BC solstices as 108478 days exactly.[12] It seems likely, therefore, that Hipparchos was treating the times as if

11 See note 6 above.

12 Rawlins (1990:49–51); Jones (2005:23–24). For the tablet (also known as ACT 210) see Ossendrijver (2012:496–500). If Hipparchos's observed time for the solstice of 135 BC was 108478 days later than the assumed time of the Meton-Euktemon solstice, it would have been on June 26 at daybreak. The true moment of solstice was on June 26 at about 8 AM.

they were precise to the quarter day: effectively noon, 6 PM, midnight, and 6 AM. This is concordant with his statement, quoted by Ptolemy (*Almagest* 3.1, H1.194–195), that "both I and Archimedes may have committed errors of up to a quarter of a day in our observations and calculations" of the times of solstices, though strictly speaking this is a statement about accuracy, not precision. The reports of Hipparchos's equinox observations that are cited in *Almagest* 3.1 (H1.195–196) all have such quarter-day times.

By chance a report of another summer solstice observed by Hipparchos has recently come to light in a source independent of Ptolemy, a fragment of an instructional text on astronomical calculations in the papyrus *PFouad* 267A, recto lines 10–12.[13] The date of the solstice is given as 158 BC, June 26, at a seasonal hour of the day whose number the papyrus's scribe unfortunately omitted to write. A combination of information in the papyrus allows us to estimate the time of the solstice in question according to the solar tables that the text's author was using as having been about an hour after sunset. The tables were allegedly framed in agreement with Hipparchos's observations,[14] of which the solstice of 158 BC is the only one specifically mentioned, but we cannot tell how precise the fit really was.[15] All we can say, therefore, is that in this papyrus's source a Hipparchian solstice observation was reported to an ostensible precision of hours, but it cannot be excluded that this was merely someone's way of expressing a time that Hipparchos recorded as precise to the quarter day.

Quarter-day precision would be a reasonable outcome of a simple method of interpolation applied to observations made at one-day intervals around the expected dates of solstices or equinoxes, which for Hipparchos would most probably be observations of the Sun's altitude at noon made by means of a meridian instrument similar to the ones that Ptolemy describes in *Almagest* 1.12. Because the daily change in solar declination approaches zero at the solstices, Hipparchos would likely have estimated the moment of solstice as halfway between two dates of observed equal declination sufficiently before and after the solstice so the daily change is perceptible. Supposing two such observations were found, the solstice would have been estimated as occurring at noon if the interval between the pair was an even number of days or

13 Fournet & Tihon (2014:22–23 and 28–29).

14 Recto lines 7–8: ἀκολούθως ταῖς Ἱππάρχου τηρήσεσιν ἐπραγματεύσατο. The agreement of the model with the report of Hipparchos's observation of the autumnal equinox in 159 BC, which is transmitted in *Almagest* 3.1 but not in the papyrus, is almost perfect.

15 The true moment of solstice was on June 26 at about 6 PM.

midnight if the interval was an odd number of days. If, however, the observation preceding the solstice was not found to have an exact counterpart after the solstice, but instead the declinations of two consecutive post-solstice observations appeared to flank that of the pre-solstice observation, the interpolated time of solstice would be between midnight and noon or between noon and midnight, and 6 AM or 6 PM would be a reasonable estimate. Refining the time to the higher precision of single hours, as Ptolemy appears to do for his own solstice observation, would have required an instrument enabling measurements of declinations on the order of single minutes.

In his *On the Displacement of the Solstitial and Equinoctial Points* Hipparchos probably did not report the individual noon observations from which he derived his interpolated solstice times, but since the book is known to have contained many such solstice times, Ptolemy would have known the precision with which they were expressed and likely he would have at least guessed how Hipparchos obtained this precision. But what would Hipparchos or Ptolemy have known about the older solstice reports from 432 and 280 BC, which were probably both transmitted as one-off dates rather than selected from larger sets? I think a plausible explanation of Ptolemy's assessing them as crude is that they were originally reported without specification of time of day, as we find the 432 BC date recorded in Diodoros and in the Miletos inscription. Hipparchos would therefore have received them as observations having a precision of one day, and conjectured that each report represented the observation from among a series of consecutive observations for which the solar declination was greatest. He would have assigned the 432 BC observation to "morning," guessing that Meton and Euktemon were making observations of the Sun's rising point on the horizon (a reasonable assumption for this period), and the 280 BC observation to noon in the belief that Aristarchos observed the Sun's meridian altitude.

If the foregoing reconstruction is correct, it casts an interesting sidelight on Hipparchos's attempts to measure the length of the mean tropical year ("mean" because, unlike Ptolemy, he suspected that this parameter was not a constant) and on Ptolemy's ostensible confirmations of the value 365 1/4–1/300 days that Hipparchos apparently adopted. This value was obtained from, or at least consistent with, the interval between the 280 and 135 BC solstices, whereas the value obtainable from comparing the 432 and 135 BC solstices, if this is what BM 55555 gives us, was significantly less, closer to 365 1/4–1/240 days. Why did Hipparchos prefer the value obtained from an interval that was only about half as long as the longest interval available to him? The precision of the times was not the decisive issue, if we have correctly interpreted the charge of "crudeness" that Ptolemy makes against both. Hipparchos probably had greater doubt about the *accuracy* of the 432 BC observation, and perhaps also was less confident about the synchronization of its reported Athenian calendar date with the chronological systems (the Egyptian and Kallippic calendars) that he used for his own observations.

For Ptolemy the time scale of available solstice observations was about double that available to Hipparchos, if for the sake of argument we treat his own solstice observations as genuine. He would have known that it was methodologically preferable to compare observations from his own time with Hipparchos's observations (or possibly still better, Archimedes's observations), rather than the earliest ones, both because their claimed precision more than compensated for the shorter time span, and because they were transmitted to him in the context of larger data sets that allowed a better assessment of their accuracy. That he chose to demonstrate the length of the tropical year using the least suitable of the historical solstice observations available to him is symptomatic of the highly dialectical character of *Almagest* 3.1.[16]

5 Greatest Elongations: The Case of Recent Observations

Almost the entire process of deduction and quantification of the models for Mercury and Venus in *Almagest* 9 and 10 is carried out using observations of a single type, greatest elongations of the planet; only the final stage of correction of the periodicities for each planet is based on analysis of a pair of observations of the planet's position at arbitrary dates, one of which is a historical observation. Ptolemy uses no historical observations of greatest elongations of Venus in the *Almagest*, but he provides two determinations of Mercury's apsidal line, one based on a set of recent greatest elongations, the other on a historical set. His purpose is to demonstrate that the apsidal line has shifted eastward in his tropical frame of reference by a rate of 1° per century, which is identical to his rate for precession so that Mercury's apsidal line is sidereally fixed. Although he declares that this is true of the apsidal lines of all five planets, Mercury is the only one that gets a demonstration of this kind.

The configuration we are calling, for short, a "greatest elongation" is properly speaking a moment of greatest elongation from the mean Sun, that is, a moment when the difference between the true longitude of the planet and the mean longitude of the Sun attains a local maximum. The theoretical interpre-

16 See Jones (2005:18–27) for a broader discussion of this chapter.

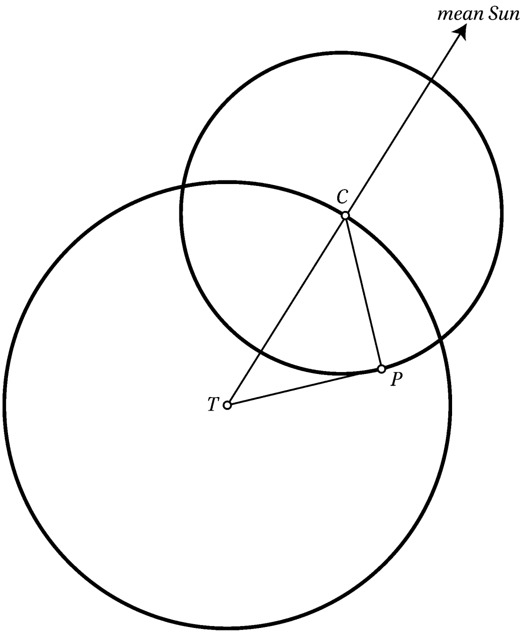

FIGURE 10.2 *A simple epicyclic model for an inferior planet, shown approximately to scale for Venus*

tation of this configuration depends on what kind of model is assumed. If it is a simple epicyclic model for an inferior planet (Fig. 10.2, drawn to scale for Venus), such that the planet P revolves uniformly around its epicycle while the epicycle's center C revolves uniformly, in alignment with the mean Sun, along a deferent circle concentric with the Earth T, greatest elongation occurs when the planet is exactly at either of the two points where a tangent from the center of the Earth touches the epicycle. According to the simple model the arc of greatest elongation is a constant (positive if the planet is currently visible in the evening, negative if visible in the morning), dependent only on the ratio of radii of the epicycle and deferent, and the time intervals between successive greatest elongations of the same sign equal to the synodic period of the planet, which is also constant in this model.

In Ptolemy's planetary models with eccentric deferent and equant, the interpretation of a greatest elongation is more complicated (Fig. 10.3, drawn to scale for Venus). Here it is the radial line from the equant E to the epicycle's center C that is aligned with the mean Sun, whereas the planet's true longitude is the direction of the radial line from the Earth's center T to the planet P_1. When the angle between these radii is maximum, the planet is not, in general, at the exact

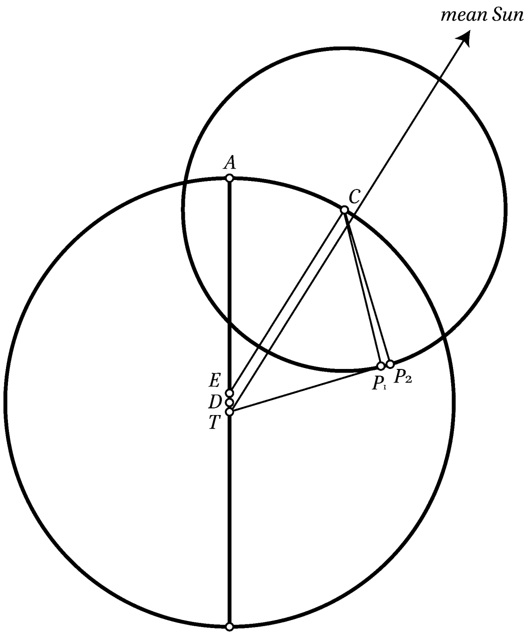

FIGURE 10.3 *Ptolemy's equant model for Venus*

point P_2 where a tangent from the Earth's center touches the epicycle (which we will call the "true tangent point"); however, in his demonstrations, Ptolemy consistently treats the planet as if it was at the true tangent point.

The difference in time between the moments when the planet is at greatest elongation and at the true tangent point varies more or less sinusoidally as a function of the mean argument of zodiacal anomaly (i.e. the elongation of the mean longitude of the epicycle's center from the apogee of the deferent, A), with maximum time difference at apogee and perigee and zero near quadrature. In the case of Mercury the maximum difference is less than a day, but for Venus it is as much as six days. Over that interval, Venus's elongation from the mean Sun can change by as much as 6 minutes, which is at the threshold of being significant. However, the only parts of Ptolemy's deduction of Venus's model that could potentially be affected by his conflation of the two configurations are the measurements of the deferent's eccentricity and the size of the epicycle, which are based on elongations found when the epicycle's center is close to either end of the apsidal line so that the discrepancy is near its maximum; and even here, the effects of the discrepancies at the apogee and perigee tend to cancel each other out with respect to the eccentricity. The determination of the apsidal line itself depends only on symmetries of greatest elongations, which are not affected by the conflation, while the deduction of the equant uses greatest elongations in which the mean argument of zodiacal anomaly is near ±90°, so that the discrepancy is negligible.

The important point here is not the—at worst barely detectable—errors that Ptolemy introduces in his theory of the inferior planets by conflating the two configurations, but rather that the observations that he actually needs are of the planet at its true tangent points, and greatest elongations are merely an acceptable approximation that can be determined by comparison of observed longitudes of the planet with computed mean longitudes of the Sun. Further, he is not interested *per se* in the dates when the planet is at these points. Ideally, he would want to be able to observe the points themselves on any given date, and it is an inconvenience for him that the planet renders them vicariously visible only at scattered dates that have no natural correlation with the symmetries of the model that his analytical approach for the inferior planets seeks to exploit.[17]

How does one observe a greatest elongation? The arc of the planet's elongation from the mean Sun is of course not directly observable. What *is* observable is a criterion equivalent to the attainment of maximum elongation, namely the moment when the planet's true rate of longitudinal motion exactly equals the Sun's mean rate of longitudinal motion. Even this criterion could not be tested directly right at the sought date since the daily change in the daily longitudinal progress of Mercury and Venus around their greatest elongations is respectively on the order of four minutes and half a minute, in other words below the precision of the stellar coordinates on which ancient measurements of planetary longitudes depended (ten minutes in Ptolemy's star catalogue), to say nothing of the effects of measurement error. As was the case with solstices, one would have to estimate the moment of greatest elongation as the midpoint between two observed longitudes separated by several days, such that the increase in longitude is equal to the motion of the mean Sun in an equal interval.[18] (Incidentally, all the reports of greatest elongations in the *Almagest* are ostensibly

17 As a corollary, it does not follow from the fact that the superior planets reach all elongations from the Sun that methods comparable to the ones he uses for the inferior planets were theoretically impossible for them. The counterpart of greatest elongations for the superior planets would be observations of the planet at the moment when it is travelling at its own mean rate of longitudinal motion. But aside from the—not insurmountable—problem of establishing the alignment of a superior planet's mean longitude, which is the counterpart of the mean Sun for the inferior planets, the smaller daily changes in longitude would have been an obstacle to accurate determination of these extremal moments.

18 Swerdlow (1989:35) remarks on the impossibility of detecting the date of greatest elongation from the planet's day-to-day increase in longitude, but does not consider the magnifying effect of comparing longitudes separated by longer intervals.

observations made while the planet was visible in the evening or morning, not statements of an interpolated "exact" time that could fall at any stage of day or night.)

Before considering the historical observations of greatest elongations in the *Almagest*, it will be helpful to look at four recent ones that Ptolemy tells us were among the observation reports that he personally received from Theon the Mathematician. For each, we give the report itself followed by the proleptic Julian calendar equivalent of Ptolemy's Egyptian calendar date, recomputation of what *should* have been observed according to modern theory, the planet's rate of longitudinal motion, and the approximate date when the planet was actually progressing at the rate of the mean Sun.

> (1) "In the fourteenth year of Hadrian, Mesore 18 in the Egyptian calendar, in the evening, as we found in the observations we got from Theon, he says that (Mercury) was at its greatest distance from the Sun, 3 5/6 ° behind the star on the heart of Leo (α Leo)."[19] (*Almagest* 9.9, H2.275)
>
> > Date of observation: AD 130, July 4, evening
> > Longitude of Mercury (17:30 UT): 127° 24′
> > Elongation from Regulus: 3° 28′
> > Rate of Mercury's longitudinal motion: 57′ / day
> > Greatest elongation: between July 3 and 4 (error < 1 day)
>
> (2) "Among the observations given to us by the mathematician Theon, we found one recorded in the sixteenth year of Hadrian, on Pharmouthi 21/22 in the Egyptian calendar, at which, he says, the planet Venus was at its greatest elongation as evening star from the Sun, and was the length of the Pleiades[20] in advance of the middle of the Pleiades; and it seemed to be passing it a little to the south." (*Almagest* 10.1, H2.296)
>
> > Date of observation: AD 132, March 8, evening
> > Longitude of Venus (18:00 UT): 32° 12′
> > Elongation from center of Pleiades: 1° 41′
> > Rate of Venus's longitudinal motion: 50′ / day
> > Greatest elongation: February 21 (error 16 days)

19 The identifications of the fixed stars in the reports follow Toomer.

20 The apparent diameter of the Pleiades is slightly less than 2°; Ptolemy takes it to be 1° 30′ (H2.296).

(3) "Similarly, in the (observations we got) from Theon, we found that in the twelfth year of Hadrian, Athyr 21/22 in the Egyptian calendar, Venus as morning star had its greatest elongation from the Sun when it was to the rear of the star on the tip of the southern wing of Virgo (β Vir) by the length of the Pleiades, or less than that amount by its own diameter; and it seemed to be passing the star one moon to the north." (*Almagest* 10.1, H2.297–298)

Date of observation: AD 127, October 12, morning
Longitude of Venus (3:00 UT): 151° 45′
Elongation from β Vir: 1° 2′
Rate of Venus's longitudinal motion: 1° 6′ / day
Greatest elongation: September 22 (error 20 days)

(4) "In the (observations) given to us by Theon we find that in the thirteenth year of Hadrian, Epiphi 2/3 in the Egyptian calendar, Venus was at its greatest elongation from the Sun as morning star, and was 1 2/5 ° in advance of the straight line through the foremost of the three stars in the head of Aries (γ Ari) and the star on the hind leg (μ Cet), while its distance from the foremost star of those in the head was approximately double its distance from the star on the leg." (*Almagest* 10.2, H2.299)

Date of observation: AD 129, May 20, morning
Longitude of Venus (2:00 UT): 12° 0′
Elongation from line through μ Cet and γ Ari: 1° 29′
Rate of Venus's longitudinal motion: 1° 3′ / day
Greatest elongation: May 6 (error 14 days)

These reports present us with an alarming disjunction between their positional information, which is accurate by the standards of ancient ancient naked-eye observations, and the very large deviations of three of the dates from the actual dates of greatest elongation. The exception is observation (1), which is essentially a correct determination of the date and position of Mercury's greatest elongation. Ptolemy's wording explicitly credits Theon with the identification of the date as that of greatest elongation. But this is the case also with observation (2); and in this observation, as well as in (3) and (4), the error in the date of greatest elongation is so large that one has difficulty believing that it is merely due to defects in the observations or sloppy analysis.

Swerdlow argues persuasively that Ptolemy could not have originally obtained the structure and parameters of his model for Venus by the route that he sets out in *Almagest* 10, and, drawing attention to the fact that many of the ostensible greatest elongations that Ptolemy cites have dates significantly differing from the actual dates of the phenomenon, he offers the surely correct explanation that Ptolemy has chosen observations that merely bring the planet close to greatest elongation while situating the mean Sun almost exactly in configurations relative to the planet's apsidal line that permit the *Almagest*'s didactically elegant deduction through symmetries.[21] I think one can take this reconstruction a bit further.

As we saw above, a greatest elongation from the mean Sun is a configuration in which the longitude of an inferior planet approximately coincides with the longitude of the true tangent point of its epicycle on either the positive (evening) or negative (morning) side of the epicycle's center, so that one can obtain from observation and calculation the elongation of the true tangent point from the mean Sun. If we consider the elongations of the evening and morning true tangent points from the mean Sun as two functions of the longitude of the mean Sun, Ptolemy's planetary models predict that the evening and morning functions will be exact mirror images of each other with respect to the apsidal line. The compromises that Swerdlow has identified were necessitated by the fact that the greatest elongations available to Ptolemy from his observational records would not have included a set falling in locations that allowed him to exploit this symmetry in the most direct manner.

In *Almagest* 10.1 Ptolemy professes to find Venus's apsidal line as the line of symmetry of two pairs of equal but opposite greatest elongations; the demonstration imposes no constraint on the specific magnitudes of the elongations so long as they are pairwise equal and opposite, and no constraint on the corresponding locations of the mean Sun so long as both pairs are symmetrically placed with respect to the same apsidal line. Then in 10.2 he finds the deferent's eccentricity and the epicycle's radius using a pair of greatest elongations with the mean Sun at opposite ends of the apsidal line; here the magnitudes as well as the positions of the mean Sun are critical. In each of the three pairs of greatest elongations, one is by Theon and the other by Ptolemy. It is noteworthy that all four of the observations used in 10.1 as well as the earlier of those used in 10.2 (the Theon observation from AD 129) are on dates *later* than the true greatest elongations by more or less consistent intervals in the range 16±4 days, while the remaining observation in 10.2 (an observation by Ptolemy from AD 136, H2.300) is 25 days *before* a true greatest elongation that is also the one falling closest to one of the observations used in 10.1.

21 Swerdlow (1989).

What I suspect to have happened is that Ptolemy started off with a set of observations of Venus at, or very close to, the true dates of greatest elongation, partly drawn from Theon's observations and partly from his own. Theon may himself have identified certain observations as greatest elongations, as Ptolemy attests that he did for the Mercury observation cited in *Almagest* 9.9. Whoever did it, the method would have been the one outlined above, taking an observation from the halfway date of two fairly widely spaced observations between which Venus's progress was approximately equal to that of the mean Sun. Either these did not yield pairs exhibiting the exact symmetries needed for the demonstration of the apsidal line, or Ptolemy had foreknowledge of the apsidal line that he was seeking, or both; in any case he chose to apply a roughly consistent temporal shift to two pairs of greatest elongations that *nearly* provided the symmetries, as well as to one more that appeared to have the mean Sun near one end of the apsidal line. For each of these new, symmetrically paired dates, he selected one genuine observation among Theon's that was *not* indicated by Theon as a greatest elongation but that fell as close as possible to the earlier date. (In other words, I disbelieve Ptolemy's claim that Theon called the observation of AD 132, March 8 a greatest elongation.) Then he fabricated—*not* interpolated—an observation of his own that supplied the exact equal-but-opposite counterpart near the later date. Again, for the eccentricity and epicycle radius he selected a genuine Theonic observation, not of a greatest elongation, close to the shifted date of the apsidal greatest elongation, and fabricated an observation of his own with the mean Sun in the diametrically opposite position, and with an elongation chosen so as to lead to values for the eccentricity and epicycle radius that Ptolemy had decided on in advance.

Given a series of daily, or near-daily, observations of an inferior planet's position over a sufficient time span around the estimated date of greatest elongation Ptolemy, or Theon, should have been able to establish which observation was closest to the moment of greatest elongation subject to errors of one or two days. A span of as much as twenty days was desirable for Venus; for the rapidly accelerating Mercury just eight or ten days should have sufficed, while beyond about twelve days the asymmetry of the elongation function around its extreme becomes too pronounced for the method of taking the midway date to work. The large discrepancies in the reports of Venus from *Almagest* 10.1–2, since they can be accounted for by the systematic shift conjectured above, are not good evidence that this level of accuracy was not attained in practice. Ptolemy's remaining two greatest elongations of Venus, used in *Almagest* 10.3 to locate the equant, are respectively just three days and one day off from the correct dates, and even these discrepancies are in part due to the circumstance that his procedure requires two observations with the mean Sun near exact quadrature relative to the apsidal line. The discrepancies for his recent reports of Mercury's greatest elongations, averaging under three days with a maximum discrepancy of six days, can also be explained as adjustments for the sake of his deductive arguments.

6 The Historical Greatest Elongations

Ptolemy's historical reports of greatest elongations all appear in a single chapter, *Almagest* 9.7, the counterpart for Mercury of *Almagest* 10.1 for Venus in which the planet's apsidal line is determined as the line of symmetry of two pairs of equal but opposite recent observations of greatest elongations. Only for Mercury, however, does Ptolemy carry out a similar determination using a set of historical observations, whereas in the case of Venus he writes that "the available ancient observations did not supply us with exact pairs of positions for this purpose" (*Almagest* 10.1, H2.296).

In introducing the historical observations in 9.7, he characterizes them as "the ancient observations made near the greatest elongations" (H2.264) and none of these reports has wording comparable to that of the two reports from Theon discussed above asserting that the observers had identified the dates as falling on or close to greatest elongations. The implication appears to be that Ptolemy, or some intermediary such as Hipparchos, selected the cited observations from a sufficiently abundant transmitted corpus so that it was possible to find an observation of Mercury approximately on the halfway date of two chronologically proximate observations between which the planet's average speed was close to that of the mean Sun.

Two of the observations are Babylonian:

> In the 75th year according to the Chaldeans, Dios 14, at dawn, (Mercury) was half a cubit above the southern scale (α Lib).
>
> H2.267

> In the 67th year according to the Chaldeans, Apellaios 5, at dawn, (Mercury) was half a cubit above the northern forehead of the scorpion (β Sco).
>
> H2.268

Like the one other Babylonian planetary observation in the *Almagest* (in 11.7, H2.419), these appear to be faithful translations of records of the type known as "normal-star passages" which occur frequently in the Babylonian Astronomial Diaries, Goal Year Texts, and Excerpt Texts;[22] the year count is according to the Seleucid Era, the calendar date is probably a direct rendering of the original Babylonian calendar date with schematic substitution of a Macedonian month name, and the metrology of cubits and fingers literally reproduces the meaning of the Babylonian units.[23] Ptolemy interprets the reports as meaning that the planet was due north of the named fixed star in ecliptic coordinates, i.e. at the same longitude as the star, on the date of the observation. His procedure, therefore, is to express the date in his own chronological system (Egyptian calendar, Era Nabonassar), equate the planet's longitude with the longitude of the star provided by his own star catalogue, corrected for precession, and calculate the mean Sun for the date using his own solar theory.

The survival of a significant fraction of the cuneiform tablets of the Babylon astronomical archive makes it possible for us to perceive several obstacles to using planetary observations from the archive in the way that Ptolemy professes to be doing—obstacles that would only have become more severe if the intermediate stages of their transmission involved losses and distortions in the observational record. In the first place, observations of Mercury at a particular time of night (i.e. shortly after sunset or shortly before sunrise) were not available in all ranges of longitude. In *Almagest* 13.8 (H2.597–598) Ptolemy states that the planet cannot make an appearance in the evening when it is around the beginning of Scorpio or in the morning when around the beginning of Taurus; and the Babylonian mathematical models for calculating visibility dates for Mercury similarly assume that intervals of evening visibility will be "missed" when the predicted first visibility would occur in Libra or the first few degrees of Scorpio, while morning visibility will be "missed" for predicted first visibility occurring in much of Aries and Taurus.[24] But the conditions for simply sighting the planet were more generous than those allowing its position to be determined, since that required at least one identifiable star to be visible together with the planet. The Babylonian observational records show that the longitudinal ranges within which Mercury was never or rarely observable together with a Normal Star in the morning or evening were much more extensive than the ranges in which visibility was "missed"; in fact for either time of night observations were practically limited to about half the ecliptic, with further gaps caused by the highly uneven distribution of the Normal Stars

22 Jones (2004).

23 Jones (2006: 273–276); Stern (2012: 238–243).

24 Neugebauer (1975:1.403–404).

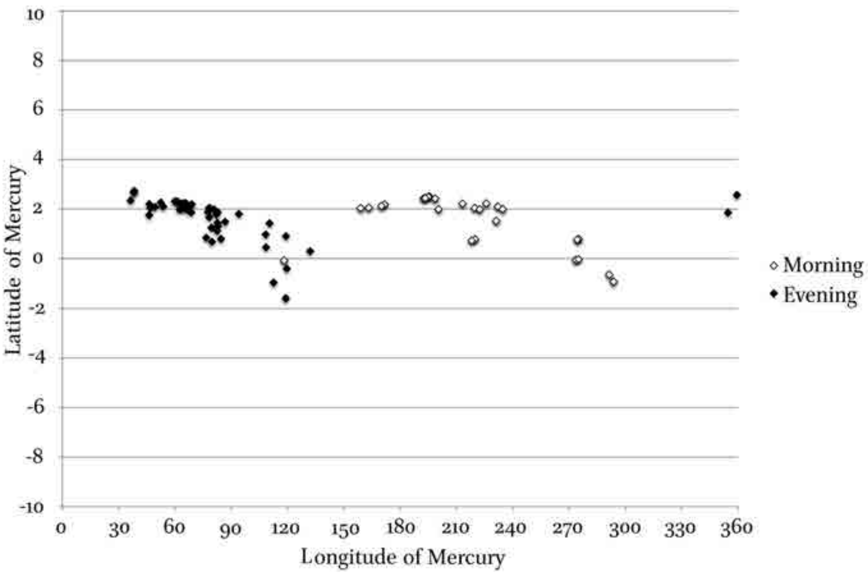

FIGURE 10.4 *Locations of Mercury on the dates of surviving Babylonian Normal Star observations*

(Fig. 10.4).[25] The major "blacked-out" ranges approximately coincide with Aquarius through Cancer for morning observations and Virgo through Aquarius for evening observations; the corresponding "blacked-out" ranges of longitude of the mean Sun are roughly Pisces through Cancer for morning observations and Leo through Aquarius for evening observations (Fig. 10.5). These gaps are all the more deleterious because Mercury's geocentric apsidal line falls roughly in their middles, thus greatly limiting the opportunities of finding symmetrically placed observations of equal but opposite greatest elongations. As Swerdlow has remarked, this was probably a major factor contributing to Ptolemy's erroneous placement of Mercury's apogee at much too low a longitude, near the beginning of Libra.[26]

Moreover, the chronological spacing of the Babylonian observations was not dense. At most one observation was recorded for each Normal Star that a planet passed, usually on the date when the planet came closest in longitude to the star. Only in a few regions of the ecliptic were Normal Stars closely enough spaced to give opportunities for several Normal Star passages to be

25 Figs. 4–7 were prepared from the database of Babylonian planetary Normal Star observations described in Jones (2004:479–481).

26 Swerdlow (1989:46–47).

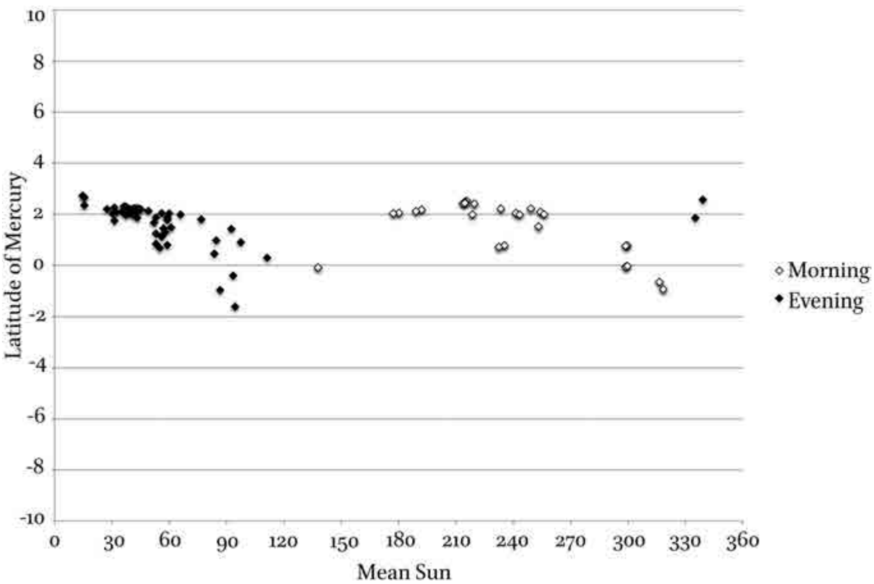

FIGURE 10.5 *Locations of mean Sun on the dates of surviving Babylonian Normal Star observations of Mercury*

observed in rapid succession. In the case of Mercury, during the comparatively brief periods of the planet's visibility, it was seldom that the Babylonian observers recorded more than two Normal Star passages. Hence the conditions would rarely have been satisfied for determining the approximate date of a greatest elongation, let alone for finding an actual observation made on that date. How Ptolemy satisfied himself that the two Babylonian reports cited in *Almagest* 9.7 were close to dates of greatest elongation is something of a mystery.

These are limitations that would have been obvious to Ptolemy simply from perusing the transmitted records. It would not have been quite as straightforward a matter for him to know what the relationship was between a report of the kind he cites, stating that a planet was so many units above or below a Normal Star, and the actual configuration of the planet and star. He assumes that the absence of a reported distance east or west (or as the Babylonian records would have said, "behind" or "in front") means that the planet was longitudinally aligned with the star. With the resources of modern theory at our disposal, we know that this was by no means the case. Most of the planetary Normal Star observations have no indication of east-west separation, despite the fact that observations were made at about the same time on successive days. Taking in aggregate all the reports of a particular planet recorded as being simply above or below any Normal Star, the relative positions of planet relative to star,

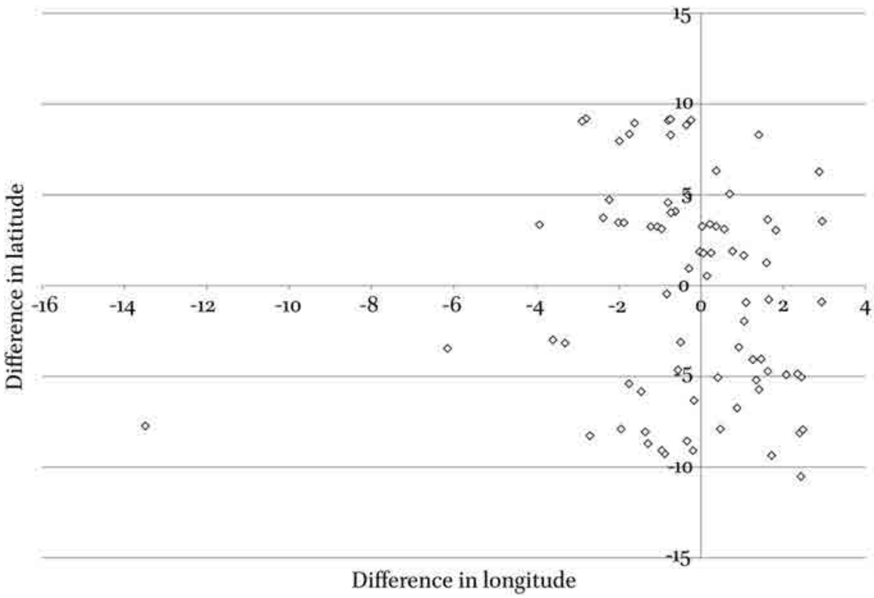

FIGURE 10.6 *Locations of Mercury relative to Normal Star on dates of surviving Babylonian observations*

as reconstructed by modern theory, form a cloud that, in the case of an inferior planet, has substantial longitudinal spread (Figs. 10.6–7).[27] If Ptolemy had access to a large enough number of the Babylonian observations, he ought to have been able to infer this aspect of observational practice simply from the abundance of reports lacking east-west distance specifications.

On top of all these problems, he must have been conscious that the translation of Babylonian calendar dates into his Egyptian calendar framework was subject to uncertainties of ±1 day since the beginnings of Babylonian months were determined by observation or calculation of lunar crescent visibility, not a schematic pattern that could be reliably mapped on to another calendrical framework. An error of as little as a day would have grave consequences for any analysis Ptolemy based on an observation, because it would cause an error of almost a degree in the assumed longitude of the mean Sun. In short, the Babylonian corpus was a highly unsatisfactory resource for obtaining greatest elongations.

27 Some of the spread in Figs. 6–7 is due to uncertainties in converting Babylonian calendar dates to the proleptic Julian calendar.

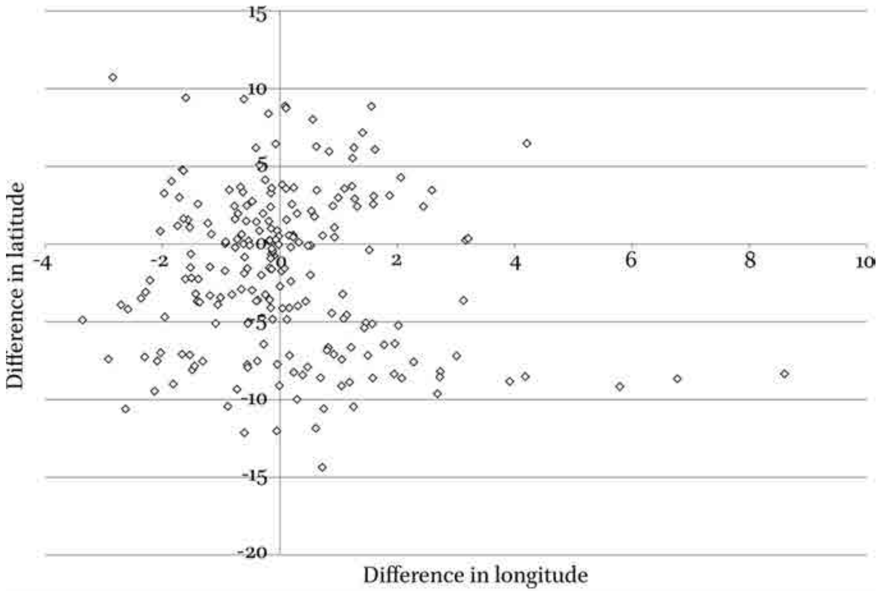

FIGURE 10.7 *Locations of Venus relative to Normal Star on dates of surviving Babylonian observations*

We lack an independent source of information about the Dionysian observations that supplied Ptolemy with his remaining four historical greatest elongations. Nevertheless the reports that he provides allow us to notice some differences in the observational practices underlying this corpus compared with the Babylon archive. Two specimens will illustrate the character of these reports; the first of them is one of his four greatest elongations in 9.7, while the second is an observation cited not as a greatest elongation but as an observed position used to correct the planet's periodicities in 9.10:

> In the 23rd year according to Dionysios, Hydron 21, at dawn, Stilbon (Mercury) was 3 Moons to the north of the brightest star in the tail of the goat-fish.
>
> H2.264

> In the 21st year according to Dionysios … Skorpion 22, … at dawn, Stilbon was 1 Moon to the rear of the straight line through the northern forehead of the scorpion and the middle one, and was 2 Moons to the north of the northern forehead … Furthermore it is clear that it had not yet reached its greatest elongation as morning star, since 4 days later, on Skorpion 26, it is recorded that its distance from the same straight line towards the rear

> was 11/2 Moons; for the elongation had become greater, the Sun having moved about 4 degrees, but the planet half a Moon.
>
> H2.288–289

Aside from using a different calendrical system and different metrology, the first of these examples resembles the Babylonian observations in reporting the planet's position as simply north of a reference star, and Ptolemy interprets it in the same way, as implying that the planet and star had the same longitude.[28] In contrast to the situation with respect to the Babylonian observations, here it seems that Ptolemy's interpretation is legitimate. The second example seems to be more typical of the records for Mercury from this corpus, since two of the other reports in 9.7 are of the same kind: the planet's location is specified in east-west distance relative to an imagined "straight line" through a pair of stars as well as in north-south or radial distance relative to a single star, thus providing a pair of coordinates fixing the planet's position. (The fourth report in 9.7 is given only in Hipparchos's reduction to an elongation in degrees from a star, so the original form cannot be recovered.) In the second example quoted above, Ptolemy also informs us that another observation was recorded four days later, allowing him to confirm that the planet had not yet reached its greatest elongation. Hence we can see that this corpus potentially contained a density of observations of Mercury that would have enabled him to estimate some dates of greatest elongation and to find observed positions on these dates.

Were the Dionysian observations of Mercury subject to the large blackout zones that we found in the Babylonian records? The more southerly latitude of their presumed place of observation, Alexandria, ought to have offered slightly more favorable conditions for sighting Mercury together with nearby stars. As it happens, all the reports that Ptolemy quotes in what looks like their original wording had Mercury within the zones where the Babylonian records attest to favorable conditions of visibility. However, the last of the reports in *Almagest* 9.7, which Ptolemy gave only according to Hipparchos's reduction, had Mercury visible in the evening about two-thirds of the way through Virgo, more than 30° inside the Babylonian evening blackout zone.[29]

28 Ptolemy's single historical observations of Mars and Jupiter from this corpus, in *Almagest* 10.9 and 11.3, are also ostensible alignments of planet with star, indeed worded as if they were seen as occultations.

29 One might expect Ptolemy's reports of his own observations of Mercury at Alexandria to provide further evidence for the extent of the blackout zones at this terrestrial latitude.

As was the case with the Babylonian reports, the calendar conversions may have been subject to uncertainty, though for a different reason. The calendar of Dionysios was a solar calendar, apparently invented purely for astronomical applications, with months named after the zodiacal signs through which the Sun passes in the course of the year. If, as seems likely, the calendar likely followed a cycle of three 365-day years followed by a 366-day year, the mapping of its dates on to Ptolemy's chronological system ought to have been unambiguous. However, some of the Dionysian planetary observations cited in the *Almagest* describe configurations that were in effect as much as two days before or after the Egyptian calendar dates that Ptolemy assigns to them.[30] A plausible explanation of these discrepancies is that Ptolemy, or a predecessor who carried out the date conversions, lacked complete information about how the Dionysian year was partitioned into its zodiacal months.

On the whole, the Dionysian reports were far more suitable for extracting greatest elongations than the Babylonian corpus, and this should have been obvious to Ptolemy. But there was a serious problem with them that becomes apparent if we consider the entire selection of historical observations in *Almagest* 9.7. Unlike Venus, Mercury's synodic period is short and does not have near resonance with the solar year like the one that causes Venus to repeat its phenomena at nearly the same longitudes after only five synodic cycles. Hence it does not require a long span of time to accumulate a reasonably dense and even distribution of greatest elongations of both kinds throughout the ecliptic; in just thirteen years, there will be 41 evening and 41 morning greatest elongations corresponding to positions of the mean Sun spaced an average of under 9° apart (Fig. 10.8). Some of these would have fallen within the "blacked-out" zones, but in other parts of the ecliptic the observational practices of the Dionysian observers ought to have provided Ptolemy with sufficient observations to provide him with historical greatest elongations close to most of the situations that he wanted.

But this was clearly not the case: he tells us that he was unable to find suitable pairs of equal but opposite greatest elongations, so instead he twice constructs pairs by matching a single Dionysian observation with a simulated equal but opposite greatest elongation linearly interpolated between two actual observa-

Their relevance is uncertain however, both because he professes to have observed them using his armillary instrument and because suspicion of tampering generally adheres to his reports of his own observations. A couple of his reports had Mercury visible in the morning very deep within the Babylonian blackout zone, at about Taurus 20° (*Almagest* 9.7, H2.262–263) and Gemini 20° (9.9, H2.275).

30 Jones (2006:287).

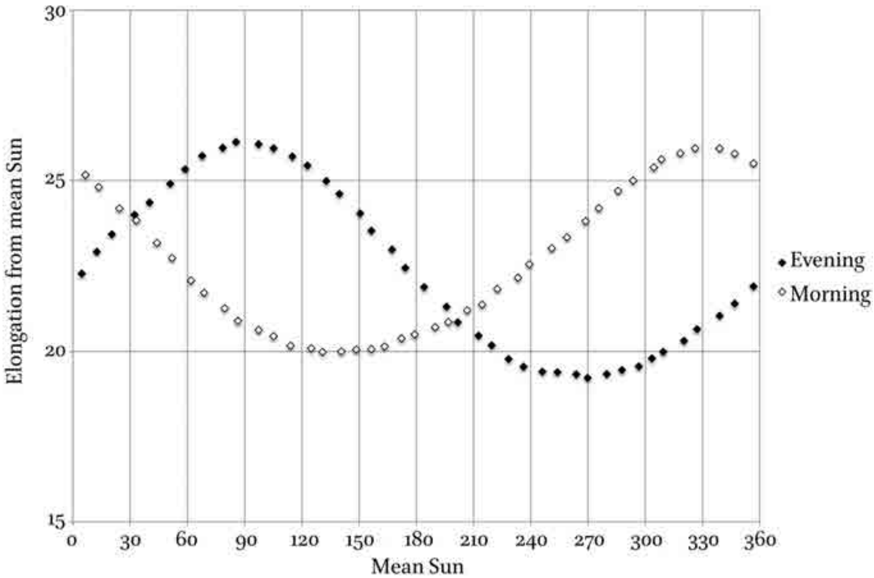

FIGURE 10.8 *Greatest elongations of Mercury from mean Sun computed by modern theory for 270–258* BC

tions for which the difference in the mean Sun is in one instance 33 1/3 ° and in the other 19 2/3 °.[31] What is more, the second time that he does this, he uses the two Babylonian observations that we have referred to above instead of the far preferable Dionysian observations to obtain his simulated matching observation. The reason that he was compelled to resort to these measures was almost certainly that he did not have many years' worth of Dionysian observations, I would suppose not much more than eight years from 265 through 257 BC from which all the examples cited in the *Almagest* come.

The Dionysian observers, whoever they were, were active from at least as early as 272 BC (the year of Ptolemy's one historical observation of Mars in *Almagest* 10.9, H2.352) to at least as late as 241 BC (the year of the historical observation of Jupiter in *Almagest* 11.3, H2.386, and the observation of the same planet in *POxy astron.* 4133). The two observation reports for Jupiter (*Almagest* 11.3, H2.386 and *POxy astron.* 4133) that give us the *terminus post quem* for the end of their observational program apparently are known to us only because an astronomer active in AD 104/105 used them to investigate a 344-year period

31 Applying linear interpolation was not unreasonable in these situations, since the greatest elongations in question were in parts of the ecliptic where the elongation varies fairly linearly as a function of the longitude of the mean Sun.

relation for Jupiter.[32] Similarly, the report for Mars (*Almagest* 10.9, H2.352) that gives us the *terminus ante quem* for the program's beginning is likely to have survived and reached Ptolemy's hands by way of an astronomer active around AD 92—Agrippa or Menelaos?—who was investigating a 363-year period relation for Mars. The Dionysian observers' records probably took in all the planets throughout the several decades of their work. What is not at all plausible is that they concentrated all their attention on Mars for just a short interval around 272, on Mercury for a few years around 260, and on Jupiter around 241. Ptolemy's small chronological window on the Dionysian Mercury observations is further confirmation that he depended for his historical observations on intermediate sources that transmitted only a small selection from the original corpora.

7 Conclusion

It is a commonplace to say that, because he lived in Alexandria, Ptolemy had access to uniquely rich resources of past astronomy through the library of Alexandria.[33] But the bulk and richness of the Alexandrian library's holdings have been greatly exaggerated even for the Hellenistic period, and when it comes to Ptolemy's time we have practically no reliable information about the library's condition.[34] In fact thanks to Galen we know much more about libraries in Antonine Rome than in contemporary Alexandria, and it would probably be safest to suppose that conditions in Alexandria were similar to—but perhaps not quite as good as—those in the capital, with a multiplicity of smaller public and private collections rather than a single predominating repository imagined anachronistically as a precursor of the modern research library.[35] Ptolemy is not known to have had any status that would have given him special access to out-of-the-way archives. It would always have been easier to find and consult the recent astronomical literature than works produced in or before the early Hellenistic period.

The solstices, equinoxes, greatest elongations, and oppositions on which Ptolemy's solar and planetary theories so heavily depended represented a dis-

32 Jones (1999).

33 E.g. Pedersen (1974:13): "It was Ptolemy's personal merit that he was more careful than most other Hellenistic authors in quoting his sources and acknowledging his predecessors; but it was the great Alexandrian library which enabled him to do so."

34 Bagnall (2002).

35 Nicholls (2011).

tillation of large sets of direct observations, and his limited and indirect access to historical observation records rendered them a problematic source for such interpolated observations. On the one hand, he had a few—very few—solstice reports going back as far as the fifth century BC, but with these the process of determining a solstice date from multiple individual observations, whatever form it took, had been carried out at the time, so that Ptolemy could only make a rather pessimistic guess about their quality. On the other hand, he had no historical observations of greatest elongations of the inferior planets reported as such, and probably also no historical reports of oppositions of superior planets with the mean Sun, but only reports of observed positions of the planets relative to fixed stars.

It should have been possible for Ptolemy to obtain some reasonably accurate interpolated dates and positions of mean oppositions; these would have required only a pair of observed positions close to the event, or even just a single observation if it fell close enough so that one could use an estimate of the planet's rate of retrograde motion. Hence he could have tried to establish an apsidal line and eccentricity for a superior planet from historical observations using the same method of analysis that he applies in the *Almagest* to recent observations, though the results would likely not have been sensitive enough to demonstrate more than the weak conclusion that the phenomena "fit" the assumption of a sidereally fixed apsidal line. The difficulty with which Ptolemy cobbles together a not entirely satisfactory set of historical greatest elongations of Mercury to furnish the *Almagest*'s specious demonstration that its apsidal line is sidereally fixed shows that the historical observations available to him could not have provided an adequate supply of greatest elongations of the inferior planets for purposes of research.

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CHAPTER 11

Mesopotamian Lunar Omens in Justinian's Constantinople

Zoë Misiewicz

1 Introduction

There is broad recognition of a relationship between the Greek and Mesopotamian celestial sciences,[1] especially in the areas of mathematical astronomy and horoscopic astrology. In the former area, shared numerical coefficients and at least one broader predictive scheme can be identified,[2] and in the latter, although there is limited survival of Mesopotamian horoscopes *per se*,[3] the later Greek horoscopic tradition incorporates several concepts that can be shown to have Mesopotamian predecessors.[4] A somewhat less-studied area is the circulation of universal celestial omens, which constitute a major part of the Mesopotamian scholarly tradition as a whole but are less common in the Greek material.[5] These omens associate a particular celestial phenomenon with an outcome relevant for a region as a whole, rather than a single individual.

The fundamental work on the relationship between Mesopotamian and Greek omen texts of this sort is Bezold and Boll's 1911 paper "Reflexe Astrologischer Keilinschriften bei Griechischen Schriftstellern", where the authors make a very broad case for the existence of such a relationship. Bezold and Boll consider the Greek corpus as a whole, rather than the place of any individual text or author. However, the Greek corpus is not in fact a unified whole; Greek texts were produced in a wide variety of different locations and contexts over a long period of time, and by considering their individual contexts and creators, we

1 For a brief overview, cf. Pingree (1965), or Pingree (1997: 21–29) for the astrological and divinatory material in particular.

2 For the former, cf. Aaboe (1955); for the latter, Jones (1997).

3 The standard edition of the horoscope texts, Rochberg (1998), contains only 32.

4 For discussion of planetary exaltations, the micro-zodiac, and trine aspect, cf. Rochberg (2010: 143–165).

5 There is in fact an abundance of this sort of material in the extensive *Catalogus Codicum Astrologorum Graecorum*, but it forms a much smaller part of the overall corpus of Greek astrological texts than the comparable Mesopotamian material in the Mesopotamian corpus.

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can gain much more insight into the texts themselves. Bezold and Boll do focus on a single context and time period for the Mesopotamian material, namely the Neo-Assyrian palace context of the seventh century BCE. They draw primarily upon two types of text produced by scholars associated with the palace: the celestial omen series *Enūma Anu Enlil* and the reports sent by scholars to the king. Tablets containing lunar omens of the type that appear in *Enūma Anu Enlil* date back to the Old Babylonian period (early second millennium BCE),[6] and *Enūma Anu Enlil* itself continued to be copied into the Hellenistic period.[7] In other words, omens of this type formed an important part of the Mesopotamian tradition over an extended period of time. Both for this reason and because the circulation of universal omens has been less studied than the circulation of other astronomical/astrological material, the following investigation will focus particularly on omens of the *Enūma Anu Enlil* type, as represented in the abundant Neo-Assyrian material.

On the Greek side, one text that has attracted particular attention for its similarities to Mesopotamian omen material is the "moon book" included in a compilation of ominous works[8] by John Lydus, a bureaucrat working in Constantinople at the time of Justinian (r. 527–565). Even without the Mesopotamian connection, this text forms a promising object of study because we are fortunate enough to have abundant evidence concerning the life of John Lydus and the intellectual atmosphere of the eastern Roman empire under Justinian. At a time when Neoplatonist philosophers were reportedly leaving Athens for the more welcoming Persian empire, and a newly-promulgated law code reaffirmed various sanctions against astrologers, it is all the more striking that an imperial bureaucrat, and holder of an imperial teaching post that was at least nominally restricted to Christians, should proudly offer up a collection of ancient divinatory wisdom of a sort that (he claims) was often met with skepticism in his day. Lydus' expressed motivation for creating this work, along with his general claims about the causes and validity of omens, will be examined more closely in what follows.

In addition to the contextualizing benefits of looking closely at a single Greek text, our focus on a single work will enable us to be more precise than Bezold and Boll about the text's relationship to the Mesopotamian material and the certainty with which we can assert the existence of this relationship. In the

6 Hunger-Pingree (1999: 7).

7 Hunger-Pingree (1999: 14).

8 The compilation as a whole is known as *De Ostentis* (*On Celestial Signs*), abbreviated *De Ost.*

absence of evidence that one text is a straightforward copy or translation of another, any study of the similarities between universal omen texts is made more challenging precisely because of the universal nature of the material. When two texts speak of lunar eclipses or earthquakes in association with war or famine, one might suppose that this is simply a matter of coincidence and not evidence of any relationship between them. It is only as the number of correlations increases that we can speak more convincingly of the high probability of a shared tradition, especially in a case like this one where a long chronological gap separates the textual products of two very different cultures. Establishing with reasonable certainty that Lydus' moon book was in fact related to the Mesopotamian celestial omen tradition will thus be our first task. We will begin by reviewing the evidence that Bezold and Boll presented, then proceed to a more systematic analysis of the moon book that takes into account both its similarities to and differences from the Mesopotamian material. This analysis will support the argument that we are looking here at the formation of omens from common elements within a shared tradition, but not at a case of direct transmission of complete omen texts. Finally, we will turn to a consideration of who John Lydus was and what this material meant in his own time.

2 The Evidence of Bezold and Boll

2.1 *Overview*

Bezold and Boll sought "evidence for a direct dependence of the Greek on the cuneiform sources",[9] a very ambitious goal that, as we will see, they were not quite able to accomplish: the search for a "direct" relationship between texts separated by more than a thousand years is particularly problematic. Nevertheless, these scholars did gather a great mass of material that reveals some strong similarities between Greek and Akkadian omen texts.

Bezold and Boll arrange their evidence in order of increasing persuasiveness, beginning with individual words or concepts and moving on to descriptions of celestial phenomena, then to complete sentences or groups of sentences, and finally to one text in which they find numerous similar sentences appearing in the same order in both Greek and Akkadian.[10] In almost all of these cases,

9 Bezold and Boll (1911: 41): "Beweis der direkten Abhängigkeit der griechischen von den keilinschriftlichen Quellen".

10 Bezold and Boll (1911: 45 ff.). This last Greek text (CCAG VII p. 167 ff.), a collection of earthquake omens attributed to Hermes Trismegistus, is not part of Lydus' moon book.

they mix evidence from various Greek sources, so that, for example, a line from Aratus (3rd c. BCE) is set next to a line from Lydus (6th c. CE) in a comparison with Akkadian texts concerning the moon's horns.[11] Of course, astronomical and astrological ideas did indeed circulate throughout the Greek and Roman world over an extended period of time; Cicero, for example, prepared a Latin translation of Aratos' *Phainomena* in the first century BCE, and many of Lydus' direct sources were Latin texts from that same time period.[12] Nevertheless, there is much to be gained by looking at an individual Greek text and its intellectual predecessors, rather than simply conflating all Greek material into an amorphous whole. This is the task that will be undertaken here for Lydus' moon book.

Bezold and Boll describe this moon book as the "richest for [their] investigation",[13] and include numerous examples drawn from here throughout their paper. We will briefly survey these examples before moving on to a more comprehensive treatment of the moon book as a whole.

2.2 *Individual Details*

While admitting that individual details are "in themselves by no means sufficient as proof",[14] Bezold and Boll begin their argument by collecting a number of these, pairing Akkadian expressions with Greek parallels drawn from a variety of sources. Several of their Greek examples are from Lydus' moon book: divine anger (θεοχολωσίαν), destruction of humans (φθορὰ ἀνθρώπων and similar phrases), change of government (μεταλλάξει δὲ καὶ ὁ ἡγούμενος τῆς χώρας and similar phrases), insurrection (ἐπανάστασις), the approach of enemies (ἐφόδους πολεμίων), flight (φυγή), famine (λιμός), illness (νόσοι), abundance (σῖτος ἔσται πολύς), drought (αὐχμός), locusts (ἀκρίδες), and heavy rain (κατομβρία). They also note cases where the same omen is positive for people or livestock but negative for crops, or vice versa.[15]

In isolation, we cannot draw any conclusions from these examples. The expressions are cut off from their contexts, and there is no indication of what fraction of the text is included in this material. Given a large enough body of text, we might expect to find occasional common concepts purely by coin-

11 Bezold and Boll (1911: 36).

12 Lydus' sources will be discussed further in Section 4.

13 Bezold and Boll (1911: 5): "dieses Kapital war das ergiebigste für die vorliegende Untersuchung."

14 Bezold and Boll (1911: 14): "an sich keineswegs zum Beweis genügen".

15 Bezold and Boll (1911: 22).

cidence.[16] This is of particular concern when dealing with texts that focus on the affairs of a country at the most general level. In what follows, I will attempt to go further with this analysis, looking not only at the fact that some parallels exist but at just how many of the predictions found in Lydus' moon book have Mespotamian parallels, and, equally important, how many do not. However, I will first complete the overview of Bezold and Boll's arguments.

2.3 *The Horns of the Moon*

The next section of Bezold and Boll's paper deals with one particular aspect of the moon's appearance as it occurs in various omen protases; namely, they collect statements referring to the moon's "horns" and their relation to each other. The majority of their Greek examples (six of eleven) are drawn from Lydus' moon book. These include such expressions as "If the moon holds its horns on an equal basis"[17] and "If the left horn of the moon seems to go beyond the other".[18]

In the Mesopotamian material, Bezold and Boll find 27 similar expressions concerning the moon's horns, including some comparing the two horns. With the assistance of an astronomer, they group these expressions into six categories, based on their astronomical content: the moon and the clouds, the brightness of the horns, the asymmetric appearance of the horns, the position of the horns with respect to the horizon, the moonset, and the phases of the

16 Lydus' moon book covers approximately seven pages in the (second) edition of Wachsmuth, and just over four in that of Bandy. The Mesopotamian celestial omen series *Enūma Anu Enlil* fills at least eight volumes in its modern editions, and publication is not yet complete. The most recent editions are Verderame (2002b), tablets 1–6; Rochberg (1988), tablets 15–22; van Soldt (1995), tablets 23(24)-29(30), Gehlken (2012), tablets 44–49; Reiner-Pingree (1981), tablets 50–51; Reiner-Pingree (1998), tablets 59–60; Reiner-Pingree (1975), tablet 63; Reiner-Pingree (2005), tablets 64–65.

17 ἐὰν ἡ σελήνη ἐξ ἴσου ἔχῃ τὰς κεραίας (*De Ost.* B30, W19). The standard numbering system for *De Ost.* is that of Wachsmuth (1897). However, Bandy (2013) introduces a new numbering system that almost doubles the number of sections, allowing for more precise references. This is particularly helpful for the moon book chapter, which is given twelve section numbers rather than four. For convenience, I include both section numbers, distinguished by "W" and "B". The two numbering systems are identical until chapter 9, so references up to this point have a single number. Since Bandy's section numbers are not maintained in his translations, I will simply cite a page number when referencing one of his translations. In cases where the Greek text itself differs, I have generally followed Wachsmuth.

18 ἐὰν ἡ ἀριστερὰ κεραία τῆς σελήνης δόξῃ ὑπερβάλλειν τὴν ἄλλην (*De Ost.* B27, W18).

moon.[19] Most of these groups are not found in Lydus' moon book, which makes no mention of the brightness of the horns, for example.

The references to the moon's horns are certainly striking; although the expression, once heard, can easily be associated with the shape of the moon,[20] there is no intrinsic need to describe the moon in this way. It is certainly plausible that this shared terminology is indicative of some historical relationship between the omen texts, especially in light of the further similarities that will be discussed shortly. Nevertheless, we may still hesitate to proclaim confidently with Bezold and Boll that this description of the moon's horns "points with certainty to a close connection of the sources in which it is found."[21] When we revisit the topic of the moon's horns, we will look at the material from the opposite direction: rather than considering all Mesopotamian references to the horns and comparing them to a variety of Greek texts, we will look at one particular Greek text and see that its horn references, at least, do have parallels in the earlier Mesopotamian material. Our goal will not be to determine whether the entirety of the Mesopotamian omen tradition was somehow diffused throughout the later Greek material, but rather to address the simpler question of whether one individual Greek text shows evidence of Mesopotamian ideas.

2.4 *Complete Omen Parallels*

Some of Bezold and Boll's strongest evidence concerning the relationship between Lydus' moon book and the Mesopotamian omen texts appears in the fourth section of their work, where they compare complete omen statements that are similar in both protasis and apodosis. Even here, however, some caution is required. There is considerable subjectivity in the assessment of how similar two statements are, as will be seen by a survey of Bezold and Boll's examples. In each of the following examples, the Akkadian text is drawn from the more recent edition of Rochberg-Halton (1988, *Enūma Anu Enlil* 15–22) or Hunger (1992, Reports), rather than the earlier edition of Virolleaud that Bezold and Boll had available. The first pairing of a Mesopotamian omen text with a line from Lydus' moon book reads as follows:

19 Bezold and Boll (1911: 34). The astronomer assisting them was August Kopff.

20 This description does not necessarily refer only to the crescent moon; one Akkadian text (Report no. 384 in Hunger (1992)) refers to the "horns" of the eclipsed sun; presumably the same description could refer to the eclipsed moon as well.

21 Bezold and Boll (1911: 37): "weist mit Sicherheit auf einen ganz engen Zusammenhang der Quellen hin, in denen sie sich findet."

EAE 17 II.3: DIŠ AN.MI EN.NUN U_4.ZAL GAR ZI-*ut* LUGAL IM.GI *šá a-a-bi-šú i-kaš-ša-du u* ⸢É⸣ …

If an eclipse occurs (in Ayyaru) in the morning watch, attack of a usurper king who will conquer his enemies and the house …[22]

Σελήνη Λέοντι … εἰ ἡ σελήνη ἀμαυρὰ γένηται τη ἑωθινῇ φυλακῇ, στράτευμα ἀλλότριον ἐπελεύσεται τῇ τοῦ βασιλέως χώρᾳ.[23]

Moon in Leo … If the moon becomes faint in the morning watch, an army belonging to another will attack the land of the king.

These omens certainly have several elements in common: both can be taken to describe lunar eclipses in the morning watch,[24] and both associate this phenomenon with some sort of military disturbance. What is not immediately clear is whether the military disturbance involved is the same in both cases. A secondary meaning of the Greek term ἀλλότριος ("belonging to another") is "foreign", though it can also simply have the sense of "hostile";[25] together with the phrasing about "attacking the land of the king", this might suggest an external enemy. By contrast, the Akkadian LUGAL IM.GI (or NI_2.GI), *šar ḫammāʾi* ("usurper king"), would appear at first glance to suggest an internal uprising. However, a closer examination of its usage reveals that the *šar ḫammāʾi* can in fact be found on the periphery of the land, at least in the earlier Old Babylonian period; an extispicy text proclaims that "usurper kings will rise at the periphery of the country; some will fail, some will succeed".[26] There is enough overlap among the various possible meanings of the Greek and Akkadian terms that, at least in this case, the similarity between the two omens does mostly stand up to scrutiny. However, this example is indicative of the issues that can arise when trying to assess the degree of similarity between two texts, and it remains

22 Composite text and translation adapted from Rochberg-Halton (1988: 127). The Akkadian text has been recovered from several copies, not all of which were available to Bezold and Boll; their version did not include the phrase about conquering enemies or any mention of a house.

23 *De Ost.* B31, W19.

24 It is possible for the moon to appear dim for other reasons, but the Akkadian omen texts frequently use this expression to refer to an eclipse. Cf. Verderame (2002a: 447–448).

25 LSJ s.v. ἀλλότριος.

26 YOS 10 11 ii 4, cited and translated in CAD H s.v. *ḫammāʾu*: "*šar-ru-ú ḫa-am-me-e kibrat mātim itebbûnim annûm imaqqut annûm itebbi.*"

difficult to evaluate its significance when it is considered in isolation from its textual context. Moreover, there is no connection between the zodiacal position and month mentioned in the two omens.

Other parallels suggested by Bezold and Boll are more problematic. For example, they adduce two different Greek lines for comparison with the same Mesopotamian text, as follows:[27]

> EAE 17 V.3: DIŠ *ina* ITI.NE AN.MI EN.NUN U_4.ZAL.LI GAR [NUN *šu-ut* SAG.MEŠ-*šú* HI.GAR.MEŠ-*šú*].
>
> If an eclipse occurs in Abu in the morning watch, [the prince's courtiers will rebel against him].[28]
>
> Σελήνη Παρθένῳ … εἰ τῇ ἑωθινῇ φυλακῇ τὸ αὐτὸ γένηται, μέγας ἀνὴρ ἀπολεῖται.[29]
>
> Moon in Virgo … If the same thing occurs [i.e., the moon becomes dim] in the morning watch, a great man will die.
>
> Σελήνη Τοξότῃ … εἰ ἡ σελήνη ἀμαυρὰ γένηται κατὰ τὴν πρώτην φυλακὴν ἢ κατὰ τὴν μεσομηνίαν, οἱ περὶ τὰ βασίλεια ταραχθήσονται … εἰ δὲ τῇ ἑωθινῇ, ἀνὴρ δυνατὸς ὑπὸ βασιλέως ταραχθήσεται.[30]
>
> Moon in Sagittarius … If the moon becomes faint during the first watch or during the middle of the month, those concerned with royal matters will be disturbed.[31] … And if (it happens) in the morning (watch), a powerful man beneath a king will be disturbed.

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27 Bezold and Boll (1911: 38).

28 Rochberg-Halton (1988: 131). For consistency I refer to Rochberg-Halton's (1988) EAE edition for texts and (sometimes adapted) translations, but this particular omen is actually attested in complete form only in *Iqqur Īpuš*, whence Rochberg-Halton restores it. There is enough uniformity in the Mesopotamian omen tradition that restorations of this sort can be accepted with reasonable certainty.

29 *De Ost.* B32, W19.

30 *De Ost.* B35, W20.

31 Bezold and Boll (1911: 38) gloss this as "the courtiers will revolt" ("die Hofleute werden sich empören"), equating the vague Greek expression with the more precise Akkadian. When the same Greek verb occurs a few sentences later in a different context ("a powerful man beneath a king will be disturbed"), they interpret it more literally.

The aim of presenting these two different Greek omens together seems to be to approach the sense of the Akkadian text by somehow conflating elements drawn from both of them. The death of a great man, combined with disturbances involving people connected to royal affairs, may be considered evocative of a rebellion by the prince's entourage. Unfortunately, this sort of reasoning is lacking in justification and therefore unpersuasive; we are faced with two distinct Greek omens, not one conveniently merged one. While we can recognize common elements in the different omens—the various watches; disturbances or maybe even rebellion among the people surrounding the ruler—there is no reason to suppose that the specific combination of elements is based on a direct derivation of one from the other. Rather than arguing that the Greek authors took a single Akkadian omen and altered it in two different ways to derive two different Greek omens, it will ultimately be more productive to argue that there was a tradition of creating omens out of specific elements (lunar eclipses, watches, and so on) and that these common elements were combined in various ways in the course of centuries of development. In other words, the creator of Lydus' moon book text was working within a tradition that shared elements with the omen tradition of Mesopotamia, but this was a case of broader and less direct circulation of concepts, not of word-for-word transmission of omen statements.

Other parallels listed here by Bezold and Boll are somewhat less problematic but also less striking, and will be described only briefly. First, the phenomenon of a lunar eclipse in the second watch is associated with the outcome "approach of enemies" in Lydus' moon book and with "the enemy will take my fortress" in the Akkadian parallel;[32] these are quite similar in content but also quite general, and again, the month and zodiacal position do not align. A Greek omen predicting rain when winds blow throughout the whole month is compared to an Akkadian omen similarly associated with rain, "when Adad throws down his mouth."[33] A final pair of omens shows considerable divergence: both deal with a lunar eclipse in the middle of the month, but Lydus' Greek states simply that "there will be prosperity" (εὐθηνία ἔσται), while the Akkadian parallel associates the phenomenon with "misfortune for Elam and Amurru, good fortune for the king my lord."[34] There is, of course, a sense in which the two apodoses

32 Bezold and Boll (1911: 39).

33 Bezold and Boll (1911: 39). This protasis is related to the Greek only in that both can be associated with storms; KA in the context of "*Adad* KA-*šu iddi*" is now read GÙ = *rigmu*, and translated as "Adad thunders". Cf. CAD R (1999: 332) s.v. rigmu, or an example in Rochberg-Halton (1988: 263).

34 Hunger (1992: 222): HUL *šá* KUR.NIM.MA.KI / *u* KUR.MAR.TU.KI / SIG5 *šá* LUGAL *be-lí-ia* (translation adapted slightly).

are broadly related, but the Greek term suggests prosperity in the sense of abundant grain,[35] while the cuneiform SIG$_5$ (*damiqtu*) is much more general.[36] At the same time, the Akkadian is more detailed in its inclusion of a negative outcome for two neighboring regions.

In short, these parallels are a mixed bag. Some do reveal strong similarities, while other pairings seem overly optimistic. Moreover, they continue to be presented in isolation, making it difficult to assess their overall significance.

It should be noted at this point that it is sometimes possible to find further examples of the sort discussed above, where both the protasis and apodosis of the Greek and Akkadian omens align. One such pair of examples reads as follows:

> EAE 17 III.1: [DIŠ *ina* ITI.SIG$_4$ A]N.⌜MI EN.NUN AN.USAN$_2$ GAR⌝ ZI KU$_6$.HI.A // ZI BURU$_5$.MEŠ
>
> [If] an eclipse occurs [in Simānu] in the evening watch, influx of fish, variant: influx of locusts.[37]
>
> Σελήνη Διδύμοις … εἰ δὲ τῆς πρώτης φυλακῆς ἐκλίπῃ ἡ σελήνη, ἀκρίδες ἔσονται.[38]
>
> Moon in Gemini … And if the moon is eclipsed in the first watch, there will be locusts.

In this case, there are four elements of agreement: the eclipse of the moon, the watch in which it occurs,[39] the associated terrestrial outcome (locusts), and also the month, if we associate Gemini with June, as is done in a very close parallel to Lydus' text.[40] On the surface, this seems like very strong evidence for a

35 cf. LSJ s.v. εὐθηνία.

36 Even my translation of "good fortune" is an interpretation; *damiqtu* is simply a substantivized adjective meaning "good".

37 Text and translation from Rochberg-Halton (1988: 129). Here and elsewhere, the abbreviation "var." is expanded to "variant".

38 *De Ost.* B29, W18.

39 The Mesopotamian omens use a system of three watches (evening, middle, and morning), as does Lydus' moon book (first, second, morning). In comparing omens from the two systems, it seems reasonable to assume that the Mesopotamian "evening" watch corresponds to the Greek "first" watch. For a chart of the terminology for watches in Greek and Akkadian, see below p. 368 (Table 11.2).

40 C. Scor. I. R. 14 F. 161ff., published in CCAG XI.I (1932: 146–155). This text is almost iden-

connection between the two texts. And yet this very similar pair appears largely in isolation; both the Greek and Akkadian exemplars are surrounded by other omen statements that bear no such resemblance to each other. Since the same Akkadian omen can appear in multiple places in the Mesopotamian corpus, it could be argued that we simply do not yet have the precise Mesopotamian text that would match exactly with the Greek. However, certain characteristics of this Greek text speak against ever finding such a perfect match; in particular, the Greek omens lack the systematic organization of their Mesopotamian counterparts. This issue of organization will be revisited in the fuller analysis that follows.

2.5 *Systems of Parallels*

Bezold and Boll acknowledge the weakness of some of their isolated examples, and seek to provide more convincing evidence in the form of systems of parallels. That is, they present comparable blocks of text consisting of several omens. In theory, evidence of this sort is indeed much more persuasive, and one of their examples of this type will form a key part of my later argument. However, their first attempt is less successful. The Akkadian text that they consider[41] is found in EAE 22[42] and consists of monthly sets of the same four omen protases. The first set of omens reads as follows:

I.1 DIŠ *ina* ITI.BARA$_2$ TA UD.1.KAM EN UD.30.KAM AN.TA.LÙ *it-tab-ši ub-bu-ṭú* GAR LUGAL *šá-lim* ŠE GU-*um* TUR.

I.2 BE ^{d}IŠKUR KA-*šu* ŠUB-*di* ŠE GU-*um* TUR-*ir*.

I.3 BE *ri-i-bu i-ru-ub* LUGAL KUR-*su* BAL-*su nap-pah-tum in-nap-pah*.

I.4 BE IM.GÚ KUR *is-húp* ŠÈG.MEŠ *ina* KUR TAR.MEŠ (MU.10.KAM KUR *di-bi-*[*r*]*i* IGI).

I.1 If an eclipse occurs in Nisannu from the 1st to the 30th day: there will be famine; well-being of the king; grain and flax will decrease.

I.2 If Adad thunders: grain and flax will decrease.

I.3 If there is an earthquake: the king's land will rebel against him and a revolution will flare up.

tical to Lydus' moon book, consisting of essentially the same omens in the same order, but refers to the solar position in the zodiac rather than the lunar position, and has corresponding month names written in the margins.

41 Bezold and Boll (1911: 41–42).

42 Rochberg-Halton (1988: 262 ff.). The text was known to Bezold and Boll in its earlier publication as *Ach. Sin* XXXV.

I.4 If mud covers the land: rains in the land will stop (variant in one source: for ten years the land will experience hardship).[43]

Bezold and Boll were unsure of the reading of the cuneiform IM.GÚ, speculating that it might be understood as *girginakku* (IM.GÚ.LÁ), a term whose meaning was also uncertain.[44] They then translated the expression IM.GÚ *māta is-kup* as "a cyclone(?) prostrates(?) the land(?)",[45] with a question mark after each word. This dubious reading—which has since been revised, with IM.GÚ now understood as *qadūtu*, mud or sediment[46]—was then used as a significant point of comparison for the Greek material. As evidence for the relationship between Lydus' text and this tablet with its four-part repetition, Bezold and Boll cite numerous instances from the Lydus text of eclipses, earthquakes, and winds, along with a couple of instances of "sound from the sky".[47] The case for this specific parallel is rather weakened by the revision of the Akkadian reading to refer to mud or silt rather than wind, since no comparable phenomenon is mentioned in Lydus' moon book.

Bezold and Boll themselves were not completely satisfied with this example, not for the reason laid out above but because the shared concepts were scattered throughout the Greek text, rather than found in the same order as in the Akkadian. They were searching for indisputable evidence of transmission in the form of a single cuneiform text that could be taken as a direct source for the later Greek material, but they were aware that the evidence discussed thus far did not support the idea of a systematic transmission of Mesopotamian divinatory texts into Greek:

> If the Greeks[48] in fact methodically drew astrological content from the Babylonian-Assyrian inscriptions, then we must expect to find among them the same ordering of the omens communicated in the latter. Unfortunately in this respect the material so far examined by us initially proved rather uncooperative.[49]

43 Text and translations from Rochberg-Halton (1988: 262 ff.), with minor alterations.

44 *girginakku* is now understood to mean "library"; cf. CAD G s.v. girginakku.

45 Bezold and Boll (1911: 41): "ein Drehsturm(?) das Land(?) niederwirft(?)".

46 Borger (2003: 390); CAD Q (1982: 52), s.v. *qadūtu*; Rochberg-Halton (1988: 265).

47 Bezold and Boll (1911: 41–42).

48 This presumably refers to anyone writing in Greek, but is perhaps not the best description of someone like Lydus, a late Roman who opposed the replacement of traditional Latin with more widely-understood Greek in legal and governmental contexts.

49 Bezold and Boll (1911: 42): "Haben die Griechen in der Tat planmässig aus den babylonisch-

However, Bezold and Boll persisted in seeking direct correspondences between texts as a whole, which brings us to their final example.[50] In this typical Mesopotamian text,[51] we find a systematic vertical variation of the protases. The text reads as follows:

I.1 [DIŠ] *ina* ITI.BARA$_2$ AN.MI EN.NUN AN.U[SAN$_2$] GAR *ub-bu-ṭú* GAR-⸢*ma*⸣ ŠEŠ ŠEŠ-*šú* KÚ KIMIN ^{d}*Ir-ra* KÚ.

I.2 DIŠ *ina* ITI.BARA$_2$ AN.MI EN.NUN MURUB$_4$.BA GAR EBUR KUR NU SI.SÁ KIMIN *ub-bu-ṭú* GÁL-*ši*.

I.3 DIŠ *ina* ITI.BARA$_2$ AN.MI EN.NUN U$_4$.ZAL.LI [GA]R LUGAL *ana* LUGAL SILIM.MA KIN-*ár*.

I.1 [If] an eclipse occurs in Nisannu in the evening watch, there will be famine and brother will consume his brother, variant: Irra (= plague) will consume.

I.2 If an eclipse occurs in Nisannu in the middle watch, the harvest of the land will not thrive, variant: there will be famine.

I.3 If an eclipse occurs in Nisannu in the morning watch, king will send (messages of) reconciliation to king.[52]

There is some room for dispute about the term *ub-bu-ṭú*, translated as "famine" by Rochberg-Halton (1988: 123) but understood as "destruction" (Vernichtung) by Bezold and Boll (1911: 43). The same signs can in fact be read as *ár-bu-tu*, devastation,[53] but the evidence of CAD supports Rochberg-Halton's translation: *ub-bu-ṭú* appears with the verbs GAR (as above, though more commonly in the plural) or *ibašši*, while *ár-bu-tu* appears with *alāku*.[54] Rochberg[55] additionally points out that some sources use the variant spelling *ibbuṭu* for this term, which can be reconciled more easily with a reading of *ubbuṭu* than with a reading

assyrischen Inschriften astrologischen Inhalts geschöpft, so ist zu erwarten, dass sich bei ihnen auch die Reihenfolge der in den letzteren mitgeteilten Omina wiederfinden werde. Leider erwies sich in dieser Hinsicht das von uns bisher geprüfte Material zunächst ziemlich spröde."

50 Bezold and Boll (1911: 43).

51 From *Enūma Anu Enlil* 17.

52 Text and translation from Rochberg-Halton (1988: 123).

53 This reading is "generally preferred" by Gehlken (2012: 150).

54 CAD s.v. ubbuṭu A, *arbūtu*.

55 Personal correspondence, 14 September 2014.

TABLE 11.1 *Apodoses associated with lunar eclipse or dimness*

Watch	Greek apodosis	Akkadian apodosis
1	War	Devastation (famine)
2	[combined with 1]	Harvest will not thrive
3	Shortfall of provisions	Reconciliation

of *arbūtu*.[56] Furthermore, the two terms are orthographically distinguished in omens of the Old Babylonian period, where *arbūtu* (accompanied by the verb *alāku*) is written with an additional sign, *ḫa-ar-bu-tam*.[57] This initial *ḫa* does not appear in the spelling of the word *ubbuṭu* in a text from this same period.[58] Finally, the reference to brother consuming brother may also speak in favor of the reading of "famine". In any case, these different possible readings, along with the problematic readings seen earlier, warn against basing an argument too much on any single parallel, an issue that will be revisited later.

In the argument of Bezold and Boll, this devastation/famine is taken as comparable to the Greek "war" (πόλεμος), as part of a longer passage that they associate with the Akkadian text above:

> εἰ κατὰ τὴν πρώτην ἢ δευτέραν φυλακὴν ἡ σελήνη ἀμυδρὰ φαίνοιτο, πόλεμος ἔσται. εἰ δὲ κατὰ τὴν ἑωθινήν, εἰρήνην μετὰ ἐλλείψεως τῶν ἐπιτηδείων δηλοῖ.[59]
>
> If the moon appears dim during the first or second watch, there will be war. And if (it happens) during the morning (watch), it indicates peace with shortfall of provisions.

The apodoses associated with the different watches in the Greek and Akkadian texts can be represented in tabular form (Table 11.1).

Bezold and Boll (1911: 43) see a straightfoward connection between the Greek and Akkadian outcomes given for the first watch, as long as they interpret

56 Cf. Rochberg-Halton (1988: 181), n. 2.

57 MS 3118: 20 and MS 3117: 23 in George (2013: 72, 77).

58 BM 22696, unpublished. Again, the term *ubbuṭu* here is accompanied by the verbs *šakānu* and *bašû*, rather than *alāku*. I am grateful to Francesca Rochberg (personal correspondence, 8 October 2014) for this example of an orthographic distinction between the two nouns.

59 *De Ost.* B25, W17.

ub-bu-ṭú as "devastation" rather than "famine". Since the Greek text gives a combined prediction for the first and second watches together, Bezold and Boll then turn to the third watch for a comparison with the second Akkadian apodosis, and find that "shortfall of provisions" does correspond with "the harvest will not thrive".[60] Moreover, they bring in another Greek text that is closely related to Lydus' moon book, but even more concise; here, the final watch is omitted entirely, and all of the Greek apodoses found in Lydus are associated with the first or second watch: "If ever the moon becomes dim in Aquarius during the first or second watch, it signifies wars and instabilities, and scarcity of grain."[61]

The basic point is that these Greek omen texts that deal with a lunar eclipse in various watches include the same two apodoses that are found in the Akkadian omen text, in the same order—at least, if one accepts the reading *ub-bu-ṭú* = devastation. This is taken as evidence that the Greek text is ultimately derived from the Akkadian,[62] an argument that is plausible if not entirely watertight.

There is an obvious way to test the theory that these two passages are directly related. They are both part of larger texts containing numerous other omens with similar content, so we can consider whether the other Greek omens show a dependence on the other Akkadian omens. EAE 17–18 once contained a complete system of omens concerning lunar eclipses in each of the three watches of the twelve months, and 29 of the expected 36[63] are in a reasonable state of preservation. Meanwhile, Lydus' moon book contains a total of ten omens about the moon appearing dim or eclipsed in a particular watch.

The fact that Bezold and Boll had access to this material but present a comparison of only a few lines together suggests already what the result of further investigation must be: the systems as a whole do not reveal close similarities. Certain individual omens can be paired together, with varying degrees of success; in fact, the most notable of these have already been discussed above. Other omens can be considered similar only if one disregards the

60 Bezold and Boll (1911: 43).

61 Ps.-Melampous, in CCAG IV (1903: 113): ἐὰν ἐν ὑδροχόῳ ἡ σελήνη κατὰ τὴν πρώτην ἢ τὴν δευτέραν φυλακὴν ἀμαυρωθῇ, πολέμους σημαίνει καὶ ἀκαταστασίας, σίτου δὲ σπανίαν. Incidentally, this text begins with the Aries section, which would correspond to the Babylonian new year if the sections referred to the position of the sun rather than the moon.

62 Bezold and Boll (1911: 42).

63 At least one month (Ulūlu) actually contains more than three omens, with two concerning the evening watch.

particular watch involved, and some have no counterpart at all. In all cases beyond the example just discussed, the ordering of omens seems completely unrelated.

It seems unlikely, then, that we have a case of Bezold and Boll's presumed Greek translator or editor working directly with the Akkadian material. Yet the sheer number of similarities is striking, as is the appearance of the shared system of night watches. At this point, we are faced with several options: we can dismiss everything as mere coincidence; we can maintain that we simply have yet to find the perfectly-matching text in the abundant Mesopotamian material, but that such a text did once exist; or we can turn to an alternative explanation for the relationship between the Greek and Akkadian material. The accumulation of evidence seen thus far, despite its problematic nature, is too significant to dismiss completely. Yet attempts to find an exact Mesopotamian parallel have failed, and the style of Lydus' moon book is different enough from the Mesopotamian omen series that we should not pin our hopes too strongly on this possibility. In light of these considerations, it is the third option that seems most promising.

3 A More Comprehensive Approach

3.1 *Overview*

I have suggested earlier that, at least for the most part, we are dealing here with the circulation of the concepts used in the creation of omen statements, rather than with a direct transmission of the complete omen texts themselves. Instead of looking simply at individual sentences out of context and trying somehow to assess the degree of similarity between single expressions, it will prove more productive to examine the overall structure and content of the Greek text and consider which of its elements can be found in Akkadian omen texts as well.[64] This will be done in four parts: we will consider first the overall structure of the texts, then the temporal elements included within the omens, followed by the lunar phenomena of the protases, and finally

64 This is an approach that Bezold and Boll also favor to some extent, especially in the final section of their paper where they look for individual parallels appearing in the same order in both a Mesopotamian and a Greek earthquake omen text. However, their approach still relies on extreme selectivity; from a list of a dozen apodoses that the Greek text associates with an earthquake in a given month, Bezold and Boll may highlight one or two that seem close to the corresponding Mesopotamian omen statements, and even in this they are not always successful.

the terrestrial phenomena of the apodoses. For these latter two sections, the analysis will be restricted to the omens concerned with lunar phenomena, which constitute about a third of the whole. This restriction will allow for a closer examination of the material than would otherwise be possible here. A key aspect of the analysis will be the consideration of differences along with similarities, something that was omitted entirely from the analysis of Bezold and Boll. An apparent overlap in content is much more likely to be significant if similar overlap can be shown for most of the material in the text, while finding one common phrase in isolation among ten unrelated phrases is considerably less persuasive. Moreover, by considering the totality of the material, the importance of any individual phrase for the overall argument will be lessened.

There are two major sources of relevant Akkadian omen material that will be considered here: the celestial omen compendium *Enūma Anu Enlil* (along with the related omen series *Iqqur Īpuš*) and the corpus of omen reports sent by scholars to the Neo-Assyrian kings, which cited specific omens related to the current situation.[65] Due to space constraints, a single Greek passage will generally be compared to either an Akkadian passage drawn from the reports or an Akkadian passage drawn from the omen series, but not both. However, there is considerable overlap between the omens of the series and the omens of the reports; they are part of the same overall body of knowledge, though the report-writers tended to make repeated use of a small subset of the available omens.

The comparison will ultimately support the argument that, even if not copied directly from some Akkadian source, Lydus' moon book was at least composed almost entirely of the same familiar elements. Its overall structure, the lunar phenomena with which it is concerned, the temporal elements elaborating on the celestial phenomena, and the majority of the associated terrestrial outcomes are also found in the lunar sections of the Mesopotamian celestial divination series *Enūma Anu Enlil* or in the related scholarly reports.

3.2 *Overall Structure and Temporal Elements*

The moon book is arranged in a way that suggests a reference text; it groups omens into twelve sections based on the zodiacal position of the moon and includes a variety of possible situations, not simply those relevant for an individual moment in time. However, the moon book is not comprehensive and systematic in the way of the Akkadian omen compendia. A typical text in an

65 Both were also used by Bezold and Boll as sources of parallels, cited above.

Akkadian omen series varies its protases systematically, considering the significance of a phenomenon that takes place in each of the four cardinal directions, or during each of the three night watches, or one that appears in each of the standard four colors. This sort of systematic variation can be seen in the Mesopotamian text considered above, p. 362: "If an eclipse occurs in Nisannu in the evening watch", "if an eclipse occurs in Nisannu in the middle watch", "if an eclipse occurs in Nisannu in the morning watch"; after various other Nisannu omens, the same protases are repeated for the following month.[66] The phenomenon described in the protases varies from line to line in precisely one element, first the watch and later the month in which it occurs. Lydus' moon book is much less thorough. A typical section of the text reads as follows:[67]

> Σελήνη Ὑδροχόῳ. εἰ κατὰ τὴν πρώτην ἢ δευτέραν φυλακὴν ἡ σελήνη ἀμυδρὰ φαίνοιτο, πόλεμος ἔσται. εἰ δὲ κατὰ τὴν ἑωθινήν, εἰρήνην μετὰ ἐλλείψεως τῶν ἐπιτηδείων δηλοῖ. εἰ δὲ σεισμὸς ἢ ἦχος ἐκ τοῦ οὐρανοῦ γένηται, νόσους σημαίνει. εἰ δὲ ὀμίχλη γένηται, σίτου καὶ οἴνου δαψίλειαν δηλοῖ. εἰ δε παρ' ὅλον τὸν μῆνα ἐπιτείνουσι πνεύματα, ὑετὸς ἥξει. εἰ ὁ Ἕσπερος ἐν τῇ σελήνῃ εἰσελθῃ, ἴδιοι ἰδίοις δυνατοὶ ἐπιβουλεύσουσιν. εἰ δὲ δόξῃ ἐκλιπεῖν ἡ σελήνη, ⟨ἐλάττωσιν Ῥωμαίοις ἀπειλεῖ⟩.[68] εἰ δὲ αἱ κεραῖαι τῆς σελήνης συνέλθωσι, σίτου ἀφθονία ἔσται. εἰ δὲ ἄστρον ἐκτρέχον ἐπὶ τὸν οὐρανὸν αὐλακίζει, κίνδυνον τοῖς παραλίοις ἀπειλεῖ.[69]
>
> Moon in Aquarius. If the moon appears dim during the first or second watch, there will be war. And if (it happens) during the morning (watch), it indicates peace with shortfall of provisions. And if an earthquake or a sound from the sky occurs, it signifies illnesses. And if a mist occurs, it indicates abundance of grain and wine. And if winds increase throughout the whole month, rain will come. If Hesperos (the evening star) comes into the moon, powerful private individuals will plot against private individuals. And if the moon seems to be eclipsed, ⟨it threatens defeat for Romans⟩. And if the horns of the moon come together, there will be abundance of grain. And if a star, running forth, leaves a trail upon the sky, it threatens danger for those by the sea.

66 Rochberg-Halton (1988: 123 ff.).

67 This is the second section of the text; the first (Capricorn) contains significantly more restoration.

68 This is restored by Bandy on the basis of the parallel in C. Scor. I. R. 14.

69 *De Ost.* B25, W17.

TABLE 11.2 *Cuneiform and Greek watch schemata*

	Cuneiform term	Translation	Greek term	Translation
1	EN.NUN AN.USAN$_2$	Evening watch	πρώτη φυλακή	First watch
2	EN.NUN MURUB$_4$.BA	Middle watch	δεύτερα φυλακή	Second watch
3	EN.NUN U$_4$.ZAL.LI	Morning watch	ἑωθινὴ φυλακή	Morning watch

At first glance, this appears to be a fairly thorough collection of ominous phenomena and their associated outcomes. However, unlike in the Akkadian material, the same protases are not repeated for each of the different sections. While this Aquarius section refers to the moon appearing dim during various watches, that phenomenon is entirely absent from the following section (Pisces). The Pisces section includes the first watch in an omen about the moon's horns coming together, but does not discuss the occurrence of that same phenomenon in the other two watches. Meanwhile, the Aquarius section mentions the coming together of the horns without any temporal qualification at all. The overall result is a collection of omens that is much less thorough and systematic than *Enūma Anu Enlil*. The Mesopotamian scholars went to great effort to include in their omen compendia all conceivable phenomena, including some that were not even possible.[70] Lydus' moon book is much more haphazard. Someone hoping to look up the significance of a particular phenomenon occurring at a particular time might find what he was looking for, but might equally be out of luck. In other words, this moon book could not have functioned as an effective reference text, despite what its overall structure might suggest.

Nevertheless, there are certain systematic features visible in the moon book, even if they are not fully elaborated. For example, we have already seen mention of the night "watches" in various examples. At the level of precise detail, this tripartite division of the night is one of the most striking similarities between Lydus' moon book and the Akkadian omen texts. There is a one-to-one correspondence of the terms by which these watches are denoted in the Greek and Akkadian sources (Table 11.2). This similarity is particularly striking because it consists of a complete schema, not simply isolated elements.

Another major structural feature is the organization of omens into twelve sections. This is visible in *Enūma Anu Enlil* in the association of omens with the

70 For a discussion of impossible omens, see Rochberg (2010: 387–393).

twelve months, and is even more prominent in the related menological series *Iqqur Īpuš*, whose second half is devoted to celestial and meteorological omens. *Iqqur Īpuš* generally groups omens in sets of twelve, systematically running through the months of the year for each phenomenon.[71] Lydus' moon book also shows a fundamental twelve-part division, based on the signs of the zodiac. Each section begins with the position of the moon in a different sign. This may seem like a completely different system from the month-based organization of the Neo-Assyrian omen compendia, but a close parallel to Lydus' text reveals that the systems may in fact be quite close. This parallel,[72] mentioned earlier (p. 359. n. 41), contains almost exactly the same omens as the Lydus text, with only minor differences of wording, and in the same order. In short, the two texts are almost identical. However, the parallel does not begin each section with the words "moon in [zodiacal sign]", but with the name of the zodiacal sign alone. Each zodiacal sign is then associated with a month, as might be expected if the sign referred to the position of the sun rather than the moon. For example, Capricorn is associated with January. These month names are written in the margin of the manuscript at the start of each section.

Certain phrases within the sections suggest that this standard monthly division may have been what the author had in mind when creating the text. For example, in the Taurus section, one omen begins, "If an earthquake occurs from the first of the month to the twelfth",[73] or perhaps even "If an earthquake occurs from the first of May to the twelfth".[74] A later sentence in the same section predicts the outcome of an earthquake occurring from the twelfth to the thirtieth. It is certainly possible that the intent is to combine the moon's position in the zodiac with the date of whatever month it happens to be at the time, but these references to dates within the month are more straightforward when the section as a whole is taken to refer to one particular month. An omen in the Gemini section similarly speaks of an earthquake taking place "from the beginning of the month to the ninth of this month",[75] with no other indication of which month is meant.

The zodiacal signs themselves are Mesopotamian in origin, but of a later date than the standard *Enūma Anu Enlil* compendium.[76] Of course, the start of the

71 Sometimes an intercalary month is included as well, bringing the total to 13.

72 C. Scor. I. R. 14 F 161 ff., published in CCAG XI.I (1932: 146–155).

73 *De Ost.* W18.

74 *De Ost.* B28. Taurus is the section equated with May in the parallel manuscript.

75 ἀπὸ νεομηνίας ἕως ἐννάτης τοῦ μηνὸς τούτου (*De Ost.* B29, W18).

76 *Enūma Anu Enlil* did continue to be copied in Akkadian throughout the second half of the first millennium BCE.

Greek text with Capricorn (January) rather than Aries (April), the time of the Babylonian new year, makes it clear that this text, even if based at some level on Mesopotamian principles, was ultimately the product of a different world.

Besides the zodiacal signs and the watches, other temporal indicators in the moon book refer simply to the time of month: during midmonth,[77] throughout the whole month,[78] on the first day,[79] or in various date ranges (1st to 12th, 12th onwards, 10th to 30th, and so on).[80] Certain phenomena are also said to occur either during the day or at night. In one case, a seven-day duration is mentioned.[81] In the Mesopotamian omen compendia, a much greater selection of dates appears, and these dates are generally very precise. In EAE 16, for example, a series of omens discusses eclipses happening on the 14th, 15th, or 16th of Ayyaru; each omen refers to a specific one of these dates, rather than to "midmonth" in general.[82] In the lunar eclipse tablets, there is a significant focus on the middle of the month, since this was the time at which lunar eclipses could occur—a coincidence of timing that relies on a lunar calendar in which months actually begin with the new moon. Yet in typically comprehensive fashion, *Enūma Anu Enlil* also includes omens referring to eclipses on specific other dates. The possibilities for eclipses on these other dates are not elaborated to the same extent as for those occurring in the middle of the month, but the Du'ūzu section, for example, includes single omens for eclipses on the 19th, 20th, 21st, 24th, and 25th, along with one omen for the date range "from the 1st to the 30th".[83] While some date ranges do occur in the Lydus text, these are specifically for earthquakes; the lunar omens refer only to the general middle of the month, and the text includes no individual dates of phenomena.

In terms of overall structure and organizational components, then, Lydus' moon book and the Akkadian omen series have both striking similarities and significant differences. They share a basic division of omens into twelve parts, and they use the same system of watches, but the Akkadian texts are more systematic, precise, and elaborate. This is the sort of relationship that might be expected if both developed within a shared tradition, but the one is not a direct adaptation of the other.[84]

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77 κατὰ τὴν διχομηνίαν (*De Ost.* B24, W17).

78 παρ' ὅλον τὸν μῆνα (*De Ost.* B25, W17).

79 ἐν ἡμέρᾳ πρώτῃ (*De Ost.* B27, W18).

80 The events occurring in particular date ranges are all earthquakes.

81 *De Ost.* B28, W18.

82 Rochberg-Halton (1988: 87–88). These protases are repeated for the other months as well.

83 Rochberg-Halton (1988: 96–97).

84 It is not possible to elaborate here on the precise nature of this shared tradition, both

3.3 *Lunar Phenomena*

Lydus' moon book contains more than a hundred omens dealing with a variety of celestial and meteorological phenomena, with considerable attention devoted to the appearance of the moon and the occurrence of earthquakes. All are deserving of study, but for the purposes of this paper, we will focus particularly on the protases concerning lunar phenomena since they form a sizeable but unified collection. Similar analysis of the remaining protases will be undertaken in future work.

There are 34 omens with protases mentioning lunar phenomena in isolation,[85] which can be grouped as follows, with the number of occurrences in parentheses:

i) The moon appears dim or faint (11)[86]
ii) The moon's horns come together (6)[87]
iii) The moon appears red (5)[88]
iv) The moon is eclipsed, or seems to be eclipsed (4)[89]
v) The moon appears disturbed (3)[90]
vi) The moon's horns are unequal (3)[91]
vii) The moon's horns are equal (2)[92]

For each of these groups, we will consider Mesopotamian omens that concern the same phenomena. The goal here is not to show that any individual Greek omen was derived from an individual Mesopotamian predecessor, but simply to show that almost all of the lunar phenomena found in Lydus' moon book were familiar in the Mesopotamian material as well.[93] This

because of space constraints and because of a lack of evidence. Some role may have been played by travelling experts, an idea developed more generally by Burkert (1983).

85 Another four deal with Venus in relation to the moon, and will not be considered here.

86 ἡ σελήνη ἀμυδρὰ φανῇ (*De Ost.* B24, W17; see also B24, W17 [again]; B25, W17 [twice]; B30, W19; B31, W19; B32, W19 [twice]; B35, W20 [thrice]).

87 αἱ κεραῖαι τῆς σελήνης συνέλθωσι (*De Ost.* B25, W17; see also B24, W17; B26, W17; B32, W19; B34, W20; B35, W20).

88 ἡ σελήνη αἱματώδης φανῇ (*De Ost.* B27, W18; see also B31, W19; B34, W20; B35, W20 [twice]).

89 δόξῃ ἐκλιπεῖν ἡ σελήνη (*De Ost.* B25, W17; see also B29, W18; B32, W19; W20, omitted by Bandy).

90 ἡ σελήνη ταραχώδης φανῇ (*De Ost.* B27, W18; W18, omitted by Bandy; see also B29, W18).

91 e.g., ἡ ἀριστερὰ κεραία τῆς σελήνης δόξῃ ὑπερβάλλειν τὴν ἄλλην (*De Ost.* B27, W18; see also B28, W18; B30, W19).

92 e.g., ἡ σελήνη ἐξ ἴσου τὰς κεραίας ἔχῃ (*De Ost.* B28, W18; see also B30, W18).

93 The one Greek protasis that I have not yet seen in the Akkadian sources is the reference to the moon being "disturbed"; it is possible that the terminology is not immediately recog-

supports the argument that the texts were products of the same tradition, rather than independent developments.

The Akkadian omen tradition is vast, and the omen compendia are extremely thorough in their enumeration of possible phenomena, as has been discussed above. However, a much smaller subset of omens was actually used by the Neo-Assyrian scholars responsible for observing celestial phenomena and reporting ominous occurrences to the king. Omens that the scholars found relevant in practice are preserved in their reports, and it is perhaps significant that the lunar phenomena of Lydus' moon book show considerable overlap with those of the reports.[94] The significant lunar events of the Greek text were also significant to the Neo-Assyrian scholars, beyond the level of theoretical scholarly elaboration. For this reason, I will draw primarily on the reports when presenting Mesopotamian lunar protases to be compared to the Greek categories above.

Groups i and iv should be considered together, since the description of the moon as "dim" can often refer to a lunar eclipse.[95] The Akkadian employs two different terms for these two types of dimness, so that it is possible to see the Greek text as representing a continuation of this distinction, with the frequent references to the moon appearing "dim" referring in the Greek to luminous phenomena rather than eclipses. However, it is also possible that ἀμυδρός in the Greek is used to describe the eclipsed moon. In any event, examples of both types of dimness appear in the Akkadian material, although there is only one instance of *ekēlu* in the reports (Report no. 502: 14), and it is in reference to a constellation rather than the moon. Two Akkadian omens concerning lunar dimness read as follows:

> EAE 1.50: DIŠ UD.DA 30 *ma-gal ek-let* URU ZAG.MU KÚR KUR-*ád*
>
> EAE 1.50: If the light of the moon is very dim: an enemy will conquer a border town.[96]

nizable, but it is also possible—perhaps even likely—to find some degree of innovation even within a shared tradition, as will be discussed further in the case of the omen apodoses.

94 The one exception, again, is the Greek description of the moon as "disturbed".

95 For the Akkadian material, see Verderame (2002a: 447–448); he explains that the Akkadian term *adāru* "usually indicates eclipses", while *ekēlu* "is employed chiefly in connection with luminous phenomena and does not indicate the darkening from eclipse as is the case with the verb *adāru*".

96 Verderame (2002b: 31).

> Report no. 103: DIŠ[97] *ina* ITI.DU$_6$ 30 *a-dir* ŠUB-*tim* ERIM GAL ZI KÚR BE-*ma* ZI-*ut* BURU$_5$ GÁL-*ši* [*x x*]

> Report no. 103: If the moon is dark in Tašrītu: fall of a great army; there will be an attack of an enemy or of locusts […][98]

From here, I will simply go through the remaining groups in order of decreasing frequency, citing one or two Akkadian omens that mention each phenomenon. Horn protases similar to those of Group ii are particularly abundant in the Reports, and many are repeated numerous times by different scholars, often including some from Babylonia and some from Assyria. Two examples of omens concerning the meeting of the moon's horns read as follows:

> Report no. 89: DIŠ *qar-nu qar-nu i-dir* A.KAL DU: A.AN.MEŠ GÁL.MEŠ.

> Report no. 89: If one horn meets the other: the flood will come; variant: there will be rains.[99]

> Report no. 109: DIŠ ^{d}30 ^{d}UTU *ik-šu-dam-ma it-ti-šú it-ten-tu$_4$ qar-nu qar-nu i-dir: ina* KUR *kit-tú* GÁL-*ši-ma* DUMU KI AD-*šú kit-tum i-ta-am-me*.

> Report no. 109: If the moon reaches the sun and follows it closely, one horn meets the other: there will be truth in the land, and the son will speak the truth with his father.[100]

There are several omens concerning the moon's redness (Group iii) cited in the reports, all but one written by the Babylonian Nergal-eṭir. In one report, he includes two different omens dealing with this phenomenon:

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97 For consistency with the EAE editions, I have changed Hunger's "1" to "DIŠ" whenever it occurs at the beginning of an omen.

98 Text and (very slightly modified) translation from Hunger (1992: 63).

99 Hunger (1992: 53). This particular instance was written out by the Assyrian scholar Balasî; the same omen (though without the variant) appears also in Reports 410 and 411, by the Babylonian scholar Rašil, and Report 459, by the Babylonian scholar Bel-le'i.

100 Hunger (1992: 67). This instance appears in a report by the Assyrian scholar Akkullanu. It also appears, sometimes in broken form, in Reports 90 (by the Assyrian Balasî), 108 (also by Akkullanu), 151 (by the Assyrian Nabû-mušeṣi), 172 (by the Assyrian Bamaya), 195 (author unknown), 271 (by the Babylonian Nergal-eṭir), 294 (by the Babylonian Nabû-iqiša), 347 and 348 (by the Babylonian Ašaredu the Younger), and 373 and 274 (both by the Babylonian Nabû-šuma-iškun).

Report no. 263: DIŠ 30 *ina* IGI.LAL-*šú* SA_5 KUR HÉ.NUN IGI GÁN.BA *nap-šá* KUR KÚ. DIŠ 30 *ina* IGI.LAL-*šú* SA_5-*ma* SI KAB-*šú* *ke-pat* SI ZAG-*šú* *ed-de-et* KUR KÚR *ta-sà-kip* ᵈIM RA.

Report no. 263: If the moon is red at its appearance: the land will see plenty; the land will enjoy abundant business. If the moon is red at its appearance, and its left horn is blunt, its right horn pointed: you will drive back the enemy land; Adad will devastate.[101]

Omens concerning the differing lengths of the moon's horns (Group vi) are less frequent, and appear only in the Babylonian reports (as opposed to the Assyrian), though the sample size is small enough that this may not be significant. The following omen appears only a few times:

Report no. 251: DIŠ 30 *ina* IGI.LAL-*šú* SI ZAG-*šú* GÍD.DA-*ma* SI KAB-*šú* *ik-ru*: LUGAL KUR *la šu-a-tum* ŠU-*su i-kaš-šad*.

Report no. 251: If at the moon's appearance its right horn becomes long, its left horn short: the king will conquer a land not his own.[102]

The omens of Lydus' moon book, while similar in the general concept of one horn exceeding the other, do not in fact include this specific configuration of the right horn being longer than the left horn; two of them do not indicate which of the horns is the longer, while the one that does refers instead to the left horn being longer than the right. Perhaps also relevant here are the Assyrian report omens that refer to one horn "passing" the other.

Finally, we have an Akkadian omen in which the moon's horns are equal:

Report no. 505: [DIŠ 3]0 *ina* IGI.LAL-*šú* SI.MEŠ-*šú* *mit-ha-ra* [*a*]-*na* KUR *šu-ub-tum ne-eh-tum*.

Report no. 505: [If the m]oon's horns at its appearance are equal: for the land, peaceful dwelling.[103]

101 Hunger (1992: 146).

102 Hunger (1992: 140).

103 Hunger (1992: 281). This omen in its entirety is quite similar to an omen found in Lydus' moon book: "If ever the moon holds its horns on an equal basis, there will be peace and prosperity" (*De Ost.* B30, W19).

This has been only a sampling of the relevant Akkadian material, but it should suffice to show that the vast majority of the lunar protases found in Lydus' moon book have counterparts in Mesopotamian omen texts. In most cases, the texts are quite explicit about the phenomena being described: the moon is faint, eclipsed, or bloody/red; its "horns" come together or are equal in length, or one horn is longer than the other. It is only the vague statement about the moon appearing "disturbed" that cannot be trivially matched to a Mesopotamian counterpart, and this omen appears only three times in the Greek text. On the whole, the similarities seem to outweigh the differences; we are not looking at a perfect matching of content, but there are enough similarities to support their attribution to a broad circulation of celestial omen concepts, rather than a case of independent development.

3.4 *Terrestrial Phenomena*

The apodoses of the lunar omens in Lydus' moon book deal most frequently with military matters or agriculture and animal husbandry, though there are numerous other apodoses as well. For almost all of these apodoses, or groups of apodoses in cases where several are similar, I have noted similar apodoses from the lunar eclipse sections of the Mesopotamian omen compendium *Enūma Anu Enlil*. This text in particular was chosen because it provides at least a broad unity of content in its protases, unlike the variety of the Reports.[104] Due to space constraints, I have cited only the apodoses of these omens, but all of the protases deal with lunar eclipses in various forms.

Again, the goal here is not to make a thorough survey of all Mesopotamian omens that might possibly be related to those of Lydus' moon book—no more than a few Mesopotamian parallels are cited for each Greek apodosis grouping—but only to provide a rough estimate of what percentage of Lydus' material does have some sort of Mesopotamian counterpart. In other words, I want to move beyond Bezold and Boll's approach of highlighting only the best pairs of omens and instead consider the moon book's predictions as a whole. Some of these apodoses do correspond neatly to the apodoses of Mesopotamian lunar omens, while others correspond only if one is willing to adopt a flexible standard for similarity, and there are still more for which I have been unable to find any Mesopotamian comparanda at all. Nevertheless, the overall picture should be clear: there is a broad similarity in content between

104 Further work will present the entirety of the material, along with the remaining lunar omens of *Enūma Anu Enlil*, some of which have been recently re-edited by Verderame (2002b) and some of which still await future editing.

the predictions of Lydus' lunar omens and those of the Mesopotamian omen series. This similarity, however, is apparent only in the general concepts represented, while the phrasing used to describe these concepts is alike only in some of the most basic expressions.

In the tables that follow, I present the apodoses of the lunar omens found in Lydus' moon book along with potentially similar apodoses from *Enūma Anu Enlil* 15–22. The three thematic groupings (agricultural, military, and other) are only for convenience, and some individual apodoses could potentially be reclassified.

TABLE 11.3 *Agricultural apodoses*

Apodoses in Lydus' moon book	**Translation of moon book apodoses**	**Apodoses in EAE 15–22**	**Translation of EAE 15–22 apodoses**[105]
σίτου ἀφθονία (*De Ost.* B25, W17); ὁ σῖτος ἔσται ἀφθονώτατος (*De Ost.* B27, W18); σῖτος ἔσται πολύς (*De Ost.* B34, W20; B35, W20)	Abundance of grain; grain will be most abundant; there will be much grain	*ša-pak* ŠE *ina* GÁ×ŠE.MEŠ: Rochberg-Halton (1988: 245); ŠE.GÙN.NU SI.SÁ: Rochberg-Halton (1988: 126)	Grain will be heaped up in the granaries; the crop will prosper
ἐλλείψεως τῶν ἐπιτηδείων (*De Ost.* B25, W17); λιμός (*De Ost.* B27, W18); σίτου ἀπορία (*De Ost.* B27, W18)	Shortfall of provisions; famine; lack of grain	*nu-šur-re* ŠE *ina* KISLAH.MEŠ GÁL-*š*[*i*]: Rochberg-Halton (1988: 129); SU.KÚ *ina* KUR GÁL: Rochberg-Halton (1988: 238)	There will be a decrease of grain in the silos; there will be famine in the land
αὐχμός (*De Ost.* B29, W18); ὕδατος ἔσται λεῖψις (*De Ost.* B30, W19)	Drought; there will be a shortage of water	*ar-ru-ur-tú*: Rochberg-Halton (1988: 148); ŠÈG *ina* AN-*e* A.[KAL *ina* ÍD UD.DU]: Rochberg-Halton (1988: 149)	Drought; rain in the sky (and) flood [in the river will dry up]

105 Translations (sometimes slightly adapted) from Rochberg-Halton (1988).

Apodoses in Lydus' moon book	**Translation of moon book apodoses**	**Apodoses in EAE 15–22**	**Translation of EAE 15–22 apodoses**
ἀκρίδες (*De Ost.* B29, W18)	Locusts	BURU$_5$.MEŠ: Rochberg-Halton (1988: 129)	Locusts
φθορὰ κτηνῶν (*De Ost.* B32, W19)	Destruction of herds	[^{d}*Ṣal-bat-a-nu* SAR-*ma bu-l*]*am* ZÁH: Rochberg-Halton (1988: 124)	[Mars will arise and destroy] the [he]rd
κατομβρίαν … εἰς ἀπώλειαν καρπῶν (*De Ost.* B32, W19)	Heavy rain to the point of destruction of crops	[EBUR KUR ^{d}IŠKUR RA-*iṣ*][106]: Rochberg-Halton (1988: 131); EBUR KUR *bi-ib-lum* [TÙM(?)]: Rochberg-Halton (1988: 150)	[Adad will flood the harvest of the land]; a devastating flood will carry away the harvest of the land
εὐθηνία (*De Ost.* B24, W17); ⟨εὐετηρί⟩ας (*De Ost.* B24)[107]	Prosperity; ⟨plenty/a good season⟩	EBUR KUR SIG$_5$: Rochberg-Halton (1988: 151); *nu-ḫuš* UN.MEŠ KUR.BI: Rochberg-Halton (1988: 118)	The harvest of the land will be good; abundance for the people of that land

106 Restored on the basis of a parallel text in Iqqur Īpuš.

107 Restored from parallel text; not in Wachsmuth. For a discussion of the connection between εὐθηνία and agricultural abundance in particular, see above pp. 358–359.

TABLE 11.4 *Military apodoses*

Apodoses in Lydus' moon book	**Translation of moon book apodoses**	**Apodoses in EAE 15–22**	**Translation of EAE 15–22 apodoses**[108]
πόλεμος (*De Ost.* B25, W17); πόλεμοι (*De Ost.* B27, W18)	War(s)	*ger-ret* KÚR GÁL.MEŠ: Rochberg-Halton (1988: 269)	There will be military campaigns of the enemy
εἰρήνη(ν) (*De Ost.* B25, W17; B26, W17; B30, W19)	Peace	SILIM.MU GAR-*an*: Rochberg-Halton (1988: 242); SILIM.MU SIG_5 *ina* KUR.KUR GAR: Rochberg-Halton (1988: 261)	Peace will be made; in all lands there will be good peace
ἔφοδον πολεμίων (*De Ost.* B24, W17); στράτευμα ἀλλότριον ἐπὶ τὴν βασιλέως ἥξει χώραν/ἐπελεύσεται τῇ τοῦ βασιλέως χώρᾳ (*De Ost.* B30, W19; B31, W19)[109]	Approach of enemies; an army belonging to another will come against/attack the land of the king	ERÍN.MAN.DA ZI-*ma ana* KUR U_5: Rochberg-Halton (1988: 124); KÚR ZI-*ma* KUR KÚ: Rochberg-Halton (1988: 241)	The Ummanmanda will attack and overrun the land; the enemy will attack and ravage the land
⟨ἐλαττωσιν Ῥωμαίοις⟩ (*De Ost.* B25, restored from parallel text, not in Wachsmuth)	⟨Defeat for Romans⟩	KÚR BAD_5.BAD_5 KUR PA-*aṣ*: Rochberg-Halton (1988: 133); ŠUB-*tim* ERIN_2-*šú ina* GIŠ.TUKUL GÁL: Rochberg-Halton (1988: 117)	The enemy will defeat the land; the downfall of his army in battle will occur

108 Translations from Rochberg-Halton (1988).

109 In both cases, Bandy restores "τῶν Περσῶν" ("of the Persians") after βασιλέως, but does not cite manuscript evidence for this.

Apodoses in Lydus' moon book	**Translation of moon book apodoses**	**Apodoses in EAE 15–22**	**Translation of EAE 15–22 apodoses**
ἐπαναστάσεις (*De Ost.* B27, W18); ἀνταρσίαν (*De Ost.* B34, W20); πολέμους ἐμφυλίους (*De Ost.* B32, W19)	Insurrection(s); internal wars	HI.GAR *ina* KUR GÁL-*ši*: Rochberg-Halton (1988: 126); HI.GAR *ana* LUGAL GÁL: Rochberg-Halton (1988: 133)	There will be rebellion in the land; there will be rebellion against the king
πόλεις πόλεσι συρραγήσονται (*De Ost.* B27, W18)	Cities will clash with cities	URU KI URU É KI ⸢É⸣ [KÚR-*ir*]: Rochberg-Halton (1988: 90)	City against city, house against house [will be hostile]
τοῖς ἐν θαλάσσαις πόλεμον (*De Ost.* B35, W20)	War for those on the seas	–	–

TABLE 11.5 *Other apodoses*

Apodoses in Lydus' moon book	**Translation of moon book apodoses**	**Apodoses in EAE 15–22**	**Translation of EAE 15–22 apodoses**[110]
φθορὰ ἀνθρώπων (*De Ost.* W18, omitted by Bandy)	Destruction of humans	NÍG.HA.LAM.MA UN.MEŠ: Rochberg-Halton (1988: 128)	Destruction of people

110 Translations from Rochberg-Halton (1988).

TABLE 11.5 *Other apodoses* (cont.)

Apodoses in Lydus' moon book	Translation of moon book apodoses	Apodoses in EAE 15–22	Translation of EAE 15–22 apodoses
φθίσις ἀνθρώπων (*De Ost.* B35, W20)	Wasting away of humans	UN.MEŠ KUR TUR.MEŠ: Rochberg-Halton (1988: 123); *su-hur-re* UN.MEŠ [*suhurrû* = *ṣuhurrû*]: Rochberg-Halton (1988: 125)	The people of the land will diminish; diminution of the population
θόρυβοι (*De Ost.* B28, W18; B34, W20); θόρυβον τῇ βασιλείᾳ (*De Ost.* B28, W18)	Uproars; uproar for the kingdom	[*dil-hu* GÁL-*ši*]: Rochberg-Halton (1988: 145); *la mit-gur-ti* KUR.KUR *in-niš*-[*ša-a*]: Rochberg-Halton (1988: 151)	[There will be trouble]; countries will become confused because(?) of discord
φυγαί (*De Ost.* B28, W18)	Exiles	KUR-*su* BIR-*ah*: Rochberg-Halton (1988: 121)	His land will be scattered
ἀπώλειαν δυνατῶν (*De Ost.* B31, W19); μέγας ἀνὴρ ἀπολεῖται (*De Ost.* B32, W19; B32, W19); ἀνὴρ δυνατὸς ἀναιρεθήσεται (*De Ost.* B33, W20)	Destruction of powerful (men); a great man will die; a powerful man will be killed	LUGAL BE: Rochberg-Halton (1988: 104); LUGAL GAL BE: Rochberg-Halton (1988: 97); ŠEŠ LUGAL GAZ: Rochberg-Halton (1988: 133)	The king will die; a great king will die; a brother will murder the king

Apodoses in Lydus' moon book	**Translation of moon book apodoses**	**Apodoses in EAE 15–22**	**Translation of EAE 15–22 apodoses**
ἑτέρου προαγωγὴν (*De Ost.* B34, W20)	Promotion of another	DUMU-*šú šá* [*ana* LUGAL-*tim la zak-ru* LUGAL-*tam* DIB-*bat*]: Rochberg-Halton (1988: 129); DUMU LUGAL AD-*šú* HI.GAR-*ma* AŠ.TE DIB-*bat*: Rochberg-Halton (1988: 133); [SAG.KALAG.GA KUR DIB-*bat*]: Rochberg-Halton (1988: 146)	His son, who [was not named for the kingship, will seize the kingship]; the son of the king will rebel against his father and seize the throne; [a high-ranking official will seize the land]
τετραπόδων δὲ θάνατος καὶ θηρίων (*De Ost.* B34, W20); θάνατος τετραπόδων (*De Ost.* B35, W20); φθορὰ ὑποζυγίων (*De Ost.* W20, omitted by Bandy)	Death of four-footed (creatures) and wild animals; death of four-footed (creatures); destruction of beasts of burden	[^{d}IŠKUR MÁŠ.A]NŠE *na-maš-šá-a u* ŠE-*am* RA-*i*[*ṣ*]: Rochberg-Halton (1988: 141)	[Adad] will trample the [he]rds, wild animals of the open country, and the grain
οἱ περὶ τὰ βασίλεια ταραχθήσονται (*De Ost.* B35, W20)	Those concerned with royal matters will be disturbed	MAN MAR.KI ARAD.MEŠ-*šú ina* SAL.KÚR BAL.MEŠ-*šú*: Rochberg-Halton (1988: 128); [NUN *šu-ut* SAG.MEŠ-*šú* HI.GAR.MEŠ-*šú*]: Rochberg-Halton (1988: 131)	The servants of the king of Amurru will revolt against him in hostility; the prince's courtiers will rebel against him
πόλεις πρὸς πόλεις καταφεύξονται (*De Ost.* B29, W18)	Cities will flee for refuge to cities	–	–

TABLE 11.5 *Other apodoses* (cont.)

Apodoses in Lydus' moon book	Translation of moon book apodoses	Apodoses in EAE 15–22	Translation of EAE 15–22 apodoses
ἀνὴρ δυνατὸς ὑπὸ βασιλέως ταραχθήσεται (*De Ost.* B35, W20)	A powerful man beneath a king will be disturbed	–	–
σφαγὰς (*De Ost.* B35, W20)	Slaughters	–	–

More than a quarter of the Lydus omens considered here refer to agricultural outcomes. The only crop mentioned specifically is "grain", which can encompass both wheat and barley but can also refer to food in general (cf. LSJ s.v. σῖτος). The comparable Mesopotamian ŠE can also refer to grain or barley (cf. CAD Š2 s.v. *še'u*), so the two terms express broadly the same concept, but they are not necessarily identical. The agricultural concepts mentioned in the Greek and Akkadian texts are quite similar overall, though the wording differs; particularly noteworthy is the Mesopotamian attribution of certain outcomes to divine agency.

The military apodoses are somewhat less striking, because the Greek expressions are often extremely vague; it is possible to find Mesopotamian parallels for outcomes like "war", "peace", and "insurrection", but it is much more difficult to assess whether these parallels are meaningful. We are looking here at only the broadest similarity of content.

One notable difference between the Greek and the Mesopotamian apodoses is in the people involved. The Akkadian omens focus very strongly on the king, and other people are mentioned only in relation to kingship. In the Greek apodoses we see the less specific "great man" or "powerful man". He is particularly prominent in negative apodoses; the Greek is much more reticent in predicting negative outcomes for the ruler as an individual, while the Akkadian omens specifically mention the death of the king on numerous occasions (e.g., "a brother will murder the king"), and exclude other powerful individuals from consideration. Various factors could explain this: on the Mesopotamian side, there was the concept of averting an unfavorable omen by means of a *namburbû* ritual, so that the predicted death of the king was not actually expected to come to pass.[111] On the Roman side, laws maintained over centuries had

111 For example, a passage from a report reads: " 'If a strange star comes close to Jupiter: in this

explicitly forbidden making predictions about the well-being of the emperor, since these predictions could be used as a tool for political gain.[112] This significant difference in content emphasizes that even if the two bodies of omens were formed from essentially the same components, we are not looking at a case of mindless copying, but at an arrangement of the material to fit the needs of a particular culture. For the Greek material, it remains to be considered just what culture this was, but it is worth keeping in mind that Lydus was a compiler rather than a composer of the text.

On the whole, the matches among the apodoses are satisfying in quantity but perhaps rather disappointing in quality: there is significant variation in the expressions used, to such an extent that some should perhaps not be compared at all. Yet when considering the omen statements as a whole, the weight of evidence for a relationship is not insignificant; in addition to the broad similarities of content among the protases and apodoses, we have seen use of the same system of watches and striking terms like the "horns of the moon". In the end, it comes down to a question of probability. We do not have here a case of direct borrowing or translation, but it seems highly unlikely that the two systems could represent independent developments, especially in light of the known relationships between other Greco-Roman and Mesopotamian concepts in astronomy and astrology. Instead, we are most likely looking at a case of shared tradition, within which common concepts were developed and adapted to current needs. A detailed discussion of the process of development remains a task for future study; for now, we will turn to the product of this development, Lydus' moon book, and its place in Lydus' world.

4 Celestial Omens in Constantinople

4.1 *Introduction*

Bezold and Boll focused primarily on the texts that Lydus compiled, and not on the role of Lydus the compiler himself. This leaves an area ripe for investigation, since John Lydus is by no means a shadowy or mysterious figure. Another of his

year the king of Akkad will die, but the harvest of the land will prosper.' This is a bad sign for all lands. Let the king my lord perform a *namburbi* ritual and so make its misfortune pass by." DIŠ MUL.SAG.ME.GAR MUL.MÌN-*ma* TE-*šú ina* MU BI LUGAL URI.KI ÚŠ-*ma* BURU$_{14}$ KUR SI.SÁ. GISKIM *an-ni-ti* HUL *ša* KUR.MEŠ *ši-i*. NAM.BÚR.BI LUGAL *be-lí li-pu-uš-ma* HUL-*šú lu-ú-še-ti-iq*: text and (slightly adapted) translation from Hunger (1992: 160).

112 Cramer (1954: 250).

works, *On the Magistracies* (*De Magistratibus*, abbreviated *De Mag.*),[113] provides abundant detail about his life and career in the imperial bureaucracy, while numerous other sources illuminate the world of Justinian's Constantinople, in which Lydus lived.[114] This contextual material, combined with some of the more discursive material from *De Ost.* itself, allows us to construct a fairly comprehensive picture of Lydus' world, his place within it, and the various discourses within which he situated his own text.

4.2 *The Legal Status of Astrology and Divination*

The appearance of Lydus' ancient celestial omens in Constantinople at the time of Justinian is rather surprising. Pre-Christian intellectual traditions could be viewed with suspicion,[115] and astrology[116] in particular was not looked on favorably by Roman law. Unlike in Mesopotamia, the interpretation of celestial omens was not simply a standard practice that was automatically accepted. This makes Lydus' compilation of the *De Ostentis* under Justinian particularly noteworthy.

Not all intellectuals prospered under Justinian. One story relates the "closing" of the Neoplatonic Academy at Athens as a result of legislation cracking down on pagans, with the result that a group of philosophers left the empire entirely and settled temporarily in the Persian court.[117] There is some disagreement among modern scholars about the reliability of this account,[118] but the rough outline at least is generally accepted, and the story is indicative of the problems that might be faced by proponents of ancient learning.

Among intellectual activities, astrology in particular had a fraught history in Rome.[119] Astrologers had been subjected to numerous expulsions from the

113 Edition and translation: Bandy (1983).

114 Lydus' career in Constantinople began under Anastasios (r. 491–518), but his major works were produced during the reign of Justinian.

115 Cf. Wildberg in Maas (2005: 329ff.).

116 This is not to say that Lydus' celestial omen interpretation was equivalent to astrology, but the legal tradition did associate astrology with divination, as will be seen later in CJ 9.18.5, for example.

117 It is worth noting at this point that Lydus himself studied under the Athenian Neoplatonist philosopher Agapius at the beginning of his time in Constantinople (*De Mag.* 3.26).

118 Wildberg in Maas (2005: 331) argues that "neither the general law 1.5.18 nor the decree specifically sent to Athens could have amounted to a 'closing' of the Neoplatonic academy", while Watts (2004: 176) maintains that "[t]he prohibition of teaching … was perfectly designed to drain the life out of the institution that Damascius had just begun to rejuvenate [i.e., the Neoplatonic school]".

119 It is not at all clear that the sort of celestial omen interpretation presented in Lydus'

city, mainly for political reasons, beginning in Republican times,[120] and Augustus imposed further empire-wide restrictions on the practice of astrology at the beginning of the first century CE.[121] Anti-astrology legislation continued in the later empire, and Marie Theres Fögen highlights three key stages in its development: first, Diocletian separated astrology from the acceptable practice of geometry,[122] then it was classified as "error" in a decree of the emperors Valentinian and Valens in 370 CE,[123] and finally Honorius and Theodosius proclaimed in 409 CE that astrologers must either abandon their error, allow their books to be burnt, and convert to Catholicism, or else be expelled—not only from Rome, but from all communities.[124] Fögen argues that astrology gradually came to be

De Ostentis would have been considered astrology; indeed, distinguishing omen interpretation from astrology may be a key element in understanding why Lydus' work was considered acceptable. Nevertheless, it is worth considering the treatment received by practitioners of this related discipline that also involved making predictions of terrestrial events on the basis of celestial phenomena.

120 The first attested expulsion decree dates from 139 BCE. Cf. Cramer (1954: 234–235).

121 Cramer (1954: 232).

122 CJ 9.18.2: artem geometriae discere atque exerceri publice intersit, ars autem mathematica damnabilis interdicta est ("To learn and practice the art of geometry is in the public interest, but the condemnable astrological art is forbidden").

123 CTh 9.16.8: cesset mathematicorum tractatus. nam si qui publice aut privatim in die noctuque deprehensis fuerit in cohibito errore versari, capitali sententia feriatur uterque. neque enim culpa dissimilis est prohibita descee quam docere ("The teaching of astrology shall cease. For if any person, either in public or in private, during the day or during the night, should be apprehended while engaged in this forbidden charlatanry (error: false doctrine, superstition), each of the two persons involved shall be stricken with a capital sentence. For the crime of learning forbidden doctrines is not unlike that of teaching them." Trans. Pharr (1952)).

124 CTh 9.16.12: mathematicos, nisi parati sint codicibus erroris proprii sub oculis episcoporum incendio concrematis catholicae religionis cultui fidem tradere numquam ad errorem praeteritum redituri, non solum urbe Roma, sed etiam omnibus civilitatibus pelli decernimus. quod si hoc non fecerint et contra clementiae nostrae salubre constitutum in civitatibus fuerint deprehensi vel secreta erroris sui et professionis insinuaverint, deportationis poenam excipiant. ("We decree that astrologers shall be banished not only from the city of Rome but also from all municipalities, unless, after the books of their false doctrine (error) have been consumed in flames under the eyes of the bishop, they are prepared to transfer their faith to the practice of the Catholic religion and should never return to their former false doctrine (error). But if they should not do this and, contrary to the salutary constitution of Our Clemency, should be apprehended in the municipalities or should introduce there the secrets of their false doctrine (error) and profession, they shall receive the punishment of deportation." Trans. Pharr (1952)).

considered not only a mistaken and forbidden intellectual practice, but specifically a heresy placed in opposition to correct religious belief.[125]

Significantly, Justinian preserved several earlier decrees of this sort in his newly-promulgated law code, and all laws included therein were considered valid for the present day.[126] The decrees retained by Justinian were not restricted to those concerned solely with "astrology", but extended to a broad range of related discipines:

> nemo haruspicem consulat aut mathematicum, nemo hariolum. augurum et vatum prava confessio conticescat. Chaldaei ac magi et ceteri, quos maleficos ob facinorum magnitudinem vulgus appellat, nec ad hanc partem aliquid moliantur. sileat omnibus perpetuo divinandi curiositas.
>
> No person shall consult a soothsayer or astrologer or a diviner. The wicked doctrines of augurs and seers shall become silent. The Chaldaeans and wizards and all the rest whom the common people call magicians, because of the magnitude of their crimes, shall not attempt anything in this direction. The inquisitiveness of all men for divining shall cease forever.[127]

In light of this decree, with its thorough enumeration of disciplines related to astrology, it would be difficult to argue that the topic of Lydus' work fell somehow outside of the forbidden areas. A more likely explanation for his work's acceptability is that it was not connected to the actual practice of any of these disciplines, though it might nevertheless seem to exhibit a certain "inquisitiveness for divining". Of course, the mere existence of laws does not imply their enforcement, but their existence is still noteworthy. It was in the context of these laws that John Lydus, an imperial bureaucrat and teacher whose earlier work had met with the emperor's approval, proudly produced a compilation and translation of ancient texts on celestial divination.

4.3 *Lydus and His World*

In the introduction to this work, Lydus mentions one of his reasons for compiling it: "I thought," he says, "that the deed would be advantageous to the remembrance of me."[128] In other words, this was not a secret project of which

125 Fögen (1993: 20–25, esp. 25).

126 Cf. Humphress (2005: 162, 163).

127 CJ 9.18.5 = CT 9.16.4, trans. Pharr (1952).

128 πρὸς τῆς ἐμῆς ἔσεσθαι μνήμης τὸ πρᾶγμα νομίζων (*De Ost.* 1).

to be ashamed; Lydus wrote it in the expectation that it would improve his reputation. Nor was Lydus himself some sort of deviant on the margins of society; he was firmly ensconced in the imperial bureaucracy when he produced the *De Ostentis*, and he retired honorably almost a decade later.[129]

We have access to a large quantity of information concerning Lydus' life.[130] As the name Lydus suggests, he was born in Lydia, specifically in the city of Philadelphia. At the age of 21 he moved to the imperial capital, Constantinople, in order to launch his career,[131] and studied philosophy under the Neoplatonist Agapius while searching for employment.[132] Within a year he had managed to obtain a position in the praetorian prefecture, thanks to the support of a fellow Philadelphian who had just become head of that institution.[133] He was employed in the judicial branch of the prefecture, an arm of the imperial bureaucracy that dealt with both financial and judicial matters.[134] Lydus' career initially advanced at a good pace,[135] but changes within the prefecture ultimately slowed down his progress and left him dissatisfied.[136] Nevertheless, he had stable employment for forty years, in a branch of the imperial bureaucracy, and retired honorably at the end of it.[137]

Lydus' most noteworthy qualification was his knowledge of the Latin language, at a time when judicial and governmental affairs were increasingly being conducted in Greek.[138] He was particularly concerned with defending the traditional use of Latin, and greatly lamented its abandonment.[139] This concern with Roman tradition will be relevant for our later discussion of Lydus' sources.

Today, Lydus is best known for his book on the praetorian prefecture and for his role within that institution, but for our purposes here, the more important point is that he combined this role as a bureaucrat with a role as a literary intellectual. Michael Maas has aptly described Lydus as a "civil savant" who seem-

129 Kelly (2004: 13).
130 The brief account that follows is drawn primarily from his work *De Magistratibus*, *On the Magistracies*.
131 *De Mag*. 3.26.
132 *De Mag*. 3.26.
133 *De Mag*. 3.26.
134 Kelly (2004: 11–12).
135 Cf. Kelly (2004: 12).
136 Cf. *De Mag*. 3.28: "I came to hate the service" (ἐμίσησα τὴν στρατείαν).
137 Cf. Kelly (2004: 13).
138 cf. Kelly (2004: 32–36).
139 Maas (1992: 32), Kelly (2004: 33).

ingly managed to bridge both worlds, the bureaucratic and the intellectual.[140] In fact, Lydus' literary accomplishments were apparently impressive enough that the emperor Justinian asked him to write both a panegyric of Justinian himself and a history of the recent war with the Persians.[141] Neither of these survives, but in one of his works that has come down to us, Lydus includes the text of a letter written in the emperor's name, which praises Lydus' scholarship and linguistic skill and also awards him a monetary grant and a teaching position.[142] The exact date when Lydus took up this teaching position is unknown, but it may have been at approximately the same time that he compiled the *De Ostentis*.[143]

In short, Lydus was a respected bureaucrat whose literary skills were appreciated by the emperor and who, at some point in the second half of his career, turned those literary skills to the production of a work on ancient celestial and meteorological omens. The publication of this work can be dated to 543 CE based on its dedication to the city prefect of that year,[144] though of course Lydus could have been working on it for a longer period of time.

4.4 *Lydus on Omens*

At several points in the *De Ostentis*, Lydus offers explanations for why he compiled the work or makes remarks that elucidate his views on the function and significance of omens. These two issues, his expressed motivations and his expressed views about omens, are closely related. Early on in the work, he asserts the importance of experience in confirming the validity of omens,[145] drawing on his own personal observations as evidence:

> τῆς μὲν οὖν τῶν πολλῶν δόξης κἀγὼ πρῴην ἐτύγχανον ὢν καὶ γράμματα μόνα τὰ περὶ τούτων γεγραμμένα τοῖς ἀρχαίοις ἐνόμιζον, ἐπειδὴ δὲ ἡ πεῖρα τὴν περὶ αὐτῶν ἀλήθειαν ἔδειξε …[146]

140 Maas (1992: 29).
141 *De Mag.* 3.28.
142 *De Mag.* 3.29.
143 Maas (1992: 35), Kelly (2004: 13).
144 Maas (1992: 34).
145 It should be noted that this is very different from the Mesopotamian approach to omens, which emphasized scholarly associations and often linked protasis to apodosis via wordplay; cf. Rochberg (2010: 401–402). An earlier current in modern scholarship emphasized the presumed empirical origins of the Mesopotamian omen tradition, but this position has been largely rejected.
146 *De Ost.* 1.

> So I, for my part, used to be of the same opinion as many people and thought that the things written by the ancients concerning these matters were mere writings. But since experience made known the truth about them …

Lydus goes on to describe a recent incident when a comet appeared in the sky and was taken to presage an attack of the Persians that did in fact occur. His statement makes clear that belief in the validity of omens was not at all universal in his time, and he appeals to the criterion of experience rather than ancient authority to make his case for a reconsideration of this view. Lydus is not always consistent in his arguments, but each individual statement offers some insight into the approaches that he considered most likely to be persuasive.

Shortly after this appeal to experience, Lydus goes on to explain what he was trying to accomplish in this work and, perhaps even more telling, to proclaim what he was not trying to accomplish. He asserts that he was "eager to speak about [these things] not in order to state their physical causes or the theories about them, for these things should be left to the philosophers, but (in order) perhaps to learn beforehand from the celestial signs the result of the things that will be."[147] In other words, Lydus clearly distinguishes himself from the philosophers and their concerns.

Michael Maas sees Lydus' work as a case in which "antiquarian scientific material found a haven in a Christian cosmos",[148] and Lydus himself as someone who "successfully walked the tightrope between ancient knowledge, professional expertise, and Christian belief."[149] This is a topic greatly deserving of further research, and I can here do little more than scratch the surface with a presentation of some of Lydus' explicit statements about omens and their origins. These include the aforementioned appeal to experience as the basis for knowledge, along with references to both nature and divine providence as sources of celestial signs. On the one hand, Lydus asserts that "nature itself makes known occurrences beforehand",[150] while on the other hand he maintains that "providence makes known the things that are from itself".[151] The con-

147 σπουδὴ δὲ ἡμῖν ἐστὶν εἰπεῖν περὶ [τούτων], οὐχ ὥστε τὰς φυσικὰς αἰτίας ἢ τὰ περὶ τούτων εἰπεῖν θεωρήματα, φιλοσόφοις γὰρ δὴ τὰ περὶ τούτων ἀνείσθω, ἀλλ' ὅπως οἷόν τέ ἐστιν ἐκ τούτων δὴ τῶν διοσημεῖων τὴν τῶν ἐσομένων ἴσως προμανθάνειν ἀπόβασιν (*De Ost.* 4).

148 Introduction to Bandy (2013: xix).

149 Introduction to Bandy (2013: xxi).

150 τῆς φύσεως αὐτῆς προδεικνυούσης τὰ πράγματα (*De Ost.* 7).

151 τὰ ἐξ αὐτῆς ἡ πρόνοια δείκνυσι (*De Ost.* 5).

cept of providence (πρόνοια) was not a Christian innovation, but occurs already in Stoic physics.[152] However, Lydus refers not only to providence in general but to "the providence of God"[153] and, even more explicitly, "the all-wise providence of the ineffable father of all".[154] A distinction between "natural" and "given" signs is made by the Christian theologian Augustine of Hippo (354–430),[155] further demonstrating how sign interpretation could find a place in the Christian cosmos. Lydus does not explicitly distinguish these types, and does not reference Augustine, but the fact that signs could be a topic of Christian writing may have been beneficial to him.

Yet at another point, Lydus includes a sharp attack on people who are closed-minded due to their religious beliefs:

> οἱ δεισιδαιμονίαις τισὶν ἀναδεδεμένοι (ταύτῃ γὰρ καὶ ῥελεγιῶνες παρ' Ἰταλοῖς καλοῦνται παρὰ τὸ ἀναδεσμεῖν ἀγκτῆρος δίκην τοὺς πίπτοντας ⟨ὑπ' αὐτὰς⟩ οὐ τἀληθὲς σκοπεῖν φιλοῦσι, κἂν εἰ τυχὸν παρὰ τοῖς μὴ τὰ αὐτὰ δοξάζουσιν ᾖ αὐτοῖς, ἀλλ' ἔχειν νόμον συνεκτικὸν τῆς ἐκείνων δόξης ὑπολαμβάνουσι τὸ μάχεσθαι πρὸς τοὺς ἐναντίους εἰκῇ καί, τὸ δὴ σχετλιώτερον, ἴσως καὶ αὐτοὶ συναισθανόμενοι τῆς αὐτῶν πλάνης, εὐσεβὲς ὅμως νομίζουσιν, εἰ καὶ ψευδόμενοι, ταῖς οἰκείαις συμμαχοῖεν πλάναις. οὐ γὰρ ἐπίστανται τὴν φύσιν τῶν εἰκῇ διαβαλλομένων αὐτοῖς, φάσκοντες ὡς ψευδὴς καὶ διάφωνος τοῖς παλαιοῖς ἡ περὶ διοσημειῶν ἐξερεύνησις.[156]
>
> Those given up to certain superstitions—for this reason they are even called *religiones* among Italians, because they tie up like a bandage those belonging ⟨to their (group)⟩—do not like to examine the truth, even if it happens to occur among those not thinking the same things as

152 Plutarch (late first–early second century C.E.) says of Chrysippus (280–207 B.C.E.), the third head of the Stoic school, that "he never utters a word on any topic … without prefacing his remarks … with references to Zeus, fate, [and] providence and stating that the cosmos is one and finite, being held together by a single power." Plutarch *On Stoic Self-Contradictions* 1035b, trans. Inwood and Gerson (2008: 9). οὔτε … φαίνεται τὸ παράπαν φθεγγόνεμνος, εἰ μή … προγράψιε τὸν Δία, τὴν εἱμαρμένην, τὴν πρόνοιαν, τὸ συνέχεσθαι μιᾷ δυνάμει τὸν κόσμον ἕνα ὄντα καὶ πεπερασμένον.

153 τὴν τοῦ θεοῦ πρόνοιαν (*De Ost.* 9).

154 τὴν πάνσοφον πρόνοιαν τοῦ πάντων ἀρρητου πατρός (*De Ost.* B23, W16a). Trans. adapted from Bandy (2013: 109).

155 Jackson (1969: 13 ff.). Augustine lists smoke that signifies fire as an example of a "natural sign".

156 *De Ost.* B23, W16.

> them. Instead, they suppose that to argue against their opponents is a custom admissive of their opinion. Even more shocking: although they are probably aware of their own error, they consider it pious, even if they are mistaken, to fight on behalf of their own errors. For they do not understand the nature of the things discredited by them without good reason, saying that the investigation by the ancients concerning celestial sign is false and inconsistent.[157]

He also presents his discussion of celestial signs as a response to "those opposing the celestial signs and daring to contradict Ptolemy",[158] whose *Tetrabiblos* includes discussion of the personal horoscopic predictions more commonly described as "astrology" along with universal omen material of the type found in Lydus.

In other words, there is a careful balancing act at work here as Lydus brings together ideas from two different worldviews. This integration of ancient ideas into a Christian worldview may help to explain the confidence with which Lydus could present his work in an environment that one might have expected to be hostile.

4.5 *Lydus on His Sources*

The initial motivation for this paper was the long-recognized connection between Lydus' *De Ostentis* and the Mesopotamian omen tradition, which was discussed earlier. However, this was not a matter of direct transmission, as can be argued both from the textual evidence considered above and from the context: working in the sixth century CE, Lydus would certainly not have had direct access to cuneiform texts or to a scholar trained in those texts. Instead, we are looking at a case where certain conceptual ideas circulated within a broader region over an extended period of time, undergoing a constant process of change and adaptation.

It would be far beyond the scope of this paper to investigate the overall development and circulation of celestial omen ideas from the Neo-Assyrian period to the time of Justinian. We can, however, consider Lydus' own perception of his sources, as expressed in the introduction to the *De Ost.* and elsewhere throughout the work. Despite our focus on the relationship to Mesopotamian material, it was not in Mesopotamian scholarship that Lydus perceived his own sources. In fact, Mesopotamians do not figure at all in his introduction to the topic, not

157 I have followed the translation of Bandy (2013: 105) on certain points.

158 τοὺς ταῖς διοσημείαις ἐνισταμένους καὶ Πτολεμαίῳ τολμῶντας ἀντιλέγειν (*De Ost.* 8).

even in the guise of "Chaldaeans", who were frequently associated with astrological knowledge by other Greek or Latin authors. Lydus' account contrasts with the work of Cicero, for example, who attributes to the Assyrians and Chaldaeans the earliest knowledge of prediction from celestial signs.[159]

Instead, Lydus refers to three different groups of authorities: those involved in the development and dissemination of celestial knowledge through the ages, beginning with "the Egyptians" in general and including named individuals from Zoroaster and Petosiris through to Ptolemy;[160] the Etruscans, to whom he assigns a primary role in the history of Roman celestial sign interpretation (which was also the celestial sign interpretation of his own time, since he perceived Justinianic Constantinople as a continuation of Rome); and finally a collection of individual Roman writers, including Capito, Fonteius, Apuleius, Vicellius, Labeo, Figulus, and Pliny the Elder.[161] Many of these Roman writers are mentioned specifically as the sources for individual texts included in the compilation that is *De Ostentis*. Other passages, such as extended excerpts from the *Tetrabiblos* of Ptolemy, are quoted without attribution.[162]

It is his perceived Etruscan predecessors to whom Lydus devotes by far the most attention. At the beginning of his work Lydus gives a fairly lengthy treatment of these supposed predecessors, and several of the individual works that make up the whole are also attributed to Etruscans. In some cases, especially concerning the topic of thunder omens, these attributions are accepted by at least some modern scholars.[163] The lack of Etruscan-language sources for comparison makes this a difficult problem, which I will not attempt to treat further at this time; I will simply note for now that even those who accept some sort of Etruscan origin for the thunder omens often see the Etruscans themselves as ultimately dependent on Mesopotamia.[164]

159 *De Div.* I.2. Cicero, of course, was writing hundreds of years before Lydus, but many of Lydus' direct sources date from within a hundred years of Cicero's time.

160 *De Ost.* 2.

161 *De Ost.* 3.

162 *De Ost.* B10, W9a is the beginning of *Tetrabiblos* II.9, with the addition of a single sentence and some very minor variations, while *De Ost.* B11, W9b and *De Ost.* B13, W9d include passages from *Tetrabiblos* II.13.

163 E.g., Turfa in de Grummond and Simon (2006: 173): "The Greek translation of *De Ostentis* (*On Omens*) 27–38 … represents the longest coherent Etruscan document extant, albeit not in its original language. No trace of the Etruscan original has yet been found, but Lydus implied that it was of great antiquity, having been a part of the Etruscan *disciplina* dictated by the legendary Tages." See also Turfa (2012).

164 For example, Turfa (2012), which takes the brontoscopic calendar found in *De Ost.* 27–38

For present purposes, the focus will remain on the more concrete evidence for Lydus' perception of his sources, which is related to Lydus' perception of himself as a Roman. As mentioned earlier (p. 387), Lydus worked particularly with the Latin language, and he strongly promoted its continued use for legal purposes, even as it was gradually being replaced by the more widely-understood Greek. On a related note, when it comes to Lydus' view of the ultimate sources of his work, he says that his focus is on the Etruscan prophet Tages because Tages was "the originator of the subject for us, I mean people from Italy".[165] In other words, Lydus sees himself as an Italian despite being born in Anatolia and living out his life there; Lydus was a Roman, and Romans were from Italy. This concept of Romanness, along with Lydus' concern for Roman tradition, was reflected in Lydus' view of omens and their origins.

To sum up, several points about Lydus and his work should be emphasized: Lydus was a respectable bureaucrat who produced his compilation of ancient omen texts openly and even proudly; his work mingles ancient knowledge with a Christian worldview; and he perceived its ultimate origin in the Etruscans, an appropriately Italian source. Meanwhile, we have seen that at least one text included in his compendium shows numerous similarities to the Mesopotamian omen tradition, as represented by texts from the Neo-Assyrian period. These similarities are not close enough to suggest a straightforward copying of some Mesopotamian source-text, but instead point to a more general circulation of the concepts of celestial omen interpretation, as might be expected given the large gap in time and space that separates the texts. Within this gap lie abundant possibilities for further investigation.

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as the source for an understanding of Etruscan society, devotes significant attention to the Mesopotamian predecessors of the text. See also Burkert (1997: 46–51).

165 ἡμῖν, τοὺς ἐξ Ἰταλίας φημί, Τάγης ἀρχηγὸς τοῦ πράγματος γέγονεν (*De Ost.* 2).

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CHAPTER 12

A Parallel Universe: The Transmission of Astronomical Terminology in Early Chinese Almanacs

Ethan Harkness

> If I had a world of my own, everything would be nonsense. Nothing would be what it is, because everything would be what it isn't.
>
> "Alice in Wonderland" (1951)

In recent decades, the archaeological recovery of early Chinese manuscripts dating from the last three centuries BCE has deepened our understanding of the period surrounding the establishment of the Chinese empire in 221 BCE. As a field, the history of Chinese science has certainly been one beneficiary of these manuscript discoveries, with subfields such as the histories of medicine and mathematics seeing a dramatic infusion of new source materials for scholars to study and weigh against established views. The history of astronomy—broadly construed to include associated astrological theory—has likewise been transformed, but in the latter case, scholars have encountered certain unique problems with interpreting the newly available materials. In particular, they have struggled to reconcile a surprising range of seemingly familiar technical terminology, often entire systems of related technical terms, appearing in unexpected contexts with broader significance than had previously been understood, and while individual discrepancies have been recognized and interpreted in an *ad hoc* fashion, there has been relatively little effort to synthesize research of this type or consider what it might suggest when viewed as part of what is now a discernible larger pattern. The aim of this paper is, therefore, to review the most prominent examples of early Chinese astronomical terminology as it appears in new contexts and then suggest some of the implications of this cultural and linguistic phenomenon.

It should be noted at the outset, of course, that a handful of manuscript discoveries pertain directly to the history of astronomy in early China and shed

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light on that field *without* necessarily requiring the modern reader to interpret familiar terms in any radically new fashion. The most notable of these is the text commonly called *Wuxing zhan* 五星占 ("Prognostics of the Five Planets"), which was discovered in 1973 when tomb 3 at Mawangdui 馬王堆 in Changsha 長沙, Hunan yielded a cache of manuscripts written on silk and bamboo.[1] These had been interred with the tomb's noble occupant in 168 BCE, and as a group, they appear to reflect a range of that gentleman's interests, from medicine to philosophy to military arts. With varying degrees of specificity, the *Wuxing zhan* text describes the motion of the five planets visible to the naked eye (Mercury, Venus, Mars, Jupiter, and Saturn) and associates the planets with astrological omens of a largely political nature.

The *Wuxing zhan* is a special case, however, and there is little evidence that either this text or roughly contemporaneous transmitted sources of astronomical knowledge such as the "Tianguan shu" 天官書 ("Treatise on Heaven's Offices") chapter of *Shiji* 史記 (*Records of the Grand Historian*) circulated beyond the hands of an extremely limited elite readership in their own day.[2] By contrast, another variety of archaeologically recovered manuscript, also dating from approximately the same era, is rich with the vocabulary of the astral sciences and clearly circulated across social classes ranging from the highest nobility to clerical functionaries working in provincial government posts. These are the hemerological almanacs known collectively as *rishu* 日書 ("daybooks"), a genre primarily concerned with the selection of auspicious days—and avoidance of inauspicious one—for common activities such as marriages, funerals, travel, trade, seeking professional advancement, and conducting the seasonal business of agriculture, and they are among the most prevalent of excavated texts from the last three centuries BCE. Fine manuscripts have been recovered from regions as disparate as modern Gansu province in China's arid northwest and the Yangtze River provinces of Hubei and Hunan in the southeast. Thus the use of these texts as source material for the technical terminology considered below will inherently support the view that the

1 See Cullen (2011) for a study and complete translation of this text. The manuscript itself has no title; the current title was devised for convenient reference by modern editors who have transcribed the text and prepared it for publication. For the Chinese edition that has now become standard, see Liu (2004).

2 The precise date of completion for the *Shiji* 史記 is not known, but Sima Qian 司馬遷 (?145–?86 BCE) is understood to have completed the project after having inherited it from his father Sima Tan 司馬談 (d. 110 BCE). Circa 90 BCE would be a reasonable approximation, although some chapters appear to have been added later by other authors.

vocabulary found therein was widely recognized and did not constitute merely the anomalous lexicon of a particular time or place.

As an initial example, let us consider the vocabulary of the 28 *xiu* 宿 ("lodges") that traditionally divided the celestial equator into longitudinal segments of unequal degree measure. The lodges were used as fixed coordinates to describe the positions of the sun, moon, and planets, and in the classic "Tianguan shu" account of the heavens, they are grouped in four collections of seven, with one collection corresponding to each of the eastern, northern, western, and southern quadrants (literally "palaces") of the sky. For example, the presentation of the lodges of the Eastern quadrant reads as follows:[3]

> 東宮蒼龍，房、心。心為明堂，大星天王，前後星子屬。不欲直，直則天王失計。房為府，曰天駟。其陰，右驂。旁有兩星曰衿；北一星曰舝。東北曲十二星曰旗。旗中四星天市；中六星曰市樓。市中星眾者實；其虛則秏。房南眾星曰騎官。左角，李；右角，將。大角者，天王帝廷。其兩旁各有三星，鼎足句之，曰攝提。攝提者，直斗杓所指，以建時節，故曰「攝提格」。亢為疏廟，主疾。其南北兩大星，曰南門。氐為天根，主疫。尾為九子，曰君臣；斥絕，不和。箕為敖客，曰口舌。

> The Eastern Palace is the abode of the Azure Dragon, [represented by] the asterisms Chamber$_4$ and Heart$_5$. Heart$_5$ is the Bright Hall, and its largest star is Heaven's Monarch. The stars before and behind it are the Heir Apparent and the Affiliated Princes. It is not desirable that they should line up; if they do line up, Heaven's Monarch will fail in his plans. Chamber$_4$ is a Residence Hall called Heaven's Four Horses. To the north are the Right Three Horses. Beside them are two stars called Bells. The star to the north is called Linchpin. In the northeast corner, the twelve stars are called Banners. Among the Banners, four stars represent Heaven's Market. The central six stars are called the Market Tower. If the stars in the Market appear numerous, the harvest will be abundant; if few, it will be sparse. To the south of Chamber$_4$, the assembled stars are called Cavalry Officers. The Left Horn$_1$ is Principle; the Right Horn$_1$ is the General. The Great Horn$_1$ is the Court of Heaven's Monarch, Di. There are three stars on either side of it, bending around like the legs of a

3 *Shiji* (2006:1295–1298). Lodge names are hereafter written with a subscript number indicating their place in the sequence of 28 lodges. The selected translations from the "Tianguan shu" that follow are based on the recent work of David Pankenier, who has translated and contextualized the entire treatise. See Pankenier (2013), 444–511.

> tripod, and [together these are] called "Sheti". The Sheti stars align with the direction pointed out by the Dipper's Handle and thereby establish the seasons and their nodes. Therefore they are called "Shetige" ("Sheti arises"). Gullet$_2$ is the Outer Court, and it governs disease. The two large stars to the north and south of it are called the South Gate. Base$_3$ is Heaven's Root, and it governs epidemics. Tail$_6$ is the Nine Princes. They are called the lord's ministers, and they [are characterized by] mutual estrangement and conflict. Winnower$_7$ is an arrogant guest. It is called Mouth and Tongue.

Of particular interest in this passage is its focus on the meaning inherent in the patterns of the stars. Sima Qian seeks to record more than just a bare-bones taxonomy of the heavens; he also highlights the implications of various phenomena, emphasizing some and giving less weight to others. Thus, he includes omens, noting that it does not bode well if stars representing princes at court "line up" against the star known as Heaven's Monarch. Similarly, the abundance of visible stars in the constellation known as Heaven's Market directly connotes the probable abundance of the annual harvest. As part of this presentation style, we should also observe that descriptions of the lodges are interspersed with accounts of other stars and certain lodges (Chamber$_4$ and Heart$_5$) have priority over others with the result that, as a whole, the lodges are discussed in an order different from that of their natural sequential order in the heavens. Finally, the lodge Horn$_1$ is described in three separate parts—the Left, Right, and Great Horns—each of which seems to have different astrological implications.

In 1975, two largely intact daybook manuscripts were discovered in tomb 11 of the late Warring States and Qin era cemetery at Shuihudi 睡虎地 in the county seat of Yunmeng 雲夢, Hubei (hereafter, these manuscripts will be referred to as SHD-A and SHD-B corresponding to the standard Chinese references 日書(甲) and 日書(乙), respectively).[4] The tomb belonged to a bureaucrat named Xi 喜, who died in 217 BCE at approximately age 45 after holding positions that required legal expertise and serving in the Qin military, and at the time of the excavation, daybooks were still a little-known genre presenting formidable challenges to would-be readers.[5] Imagine then, the initial sense

4 For photographs and a transcription of the Shuihudi manuscripts, see Shuihudi (1990). The standard study of these texts, including a revised transcription from which the selected quotations below are drawn, is Liu (1994).

5 Xi served as a clerk in the districts of Anlu 安陸 and Yan 鄢 and as a censor in Anlu under

of familiarity when slips 68r^1–95r^1 of SHD-A were found to contain a passage that begins as follows:[6]

星：
角，利祠及行，吉。不可蓋屋。取妻，妻妬。生子，為[吏]。**68r**^{1}
亢，祠、為門、行，吉。可入貨。生子，必有爵。**69r**^{1}
抵（氐），祠及行、出入貨，吉。取妻，妻貧。生子，巧。**70r**^{1}
房，取婦、家（嫁）女、出入貨及祠，吉。可為室屋。生子，富。**71r**^{1}
心，不可祠及行，凶。可以行水。取妻，妻悍。生子，人愛之。**72r**^{1}
尾，百事凶。以祠，必有敫（徼）。不可取妻。生子，貧。**73r**^{1}
箕，不可祠。百事凶。取妻，妻多舌。生子，貧富半。**74r**^{1}
…

Stars
Horn$_1$: Favorable for sacrifice and travel—auspicious. Do not roof a house. If one takes a wife, she will be jealous. If one gives birth, the child will (grow up to) be a [clerk]. **68r**^{1}
Gullet$_2$: Sacrifice, making a door, and travel—auspicious. One may bring in goods. If one gives birth, the child will certainly (grow up to) have noble rank. **69r**^{1}
Base$_3$: Sacrifice, travel, sending out or bringing in goods—auspicious. If one takes a wife, she will be poor. If one gives birth, the child will (grow up to) be clever. **70r**^{1}
Chamber$_4$: Taking a wife, marrying off a daughter, sending out or bringing in goods, and sacrifice—auspicious. One may build a house or a room. If one gives birth, the child will (grow up to) be wealthy. **71r**^{1}
Heart$_5$: One may not sacrifice or travel—inauspicious. One may engage in hydraulic projects.[7] If one takes a wife, she will be fierce. If one gives birth, people will love the child. **72r**^{1}

the reign of the first Qin emperor. Earlier discoveries of daybook manuscripts had all been extremely fragmentary.

6 In the following passages excerpted from bamboo manuscripts, bold numbers indicate slip numbers in the standard published edition of each text, "r" and "v" indicate recto and verso, respectively, and superscript numbers indicate the register of the text on the original manuscript.

7 Based on the interpretation of *xingshui* 行水 by Li Jiahao 李家浩. Jiudian (1999: 82–83).

Tail$_6$: All affairs are inauspicious. If one offers sacrifice, it will certainly lead to a lucky break.[8] One may not take a wife. If one gives birth, the child will (grow up to) be poor. **73r¹**

Winnower$_7$: One may not sacrifice. All affairs are inauspicious. If one takes a wife, she will talk too much. If one gives birth, the child will (grow up to) experience poverty and wealth in equal measure. **74r¹**

…

The list continues through all 28 lodges, but the section quoted here is sufficient to illustrate its most important qualities. The lodges are listed in order with the text appropriate to each lodge appearing under the lodge name at the head of a new bamboo slip. The body of the text consists entirely of omens and interdictions associated with each asterism, and in the top margin of slip 68 on the recto side of the manuscript, a title, "Stars," labels the entire passage. The closely parallel passage found on slips 80¹–107¹ of SHD-B differs in the last regard, as it carries the alternative title *guan* 官 ("Offices"). While such a discrepancy might seem odd, it is not particularly unusual in a manuscript culture.[9] Moreover, in this case, the title "Offices" makes a neat connection with Sima Qian's chapter title, "Treatise on Heaven's Offices," and would appear to reflect a conceptual bureaucratization of the sky in which individual asterisms have authority over certain aspects of fate or experience.[10]

The conception of the lodges as stellar bureaucrats (or perhaps as the dwelling places of deities with bureaucratic responsibilities) was strengthened with the discovery of another daybook manuscript at Kongjiapo 孔家坡 on the outskirts of Suizhou 隨州, Hubei in 2000 (hereafter KJP).[11] Interred in 142 BCE, this manuscript has numerous substantial textual parallels with the Shuihudi daybooks, and indeed on slips 49–76, there is found an untitled version of the

8 As we will see below, parallel text of this passage in the Kongjiapo daybook manuscript suggests that the graph written as *jiao* 敫 (儌, "good luck") could in fact be *bai* 敗 ("failure"), which would seem more consistent with the context of the omen.

9 Yan Changgui 宴昌貴 has discussed the variable matching of titles with passages of text in daybook manuscripts. See Yan (2010: 83–94).

10 Another significant difference between the "Stars" and "Offices" texts is that the latter explicitly associates the 12 months of the year with 12 particular lodges among the list of 28. Ultimately, as we will see, this detail helped to clarify the intended application of the text.

11 See Kongjiapo (2006) for the standard reference to the Kongjiapo tomb and the manuscripts discovered therein. All of the following excerpts from the KJP text are based on this publication.

"Stars"/ "Offices" text. There is an important and systematic difference between the new textual witness and its predecessors from Shuihudi, however. In the KJP manuscript, the omens associated with each lodge typically have, inserted in the middle or at the end of the omen list, a bureaucratic title of the form *si*[...] 司[...] ("Minister of [...]"). For instance, corresponding to the entries for Tail_6 and Winnower_7 in the passage translated above, we find the following:[12]

> 尾：百事凶。以祠祀，必有敗。不可取（娶）妻。司亡。以生子，必貧。不可殺□。**54**
> 箕：不可祠祀，百事凶。取（娶）妻、妻□□。司棄。以生子，貧富半。**55**
>
> Tail_6: All affairs are inauspicious. If one offers sacrifice, it will certainly lead to a failure. One may not take a wife. Minister of Extinction. If one gives birth, the child will certainly (grow up to) be poor. One may not kill ...[13] **54**
> Winnower_7: One may not sacrifice. All affairs are inauspicious. If one takes a wife, she ... Minister of Abandonment. If one gives birth, the child will (grow up to) experience poverty and wealth in equal measure. **55**

A loose correlation often seems to exist between the name of a lodge, the associated ministerial title, and omens such as the fate of a child born under the influence of that lodge. In the case of Tail_6, for example, we see a theme of coming to the end, running out, impoverishment. That is to say that the implicitly bureaucratic structure of the night sky in the Shuihudi text becomes more explicit in the Kongjiapo case with appropriate office titles indicating the nature of the authority granted to each of the 28 offices. Indeed, the text of Sima Qian's survey of the heavens is also clearly motivated by a desire to classify the bureaucracy of heaven and determine which stars are responsible for which aspects of fate. Where then do the implications of the technical terminology differ?

A cursory comparison of the omens associated with the 28 lodges in Sima Qian's "Tianguan shu" and those seen in daybooks will reveal very different realms of concern—the national political stage versus personal life on a more

12 Textual lacunae in the KJP manuscript make it difficult to reconstruct what bureaucratic titles were associated with the other lodges of the Eastern quadrant, but in most cases, the *si* 司 ("Minister of ...") graph is discernible.

13 The final sentence here has no counterpart in the parallel texts of SHD-A and SHD-B.

individual and mundane level. Thus, where the "Tianguan shu" describes drama in the court of Heaven's Monarch, and by extension in the royal court of the realm, the daybooks focus most prominently on questions of marriage, childbirth, construction, career prospects, and personal fortune. Intriguing areas of overlap do exist, as in the case of the lodge Winnower$_7$, which the "Tianguan shu" calls "Mouth and Tongue" and associates with an "arrogant guest." In the daybooks we see the same lodge associated with a wife who talks too much (literally "too much tongue"). However, the overall focus clearly differs, as would be expected given the different intended readership of these texts.

Only 20 years after the discovery of the Shuihudi daybooks did scholars realize an even more fundamental difference in the two systems, namely that in the context of the daybooks, the lodge asterisms were in fact *day names*, weakly analogous, one might say, to the days Sunday and Monday found at the beginning of the English-language week.[14] Unlike the sun and moon, however, the lodges have an inherent order, and furthermore there are nearly enough of them to span one lunation of, on average, approximately 29.5 days. By parsing the sequence of lodges to pair two, or in four cases (months four, seven, ten, and twelve) three, consecutive lodges with each month of the year, the daybook manuscripts fix the first day of any month with the lodge listed first for that month, the second day with the next lodge, and so on through the list of 28 ordered lodge days. For example, in the KJP manuscript, we find the first month of the year paired with the lodges Shi 室 (House$_{13}$) and Bi 壁 (Wall$_{14}$), meaning that New Year's Day would be a House$_{13}$-day, the second day of the first month would be a Wall$_{14}$-day, the third day would be a Kui 奎 (Straddler$_{15}$) day, and so on. The second month is then paired with the lodges Straddler$_{15}$ and Lou 婁 (Harvester$_{16}$), and the pattern repeats.

The question of assigning lodge-day values to the last days of a month raises an interesting issue that is best understood in light of a distinction noted by Cheng Shaoxuan 程少軒 between the calendars used by the *designers* of a hemerological system and those in the hands of its *users*.[15] As Marc Kalinowski pointed out in his initial report on the lodge day-count system, it is not strictly a "roll-over" system in the sense that while day 29 of a given month will indeed be the same lodge day as day one, and day 30 of a 30-day month will

14 See Kalinowski (1996).

15 Cheng made this distinction with reference to the *Xingde* 刑德 and *Yinyang wuxing* 陰陽五行 silk manuscripts from tomb 3 at Mawangdui when speaking at National Tsinghua University in Taiwan as part of the international conference "Chutu wenxian de yujing" 出土文獻的語境 ("The Linguistic Context of Excavated Manuscripts"), August 27–29, 2014.

have the same lodge-day value as day two, in practice the Han civil calendar alternated between 29 and 30 day months and never yielded months of 31 days.[16] Therefore, the lodge associated with the first day of a new month is best thought of as a defined value, regardless of what lodge would seem to be coming along in the natural cycle based on the last day of the previous month. This view is correct in practice, but it regards the text solely from a user's perspective. As Cheng has noted, the implicit calendar used by the designer of a hemerological system frequently differs from that adopted by its user, and in this case, the system's designers may well have intended to let lodge days cycle from one month to the next continuously. By including eight months with two repeated days (30-day months) and four months with three repeated days (31-day months), the system approximates a solar year with a total of 364 days. Naturally, such a model has the disadvantage of losing 1.25 days per year and thus rapidly becoming out of phase with the solar "quarter remainder" calendar of 365.25 days, but as $13 \times 28 = 364$, it also has the desirable compensating quality for a hemerologist that such a year will contain exactly 13 cycles of the lodge days, thereby allowing the lodge cycle to roll over from year to year without discontinuity.

In practice, outside of the "Stars"/"Offices" text itself, one occasionally finds lodge names in the daybooks appearing in contexts such as the following agricultural passage from the KJP manuscript referring to the Ox_9 and Well_{22} lodges of the northern and southern quadrants respectively:

> 始耕田之良日，牽牛、酉、亥。辰、巳不可穜（種）、出穜（種），乙巳、壬不可予、入五穜（種）。五月東井利澍（樹）藍、韭，司清。**453**
>
> Good days to begin tilling the fields: Ox_9-days, *you*-days, *hai*-days. On *chen*-days and *si*-days, planting and laying out seeds are not permitted; on *yisi* (day 42) and *ren*[17] days, giving out and taking in the five varieties of seeds is not permitted. In the fifth month, Well_{22}-days are favorable for planting indigo and scallions. Minister of Clarity. **453**

The lodges here are clearly day qualifiers, and the apparent connection between lodges and their associated omens would again seem to lie in the seman-

16 For an overview of early Chinese calendrical science, including a survey of archaeologically recovered calendar manuscripts, see chapter three of Morgan (2013).

17 By comparison with SHD-B slip 64, this should read "*renchen*" (day 29), a prohibition that also fits better with the preceding line prohibiting planting on *chen* days.

tic range of the day name itself. Thus, Ox_9-days associate the primary farm animal used for pulling a plow with good days for tilling, and $Well_{22}$-days have an apotropaic quality that would seem to counter the danger of drought with their suggestion of plentiful irrigation. It is interesting to note that the office name, "Minister of Clarity," accompanies the omen in this passage. In fact, the office associated with the $Well_{22}$ lodge in the KJP version of the "Stars"/"Offices" text is *sijia* 司家 ("Minister of Households"), but again, such discrepancies are not uncommon in manuscripts and may reflect either scribal error or variant witnesses having been taken as source texts.

A second fundamental example, or set of examples, of borrowed astronomical language involves the orbit of the planet Jupiter and the corresponding motion of Jupiter's conceptual counterpart—a sort of shadow-planet, sometimes called "counter-Jupiter," understood to be orbiting at the same average rate as Jupiter but in the opposite direction. Since Jupiter's sidereal period of 11.86 years fairly closely approximates a 12-year cycle, the planet, known in Chinese as *Sui* 歲 ("Year"), was taken as the marker of years in a 12-year calendrical cycle by no later than the Warring States period (475–221 BCE). This cycle is once again described explicitly in Sima Qian's "Tianguan shu":[18]

> 以攝提格歲：歲陰左行在寅，歲星右轉居丑。正月，與斗、牽牛晨出東方，名曰監德。色蒼蒼有光。其失次，有應見柳。歲早，水；晚，旱。
>
> …
>
> 單閼歲：歲陰在卯，星居子。以二月與婺女、虛、危晨出，曰降入。大有光。其失次，有應見張。其歲大水。
>
> 執徐歲： 歲陰在辰， 星居亥。 以三月與營室、 東壁晨出， 曰青章。青青甚章。其失次；有應見軫。歲早，旱；晚，水。
>
> In a *Shetige* year, Counter-Jupiter moves clockwise and is in chronogram *yin*, and Jupiter moves counter-clockwise and resides in chronogram *chou*. In the first month it appears at dawn in the east with $Dipper_8$ and Ox_9, and is called "Inspector of Virtue". Its color is azure and bright. If it misses its station, a response will appear in $Willow_{24}$. If Jupiter is early, there will be floods; if late, there will be drought …

18 *Shiji* (2006: 1313).

In a *Chanye* year, Counter-Jupiter is in chronogram *mao*, and the planet resides in chronogram *zi*. In the second month, it appears at dawn with lodges Woman$_{10}$, Barrens$_{11}$, and Roof$_{12}$, and is called "Descending Entrance." It is big and bright. If it misses its station, a response will appear in Spread$_{26}$. In this year there will be great floods.

In a *Zhixu* year, Counter-Jupiter is in chronogram *chen*, and the planet resides in chronogram *hai*. In the third month it appears at dawn with lodges House$_{13}$, and Wall$_{14}$, and is called "Green Badge." It is green and very prominent. If it misses its station, a response will appear in Axletree$_{28}$. If Jupiter is early, there will be drought; if late, there will be floods.

…

The list continues through the entire cycle of twelve years, assigning to each year one of a set of 12 mysterious names that many scholars have noted resemble non-Chinese loan words.[19] The appropriate positions of Jupiter and its counterpart are also described in terms of the 28 lodges, and cases of the planet failing to appear in a timely way at its appropriate position result in predictions of death, disease, and meteorological catastrophe during the course of the year in question.

In the KJP daybook manuscript, the same ordered sequence of 12 names occurs, but the context is entirely different. Thus we find:

正月：子朔，聞（攝）民（提）[20]挌（格）司歲，四海有兵，有年。**427**[1]
丑朔，單閼司歲[21]，實日秋食。**428**[1]
寅朔，執郐（徐）司歲，日食毋寒。**429**[1]
卯朔，大巟（荒）為（落）[22]司歲，百資不食，兵起，民盈街谷。**430**[1]
辰朔，隤（敦）臧（牂）司歲，有兵。**431**[1]
巳朔，蓋（協）□司歲，民有疾，年□春□食，有兵。**432**[1]
【午朔】，□□司歲，百資不成，三種。**433**[1]
未朔，作駱（鄂）司歲，有兵起。**434**[1]

19 Major (1993) and Pankenier (2013) both agree on this point, but definitive research on the precise origin of these terms is still needed.

20 Liu (2010: 106–112).

21 Ibid.

22 Ibid.

【申】朔，奄（閹）戊（茂）司歲，有年。**435[1]**
【酉朔】… 。**436[1]**
【戌朔】… 兵。**437[1]**
亥朔，赤奮若司歲，大風，報，兵革起，火行。**438**

In the first month:
If the first day is a *zi*-day, *Shetige* is the Minister of the Year. There will be troops everywhere; there will be a harvest. **427[1]**
If the first day is a *chou*-day, *Chanye* is the Minister of the Year. There will be a solar eclipse in the autumn. **428[1]**
If the first day is an *yin*-day, *Zhixu* is the Minister of the Year. There will be a solar eclipse. It will not be cold. **429[1]**
If the first day is a *mao*-day, *Dahuangluo* is the Minister of the Year. The hundred grains will not be eaten. Troops will arise, and the people will fill the streets and valleys. **430[1]**
If the first day is a *chen*-day, *Dunzang* is the Minister of the Year. There will be troops. **431[1]**
If the first day is a *si*-day, *Xie* □ is the Minister of the Year. The people will suffer from disease. Harvest □ spring □ eclipse. There will be troops. **432[1]**
[If the first day is a *wu*-day], □□ is the Minister of the Year. The hundred grains will not succeed. There will be three plantings. **433[1]**
If the first day is a *wei*-day, *Zuo'e* is the Minister of the Year. Troops will arise. **434[1]**
If the first day is a [*shen*-day], *Yanmao* is the Minister of the Year. There will be a harvest. **435[1]**
[If the first day is a *you*-day], … **436[1]**
[If the first day is a *xu*-day], … troops. **437[1]**
If the first day is a *hai*-day, *Chifenruo* is the Minister of the Year. There will be a great wind. It will return. Arms and armor will be mobilized. Fire will spread. **438**

Clearly, while the reference of the names in the "*Shetige* cycle" is still to years—or more precisely to a rotation of deities, each of whom is "on duty" for a given year—the determining factor is *not* the stage Jupiter has reached in its 12-year cycle; instead it is the earthly branch of the sexagenary day that coincides with New Year's Day of the year in question. As planetary motion is no longer relevant to the hemerological system, we would not expect to find any link between omens and the early or late arrival of Jupiter as seen in the "Tianguan shu" text, but the content of the KJP omens does show common concern with agriculture and meteorological phenomena, as well as a previously unseen theme of military affairs.

If Jupiter is not relevant to the daybook texts, however, the same cannot be said of the term *sui* 歲, which is present but denotes something very different from the familiar planet with a 12-year period. Once again, the nature of the term as used in daybooks was clarified by the discovery of the KJP manuscript. The final 21 slips (458–478) of that manuscript constitute a kind of essay on calendrical cosmology with the explicit title "*Sui*" written in the upper margin of slip 458. As usual, the word *sui* has a connotation of "year," and this essay describes in detail a series of correlations between the months, the seasons, and a variety of other quantities including colors, directions, flavors, and the notes of the musical scale. However, in the second half of the essay, we also find a month-by-month account of the calendar year built upon a systematic description of the positions of two entities conventionally known by the names Taisui 太歲 ("Major Sui") and Xiaosui 小歲 ("Minor Sui").

> 正月并居寅，以謀春事。必溫，不溫，民多疾，草木、五穀生不齊。**469** 二月發春氣於丑，是胃（謂）五（吾）已生矣。發子氣矣，必風，民多腹腸之疾，草木不實。三月止寒於戌，是 **470** 胃（謂）吾已成矣，子敬毋殺。必溫，寒，名曰執，蚤（早）寒蚤（早）執，莫（暮）寒莫（暮）執，終日寒三執。四月并居 **471** 卯，以受夏氣。必溫，不溫，五穀夏夭，草木不實、夏洛（落），民多戰疾。
>
> In the first month, reside together at chronogram *yin* in order to plan the affairs of spring. It must be warm; if it is not warm, the people will suffer from widespread disease, and grasses, trees, and the five grains will grow irregularly.
>
> In the second month, emit spring *qi* at chronogram *chou*. This is called, "I have already generated [life]; send out your *qi*." There must be wind. [If there is not wind,] the people will suffer from widespread stomach and intestinal disease, and the grasses and trees will not bear seed or fruit.
>
> In the third month, stop the cold at chronogram *xu*. This is called, "I have already caused [living things] to develop; be respectful and do not kill [them]." It must be warm. [If it is not warm,] the cold is named "obstinacy." Morning cold is morning obstinacy; evening cold is evening obstinacy; and all-day cold is triple obstinacy.

> In the fourth month, reside together at chronogram *mao* (*si*) in order to transmit the summer *qi*.[23] It must be warm. If it is not warm, the five grains will die prematurely in summer; the grasses and trees will fail to bear seed or fruit and will fall in summer; and the people will suffer from widespread warfare and disease.
>
> …

The list continues through all 12 months, and describes the motion of two entities orbiting the compass-like schematic array of the earthly branches in opposite directions so that they meet and "reside together" in the first, fourth, seventh, and tenth months. In fact, models of this type are characteristic of other passages in the daybooks, including other sections of KJP, but it is unusual for the mechanism to be presented as part of a larger essay detailing the internal processes understood to drive the annual calendar.[24] The names of the orbiting entities also appear elsewhere in variant forms, most commonly as *Dashi* 大時 ("Great Period") and *Xiaoshi* 小時 ("Minor Period"), but these terms can be equated with Major and Minor Sui as a passage found in the "Tianwen" 天文 ("Patterns of Heaven") chapter of *Huainanzi* 淮南子 (presented to the Han court ca. 139 BCE) draws an explicit connection between the names.

> 斗杓為小歲，正月建寅，月從左行十二辰。咸池為太歲，二月建卯，月從右行四仲，終而復始。太歲迎者辱，背者強，左者衰，右者昌，小歲東南則生，西北則殺，不可迎也，而可背也，不可左也，而可右也，其此之謂也。大時者，咸池也；小時者，月建也。[25]
>
> The dipper handle is *Xiaosui* ("Minor Sui"). In the first month it is established at the chronogram *yin*, and each month it travels clockwise through the twelve earthly branches. *Xianchi* is *Taisui* ("Major Sui"). In the second month it is established at *mao*, and each month it travels counterclockwise through the four cardinal directions, starting again after a cycle has been completed. As for Major Sui:
> "One faced is disgraced; one behind is powerful.
> One on the left is in decline; one on the right is robust."

23 The chronogram *mao* 卯 here probably reflects a copyist's error; it should be *si* 巳. See Harkness (2011: 181–184).

24 See the discussion of binary systems in Harkness (2011: 60–63 and 120–130).

25 He (1998: 219).

> Minor Sui generates in the south and east and kills in the north and west.
>
> "One may not face it but may be behind it.
>
> One may not be on the left but may be on the right."
>
> They are spoken of this way. *Dashi* 大時 ("Great Period") is equivalent to *Xianchi* ("Broad Pool"); *Xiaoshi* 小時 ("Minor Period") is equivalent to *Yuejian* 月建 ("Month Establisher").

Putting these pieces together, we see that both the *sui* ("year") of the daybooks and its equivalent *shi* ("period") are systems of *two* entities moving in opposite orbits around the heavens. In this way, they do somewhat resemble Jupiter and its imaginary counterpart, but they are different in that each of the two entities has a distinct orbital period (one year and four months, respectively), neither of which resembles the 12-year period of Jupiter. Moreover, with its emphasis on the months when the two entities "reside together" the daybook text clearly interprets their conjunctions as significant moments in the course of the calendar year, a feature that is more likely to suggest the astronomical analogy of the sun and moon working together to define the lunar months.

Before moving on to give a final example of the type demonstrated above, it might be instructive to consider the significance of the examples we have already seen. What does it mean that stellar lodge names may signify days rather than asterisms, or that the spirits of the Shetige cycle are linked to the non-astronomical calendrical cycle of 12 earthly branches rather than to stages of Jupiter's progress through its orbit? On a practical level, there are implications for the way we read other Chinese texts. In the *Erya* 爾雅 (*Approaching Refinement*), for instance, the "Shi tian" 釋天 ("Explicating Heaven") chapter has the following passage:

> 大歲在寅曰攝提格，在卯曰單閼，在辰曰執徐，在巳曰大荒落，在午曰敦牂，在未曰協洽，在申曰涒灘，在酉曰作噩，在戌曰閹茂，在亥曰大淵獻，在子曰困敦。在丑曰赤奮若。
>
> When Great Sui is at the chronogram *yin*, it is called Shetige; when at *mao*, it is called Chanye; when at *chen*, it is called Zhixu; when at *si*, it is called Dahuangluo; when at *wu*, it is called Dunzang; when at *wei*, it is called Xieqia; when at *shen*, it is called Tuntan; when at *you*, it is called Zuo'e; when at *xu*, it is called Yanmao; when at *hai*, it is called Dayuanxian; when at *zi*, it is called Kundun; when at *chou*, it is called Chifenruo.

Here it is Great Sui taking positions defined by the chronograms, and although the pairings of chronograms with names from the Shetige-cycle matches the account of Sima Qian rather than that of the daybooks, all of the defining astronomical information found in the "Tianguan shu" text (lodges in which Jupiter first appears, warnings about early or late arrivals, omens) has been stripped away in the glosses such that the pairings could as easily be read in the manner of the daybooks as in that of the astronomical records.[26] In other words, a reader more familiar with the context of daybook hemerology than with court astronomy is likely to interpret the *Erya* glosses as applying to a calendrical divination procedure in the first month of the year rather than to the tracking of the planet Jupiter. In this light, one might also consider the famous opening lines of the "Lisao" 離騷 poem from the *Chuci* 楚辭 and the sense in which they are usually understood:

> 帝高陽之苗裔兮，朕皇考曰伯庸。
> 攝提貞於孟陬兮，惟庚寅吾以降。
>
> As a descendant of Lord Gao Yang, my august father was called Bo Yong.
> When the asterism Sheti pointed precisely at the first month, on day *gengyin* I was born.

This reading depends rather heavily on the assumption that the graph *zhen* 貞 ("to divine") is being borrowed for its near homonym *zheng* 正 ("precisely," "exactly"). Such a usage may indeed have precedent, but in light of the available evidence from daybooks, it is now also tempting to read the original graph *zhen* at face value, in which case we would get a line something like: "*Sheti* was divined in the first month, and on day *gengyin* I was born." According to the *Erya*, *yin* is the chronogram associated with Shetige's tenure, so by this reading the poet's birthday aligns him precisely with the appropriate minister of the year.[27] His appearance is thus a natural phenomenon—in harmony with the spirit world and therefore unquestionably legitimate and correct.

As a final example of astronomical terminology appearing in unfamiliar contexts, let us consider the case of Xianchi 咸池 ("Broad Pool"), which we have already seen briefly mentioned in the above quote from *Huainanzi* as a term

26 Da Sui 大歲 is translated here as "Great Sui" to mark the variant form of Tai Sui 太歲 ("Major Sui") that appears in this passage. In Old Chinese, *da* 大 and *tai* 太 are, in fact, equivalent.

27 The date also probably carries an implication of glowing good health as the *geng* 庚 stem is a standard homonym for *kang* 康 ("health") in Old Chinese.

synonymous with Dashi ("Great Period") and Taisui ("Major Sui"). A defining feature of all these entities is that they orbit the array of earthly branches with a period of four months or, in the schematic calendar of regular 30-day months employed by the daybooks, exactly 120 days. In this regard, an unusual passage from the KJP manuscript conforms to the same model:

> 徙：夏六月，咸池以辛酉徙西方。居四旬五日，以丙午徙 **111**^{2} 南方。居九日，以乙卯徙東方。居五旬七日，以壬子徙北方。**112**^{2} 居九日，有（又）以辛【酉徙西方】。**113**^{2}
>
> **Shifting**
> Summer, the sixth month: Broad Pool shifts to the west on *xinyou* (day 58). It abides there for 45 days and then shifts to the south on *bingwu* (day 43). **111**^{2} It abides there for 9 days and then shifts to the east on *yimao* (day 52). It abides there for 57 days and then shifts to the north on *renzi* (day 49). **112**^{2} It abides there for 9 days and then [shifts to the west on] *xin*[*you*] (day 58). **113**^{2}

Noting that 45 + 9 + 57 + 9 = 120 (days), we see that this Broad Pool has the expected orbital period. However, rather than orbiting at a steady rate, it speeds up drastically in the north and south and lingers to varying degrees in the east and west. What could be the meaning of this strange behavior?

Without more evidence, it would be difficult to answer this question definitively, but we can note that our earlier examples point not so much at two absolutely opposing lexicons—one of the court scholars and another of the widely disseminated popular literature—as they do at a spectrum of interpretations that vary widely but still at times mutually inform one another in unexpected ways. In this case, the behavior of Broad Pool, although to my knowledge having no direct counterpart in the received literature, would appear to resemble passages such as the following one from the "Tianguan shu" describing the motion of Mercury:[28]

> 其出東方，行四舍四十八日，其數二十日，而反入于東方；其出西方，行四舍四十八日，其數二十日，而反入于西方。
>
> [Mercury] appears in the east and traverses four lodges in forty-eight days. After twenty days [of the forty-eight], it turns back and sets in the east.

28 *Shiji* (2006: 1330).

> [Mercury] appears in the west and traverses four lodges in forty-eight days. After twenty days [of the forty-eight], it turns back and sets in the west.

The two texts differ in their presentation of planetary movement, with the daybook indicating the passage of time with days of the sexagenary cycle and only generally describing Broad Pool's spatial progress by the cardinal direction, while the astronomical text enumerates days and specifies the lodges through which Mercury travels. On the other hand, if one considers that Mercury's actual synodic period is approximately 116 days, rather than the 96 accounted for in the above description, it is not hard to imagine that the 20 unexplained days could be could be evenly divided and allotted to the northern and southern quarters in much the same way we find in the Broad Pool model, where an idealized approximation of 120 days corresponds exactly to two repetitions of the sexagenary cycle and thereby allows the hemerologists to employ their preferred day-count method using branches and stems.

The point here, of course, is not to insist that the KJP version of Broad Pool is necessarily modeled on the planet Mercury as more evidence would be needed to establish that case. Instead, I would argue that regardless of its particular antecedent, we can safely say, once again, that we see here both astronomical terminology and associated structures of astronomical theory applied to quite different purposes in the context of the hemerological almanacs. Having now demonstrated a variety of such cases, albeit not a comprehensive list, I would like to conclude by considering more carefully what their implications might be.

Language is a supremely malleable tool, open to innovation by means of techniques such as creative metaphor, poetic allusion, and perhaps, at times, even simple misunderstandings that become widespread and result in the development of new meanings for old words. For all of these reasons, a degree of semantic range in elements of the lexicon from any particular time or place might not be particularly noteworthy. Nevertheless, the examples quoted above are special because they consist of entire sets of technical vocabulary. They are conceptual models rather than just words, and they contain inherent, predetermined, structural relationships. We would be remiss, therefore, to regard texts like the daybooks as simply degraded, popular reflections of elite knowledge tainted by superstition. Instead, it is worth observing that the daybooks can, in some cases, preserve certain aspects of the structure of astronomical knowledge in a more systematic manner than a classical treatise such as the "Tianguan shu". We see this in the case of the 28 lodges, which clearly retain their proper sequence in the daybook texts as well as their status as bureaucratic offices in a celestial bureaucracy—even as the lodge names become day names and the meaning of the lodge omens changes in focus from concerns of the state to those of the individual.

The systematic presentation of these astronomical models in the context of the almanacs should be remembered when analyzing phenomena in the overlapping spheres of Chinese scientific and cultural history. These could be as piecemeal as minor literary references to stars or stellar deities, like we have seen in the previous example from the *Chuci*, or as coherent and enduring as the tradition of decorating tomb chambers with patterns of constellations. The latter practice, which by the Tang Dynasty (618–907 CE) had spread as far afield as the kingdoms of Korea and Japan, dates from no later than the Eastern Han Dynasty (25–220 CE) when, for example, elaborate carved stone panels featuring astronomical themes enjoyed a vogue around the city of Nanyang 南陽 in China's Henan province. One could well ask how a stone-carving artisan acquired familiarity with the constellations of the night sky. Was it through personal observation of the sky, oral folklore, observation of other artist's work, book learning, or some combination of all of these? And in the case of book learning, which books were most commonly consulted? These are topics for further historical research, but to the degree that daybooks or other almanac-like texts may have played a role, a degree of credit for the transmission of this knowledge should be granted to the resourceful hemerologists of an earlier era who adopted the structures and language of astronomy and astrology for their own purposes while still managing to preserve some of the order and the awesome majesty of the heavens.

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CHAPTER 13

Mercury and the Case for Plural Planetary Traditions in Early Imperial China

Daniel Patrick Morgan[1]

Fragmentation, not unity, was the rule in ancient China.

TERRY KLEEMAN (1998: 1)

1 Introduction

The history of astronomy in China, we are told, is a history of policy reform decided at court and realized by functionaries. This is a narrative espoused by practitioners—men and women for whom the meaning of their sciences lay as firmly in the patterns (*wen* 文) of the past as in those of heaven (*tian* 天)—and it is a narrative repeated in histories to our day. Ban Gu's 班固 (A.D. 32–92) *Book of Han* offers us one of earliest précis of this kind. "The origin of *li* numbers" 曆數之起, he tells us, lay with the thearchs and sage kings of the aeon past, who, in their wisdom, delegated functionaries to "*li* and *xiang* the sun, moon, & stars and respectfully grant the people the seasons" 曆象日月星辰， 敬授民時.[2] The sages, however, left us as much with a pattern for success as one of

1 The present article has developed out of my dissertation, the initial research for which was conducted in 2011–2012 at the Needham Research Institute with the support of the Andrew W. Mellon Foundation, what evolved therefrom having been supported by the University of Chicago's Center for East Asian Studies dissertation write-up fellowship and funding from the European Research Council under the European Union's Seventh Framework Programme (FP7/2007–2013) / ERC Grant agreement n. 269804. I would like to thank Donald Harper, Christopher Cullen, and Karine Chemla for my intellectual mentorship over this period, John Steele for inviting to contribute to this valuable project, and Alexander Jones, whose work on astronomical papyri first put the idea into my head to look beyond the well-polished surface of 'the' Chinese astronomical tradition.

2 *Han shu* 漢書 (Zhonghua shuju 中華書局 ed.), 22A.973.

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failure: directors Chong 重 and Li 黎 lost their virtue in rebellion, brothers Xi 羲 and He 和 lost themselves in drink, the temporal order teetering ever on the brink of chaos. It was this pattern, Ban Gu reminds us, that rippled through the age of man.

> 故自殷周，皆創業改制，咸正曆紀，服色從之，順其時氣，以應天道。三代既沒，五伯之末，史官喪紀，疇人子弟分散，或在夷狄，故其所記，有黃帝、顓頊、夏、殷、周及魯曆。
>
> Thus it is that all [new dynasties] since the Yin 殷 (?–1045 B.C.) and Zhou 周 (1045–771 B.C.) have corrected the *li* cycles and changed the color of [court] attire accordingly so as to obey the *qi* of their time and respond to the Dao of Heaven. After the Three Dynasties (Xia 夏, Yin-Shang 殷商, and Zhou) had disappeared, and at the end of the Five Earls (i.e. the Spring & Autumn period, 770–481 B.C.), the Clerk's Office lost its cycle/discipline, and its hereditary practitioners and their disciples dispersed, some to the Yi 夷 and Di 狄 [tribes]. This is why they record the Yellow Emperor, Zhuanxu 顓頊, Xia, Yin, Zhou, and Lu 魯 (771–249 B.C.) *li*.[3]

History proper picks up in the Han 漢 (206 B.C.—A.D. 220), whence the standard histories begin to follow astronomy court-by-court, reform-by-reform, along a line—a *dao*—predestined in its origins. This line, traced and retraced to our day, adumbrates a tradition of timeless integrity utterly unique within the world. But temporal order, let us not forget, is an imperative, an obsession, and a struggle waged against all odds.

The aim of this paper is to foreground disunities evident in the early astral sciences and explore how such disunities were perceived, perpetuated, and reconciled by later thinkers. First and foremost in this regard was the line drawn by practitioners themselves between the sciences of *tian-wen* 天文 'heavenly patterns' and *li* 曆 'sequencing'. Roughly speaking, *tian-wen* : the outdoors : phenomena :: *li* : the indoors : data (text), which is to say that *tian-wen* concerns the observation, measurement, interpretation, and recording of *xiang* 象 'image/symbol/phenomena', while *li* ('sequence', 'calendar', and, thus, 'calendro-astronomy') concerns the manipulation of data, tables, procedures, and counting rods. To "*li* and *xiang* the sun, moon, and stars," therefore, is to invoke (or *convoke*) in the early imperial mind distinct practices, skill-sets,

3 *Han shu*, 21A.973. On the "the six ancient calendar systems" (*gu liu li* 古六曆), see Zhang et al. (2008: 251–390), Hirase (1996), and Gassmann (2002).

textual genres, and professions dealing, respectively, with temporal and spatio-semantic order. The depth of the divide is easily assayed by a glance at the technical literature: self-identified *tian-wen* literature consists of catalogues of bodies, phenomena, and omina, and/or historical records; *li* literature, on the other hand, is composed of computational manuals and the tables, calendars, and ephemerides (*li*) calculated therefrom.[4]

One of the places where the domains of *tian-wen* and *li* overlap is planetary models. In this paper, we will examine the case of Mercury models as an example of the divide and interaction between the Chinese astral sciences. We will begin with introductions to the earliest materials on each side of the divide to explain the respective mechanics, assumptions, and functions behind them. The *tian-wen* models, I hope to show, make sense only as hemerologies whose function is to provide idealized norms of auspicious behavior within the context of omen reading, while *li*, on the other hand, provides us with what we would expect from mathematical models. The fact that what I identify as tian-wen models purport to occur centuries prior to planetary *li* has fostered the assumption that one is ancestral to the other. In the following section, however, I present evidence of the extensive use and development of 'old' *tian-wen* models beyond the advent of *li* as proof, instead, of their filling different niches. Then, in the final section, we then try to understand how it was that experts reconciled the two and how planetary hemerology eventually disappeared from the *tian-wen* genre.

2 The Pre-*li* Planetary Models

Preserved in the *Book of Han*, the earliest extant *li* manual is that of the Triple Concordance system (*Santong li* 三統曆), which Liu Xin 劉歆 (c. 50 B.C.—A.D. 23) composed *circa* A.D. 5 on the basis of the Grand Inception system (*Taichu li* 太初曆) of 104 B.C.[5] We can say little more about *li* before this date.[6] We do,

4 *Tian-wen* and *li* are areas around which a considerable body of secondary literature has amassed. The best Western-language introductions by far to the topic of *tian-wen* and Chinese uranomancy are Nakayama (1966) and Ho (1967). For *li*, see Cullen (1996: 1–66), Martzloff (2009), and Sivin (2009).

5 On the Triple Concordance system, see Teboul (1983). On the life and work of Liu Xin, see Xu (2005).

6 What little there is to say before 104 B.C. generally concerns the reconstruction of the civil calendar on the basis of extant calendars and date notations. See, for example, the studies

however, find planetary models in self-identified *tian-wen* sources predating the Triple Concordance system. Three of these sources are extant and firmly provenanced to the two centuries prior: the "Heavenly Offices Monograph" in Sima Qian's 司馬遷 (c. 145–c. 86 B.C.) *Records of the Grand Historian* (1st cent. B.C.); the "Heavenly Patterns" chapter of the *Huainanzi* 淮南子 (139 B.C.); and the untitled silk manuscript dubbed *Planetary Omina* (*Wu xing zhan* 五星占) excavated from Mawangdui 馬王堆 tomb 3 (sealed 168 B.C.). Three more are fragments attributed by later sources to the problematic pre-imperial figures Wuxian 巫咸, Shi Shen 石申, and Gan De 甘德 (hereafter, "the Three Experts"). The discussion of Chinese planetary astronomy usually begins here.[7]

As to the early planetary models, any discussion of the state of the field must begin at the source: the *Kaiyuan Omen Classic* (*Kaiyuan zhanjing* 開元占經), the massive 120-volume *tian-wen* compendium compiled in A.D. 729 by Gautama Siddhārtha 瞿曇悉達, a Chinese-born Indian-lineage expert active in the Tang 唐 (A.D. 618–907) astronomical office.[8] It is thanks to Gautama's meticulous cataloguing of sources that we know as much as we do about the early professional literature (as opposed to the *historical* literature of the standard history monographs), but it is thanks his occasional commentary that we know also what Gautama *thought* about it. Gautama opens the section on Mercury as follows:

> 『洪範五行傳』曰：「辰星以上元甲子歲，十一月甲子朔旦，冬至夜半甲子時，與日月五星俱起牽牛前五度，右行迅疾，常與日月相隨，見於四仲以正四時，歲一周天。」
>
> The *Hongfan wuxing zhuan* (1st cent. B.C.) says: "Mercury, starting from a high origin of *jiazi*.$_{01/60}$–XI–*jiazi*.$_{01/60}$ new moon, with winter solstice at midnight, hour *zi*.$_{s01/12}$, of day *jiazi*.$_{01/60}$ and the sun, moon, and planets starting together 5 *du* 度 before Led Ox.$_{L09/28}$ (α^2/β Cap),[9] travels swiftly

mentioned in Note 3, as well as Zhang (2007) and Li Zhonglin (2010). The one exception to this is the Mawangdui manuscript *Planetary Omina* (see Note 14).

7 For example, Maspero (1929), Teboul (1983), and Takeda (2010). Additional early sources not covered in these studies can be found in Table 2.

8 On Gautama and the foreign lineage experts at the Tang astronomical office, see Jiang (1992) and Lai (2003). On the introduction and translation of foreign astral sciences in this period through the vector of Buddhism, see Niu (2004).

9 Note that all dates are given in *y–m–d* format. Years and days are given either in ordinal numbers or sexagenary notation (*n*/60), *chen* 辰 double-hours are given in earthly branches (B*n*/12), and right ascension is counted in 'lodge entry *du*' (*ru xiu du* 入宿度) counted from

> to the right (anticlockwise), constantly accompanying the sun and the moon; it appears in the four mid-season months to set straight the four seasons, making one circuit of heaven in one year."[10]

To this, Gautama provides the following commentary:

> 案歷法，辰星夕見西方三十日而伏，二十二日而晨見東方而伏，伏入三十三日一千五百四十分日之一千一百六十八奇六十六復夕見西方如初。一終凡一百一十五日一千一百七十八奇六十六，星行度數亦如之。是七十七年而二百四十九終也。星平行日一度，一年周天。舊説皆云「辰星效四仲」以為謬矣。
>
> According to *li* method, Mercury appears in the evening in the west for 30 days before hiding, 22 days before appearing in the morning in the east and then hiding, it hides and enters for 33 days & $\frac{1168\frac{66}{x}}{1540}$ day and appears again in the evening like the first time. From start to finish it takes a total of 115 days & $\frac{1178\frac{66}{x}}{1540}$ day (sic.), and the *du* travelled are also as much. This makes 249 complete cycles in 77 years. The star's mean motion is one *du* per day, making a circuit of Heaven in one year. The old doctrines all say that "Mercury appears in the four mid-season months," which is absurd.[11]

It is not until modern times that scholars have deigned to reconsider the 'absurdities' (*miu* 謬) of the 'old' (*jiu* 舊) models in all seriousness, their interest, like Gautama's before them, being one of origins. What they added by way of explanation was a developmental teleology apropos the notion of the timeless tradition: that the 'absurd' early models *developed into* the comprehensible models of A.D. 5 and later, and that, *ipso facto*, we may determine a relative chronology between them on the basis of their accuracy and sophistication.[12] There are a number of problems with this approach, not the least of which being that the resultant chronology places the Three Experts' planetary models centuries prior to (and often in reverse order than) that now generally accepted for the

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the guide star (*ju xing* 距星), given in parentheses, of a particular lodge (L*n*/28; see Figure 2). Note that the *du* is a pseudo-angle defined as the daily travel of the (mean) sun in one day, there being thus approximately 365¼ *du* to the 'circuit of heaven' (*zhou tian* 周天). For an explanation of Chinese astronomical conventions, see Sivin (2009: 67–97). On the twenty-eight lodges, see Cullen (2011a).

10 *Kaiyuan zhanjing* 開元占經 (Siku quanshu 四庫全書 ed.), 53.2b–3a.

11 Ibid., 53.2b–3a (commentary).

12 Maspero (1929: 270), Teboul (1983: 119, 137), and Takeda (2010).

'star canons' (*xing jing* 星經) attributed to them in the self-same sources: the (purportedly) fourth- and third-century B.C. catalogues of Shi Shen and Gan De having been composed cumulatively in that order and added to up through the first century A.D., and that of Wuxian (2nd mill. B.C.) being a pseudepigraphon of the third century A.D.[13] Something is not right: why would works that are, in every other respect, open and accumulative towards contemporary knowledge *regress* vis-à-vis planetary knowledge?

To better understand Gautama's objection to "the old doctrines," let us examine several fuller expressions of Mercury's seasonal behavior. Our earliest securely datable source in this regard is the *Planetary Omina* tomb manuscript (*terminus ante quem* 168 B.C.):[14]

> 主正四時，春分效【婁】，夏至【效鬼，秋分】效亢，冬至效牽牛 … 其出四中（仲），以正四時，經也；其上出四孟，王者出；其下出四季，大秏敗。凡是星出廿日而入，經也。□□廿日不入□□。
>
> [Mercury] rules and rectifies the four seasons: at spring equinox it appears in [Pasture.$_{L16/28}$ (β Ari)], at summer solstice [it appears in Devils.$_{L23/28}$ (θ Cnc), at autumn equinox] it appears in Neck.$_{L02/28}$ (ϰ Vir), and at winter solstice it appears in Led Ox.$_{L09/28}$ (α^2/β Cap) … If it rises in the four mid-season months, it does so to set straight the four seasons—this is normal—; if it rises up in the four first months of the seasons, a [new] true king emerges; if it rises down in the four final months of the seasons, there is great depletion and defeat. In general, this star (planet) sets 20 days after rising—this is normal—while … not setting in twenty days … (lines 54–56).

Compare this to the *Records of the Grand Historian* monograph (c. 90 B.C.):

> 是正四時：仲春春分，夕出郊奎、婁、胃東五舍，為齊；仲夏夏至，夕出郊東井、輿鬼、柳東七舍，為楚；仲秋秋分，夕出郊角、亢、氐、房東四舍，為漢；仲冬冬至，晨出郊東方，與尾、箕、斗、牽牛俱西，為中國。其出入常以辰、戌、丑、未。

13 It is once again the *Kaiyuan Omen Classic* to which we owe the preservation of *both* the Three Experts' planetary models and star canons. On the openness, order, and date of the latter, see Sun and Kistemaker (1997).

14 For recent studies on the Mawangdui *Planetary Omina*, see Yabuuti (1982), Cullen (2011b), Cullen (2011c), Mo (2011), and Morgan (forthcoming [b]). For the text of the *Planetary Omina* MS itself, see Liu (2004: 29–99).

> [Mercury] rectifies the four seasons: mid-spring month, spring equinox, it emerges in the evening from the suburbs (sic.) in the five lodges east of/from Crotch.$_{\text{L15/28}}$ (β/σ And), Pasture.$_{\text{L16/28}}$ (β Ari), and Stomach.$_{\text{L17/28}}$ (41/35 Ari), where it acts upon [the State of] 齊; mid-summer month, summer solstice, it emerges in the evening from the suburbs (sic.) in the seven lodges east of/from Eastern Well.$_{\text{L22/28}}$ (γ/μ Gem), Cartbourne Devils.$_{\text{L23/28}}$ (θ Cnc), and Willow.$_{\text{L24/28}}$ (δ Hya), where it acts upon [the State of] Chu 楚; mid-autumn month, autumn equinox, it emerges in the evening from the suburbs (sic.) in the four lodges east of/from Horn.$_{\text{L01/28}}$ (α Vir), Neck.$_{\text{L02/28}}$ (κ Vir), Root.$_{\text{L03/28}}$ (α^2 Lib), and Chamber.$_{\text{L04/28}}$ (δ Sco), where it acts upon [the State of] Han 漢; mid-winter month, winter solstice, it emerges in the morning from the suburbs (sic.) west of/from Tail.$_{\text{L06/28}}$ (κ/μ Sco), Basket.$_{\text{L07/28}}$ (γ Sag), Dipper.$_{\text{L08/28}}$ (σ/φ Sag), and Lex Ox.$_{\text{L09/28}}$ (α^2/β Cap), where it acts upon the central states. Its emergence and entry is normally at *chen*.$_{\text{B05/12}}$ (ESE), *xu*.$_{\text{B11/12}}$ (WNW), *chou*.$_{\text{B02/12}}$ (ENE), and *wei*.$_{\text{B08/12}}$ (SSW).[15]

More-or-less parallel descriptions are attributed to Gan De and Shi Shen, respectively, in the *Kaiyuan Omen Classic*.[16]

From the perspective of astronomy, it is difficult to understand just what pattern these models describe. For starters, the language is ambiguous and contradictory. Our sources seem to distinguish the verb *xiao* 效/効 ('to render service' or 'to appear')—the *Records of the Grand Historian* mistakenly reads *jiao* 郊 'suburbs'—from *chu* 出 ('to emerge'). In an astronomical context, *chu* always denotes rising/first visibility; it is not clear, therefore, whether the terms *xiao*, *jiao*, and, later, *xian* 見 'appear' are freely interchangeable with *chu* or are intended to denote something else, e.g. *any* visibility. Furthermore, our sources contradict one another (and even themselves) on where these phenomena occur in time—the *month* and/or *day* of the solstices and equinoxes—and in space—5–15 *du* lodges or 41–112 *du* spans.

Even with all the philological play afforded by these ambiguities, it is still difficult to map them onto the planet's actual behavior. Let us take for example the broadest possible interpretation of the aforementioned models: that Mercury *is visible* in the *months* of the solstices and equinoxes in *the quadrant of the sky appropriate to its position vis-à-vis the sun*. This is by no means 'normal' (*chang* 常 or *jing* 經). Mercury's mean synodic period is 115.88 days (cf. Liu

15 *Shiji* 史記 (Zhonghua shuju ed.), 27.1328.

16 *Kaiyuan zhanjing*, 53.4a.

Xin's $115\frac{122\,029\,605}{134\,082\,297}$ and Gautama's $115\frac{1168\frac{66}{x}}{1540}$), which means that three of which fall approximately 17 days short of a solar year, 6 days short of a 12-month civil year, and 36 days short of an intercalary civil year. In other words, the planet's visibility pattern is sliding *ahead* through the solstitial and equinoctial points while the civil months are sliding *around* them. This might still work were the planet visible for most of the year, but Mercury's periods of potential visibility are brief, variable, and staggered in such a manner as is irreconcilable with four consecutive solstitial and equinoctial points (starting with first morning rising, Liu Xin gives 28d/37.9d/26d/24d between first and last visibilities, Gautama gives 30d/33.8d/30d/22d). Factors like weather and eyesight only exacerbate matters. Once in a while, as in 203 B.C. (Fig. 13.1), it is true that everything might align such that one could spot Mercury at some point in each of the mid-season months, but this isn't much of a 'pattern' to go on.

Any further condition our sources add to the broad interpretation is asking too much. As Fig. 13.1 shows: periods of potential visibility do not align with the solstitial and equinoctial points; *first visibilities* cannot fall in consecutive mid-season months; and that *neither* occur in *any other month* is unreal. As to position, the Gan De-*Planetary Omina* complex places Mercury's visibility phenomena *at* or *just east of* the solstitial and equinoctial lodges (compare the prior description to Fig. 13.2), which would place the planet too near to the sun to be visible (cf. Liu Xin's angle of invisibility of ≈15 *du*) and imply a pattern of *evening* risings at odds with the planet's synodic period. The Shi Shen-*Records of the Grand Historian* complex is better adapted in this regard, placing the phenomena in multi-lodge spans and alternating between evening and morning visibility. Still, what the latter offers us is conditions the occasional year might fill rather than a description of the planet's typical behavior.

The four-season Mercury scheme *is* absurd *as an astronomical model*; rather than dismiss it as such, or pass it off to ignorance, however, we might instead ask what sense it *does* make. As I have discussed elsewhere, the sort of early planetary models we see in *Planetary Omina* are heavily informed by contemporary hemerology (calendar divination).[17] The more sophisticated hemerologies in the Chinese tradition operate by correlatively arranging elements of time and space—the denary and duodenary day-count (S01–10 & B01–12), the seasons, the cardinal directions, the five agents (wood, fire, earth, metal, and water), and the twenty-eight zodiacal lodges (L01–28)—upon a schematized game board through which ontologically ambiguous 'calendar spirits' (*shensha* 神煞) cycle

17 Mo (2011).

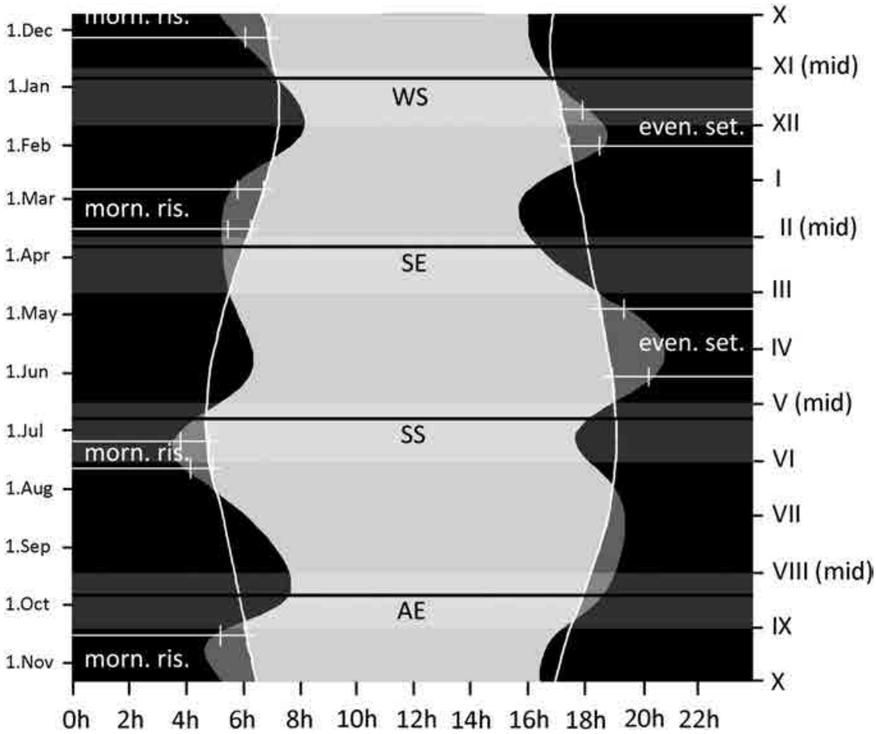

FIGURE 13.1 *Rise times and visibility phenomena for Mercury (203 B.C.)*
Note: Image redrawn from Planetary, Lunar, and Stellar Visibility *v3.1 (PLSV) for Xi'an (34°15′ N 109°00′ E) with an arbitrary critical altitude of 1°. The Y-axis is the date, the Roman numerals on the right side indicating the months of the lunisolar civil calendar, and 'mid' indicating mid-season months. The X-axis indicates time of day. The lines running vertically through the diagram indicate the hour of sunrise and sunset as it changes throughout the year. The wobbly area at the center of the diagram represents the time that the planet is above the horizon—the light gray area being time that it is above the horizon* with *the sun (and thus invisible), and the dark gray area the time that it is above the horizon* without *the sun, and thus potentially visible. The short horizontal lines running from the edges of the diagram to the vertical lines of sunrise/sunset indicate the dates of first and last visibilities, as calculated by PLSV. The light horizontal bars indicate the span of the mid-season months. The long black horizontal lines indicate the solstices (S) and equinoxes (E). For example, this diagram tells us that in 203 B.C. FES and FMR might have almost coincided with winter solstice and autumn equinox, respectively, and that the planet was likely visible in the mid-winter and mid-summer months and near the tail end of the mid-autumn month, but probably not in mid-spring.*

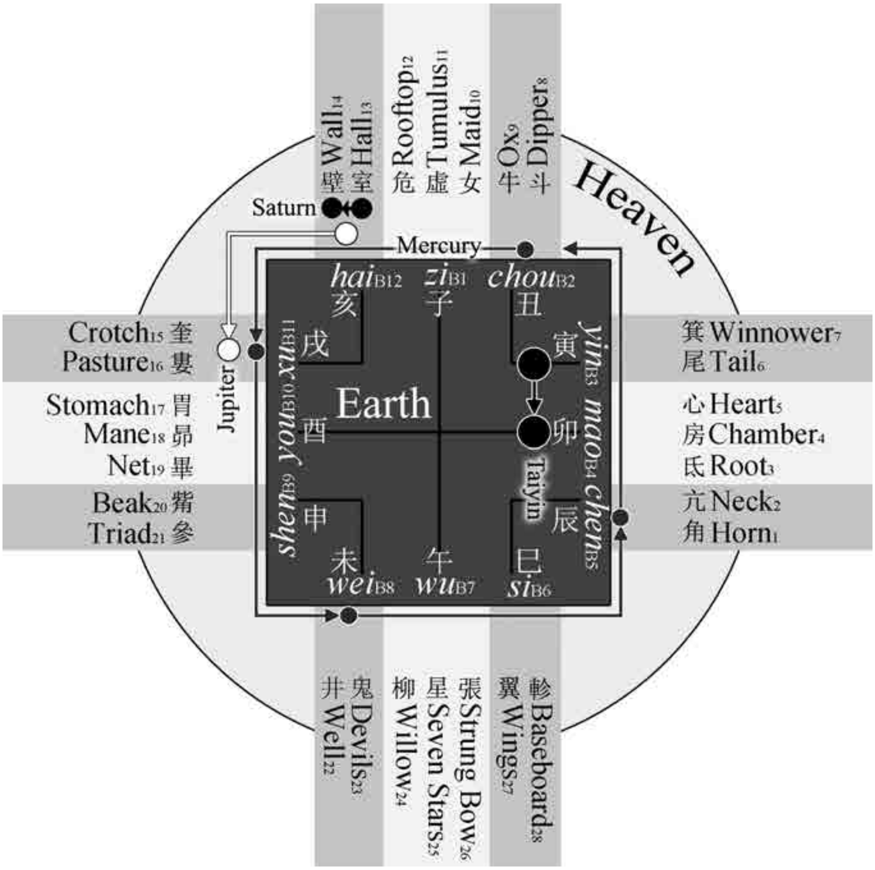

FIGURE 13.2 Wuxing zhan *planetary hemerology* (*year 1 of 60*)

and hop with the arbitrary regularity of game pieces, their relative positions determining the auspiciousness of quotidian activities.[18] With the exception of Venus and Mars (being *too well*- and *too poorly*-understood, respectively, to adapt to this purpose), *Planetary Omina* has the planets play out a hemerologically perfect 60-year cycle on just such a game board (Fig. 13.2). Saturn moves anticlockwise one lodge per year, lingering for two in Hall.$_{\mathrm{L13}}$ and Well.$_{\mathrm{L22}}$, making a circuit in 30 years. Each year, Jupiter's first morning rising moves back one month while the planet moves anticlockwise through the twelve stations (*ci* 次) *to mirror the calendar spirit Taiyin* 太陰, which moves clockwise through

18 For important Western-language studies on early Chinese hemerology, see Kalinowski (1986), Kalinowski (1998–1999), Major (1993), and Harkness (2011).

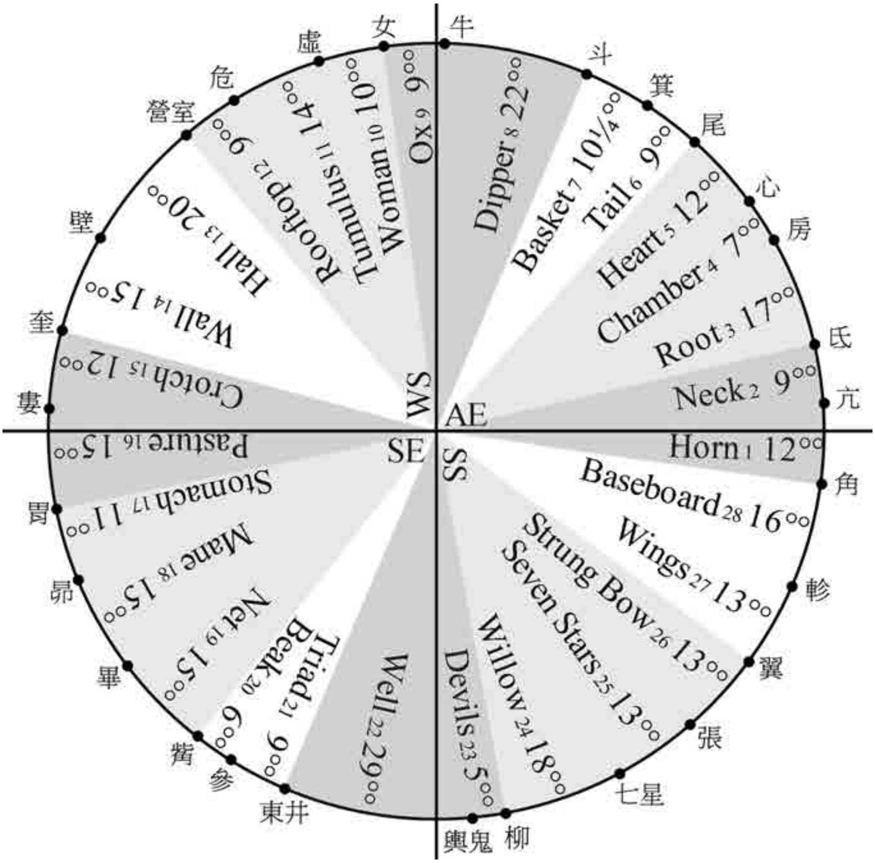

FIGURE 13.3 *The twenty-eight lodges 'ancient* du *widths'*

the earth.[19] And each year Mercury's visibility hops through the solstitial and equinoctial corner points. Hour, minute, and second hand, the planets count off the sexagenary year-cycle like clockwork.

19 On the calendar spirit Taisui, the hemerology of its terrestrial movements, and Jupiter's subordination thereto, see Hu (2000) and Tao (2003: 73–97). The *Huainanzi* tells us that "of all the venerable spirits of Heaven none is more venerable than the Green Dragon, which is also called Heavenly Monad or Taiyin" 天神之貴者， 莫貴於青龍， 或曰天一， 或曰太陰 (*Huainan honglie jijie* 淮南鴻烈集解 [Zhonghua shuju ed.], 3.126). According to Li Ling (2006), the 'Bing bi Taisui' 兵避太歲 (Weapon to Avoid Taisui) *ge* 戈 dagger-ax discovered in 1960 in a Warring States tomb in Jingmen, Hubei, and the Mawangdui 'Taiyi bibing tu' 太一避兵圖 both depict Taisui/Taiyin as a (or all three) dragon assistant(s) to the north pole deity Grand Monad (Taiyi 太一). On Taisui's later incarnations as a wriggly lump of meat and a fungus, see Song (1999: 173–176).

It is clear that there is *some* empirical basis for planetary hemerologies, e.g. the sidereal periods of Jupiter (11.86 years) and Saturn (29.46 years), and Jupiter's roughly 13-month synodic period (398.88 days), but the calendar spirit model for planetary motion and visibility results in outstanding contradictions from the perspective of even early astronomy.[20] What *use*, then, is the planet-as-calendar-spirit? The answer, Cullen (2011b) suggests, is right there in the omen series in which these models are invariably embedded (and from which, one might add, they are invariably plucked). Likening these to Mesopotamian sources studied in Brown (2000), Cullen (2011b: 248–249) notes that "one of the advantages of schematic depictions of celestial motions is that they automatically generate portents through their divergence from what is actually observed." In other words, the four-season scheme for Mercury is a hemerological archetype that our sources transpose upon astronomical phenomena *expecting* the latter to deviate therefrom, the 'aberration' (*bu chang* 不常) for which they are prepared falling within the normal range of planetary behavior (i.e., that Mercury may indeed 'appear' in any given month or lodge). It is, therefore, the very 'absurdity' of this scheme to which it owes its relevance and utility.

3 The Mathematical *li* Models

Now that we have made some sense of the early materials, let us turn by way of comparison to the "motion-degree model" (*xingdu* 行度) for Mercury in Liu Xin's Triple Concordance system.[21]

> 水，晨始見，去日半次。逆，日行二度，一日。始留，二日而旋。順，日行七分度六，七日。順，疾，日行一度三分度一，十八日而伏。凡見二十八日，除逆，定行星二十八度。伏，日行一度九分度七有奇，三十七日一億二千二百二萬九千六百五分，行星六十八度四千六百六十一萬一百二十八分。凡晨見、伏，六十五日一億二千二百二萬九千六百五分，行星九十六度四千六百六十一萬一百二十八分。

20 On the case of Jupiter and Saturn in the *Planetary Omina*, see Morgan (forthcoming [b]).

21 On the Triple Concordance system and its planetary astronomy, see Nōda and Yabuuti (1947) and Teboul (1983). Later writers treat Liu Xin's work as a revision of the Grand Inception system rather than a standalone system; his basis in its lunar and solar parameters is clear, but there is no evidence concerning what if any planetary knowledge it contained, leaving us to assume that the Triple Concordance system's planetary astronomy is Liu Xin's innovation.

> 夕始見，去日半次。順，疾，日行一度三分度一，十六日二分日一。順，遲，日行七分度六，七日。留，一日二分日一而旋。逆，日行二度，一日而伏。凡見二十六日，除逆，定行星二十六度。伏，逆，日行十五分度四有奇，二十四日，行星六度五千八百六十六萬二千八百二十分。凡夕見伏，五十日，行星十九度七千五百四十一萬九千四百七十七分。一復，百一十五日一億二千二百二萬九千六百五分。行星亦如之，故曰日行一度。
>
> Mercury: First morning visibility at half a station (15°) from the sun. Retrograde: 2 *du* per day, 1 day. First station: 2 days, then circles back. Prograde: 6/7 *du* per day, 7 days. Prograde fast: 1 *du* & 1/3 *du* per day, then hides (sets). Visible for a total of 28 days, and, retrograde aside, travels a fixed 28 *du* through the stars. Hidden (last morning rising): 1 *du* & 7/9 plus change *du* per day, 37 days & 122 029 605 parts (of 134 082 297), travels 68 *du* & 46 610 128 parts through the stars. First evening visibility at half a station from the Sun. Prograde fast: 1 *du* & 1/3 *du* per day, 16 days & 1/2 day. Prograde slow: 6/7 *du* per day, 7 days. Station: 1 day & 1/2 day, then circles back. Retrograde: 2 *du* per day, 1 day, then hides. Visible for a total of 26 days, and, retrograde aside, it travels a fixed 26 *du* through the stars. Hidden in retrograde (last evening setting): 4/15 plus change *du* per day, 24 days, travels 6 *du* & 58 662 820 parts through the stars. Evening visibility and hidden for a total of 50 days, travels 19 *du* & 74 419 477 parts through the stars. One cycle: 115 days & 122 029 605 parts. Travel through the stars [in *du*] is the same, thus we say [its average motion is] 1 *du* per day.[22]

As we can see in Tab. 13.1, the Triple Concordance *li* model divides the planet's 115.9-day synodic period into morning and evening halves, each half being comprised of five more-or-less symmetrical grades. The grades are anchored to the planet's visibility phenomena—first and last morning risings (FMR/LMR) and evening settings (FES/LES)—and described the planet's mean speed and distance travelled over a fixed number of days. Apparent travel is measured in *du* of right ascension, one *du* being the distance travelled by the (mean) sun in one day (above). From FMR to LMR, and from FES to LES, the planet appears half a station (1/24 the circumference of heaven, i.e. 15°) from the sun, moves outward, then back, and disappears again at the same distance from the sun. As a result, the planet travels the same distance in *du* as does the sun from FMR

22 *Han shu*, 21B.1000.

TABLE 13.1 *Triple Concordance motion-degree model for Mercury* (*c.* A.D. *5*)
Note: Grey cells indicate values not supplied by the text itself. > signifies 'plus change' (you qi 有奇).

Grade		*Du* per day	Days	*Du* travelled
	Morning			
1	FMR, Retrograde	−2	1	−2
2	First station	0	2	0
3	Prograde	$\frac{6}{7}$	7	6
4	Prograde fast	$1\frac{1}{3}$	18	24
5	Hidden (at LMR)	$>1\frac{7}{9}$	$37\frac{122\,029\,605}{134\,082\,297}$	$68\frac{46\,610\,128}{134\,082\,297}$
	Evening			
6	FES, prograde fast	$1\frac{1}{3}$	$16\frac{1}{2}$	22
7	Prograde slow	$\frac{6}{7}$	7	6
8	Station	0	$1\frac{1}{2}$	0
9	Retrograde	−2	1	−2
10	Hidden, retrograde	$>\frac{4}{15}$	24	$-6\frac{58\,662\,820}{134\,082\,297}$
	Total	1	$115\frac{122\,029\,605}{134\,082\,297}$	$115\frac{122\,029\,605}{134\,082\,297}$

to LMR, from FES to LES, and from FMR to FMR; and since the distance travelled by the sun is, by definition, equal to the number of days travelled, so too does the days travelled and *du* travelled by the planet equal one another over these periods. When the planet is invisible around superior and inferior conjunction, on the other hand, it must travel a number of *du* equal to the number of days *plus or minus one station* to appear on the other side of the sun.[23]

It is fair to say that the Triple Concordance motion-degree model is *crude*. After all, it plots motion along the equator (i.e., in right ascension), and it fails to compensate for the considerable eccentricity of the planet's motions, the variability of its greatest elongation, or the seasonal variability its visibility phenomena. The result, in terms of what our historical subjects were looking for from such models, is that it produces errors upwards of 30° in right ascen-

23 For a lucid explanation of these principles, see Teboul (1983: 51–79).

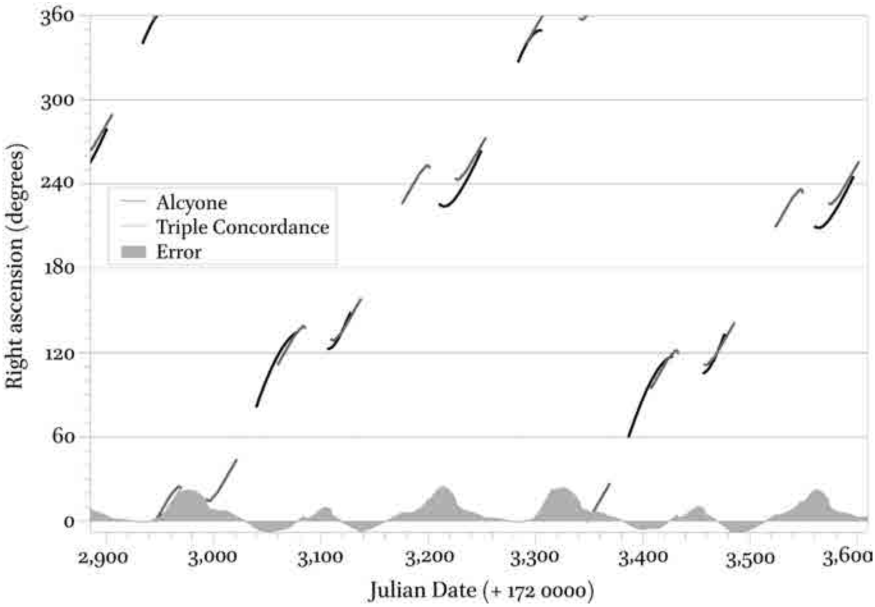

FIGURE 13.4 Li *model prediction of position and visibility for* A.D. *5–6*
Note: The Alcyone line was computed using Alcyone Ephemeris *v3.2, the breaks representing periods of invisibility as calculated by* PLSV. *The latter should be treated as a rough estimation, since here are numerous factors determining a planet's visibility that are beyond our ability to model mathematically. The Triple Concordance line was computed by the author using the instructions of the extant* li *manual, the results of which—*du *travelled from a fixed winter solstice point of Ox.$_{L09/28}$ 0 (β Cap)—were converted into degrees of right ascension travelled from said star and, from there, into right ascension.*

sion and misses expected visibility phenomena by upwards of 10 days at epoch (Fig. 13.4). It was sufficiently crude, at least, in the eyes of Liu Xin's predecessors for them to set upon improving it right away, introducing quantitative, theoretical, and algorithmic improvements to his framework over the subsequent centuries.[24] That said, it would be difficult to accuse the early *li* model of being *absurd*: it was, as Fig. 13.4 shows, clearly onto something.

24 On planetary astronomy in later systems, see Qu (2008: 532–628). For a look at what these models would become at their high point, see Sivin (2009: 516–550).

4 The History of Post-*li* Planetary Hemerology

Whether hemero-omenological *tian-wen* models *developed into* mathematical *li* models, or whether the latter *evolved from* the former, is probably the wrong question to be asking. Aside from the incommensurability of context, developmental continuity is, at very least, a matter this author has no idea how to prove. A better question might whether the one model *replaced* the other. This it did not. By my accounting, variations on the four-season scheme appear in no less than twenty-six sources spanning a period of 900 years. The nature of *tian-wen* omen literature makes it difficult to establish concrete dates and provenances for many of these sources: it is a genre within which anonymity, pseudepigraphy, and borrowing is rampant, and in which the majority of sources survive only in citation, manuscripts of questionable origin, or both. That said, titles, bibliographies, and plausible attestations offer us a number of clues sufficient to establish a rough chronology, which I offer in Tab. 13.2.

The fact that people continued to *copy* planetary hemerologies over this period tells us very little about their viability as living knowledge. For sure, Gautama copied them, but his attitude was more that of a collector intrigued by old and ridiculous curios in need of conservation. How long before his day was it, we might ask, that these models made the transition from fact to artefact? Let's set a lower limit: A.D. 479 February 24. It is on this date that the *Book of Southern Qi*'s *tian-wen* treatise records an omen reading made on the basis of our four-season Mercury model that was memorialized to sanction Xiao Daocheng's 蕭道成 (A.D. 427–482) assumption of the throne from the last Liu-Song 劉宋 (A.D. 420–479) emperor that very year:

> 昇明三年正月十八日，辰星孟効西方。占曰『天下更王』。
>
> [Song Shundi 順帝], Rising Enlightenment 3–1–18 (A.D. 479 February 24): the Chronogram Star appeared in the west in the first month of the season. The omen interpretation states: "the sub-celestial realm will change kings."[25]

This is the last of six extant records in the standard histories in which where the un-hemerological behavior of Mercury is noted and interpreted. The others are concentrated in and around the Han. The first is Liu Xiang's 劉向 (79–8 B.C.) recollection that, amid other omens, "the Chronogram Star emerged in the four

25 *Nan Qi shu* 南齊書 (Zhonghua shuju ed.), 12.204.

TABLE 13.2 *Four-season schemes for Mercury in* tian-wen *omen literature*

No.	Author	Text	Date	Source
1	Wuxian 巫咸?	anon.	?	KYZJ53.4, 8–9, 10
2	Shi Shen 石申?	anon.	?	KYZJ 53.4, 8
3	Gan De 甘德?	anon.	?	KYZJ 53.4, 8
4	anon.	*Wu xing zhan* 五星占	168 B.C.	extant (MS)
5	Liu An 劉安 et al.	*Huainanzi* "Tianwen xun" 淮南子·天文訓	139 B.C.	extant
6	Sima Qian 司馬遷	*Shiji* "Tianguan shu" 史記·天官書	91 B.C.	extant
7	Li Shuo 李朔?	*Wuling ji* 五靈紀	W. Han?	TWYL 10.1b–2a
8	Liu Xiang 劉向	*Hongfan zhuan* 洪範傳	1st cent B.C.	KYZJ 53.2–3, 9
9	Li Xun 李尋	petition	c. 6 B.C.	*Han shu*, 75.3187
10	anon.	*Chunqiu* weft 春秋緯	1st cent	KYZJ 53.3, 8
11	anon.	*Kaolingyao* 考靈耀	1st cent	KYZJ 53.8
12	anon.	*Luo shu* 洛書	1st cent	KYZJ 53.3
13	anon.	*Shangshu* weft 尚書緯	1st cent	KYZJ 53.4
14	anon.	*Yuanmingbao* 元命苞	1st cent	KYZJ 53.8
15	anon.	*Yuanshenqi* 元神契	1st cent	KYZJ 53.4
16	anon.	*Haizhong zhan* 海中占	1st cent ?	KYZJ 53.9
17	Ban Zhao 班昭	*Han shu* "Tianwen zhi" 漢書·天文志	111	extant
18	Liu Biao 劉表 & Liu Rui 劉叡	*Jingzhou zhan*荊州占	2nd cent.	KYZJ 53.2, 9–10
19	Huangfu Mi 皇甫謐	*Nian li* 年曆	3rd cent.	KYZJ 53.4
20	Jin Zhuo 晉灼	commentary	4th cent. ?	*Shiji*, 27.1372
21	Li Chunfeng 李淳風	*Jin shu* "Tianwen zhi" 晉書·天文志	646/48	extant
22	Li Chunfeng 李淳風	*Sui shu* "Tianwen zhi" 隨書·天文志	641/56	extant
23	anon.	P. 2811	Tang ?	extant (MS)
24	Puyang Xia 濮陽夏?	*Qiaozi wuxing zhi* 譙子五行志	Tang	extant (MS)
25	Li Feng 李鳳?	*Tianwen yaolu* 天文要錄	664	extant (MS)
26	Gautama Siddhārtha 瞿曇悉達	*Kaiyuan zhanjing* 開元占經	729	extant

first months of the seasons" 辰星出於四孟 during the reign of Qin Ershi 秦二世 (r. 209–207 B.C.) to presage the fall of the Qin 秦 (221–206 B.C.).[26] The second is yet another later recollection of the same phenomenon but in 204 B.C. and presaging, this time, the Han conquest of Chu two years later.[27] The third is a record Mercury's early appearances on 1-IV-*renxu*.$_{59}$ (73 B.C. May 9) and 2-VII-*xinhai*.$_{48}$ (72 B.C. Aug 16 ?) of Han Xuandi's 宣帝 Foundational Beginning reign (73–70 B.C.) as presaging the execution of an unnamed minister.[28] The fourth is a vague description of Mercury having "not appeared in a long time" 久而不効 and "missed the mark of its calculated position" 失行筭度 in the years leading up to the Nanyang rebellion of A.D. 30 in the context of a letter written by Su Jing 蘇竟 to dissuade a friend from joining the rebels.[29] The fifth is a record of the planet having "appeared before it ought to appear" 未當見而見 in Han Guangwudi 光武帝 30-IV^2-*jiawu*.$_{31}$ (A.D. 54 June 09), whereupon it turned into a comet and presaged a devastating flood and, three years later, the death of Guangwudi himself.[30]

There is a lot we might think to demand of these records. Were the phenomena real, or hoaxes perpetrated for political ends? Were the omen interpretations (*zhan* 占) and correspondences (*ying* 應) contemporaneous with observation/fabrication, or the products of later imaginations? Furthermore, given the frequency with which the planet violates the hemerology, what does the number of these records say about the selectiveness of the practice of *tian-wen* divination and/or *tian-wen* monograph compilation? These are good questions around which a significant body of secondary literature has developed;[31] they

26 *Han shu*, 36.1965; *Shuoyuan* 說苑 (Siku quanshu ed.), 18.3a–b.

27 *Han shu*, 26.1302.

28 Ibid., 26.1308. According to Zhang (1997), 2-VII began on *jiayin*.$_{51}$ (72 B.C. August 24), placing *xinhai*.$_{48}$ at the end of month VI, meaning that either the month or the sexagenary day is incorrect. PLSV confirms that Mercury, which was setting around 50 min after the Sun, could have conceivably been visible around this time. Since the text describes this emergence as 'early' (*zao* 早)—i.e. in the first month of autumn (month VII) rather than the last month of summer (month VI)—I suspect that it is the sexagenary day that is incorrect.

29 *Hou Han shu*, 30A.1043–1044.

30 Ibid., *zhi* 10, 3223.

31 On the sources, veracity, political manipulation, and historiographical functions of omen records, see, for example, Bielenstein (1950), Eberhard (1957), De Crespigny (1976), Kern (2000), and Huang (2004: 1–92). I tackle these questions as concerns Li Chunfeng's 李淳風 (A.D. 602–670) compilation of the *Book of Sui* and *Book of Jin* monographs in Morgan (forthcoming [a]).

are, on the other hand, besides the point. However selective, biased, or disingenuous these records may be, they confirm a chronology of credibility: that planetary hemerologies saw use in *some* application of *tian-wen* omen reading; that intellectuals—*tian-wen* experts, statesmen, and historians—continued to apply them centuries after the emergence of mature *li* models; and that they possessed sufficient intellectual currency in A.D. 479 to inform the Qi court's legitimation strategy and, once again, *circa* A.D. 537 when Qi scion Xiao Zixian 蕭子顯 (A.D. 489–537) wrote it into their standard history.

So, the four-season Mercury model was alive in practice, but how about in theory? In the genre of theoretical/practical omen literature, we see so much variation between individual models and omen series as to suggest that practitioners continued to tweak and expand the rules of the model well into the first millennium A.D. As we will recall from above, the models follow the same form but feature different verbs, dates, lodges, and sequences of morning/evening visibility. Likewise, the omen series all agree on the fundamentals: under normal circumstances, Mercury rises or is visible around the solstices and equinoxes; doing so, it rectifies the agricultural order, while failing to do so signals immanent disaster for agriculture, the populace, and the state (being the 'water planet', Mercury-related catastrophes often involve water); and this is so because the planet's timeliness is correlatively bound up in the timeliness and propriety of government action. Our sources, however, develop upon these fundamentals with different apodoses and different levels of specificity concerning the protases (see Tab. 13.3). Is the time right or wrong? If wrong, is it early or late? What about the lodge? In which season is it off? For how many seasons is it off? Between the model and the omen series, we find just about every conceivable permutation across our sources, no two of which are quite the same. At one point I compiled these permutations into a spreadsheet with the hope of revealing patterns of filiation and development between them, but this proved pointless: the permutations are simply too random (see Tab. 13.4), the result, the author imagines, of concerted innovation by generations of practitioners.

TABLE 13.3 *Mercury four-season omen series*

No.	Protasis	Apodosis
1a	If it does not rise when it ought to	armies arise
1b		[the state] pursues armies abroad but does not engage them in battle.
2	If it rises when it ought not to	cold/hot inversion, general environmental collapse
3	If it rises in the four mid-season months	the world is at peace/harmony
4	If it rises between Heart.$_{L04}$ and Chamber.$_{L05}$	earthquake
5	If it does not rise in the four mid-season months	disasters, famine, crop failure, yin-yang out of control, state collapse, seasonal disturbances, people injured, and lord and minister in disharmony
6a	If it rises early/in the four first-months	regime change
6b		lunar eclipse
7a	If it rises late/in the four last-months	comet, demonic celestial portents, state collapse
7b		army broken, general killed
7c		marquis do not report in
8a	If it does not rise for (1) one or (4) any season	(1) said season disadvantageous/disharmonious, (4) famine
8b		(4) cold/hot inversion
9	If it does not rise for one, two, three, or all four seasons	(1) said season in disharmony, armies arise; (2) said seasons in disharmony and/or a flood; (3) said seasons in disharmony and a big military uprising; (4) famine, dam breach and flood killing the populace and/or comet in the east
10a	If it does not appear in a specific season or none at all	(spring): 100 days of violent wind and rain, harming sprouts; (summer): drought, famine, 90 days of population displacement; (autumn): 60 days of floods; (winter): five grains not stored, population death and displacement; (None): river and sea waves, comet.
10b	… and it does not appear in correct lodge	(Seasons): same as above. (Lodges): crops damaged
11	If punishments and rites are not in proper order	Mercury does not rise on time, there are seasonal disturbances (leading to 2 and 3 above)
12	If government is (1) fast, (2) slow, or (3) stalled	(1) mercury is fast, (2) slow, or (3) hides and transforms into a comet
13	If there is a mistake in (civil) administration in winter	Mercury does not appear at the correct time / in the correct direction

TABLE 13.4 *Mercury model & series permutations*
Legend: 'No.' refers to the source numbers on Tab. 13.2. Under 'time', 'm' = (mid-season) month, 'S/E' = solstices and equinoxes, and 'S/E+1d' = within two days of the solstices and equinoxes. Under 'seq.', 'M' = morning, and 'E' = evening. Under 'L', we have the following lodge sequences: A = 16 → 23 → 02 → 09; B = 15 → 22 → 03 → 10; C = 15 & 16 → 22 → 1 & 2 → 8 & 9; D = several lodges east/west of the sun (for lodge numbers, see Tab. 13.2). For the omen series, see Tab. 13.3.

No.	Model				Omen formulae																		
	time	seq.	verb	L	1a	1b	2	3	4	5	6a	6b	7a	7b	7c	8a	8b	9	10a	10b	11	12	13
1	M	–	出	A							X		X		X			X	X	X			
2	m+S/E	EEEM	出	A	X					X	X												
3	S/E		效	D																			
4	S/E	–	效	A			X		X		X	X	X			X							
5	m+S/E	–	効	C												X							
6	m+S/E	EEEM	出郊	D		X			X			X	X			X							
7	S/E+1 d	MMEE	見	B																			
8	M							X		X	X												
9	M										X		X									X	
10	S/E	EEEM	出	-			X											X					
11	ssn																						X
12	S/E+1 d	MMEE	見	B																			
13	ssn																				X		
14	ssn																						X
15	m							X															
16	m											X	X										
17	ssn				X		X									X							
18	m	–	出	A			X	X			X		X					X	X		X		
19	m+S/E	EEEM	效	C																			
20	m+S/E	–	見	C																			
21	ssn				X		X									X							
22	ssn				X		X		X							X							
23	m+S/E	EEE?	出	D																			
24	M					X	X				X			X			X	X					
25	collectania																						
26	collectania																						

5 The Death of the Hemerological Planetary Model

We have shown there to have been plural traditions of planetary model operative at the same time, but serving different practices, questions, and professions, which is an important step for a field that tends to talk in terms of monolithic traditions. It is crucial, in my opinion, that we continue to break 'the Chinese tradition' down into a more human scale, down to the level of the tools, the practices, the questions, the individuals and collectives involved in their pursuit, and the private and institutional contexts in which these pursuits were carried out. We cannot easily leave things here, though, because the question of plurality raises the equally engaging question of dialogue.

Let us recollect our historical scope: we know *tian-wen* planetary models to have coexisted as living knowledge with *li* from at least A.D. 5 to A.D. 537 before dropping out of practical *tian-wen* literature as 'absurd' 'old' curios by Gautama's time in the eighth century. So, what was it that happened between the sixth to eighth centuries A.D.? One thing that happened was that *li* experienced something of a revolution with Zhang Zixin's 張子信 (fl. A.D. 526–576) introduction of solar and planetary speed corrections and algorithms for the seasonal variability of visibility phenomena, which his more politically stalwart disciples Zhang Mengbin 張孟賓 and Liu Xiaosun 劉孝孫 (d. A.D. 632) would spend decades bringing into the mainstream.[32] It just so happens that we see dramatic changes in *tian-wen* at around the same time. Beginning with Xiao Zixian's *Book of Southern Qi* of *circa* A.D. 537, we see a shift in the organization of *tian-wen* monograph astronomical records from the court—one court, one chronicle—to omen typology—one phenomena-class, one chronicle. These typologies, it is worth noting, coincide quite neatly with phenomena that we today would expect (if not worry ourselves about) from celestial bodies;[33] there are, historically, very few records of planets "going off course" (*shi du* 失度), but where there are, after A.D. 479, it is clear that the norm by which we judge deviation is no longer the calendar spirit archetype. This change roughly coincides with a parallel trend in the compendia, where we see elite

32 On Zhang Zixin and the eventual implementation of his techniques into official *li*, see Chen Meidong (2003: 298–303), Chen Jiujin (2008: 186–196), and Zhang et al. (2008: 425–457).

33 In the case of planets, for example, we have 'encroachment' (*fan* 犯), 'occultation' (*yan* 掩), 'holding' (*shou* 守) in station, 'daylight visibility' (*zhou xian* 晝見), 'conjunction' (*he* 合), and 'amassing' (*ju* 聚). On *tian-wen* omen terminology, see Ho (1967: 21, 34–41) and Zhuang (2009: 122–123, 128–131).

compilers begin to replace the old-style hemerological models and omen series with computational *li* models. We see this first with Yu Jicai's 庾季才 (A.D. 516–603) *Secret Garden of the Observatory* (*Lingtai miyuan* 靈臺秘苑) of *circa* A.D. 580, then again in Li Chunfeng's 李淳風 (A.D. 602–670) *Yisi zhan* 乙巳占 of A.D. 656, and, by point of criticism (above), in Gautama's *Kaiyuan Omen Classic*.[34]

Something happened in the sixth century A.D., it would seem, something big. Jiang (1991: 383) suggested that we might someday uncover evidence of Indian influence upon Zhang Zixin's work—an influence prior to the days of the seventh and eighth century A.D., when Indian lineages like the Gautamas came to run the Tang astronomical office, that might help explain the one-century disconnect between the revolution in *li* and the sudden foothold of foreign experts thereupon.[35] It is a compelling thought, but nothing of Zhang's work survives, and it is difficult to imagine anyone more isolated from outside influence than the man who "went into hiding on a sea island for more than thirty years were he devoted himself to the observation via [armillary sphere] of data on the differences and changes in the sun, moon, and [planets]" 隱於海島中， 積三十許年， 專以渾儀測候日月五星差變之數.[36] But what happened in the sixth century, more to the point, was something bigger than just *li*, it was something that left the course of *both* astral sciences permanently altered.

We have, to be fair, painted too neat a picture thus far: it is not as if *tian-wen* and *li* existed in total isolation up to some hypothetical point of singularity in the sixth to eighth centuries A.D. First of all, the fact of the matter is that the four-season model for Mercury continues to appear in post-sixth-century texts. Some of these, like the *Kaiyuan Omen Classic* and Li Chunfeng's *Book of Sui* and *Book of Jin* monographs, are academic compilations with a clear

34 See *Lingtai miyuan* (Siku quanshu ed.), *j.* 9; *Yisi zhan*, *j.* 4–6; *Kaiyuan zhanjing*, *j.* 23.2b–3a, 30.4a–b, 38.2b–3a, 45.2b, 53.3a (commentary). Note that Yu Jicai's work underwent significant changes in the eleventh century, when Wang Anli 王安禮 (A.D. 1034–1095) et al. redacted it from 120 or 115 *juan* 卷 (*j.*) to 15 and added contemporary observational data to it. On this, see *Qianding Siku quanshu zongmu* 欽定四庫全書總目 (Siku quanshu ed.), 108.27b–29a; cf. Pan (1989: 190). The fact, however, that the *Secret Garden of the Observatory*'s planetary models are corrupt and look very much like those of the *Yisi zhan* and *Kaiyuan Omen Classic*, however, suggests to the author that they are original; even if they are not, however, they are simply a *later* example of the same trend. I explore the question of change in *tian-wen* literature in further depth in Morgan (forthcoming [a]).

35 The question of foreign influence on Zhang Zixin's work is pursued in Niu (2004: 162–175). On the introduction of Indian astronomy into China, see Note 8.

36 *Sui shu*, 20.561.

historical bent (with remarks upon the limits of ancient knowledge). Still others, however, present themselves as simple collections of facts about heaven, e.g. the anonymous Dunhuang manuscript P. 2811 and the problematic *Master Qiao's Five-agents Monograph* (*Qiaozi wuxing zhi* 譙子五行志) (sources 23 & 24 on Tab. 13.2), and, beyond the scope of Tab. 13.2, works of textual scholarship with a classicist bent, for whom the ancient bears repeating, like the *History of Song* monograph (A.D. 1346) and Ming Renzong's 明仁宗 (r. A.D. 1424–1425) *Heavenly Epoch Jade* li *Auspices & Oddities Rhapsody* (*Tianyuan yuli xiangyi fu* 天元玉歷祥異賦) of 1425 (both heavily informed by Li Chunfeng).[37] If we are to maintain some sort of sixth-century singularity event we must, therefore, make a distinction between 'expert' and 'non-expert' (or 'popular') manifestations of the astral sciences in China.

Second, Gautama Siddhārtha was not the first to criticize the *tian-wen* models; the history of such criticism, in fact, goes back to the very beginnings of the astral sciences. In the first century B.C., for example, Sima Qian criticizes (two of) the Three Experts for misunderstanding what constitutes meaningful anomaly:

> 故甘、石曆五星法, 唯獨熒惑有反逆行；逆行所守，及他星逆行，日月薄蝕，皆以為占。… 余觀史記，考行事，百年之中，五星無出而不反逆行，反逆行，嘗盛大而變色 … 此其大度也。… 水、火、金、木、填星，此五星者，天之五佐，為（經）緯、見伏，有時，所過行贏縮有度。… 凡天變，過度乃占。
>
> In the old Gan [De] and Shi [Shen] methods for *li*-computing the [planets] only [Mars] had retrogradation. They took the [asterisms] it guards in retrograde, the retrogradation of other [planets], and the veilings and eclipses of the Sun and Moon all as the objects of omen-interpretation … I have looked at the Clerk's [historical] records and investigated phenomena as they happen, and [I discovered that] in a hundred years the five [planets] have never once emerged without going into retrograde; and when they retrograde they invariably become grand and change color … this is their great *du* (measure/norm) … [Mercury], [Mars], [Venus], [Jupiter], and [Saturn]—these five stars are the five assistants of Heaven. As for their actions in warp and weft (i.e., declination and right ascension), and their appearance and hiding, [everything] has its time, and the

37 Specifically, see *Qiaozi wuxing zhi*, 5.2b; *Song shi* 宋史 (Zhonghua shuju ed.), 52.1074; *Tianyuan yuli xiangyi fu*, 771.

> gain and retreat by which they exceed their [expected] travels have their norms … With celestial incidents, one only performs omen interpretation when they have exceeded their norms.[38]

This rather lengthy criticism occurs at the end of his 'Heavenly Offices Monograph', one of the first and most important entries in the *tian-wen* genre. Sima Qian is quite serious in his devotion to omenology, including the four-season model for Mercury (which appears quite developed in his monograph), it is simply that his seriousness demands that he address manifest absurdities in what constitutes normal (*chang*) behavior via the accumulated observational experience to which he was privy.

The author of the *Book of Han* monograph takes a different approach,[39] attempting instead to rationalize Gan De and Shi Shen's planetary models in terms of man's fall from sagetimes:

> 古曆五星之推，亡逆行者，至甘氏、石氏經，以熒惑、太白為有逆行。夫曆者，正行也。古人有言曰：「天下太平，五星循度，亡有逆行。日不食朔，月不食望。」… 熒惑主內亂，太白主兵，月主刑。自周室衰，亂臣賊子師旅數起，刑罰失中 … 故二星與月為之失度，三變常見 … 甘、石氏見其常然，因以為紀，皆非正行也。詩云：「彼月而食，則惟其常；此日而食，于何不臧？」詩傳曰：「月食非常也，比之日食猶常也，日食則不臧矣。」謂之小變，可也；謂之正行，非也。故熒惑必行十六舍，去日遠而顓恣。太白出西方，進在日前，氣盛乃逆行。及月必食於望，亦誅盛也。

> The calculation of the five [planets] in ancient *li* lacked retrogradation until Mr. Gan & Mr. Shi's canons, which ascribed it to [Mars] & [Venus]. *Li* is a matter of proper/forward behavior. The ancients had a saying that "When the sub-celestial realm is in grand peace, the five [planets] obey their *du*/norms without retrograding; the sun neither eclipses at

38 *Shiji*, 27.1349–1351.

39 The authorship of the *Book of Han* "Heavenly Patterns Monograph" is a perplexing problem. Beginning with the *Book of Later Han*, subsequent *tian-wen* monographs attribute its authorship to Ma Xu 馬續 (fl. A.D. 119–141) (see *Hou Han shu*, *zhi* 10, 3215; *Jin shu* 晉書 [Zhonghua shuju ed.], 11.278). Elsewhere, however, the treatise is attributed both to Ban Zhao 班昭 (c. A.D. 45–c. 117) and to Cai Yong 蔡邕 (A.D. 133–192) and Qiao Zhou 譙周 (A.D. 199–270) (see *Hou Han shu*, 84.2784 & *zhi* 10, 3215 [commentary]). On the composition of the *Book of Later Han* treatises, with comments on their predecessors, see Mansvelt Beck (1990: 56–63).

> new moon, nor the moon at full moon." ... [Mars] governs internal strife, [Venus] governs soldiers, and the moon governs punishment. Ever since the decline of the house of Zhou (in 771 B.C.), rebellious ministers and traitors have led armies in numerous uprisings, and punishments (i.e., the law) have missed the mark ... and thus it is that the two [planets] and the moon miss their *du*/norms and the three (aforementioned) incidents are normally (*chang*) seen ... Gan & Shi saw that this was normally (*chang*) so and, therefore, took it as a cycle, *but none of this is proper behavior*. The *Odes* say, "The moon eclipsed was what full oft takes place; the sun's eclipse portends a sadder case."[40] [But], the (commentary) tradition to the *Odes* states that "Lunar eclipses are not 'normal'; but they are *more* 'normal' in comparison to solar eclipses, [which is why] it is solar eclipses that are 'horrible'." To refer to this as a 'small incident' is fine, but not 'proper behavior'. Thus, [Mars] necessarily goes off and does as it pleases after travelling sixteen lodges and placing itself at a distance from the sun; and [so too] for Venus [when] it emerges from the west and advances right up to the sun, retrograding in the flourish of *qi*; and [so too], also, when we come to the moon, which necessarily eclipses at new moon as executions too flourish.[41]

In a brilliant exercise of word play and classical scholarship, the *Book of Han* monograph offers us a way to reconcile the truth of experience with the truth of ancient textual authority: to distinguish between what is 'normal' and what is 'proper' for planets to do. This conceit may well have relieved a certain degree of cognitive dissonance among men learned in both sciences.

Still, something has changed. We are a long ways here from the world of anonymous free-floating facts listed, borrowed, and developed upon in early and/or 'popular' technical literature. We are dealing, instead, with *positions*, which our monograph authors attribute with increasing clarity to historical figures and to the books, like them, that they supposedly authored—positions formed in a historical context for historical reasons (be it *li*-ological ignorance or political moralism) in need of historical elucidation. What is more, even their apologists cannot help but frame the matter in terms of *li*—"the calculation of the five [planets] in ancient *li* ..."—placing the *tian-wen* model in an awkward (and unsustainable) position.

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40 Citing "Shiyue zhi jiao" 十月之交, *Mao shi zhushu* 毛詩注疏 (Siku quanshu ed.), 19.33a; tr. Legge (1876: 229).

41 *Han shu*, 26.1290–1291.

In the next standard history monograph to offer a catalogue of omina, the *Book of Sui* "Heavenly Patterns Monograph" (A.D. 641/656), Li Chunfeng likewise inserts himself into the body of the catalogue to address the problem of old fashioned planetary models, framing them, likewise, in terms of *li*:

> 古曆五星並順行，秦曆始有金火之逆。又甘、石並時，自有差異。漢初測候，乃知五星皆有逆行，其後相承罕能察。
>
> In ancient *li*, the five [planets] all travelled prograde, it was only in Qin (3rd cent. B.C.) *li* that we first had the retrogradation of [Venus] & [Mars]. Furthermore, though Gan [De] & Shi [Shen] were contemporaries, they had their differences. Only after early Han observations (Sima Qian's?) was it known that the five [planets] all experience retrogradation. Afterwards, this [knowledge] carried on, but few were capable of investigating the matter further.[42]

After an extended account of Zhang Zixin's accomplishments vis-à-vis *li*—accomplishments otherwise covered in Li Chunfeng's *li* monograph in the selfsame history—he then concludes on a note similar to Sima Qian's:

> 後張冑玄、劉孝孫、劉焯等，依此差度，為定入交食分及五星定見定行，與天密會，皆古人所未得也。
>
> Later, Zhang Zhouxuan 張冑玄 (d. c. 613), Liu Xiaosun, Liu Zhuo 劉焯 (A.D. 544–610), et al. went by this equation-degree in [their work on] the fixed (true) crossing-entry eclipse index and five-[planet] fixed appearance & fixed motion, and it tightly accorded with heaven—*all things that the ancients did not yet get*.[43]

Li Chunfeng is, by way of our original question, an excellent example of the force, in this author's opinion, behind the change in *tian-wen* omen literature: the growing involvement of *li* experts in its (re)production after the wave of original production began to taper off in the third century A.D. (coinciding, perhaps only by coincidence, by a series of public bans on *tian-wen* from the fourth century A.D. on).[44] Historical monographs aside, it was in the period

42 *Sui shu*, 20.561.

43 Ibid.

44 On the history of these bans, see Whitfield (1998), Chen Meidong (2007: 17–32), and Lü (2003: 35–81).

after the fall of the Han that we begin to see professionals and renowned *li* experts like Gautama, Li, and Yu Jicai—all of whom, it is worth noting, served as directors of their respective courts' astronomical offices (Prefect Grand Clerk, or PGC)—produce the enormous compendia that would begin to define the field. Very little of the prior literature survives independent of their efforts, but what we can tell from extant bibliographies suggests that this trend was centuries in the making. Sun-Wu 孫吳 (A.D. 220–280) PGC Chen Zhuo 陳卓, for example, compiled a *Heavenly Patterns Collected Omina* (*Tianwen ji zhan* 天文積占) in 10 *j.* and a *Heavenly Offices Star Omina* (*Tianguan xing zhan* 天文星占) in 10 *j.*, while Jin 晉 (A.D. 265–420) PGC Han Yang 韓楊 compiled a *Heavenly Patterns Essential Collection* (*Tianwen yao ji* 天文要集) in 40 *j.*[45] The current version of Gautama's *Kaiyuan Omen Classic* comes in at 120 *j.*, and Li Chunfeng's *Yisi zhan* at 10 *j.*; Yu Jicai, in addition to his 115/120-*j. Secret Garden of the Observatory*, also compiled a *Monograph on Hanging Signs* (*Chui xiang zhi* 垂象志) in 120/148 *j*, for example, and celebrated mathematician and *li* man Zu Geng 祖暅 …, son of Zu Chongzhi 祖沖之 (A.D. 429–500), compiled a *Record of Heavenly Patterns* (*Tianwen lu* 天文錄) in 30 *j.*[46] To put the scale of these compendia into perspective, the *Book of Sui* bibliographic treatise records 97 works in 675 *j.* in the Sui 隋 (A.D. 581–618) imperial holdings; the aforementioned 8 works alone, by contrast, amount to 455/488 *j.*

Men like Li Chunfeng began to take over the field of *tian-wen* at the top—men at the forefront of *li* who knew better than to treat the planetary hemerology of the bygone era as anything other than the well-meaning but malinformed forerunner of their science.[47] The result was not singularity *per se*, but the historical circumscription of these curios to a place where they remain to this day. I bring up Li Chunfeng here because his is the most interesting cross section of attitudes towards planetary models, given that what survives of his work covers three different treatments of the topic: in his standard history monograph (finished A.D. 648–656), as previously noted, he introduces early *tian-wen* models with a note of historical explanation; in his Unicorn Virtue system (*Linde li* 麟德曆; inst. A.D. 655), he further develops the modern *li* models; and in his practical *tian-wen* compendia of A.D. 656, he provides *li*-styles models as omenological norms. What is particularly interesting, though it brings us beyond the scope of the present article, is that the *li* mod-

45 *Sui shu*, 34.1018–1019.

46 Ibid., 20.561, 34.1019, 78.1767.

47 On Li Chunfeng, see Chen Meidong (2003: 350–357) and Goodman (forthcoming).

els included in in *Yisi zhan*—as well as those found in Gautama and Yu Jicai's compendia—are radically simpler than we would expect from the state of the field in those times.[48] Sadly, these models are given little explanation, suffer from significant corruption, and have received no scholarly attention to date; were we to pursue the matter further, one imagines, one might find further evidence of plural cultures of practice lurking beneath the surface of 'the Chinese tradition'.

6 Conclusion

The astral sciences in China have always been part of a larger struggle to impose order upon a world teetering ever on the brink of chaos. The obsession with order lay behind the millennia-long outpour of observations, innovations, and refinements that drove the sciences forward; it lay also, I have attempted to show here, behind successive reimaginings of their past. The case of planetary models is revealing of the sort of ruptures that we might expect to find within the Chinese astral sciences and the discomfort we might expect them to have engendered among historically-minded experts. We began with the *tian-wen/li* framework, ruminating upon our subjects' division of practices, professions, and textual genres into juxtaposed fields. We saw that models labelled astronomically 'absurd' make sense in form and function when considered within the contexts in which we find them, and, emphasizing how the two thrived side-by-side through the centuries, questioned the assumption that the 'old' *tian-wen* models evolved into the modern *li* by which they have long been judged. Lastly, we saw how the tensions between the two seem to have erupted around the sixth century A.D., when a combination of events saw their transition into historical obscurity and eviction from expert/elite *tian-wen* literature in favor of quantitative *li*-based norms of meaningful anomaly. Moving forward,

48 See the references provided in Note 34. Unlike the *li* of its day, for example, the *Secret Garden of the Observatory* appears to use a very small denominator for the fractional parts of different grades' duration and distance; the numbers, however, are so corrupt that it is difficult to reconstruct. The *Yisi zhan* uses larger denominators befitting contemporary motion-degree models as well as a seasonal algorithm for adjusting the predicted dates of mean visibility phenomena; however, unlike contemporary models, it does not include procedures for calculating respective speed corrections. The planetary models of the *Yisi zhan* appear to be completely distinct from those of Li Chunfeng's Unicorn Virtue system instituted the year prior to its completion, for which, see *Jiu Tang shu* 舊唐書 (Zhonghua shuju ed.), 33.1175–1219.

therefore, it is my hope that when we encounter statements about "the Chinese tradition of planetary astronomy" we might rightfully ask "which one?"

This paper began years ago as a study of citation practices, in which I attempted to come to grips with what is (in my opinion) one of the most glaring problems posed by these sources: the discrepancy, noted above, between the generally accepted dates of the Three Experts' star canons (1st cent. B.C.–3rd cent. A.D.) and planetary models (4th–3rd cent. B.C.). The additive nature of their respective canons, recognized, for example, by Qian Baocong 錢寶琮 (1983), goes a long way to accommodate this contradiction.[49] So too does the clearer understanding we now possess of the manuscript culture within which the astral sciences were practiced, developed, transmitted, and consumed at this time. Liu Lexian 劉樂賢, for example, has revealed parallels between the second-century B.C. *Planetary Omina* MS and first-century A.D. (?) weft texts so considerable as to suggest that such literature was not so much *authored* as it was drawn together from a common (and anonymous) pool of omen lore.[50] If authorship was an idea imposed upon this literature only later in an attempt by technically-minded literati to collect and organize it along familiar lines, this too might explain the hodgepodge of old and new in these works. What I want to point out, however, is that the apparent contradiction—the hodgepodge—is one of our own making based on centuries-old assumptions about the teleological nature of astronomical knowledge. If, instead, we step back and look at the world through the categories by which actors organized their intellectual world prior to Gautama Siddhārtha and Li Chunfeng's day, we might rediscover the logic of the absurd.

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49 Note that the *Kaiyuan Omen Classic* is not explicit about its sources for the Three Experts, so it is also possible that the planetary models with which they have been attributed derive separately from, for example, any one of the several works (now lost) attributed to them in later commentary and bibliography.

50 See Liu (2002: 341–351) and Liu (2007). On a similar note concerning the anonymous manuscript transmission of hemerological knowledge over the same period, see Kalinowski (2008) and Harper (2010).

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CHAPTER 14

Calendrical Systems in Early Imperial China: Reform, Evaluation and Tradition

Yuzhen Guan

1 Calendrical Reforms in Early Imperial China

In imperial China the importance of a calendrical reform lay not only in the development of astronomical theories, but also in the political significance of the calendrical system (*li* 曆) to the ruling of the state.[1] An accurate calendrical system acts as a symbol that the country is governed by an appropriate ruler who follows the will of Heaven. The calendrical system is therefore a reflection of the Mandate of Heaven and is important for demonstrating imperial legitimacy. Thus, a calendrical system needs to be issued and accepted when a new dynasty or a new emperor came to power, as is explained in the following passages from the *Shi ji* 史記 and the *Han shu* 漢書:

> 王者易姓受命，必愼始初，改正朔，易服色，推本天元，順承厥意。
>
> When a new dynasty rose by accepting the Heavenly Ordinance, at first it had to be prudent. It had to obey the will of Heaven by renewing the basis of all things: the calendar and the color.[2]
>
> 帝王必改正朔，易服色，所以明受命於天也。創業變改，制不相復。
>
> It is to demonstrate his acceptance of the Heavenly ordinance that the emperor should reform the calendar and the color. In founding a new dynasty, the emperor should not depend upon former institutions.[3]

Reform of the calendrical system is usually prompted by one of two situations: the emperor orders his officials to construct a new system, or an astronomer

1 I use either *li* or "calendrical system" as the English translation of Chinese *li* 曆. See Guan Yuzhen (2015), footnote 2 for an explanation of my choice of translation for this term.

2 *Shi ji*, chapter 26, 1256, trans. Yabuuti (1974).

3 *Han shu*, chapter 21, 975, trans. Yabuuti (1974).

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proposes one to the emperor.[4] In order to convince the emperor his system is better than any other and should be adopted as the official system, the astronomer needs to explain why the current system is not appropriate or accurate and there are preserved accounts of an astronomer holding a contest to compare observed astronomical phenomena with calculations of those phenomena made by his system and other systems. The reasons behind the reforms are usually complicated and sometimes combine the need to reestablish political legitimacy with perceived astronomical failings of the current system. As has been argued by Niu Weixing, calendrical debates and reforms are not just scientific activities, there are complicated scientific, cultural and political reasons behind the results.[5] Based upon an examination of examples of reforms during the Western and Eastern Han, Yabuuti has suggested that reforms in the Western Han are influenced by *chenwei* 讖緯 "prophecy and weft-text" and *shouming gaizhi* 受命改制 theory.[6] In *chenwei* texts, prognostications were made based on theories such as *yinyang* and *wuxing*. *Shouming gaizhi* is an idea developed by Zou Yan 鄒衍 during the Warring States Period: when a new dynasty replaces the old one, the mandate of the new dynasty comes from the Heaven. However, the Eastern Han reforms are motivated by more scientific reasons.[7] In the Three Kingdoms period and the Jin dynasty, debates and tests over calendrical systems took place frequently. Observations were used to claim that a particular astronomer's suggestions were verified or to provide a basis for arguments over the determination of which calendrical system should be adopted. Usually, it was difficult to find the most appropriate system, thus a procedure is needed to decide whether to adopt a system or not. For example, during the 2nd century, the San gong yi 三公議, a public debate on the "system origin" *li yuan* 曆元, was held among astronomers in front of three high excellencies.[8]

In general, reforms of the calendrical system in early imperial China took place because the calendrical system needed to be changed when a new dynasty was founded, or when unexpected ominous phenomena happened, as

4 For a general discussion of calendrical system reforms, see Sivin (2011). Specific examples are discussed by Cullen (1991), Cullen (2007), and Morgan (2013).

5 Niu Weixing (2004).

6 *Chenwei* literally means prophecy and weft texts. *Chenwei* texts appeared on the weft texts (*weishu* 緯書) during the Han, with knowledge of metaphysics, theology and omenology, etc. The texts were prohibited in the southern and northern dynasties. For more details of *chenwei*, see See Harper (2010), Dull (1966) and Yasui and Nakamura (1966).

7 Yabuuti (1974).

8 Cullen (2007).

explained in the passages from the *Shi ji* and the *Han shu* quoted above, although sometimes this led to nothing more than changing the name of a system. The chosen system, however, must be not only accurate astronomically, but also favored both politically and culturally. In addition, however, I suggest that another factor was significant in the process of calendar reform: the influence of tradition. Using as examples the third century debates in the Kingdom Wei 魏 over the *Qian xiang li* 乾象曆, the *Huang chu li* 黃初曆 and the *Jing chu li* 景初曆, and the process of calendrical reform between AD 443 to AD 445 which led to the adoption of the *Yuan jia li* 元嘉曆, in this paper I aim to explore what is valued in the procedure to choose the best calendrical system for the country and how did astronomers, officials and the emperor balance the weight of internal technical developments within astronomy with cultural and political factors.

2 The Huangchu Debate

The centralization of imperial power gradually fragmented into several local powers at the end of the Eastern Han. In the first few decades of the third century AD, the union of China under the Han emperor was succeeded by three regional kingdoms: Wei (AD 220–AD 265) in northern China, Shu 蜀 (AD 221–AD 263) in the southwest and Wu 吳 (AD 222–AD 280) in the southeast. During the Huangchu Era (Yellow Inception, AD 220 to AD 226) of Emperor Wen 文 of the Wei (the first emperor of the Wei kingdom), the Prefect Grand Scribe 太史令 Gaotang Long 高堂隆 managed a calendrical reform to replace the current *Si fen li* system. The Assistant Grand Scribe (太史丞) Han Yi 韓翊 submitted his *Huang chu li* for discussion. It led to a San gong yi public debate in front of three high officials and tests between the *Huang chu li* and the *Qian xiang li*, a system constructed by Liu Hong 劉洪 in AD 206, against observations. This debate is described in the *Song shu*:[9]

> 光和中，穀城門候劉洪始悟《四分》於天疏闊，更以五百八十九為紀法；百四十五為斗分，造《乾象法》。又制遲疾曆以步月行。方于《太初》、《四分》，轉精微矣。魏文帝黃初中，太史丞韓翊以為《乾象》減斗分太過，後當先天，造《黃初曆》，以四千八百八十三為紀法，一千二百五為斗分。其後尚書令陳群奏，以為“曆數難明，前代通儒多共紛爭。黃初之元，以《四分曆》久遠疏闊，大魏受命，

9 The same events are also described in the *Jin shu*, see Morgan (2013) pp. 279–281.

宜正曆明時。韓翊首建《黃初》，猶恐不審，故以《乾象》互相參校。曆三年，更相是非，舍本即末，爭長短而疑尺丈，竟無時而決。按三公議，皆綜盡曲理，殊塗同歸，欲使效之璿璣，各盡其法，一年之間，得失足定，合於事宜。”奏可。明帝時，尚書郎楊偉制《景初曆》，施用至於晉、宋。

During the era of Guanghe (光和, Glorious Harmony, AD 178 to AD 184, the third reign period used by the Ling 靈 emperor of the Eastern Han), the Observer of the Gucheng Gate Liu Hong was the first to realize that the *Si fen li* is off the heavenly motions.[10] He built the method of *Qian xiang* with 589 as Era Divisor and 145 as Dou Fraction (the fraction of Dipper, the Lodge Dou). He built the Velocity Calendar (*Chi ji li* 遲疾曆) to pace the lunar motion. It is similar to the *Tai chu li* and the *Si fen li*, while finer and more accurate. During the era of Huangchu (黃初, Yellow Inception, AD 220 to AD 226, the first reign period used by the Wei kingdom) of the Emperor Wen 文 of the Wei, the Assistant Grand Scribe Han Yi believed the *Qian xiang li* reduced the Dou Fraction too much, and it will be ahead of the heavenly motions as time goes on. He built the *Huang chu li* with 4883 as Era Divisor and 1205 as Dou Fraction. Later, the Prefect of the Masters of Writing Chen Qun presented a memorial, which said, “it is difficult to get a clear understanding on the *li* and the numbers. Scholars from earlier dynasties argued a lot. The inauguration of the *Huang chu li* is because the *Si fen li* is aged and inaccurate. The mandate has come to Wei, it is a good time to correct the *li* and ascertain the seasons. Han Yi first built the *Huang chu li*, he was afraid it was not accurate and used the *Qian xiang li* to compare and adjust. During three years, even more opinions were brought up on right or wrong. (They) neglect the essential (issues) and concern only the minor ones. To argue on the size, (they) question the measures. This took a long time and there is no result. According to the San gong yi debate by the three high officials, both (systems) synthesize and explicitly made arguments, they are heading to one place from different roads. It is better to let

10 Translations of official titles are mostly taken from Bielenstein (1980). However, there are a few cases where I do not agree with Bielenstein. For example, I translate 穀城門候 as “the Observer of the Gucheng Gate” instead of “the Captain of the Gucheng Gate.” I take the Chinese character 候 for an administrator of the gate by means of making observations. According to the commentary of the *Han shu* by the early 7th century scholar Yan shigu 顏師古, “the Observer of a Gate, is responsible for reckoning time so that to opening and closing. 門候，主候時而開閉也.”

> them use instruments, to practice their theories. In the time of one year, the advantages and disadvantages will certainly be judged. The matters will be agreed." (The emperor) agreed. During the Emperor Ming era, Gentleman of the Masters of Writing Yang Wei built the *Jing chu li*, it has been used through the Jin and the Song.[11]

In this concise history of the calendrical systems and reforms in the Wei Kingdom it is explained that when Liu Hong realized that the *Si fen li* is off the heavenly motions he first built his own system with 589 as Era Divisor and 145 as Dou Fraction and then constructed the Velocity Calendar to pace the lunar motion, a new theoretical development in calendrical systems which can be credited to Liu Hong himself.[12] Changing the Era Divisor and the Dou Fraction modifies the length of a solar year, a key factor to keep the calendrical system in line with seasons. These arguments are based upon astronomical reasons, which concern the Dou fraction (Dou fen 斗分, or literally Dipper Fraction), which has long been focused on in the astronomical tradition. In the 28 lodges system, the lodge Dou is the only lodge with a length than includes a fraction rather than a whole number of *du*. The Dou fraction therefore corresponds to the fraction of a day over 365 days in a solar year and therefore represents the accuracy of a solar year in a calendrical system. The length of a solar year was a concern of all earlier and later astronomers and thus became a significant part of what was considered part of tradition within astronomy. When Han Yi argues that the *Qian xiang li* will be gradually ahead of the heavenly motions as time goes on, he also places emphasis on the Dou fraction: "He built the *Huang chu li* with 4883 as Era Divisor and 1205 as Dou Fraction."

Changing the Dou Fraction modifies the length of a solar year. However, this does not imply the value of the Dou Fraction is always calculated from the observations on solar year. According to Chen Meidong, four methods were used in calculating the mean solar year and the mean lunation, (1) divide the days between two new moons by the number of months to get the mean lunation, (2) divide the days between two winter solstices by the number of years to get the mean solar year, (3) calculate the mean lunation from the mean solar year and the intercalary period and (4) calculate the mean solar year from the mean lunation and the intercalary period. In the example of Liu Hong, the

11 *Song shu*, chapter 12, 231.

12 Velocity Calendar (lunar velocity table) is a table of the speed of the moon over the days of the anomalistic month to be used in calculating, for example, the time of eclipses in the *Jing chu li*. See Cullen (2002) and Guan Yuzhen (2015) for more details on how the table works.

Dou Fraction is derived from the length of the mean lunation.[13] However, no matter whether the Dou fraction was determined directly from measurement of the solar year or indirectly from the length of the lunation, the Dou fraction was a crucial part of the calendrical system which was used in comparing two or more systems rather than the value of the mean solar year or the mean lunation. This reflects the value of the Dou fraction within the tradition of astronomy: if astronomers wanted to have their opinions valued by high officials and the emperor, they need to integrate their astronomical arguments within what has traditionally been valued in debates.

Although the *Qian xiang li* and the *Huang chu li* differ in their treatment of the Dou fraction, it is still difficult to know which one is better only by a debate. With no astronomical observations, the San gong yi public debate was intense but not very fruitful, as stated straightforwardly in the text: "during three years, even more opinions were brought up on right or wrong. (They) neglect the essential (issues) and concern only the minor ones. To argue on the size, (they) question the measures. This took a long time and there is no result." Under such circumstances, a contest of astronomical observations was deemed necessary to decide which system is more accurate. Xu Yue 徐岳 of Donglai 東萊, one of Liu Hong's students, presents

> 史遷造太初，其後劉歆以為疏，復為三統。章和中，改為四分，以儀天度，考合符應，時有差跌，日蝕覺過半日。
>
> [Grand] Clerk [Sima] Qian 司馬遷 (145/135–86 BC) constructed the Grand Inception. Afterward, Liu Xin 劉歆 (c. 50 BC–AD 23) considered it loose and thus made the Triple Concordance. In the Manifest Harmony reign (AD 87–88), this was changed to the Quarter-remainder. Using the celestial *du* of instruments to test the match between foretoken and answer (i.e. prediction and observation), [we find that] this has slipped out of time and have become aware that it overshoots solar eclipses by half a day.[14]

According to the *Jin shu*, Dong Ba 董巴, an Attendant Serving within the Palace (給事中),[15] explained the significant context of a variety of astronomical observations from a historical perspective:

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13 Chen Meidong 陳美東 (1983).

14 *Jin shu*, chapter 17, translated by Morgan, 2013, p. 301.

15 Dong Ba was also the author of *Yu fu zhi* 輿服志 (Treatise on Carriages and Robes) and coauthor of the *Wuxing zhi* 五行志 (Treatise on wuxing) of the *Hou han shu*.

聖人迹太陽於晷景，效太陰於弦望，明五星於見伏，正是非於晦朔。弦望伏見者，曆數之綱紀，檢驗之明者也。

Sages tracked the Great Yang (sun) from gnomon shadows, verified the Great Yin (moon) via quarter and full moons, elucidated the Five Stars (planets) via appearances and concealments and settled right and wrong via the first and last day of the month. Quarter moons, full moons, concealments and appearances are the guiding order of *li* numbers and are brilliant for inspection and verification.[16]

Three kinds of astronomical events are mentioned by Dong Ba, the sun's motion, planetary appearances and the major stages of the phases of the moon. Are these events considered important in the tradition of astronomy as well as in calendrical reforms? Observational tests are valued when people cannot decide which system is better in the debate: "According to the San gong yi debate by the three high officials, both (systems) synthesize and explicitly made arguments, they are heading to one place from different roads. It is better to let them use instruments, to practice their theories." What kind of observations are important in determining the calendrical system? As noted by Morgan, Xu Yue 徐岳, a disciple of Liu Hong,[17] suggested solar eclipses:

效曆之要，要在日蝕。熹平之際，時洪為郎，欲改四分，先上驗日蝕：日蝕在晏，加時在辰，蝕從下上，三分侵二，事御之後如洪言，海內識真，莫不聞見，劉歆以來，未有洪比。

The key to testing a *li* lies in solar eclipses. In the Illustrious Tranquility period (AD 172–178), Hong was, at the time, a Court Gentleman and wished to reform the Quarter-remainder. Previously, he had sent up a solar eclipse prediction. The eclipse was on a clear day at the double-hour *chen* (08:00–10:00), and the eclipse went from bottom to top, intruding two thirds (over the disk of the sun). After the matter had been inspected, it was found to have happened just as Hong said. Everyone within the oceans recognized the truth of it, and there was no one who did not hear of it. Since Liu Xin, there has been no match for Hong.[18]

16 *Jin shu*, chapter 17, 499, translated by Morgan (2013: 302).

17 Xu Yue of Donglai 東萊 was also the author of mathematical treatises *Shushu Jiyi* 數術記遺 and commented on the *Nine Chapters* 九章算術. See Morgan (2013: 303–309) for the claims by Xu Yue.

18 *Jin shu*, chapter 17, 499–500, translated by Morgan (2013: 305–306).

We do not know whether Xu Yue suggested solar eclipses only because he believes "the key to testing a *li* lies in solar eclipses," or whether he has an inclination towards the *Qian xiang li* in this contest. However, it may be significant that Xu Yue had studied calendars and astronomy from Liu Hong. Furthermore, he was impressed with Liu Hong's ability to predict solar eclipses. These two reasons might have together influenced his argument. In any case, it was decided that a series of tests using eclipses and planetary motions were to be held over the following years. In the end, the *Qian xiang li* was preferred by the majority of scholars in the debate and achieved slightly better results in the test.[19] According to the *Jin shu*,

> 凡課日月蝕五事，乾象四遠，黃初一近。
>
> Among the predictions of five solar and lunar eclipses, the *Qian xiang* has four further, the *Huang chu* has one closer.[20]
>
> 凡四星見伏十五，乾象七近二中，黃初五近一中。
>
> Among fifteen appearances and disappearances of four planets, *Qian xiang* made seven closer and two correct, *Huang chu* has five closer and one correct.[21]

This example of calendrical system reform shows that importance of the Dou fraction and solar eclipses in evaluating systems.

3 The Test of the *Yuan jia li*

In AD 237, the *Jing chu li*, a system constructed by Yang Wei, was adopted by the Emperor Ming and was used until AD 265. When the Western Jin replaced the Wei kingdom after it conquered the Shu and the Wu, the emperor of the Jin decided to keep using the *Jing chu li*, but changed its name to *Tai shi li* 泰始曆:

> 晉武帝泰始元年， 有司奏："王者祖氣而奉其口終， 晉於五行之次應尚金，金生於己，事於酉，終於丑，宜祖以酉日，臘以丑日。改《景初曆》為《泰始曆》。" 奏可。

19 See Morgan (2013) for the details of the results of the debate and the observation test.

20 *Jin shu*, chapter 17, 500.

21 *Jin shu*, chapter 17, 502.

> In the first year of Taishi (泰始, Peaceful Harmony, AD 265 to AD 274, the first reign period used by the Emperor Wu 武 of the Western Jin), relevant department submitted a memorial, "kings succeed *qi* and keep following it to the end.[22] According the order of *wuxing*, Jin should belong to *jin* (metal), *jin* comes from *ji*, works following *you* and ends at *chou*. It is good to sacrifice on the *you* day, to sacrifice the ancestry at the *chou* day.[23] (We should) change the *Jing chu li* to *Tai shi li*." (The emperor) agreed to the memorial.[24]

The *Jing chu li* continued to be used throughout the rule of the Eastern Jin in southern China. When the Song succeeded the Jin in AD 420, it kept using the existing system but changed its name to *Yong chu li* 永初曆. In total, therefore, the *Jing chu li* was used as the official system during the Wei, Jin, Song, and Northern Wei for more than two hundred years (AD 237–451). Although neither the Jin nor Song adopted a new system when they replaced earlier dynasties, astronomers still made various efforts to study and discuss the calendrical systems. In AD 443, the 24th year after the Song replaced the Eastern Jin, He Chengtian 何承天 submitted his *Yuan jia li* to the emperor of the Song and started a calendrical reform. The debates used and discussed observations made over the previous ten years. Two years later (AD 445), the *Yuan jia li* was adopted as the official calendrical system and replaced the *Jing chu li*. A detailed account of the reform is recorded in the *Song shu*:

> 晉武帝時，侍中平原劉智，推三百年斗曆改憲，以為《四分法》三百年而減一日，以百五十為度法，三十七為斗分。飾以浮說，以扶其理。江左中領軍琅邪王朔之以其上元歲在甲子，善其術，欲以九萬七千歲之甲子為開闢之始，何承天云"悼于立意"者也。《景初》日中晷景，即用漢《四分法》，是以漸就乖差。其推五星，則甚疏闊。晉江左以來，更用《乾象五星法》以代之，猶有前却。

> During the era of the Emperor Wu of the Jin (AD 265–290), the Palace Attendant Liu Zhi of Pingyuan, calculated the course of Dou in three

22 According to the Zhonghua shuju edition, there is a missing character in the text. I believe what appears on the text "keep following it to the end 奉其口終" is originally "keep following it from the beginning to the end 奉其始終."

23 *Zu* 祖 is a sacrifice for the five heavenly gods of the East, South, Central, West and North, and the five deities of *wuxing*: metal, wood, water, fire and earth. La 臘 is a sacrifice for the ancestry at the end of a year.

24 *Song shu*, chapter 12, 259.

> hundred years to change the system, suggested the *Si fen* method is short of one day in three hundred years, to use 150 as the Du Divisor, 37 as the Dou fraction. He decorated it with superficial reasons, to support his theory. The Middle Rank Commissioner over the Army to the East of the Yangtze river Wang Shuozhi of Langya, thought this method was good, since the Ultimate Epoch is when the *sui* is at *jiazi*,[25] wanted to use the *jiazi* of 97000 years as the beginning of the creation.[26] This is what He Chengtian said: "it grieves at the ideology". The gnomon shadow of the sun at noon by the *Jing chu*, used the *si fen* method from the Han, that is why it gradually produces discrepancies. Its planetary predictions are even quite off. Since the Eastern Jin, the planetary theory of *Qian xiang* has been used to replace it, yet it has the early inadequacies.[27]

This section is a historiographical overview of the development of calendrical systems during the Eastern Jin. It introduces two figures who made suggestions to the calendrical systems. Liu Zhi "calculated the course of Dou in three hundred years to change the system" and used "150 as the Du Divisor, 37 as the Dou fraction." This means he set the Dou fraction at 37/150 (= 0.24667), which corresponds to the fraction of a day in excess of 365 days in the length of a solar year. When Liu Hong and Han Yi constructed the *Qian xiang li* and the *Huang chu li*, they both specifically noted their own value for the Dou fraction. The *Si fen li* had used 1/4 as the fraction of a day after 365 days implying a year length of 365.25 days. The year length in the *Qian xiang li* is 365 145/589 (= 365.24618), the *Huang chu li* 365 1205/4883 (= 365.24677), the *Jing chu li* is 365 455/1843 (= 365.24688). Liu Zhi used 365 37 / 150 (= 365.24667) days, which is closer to the modern value 365.2422 than the other early systems and therefore his system follows the sun's motion quite well, only second to the *Qian xiang li*. Wang Shuozhi suggested using the *jiazi* of 97000 years as the epoch of his system. Generally speaking, a discrepancy between the actual seasons and the calendrical system could be caused by two possible reasons: first, the starting point of all cycles, the epoch of the system, is not properly determined; second, the value for a solar year is not accurate. Even if the system has a proper epoch, it could still go wrong because of the accumulated differences between the

25 *Jiazi* is the beginning of the *ganzhi* cycle. Wang Shuozhi favors Liuzhi's method because Liuzhi uses the year of *jiazi* as the epoch.

26 Wang Shuozhi agrees with the principle to use *jiazi* as the epoch. Among all the years of *jiazi*, he further suggests to use the *jiazi* at 97000 years ago as the first year.

27 *Song shu*, chapter 12, 260. 卻 is usually a verb "to move/slip back". But here I think 卻 is a noun, because 有 "has" is a verb. I use inadequacy as the result of "move/slip back".

solar years and the actual seasons. Thus, He Chengtian commented on Wang Shuozhi "it grieves at the idea," implying that Wang Shuozhi could not make his system following the actual seasons only by means of changing the epoch.

In the Jin and Song, astronomers realized the *Jing chu li* is not accurate enough after being used for more than two hundred years. The discrepancy in the length of the solar year accumulated to an obvious difference that could not be ignored. In AD 443, He Chengtian constructed his system the *Yuan jia li* and submitted a memorial to the Grand Emperor of Song:

> 宋太祖頗好曆數， 太子率更令何承天私撰新法。 元嘉二十年， 上表曰：臣授性頑惰，少所關解。自昔幼年，頗好曆數，耽情注意，迄于白首。 臣亡舅故秘書監徐廣， 素善其事， 有既往 《七曜曆》 ， 每記其得失。自太和至太元之末，四十許年。臣因比歲考校，至今又四十載。故其疏密差會，皆可知也。
>
> The Grand Emperor of the Song is quite fond of *li* and numbers.[28] The Clepsydra Administrator to the prince He Chengtian privately constructed a new system.[29] In the 20th year of Yuanjia, (He Chengtian) submitted a memorial remarking:[30] I am naturally naughty and lazy, I do not often care and know. In the past since my childhood, I quite liked *li* and numbers, indulged in it and paid lots of attention, until my hair is white. My deceased uncle former administrator of rare documents Xu Guang, all along masters with these issues, has a *Qi yao li* from the past, and always marks the advantages and disadvantages.[31] Since Tai he to the end of Tai yuan, it has been more than 40 years. I thus compared, studied and examined, for again 40 years until now. That is why the accuracy, discrepancies and conjunctions can all be understood.
>
> 夫圓極常動，七曜運行，離合去來，雖有定勢，以新故相涉，自然有毫末之差， 連日累歲， 積微成著。 是以 《虞書》 著欽若之典， 《周

28 "The Grand Emperor of the Song" is Emperor Wen of the Song 宋文帝 (AD 407–453).

29 *Shuai geng ling* (the titles comes from the words *Shuai* 率 "governs" and *geng* 更, a time unit for reckoning nights) is an official in charge of time measurement and related internal affairs, including administrating clepsydra. This official works for the prince.

30 The memorial is called *The Memorial on Adopting new Calendrical System* (*Shang li xin fa biao* 上曆新法表).

31 Qi yao means seven bright stars, including the sun, the moon and five planets. *Qi yao li* is a system to calculate planetary motions. Xu Guang is not the author of the *Qi yao li*, but marked its advantages and disadvantages compared to the actual positions.

易》 明治曆之訓， 言當順天以求合， 非爲合以驗天也。 漢代雜候清臺，以昏明中星，課日所在，雖不可見。月盈則蝕，必當其衝，以月推日，則躔次可知焉。捨易而不爲，役心于難事，此臣所不解也。

A perfect sphere will always be in motion, the movements of the seven Yao,[32] move away, approach, conceal and reappear, although there are certain rules, because the new and previous will interfere each other, naturally there would be small discrepancies, with day and years passing, small amounts have accumulated to be notable. Therefore the *Yu shu* has the allusion of "*qin ruo*", the *Zhou yi* illuminates the rules to construct a *li*,[33] remarking (astronomers) should follow the Heaven to seek the agreement, rather than observe the Heaven to prove the accuracy. In the Han miscellaneous observations were done at observatory site, to use the stars culminating at dusk and dawn, to investigate the position of the sun, although it cannot be seen. The moon eclipses when it is full, it must be at its opposition. Use the moon to know the sun, then the position could be known.[34] If ignore the easier way and do not use it, yet concentrate on the difficult one, this is what I do not agree.

《堯典》 云："日永星火， 以正仲夏。" 今季夏則火中。 又 "宵中星虛， 以殷仲秋。" 今季秋則虛中。 爾來二千七百餘年， 以中星檢之， 所差二十七八度。 則堯令冬至， 日在須女十度左右也。 漢之 《太初曆》 ， 冬至在牽牛初， 後漢 《四分》 及魏 《景初法》 ， 同在斗二十一。 臣以月蝕檢之， 則 《景初》 今之冬至， 應在斗十七。 又史官受詔，以土圭測景，考校二至，差三日有餘。從來積歲及交州所上，檢其增減， 亦相符驗。 然則今之二至， 非天之二至也。 天之南至，日在斗十三四矣。此則十九年七閏，數微多差。復改法易章，則用算滋繁， 宜當隨時遷革， 以取其合。 案《後漢志》 ， 春分日長，秋分日短，差過半刻。尋二分在二至之間，而有長短，因識春分近夏至，故長； 秋分近冬至， 故短也。 楊偉不悟， 即用之， 上曆表云："自古及今， 凡諸曆數， 皆未能並己之妙。" 何此不曉， 亦何以云。 是故臣更建 《元嘉曆》 ， 以六百八為一紀， 半之為度法， 七十五為室分，以建寅之月為歲首，雨水為氣初，以諸法閏餘一之歲為章首。冬至從

32 The seven Yao are the sun, the moon and five planets.

33 *Yu shu* 虞書, *Book of Yu*. *Zhou yi* 周易, *Book of Change*. *Qin ruo* 钦若 literally means respect and follow. The word comes from *nai ming xi he, qin ruo hao tian* 乃命羲和，钦若昊天 ("therefore appoints *Xi* and *He*, follow the great heaven"), a quote from the *Yu shu*.

34 *Chan ci* 躔次 is the position of the sun according to the 12 *ci*.

上三日五時。日之所在，移舊四度。又月有遲疾，合朔月蝕，不在朔望，亦非曆意也。故元嘉皆以盈縮定其小余，以正朔望之日。

Yao dian remarks: "The longest day, the star of *huo* (Antares) is at culmination at dusk." Now in the last month of summer the star of *huo* is at culmination. Then "the equal of day and night, the star of *xu* (β Aquarii and α Equulei) is at culmination at midautumn." Now in the last month of autumn the star of *xu* is at culmination. It has been more than 2700 years (since the time of *Yao dian*), check it with the star at culmination, the discrepancy is about 27 to 28 *du*. Therefore at the winter solstices during the Yao time, the sun is around 10 *du* of the lodge of Xu nü. According to the *Tai chu li* in the Han, the winter solstice is at the beginning of the lodge of Qian niu. The *Si fen* in the later Han and the *Jing chu* in the Wei, it is at 21 *du* of the lodge of Dou. I used lunar eclipses to examine, then according to the *Jing chu*, the winter solstice at present, should be at 17 *du* of the lodge of Dou. The scribes complied the imperial edict, used gnomon to measure the shadow, examined and checked the solstices, the difference (to the *Jing chu li*) is more than three days. According to (observational results from) earlier years and what *Jiao Zhou* submitted, to check the result, also confirms each other.[35] Then the solstices at present are not the heavenly solstices. The winter solstice of heaven, the sun is at around 13 to 14 of Dou. This is because 7 intercalations in 19 years, the minor difference in numbers (lead to) big error. If again change the Factor and the Rule cycle, then the use and calculation would be complicated, it better should adjust whenever it needs, to seek the correspondence. According to the *Hou han shu* treatise, daylight is longer on Spring equinox, shorter on Autumn equinox, the difference is more than half a *ke*.[36] The equinoxes are between solstices, and the daylights are not equal. It sets the spring equinox closer to the summer solstice, therefore it is longer; the autumn equinox closer to the winter solstice, therefore it is shorter. Yang Wei did not realize this, yet used it, submitted the li memorial saying: "from the ancient times to the present, as long as *li* and numbers, all of them are not as good as mine".[37] Yet (he) did not even know this, how could he said

35 "What *Jiao Zhou* submitted" refers to the observations made in the place of *Jiao Zhou*.

36 The text is referring to the clepsydra table in the *Si fen li*, whose value of the length of daylight at the spring and autumn equinoxes is different when they should be same. He Chengtian is saying that Yang Wei failed to realize the error in this table and still adopted it in his *Jing chu li*.

37 The original quote from Yang Wei's memorial is as follows: "雖複使研桑心算， 隸首

so. Therefore I built the *Yuan jia li*, with 608 as the Ji Factor, half of it as the Du Factor, 75 as the Shi Fen, to use the month of Yin as the first month of a year, Rainwater as the first solar term, to use the year which all Factors and intercalation remainders are whole numbers as the beginning of a Rule cycle. The winter solstice moves three days and five double-hours earlier (from the *Jing chu li*). The position of the sun, moves four *du* from former. And the moon has velocity, if the conjunction and lunar eclipse, is not at the day of *shuo* or *wang*, that is not the intention of calendrical system. Therefore *Yuan jia li* uses velocity (theory) to determine the minor remainder, to revise the day of *shuo* and *wang*.

伏惟陛下允迪聖哲， 先天不違， 劬勞庶政， 寅亮鴻業， 究淵思于往籍， 探妙旨于未聞， 窮神知化， 罔不該覽。 是以愚臣欣遇盛明， 效其管穴。 伏願以臣所上 《元嘉法》 下史官考其疏密， 若謬有可採， 庶或補正闕謬，以備萬分。

詔曰：“何承天所陳，殊有理據。可付外詳之。”

I bend over and wish your majesty to allow (me) to succeed the sages and intellects, to not go against the Heaven, to work hard on a great many governing affairs, to respectfully illuminate the grand undertaking, to explore deep thoughts from ancient treatises, to discover subtle insights from what has not been heard, to see through the intelligence and understand the changing, to not failing to comprehend the essentials. That is why I humbly am delighted to meet the good time and the bright (minds), to serve with my simple and crude insight. I bend over and willing to use the system of *Yuan jia* I submitted to let astronomical officials to test the accuracy. If my erroneousness is adoptable,[38] if only I may correct the errors and check the mistakes, to be prepared for all possibilities.

The emperor announces: “What He Chengtian stated is particularly reasonable. It should be sent out to expand in detail.”[39]

運籌，重黎司晷，羲和察景，以考天路，步驗日月，究極精微，盡術數之極者，皆未能並臣如此之妙也。Even if we again ask Yan and Sang to mentally calculate, Li shou to operate using counting rods, Zhong and Li to observe with gnomon, Xi and He to measure the shadow. Even ask them to observe the heavenly motion, predict and verify of the motions of the sun and the moon to a highly accurate extent and to the extreme of the calculations. However, all of these are not as good as mine.”

38 This is a modest way of saying if there are places I have developed good ideas in my system.

39 *Song shu*, chapter 12, 260–262.

This section from the *Song shu* records the full text of the memorial He Chengtian submitted to the emperor recommending that he adopt He Chengtian's system *Yuan jia li*. He Chengtian begins with an introduction highlighting his ability and experience in calendrical astronomy which led him to construct this new system, then explains the closely bonded traditional and astronomical reasons to change the official system. An understanding of the guidelines to construct a calendrical system is essential to our understanding to the question of what is valued in the procedure to construct and choose the best calendrical system. The text referred to *Yu shu* and *Zhou yi*, "(astronomers) follow the Heaven to seek the agreement, rather than observe the Heaven to prove the accuracy" 言當順天以求合，非爲合以驗天也。The same words appear in the *Chunqiu changli* 春秋長曆, an almanac based on the *Chun qiu* by a Western Jin general and scholar Du Yu 杜預 (AD 222–285). Both sources emphasize following the actual movements of heavenly bodies and then develop theories corresponding to the heavenly motions, rather than constructing a system then observing the heavens to prove its accuracy. This guidance is clearly brought up by Jin astronomers here. Thus it is reasonable to assume it is a concern noticed by calendrical system constructors such as He Chengtian. Further, if this guidance could have affected the construction of calendrical systems, is it possible that it became part of the traditions of astronomy in the reform of calendrical system?

In this memorial, He Chengtian made three theoretical astronomical arguments in detail: first, the position of winter solstice is not accurate (the *Jing chu li* is more than three days off); second, the shadow length scheme is out of date; and third, lunar velocity should be considered into calculating *shuo*, the beginning of lunar cycles. From the examples of Liu Zhi and Wang Shuozhi, we have seen the importance of Dou fraction in the traditions of astronomy in calendrical system reforms. As I will show below, the arguments made by He Chengtian here again point at the importance of the length of a solar year and the related issues of the position of winter solstice and the shadow length scheme, which are caused by the calendrical system not agreeing with the seasons. The emperor agreed with He Chengtian that astronomers should test the accuracy to prove his suggestions. The result of two tests, one using eclipses to find out the position of the sun, another measuring the length of gnomon shadow on winter solstices, is also recorded in the *Song shu*:

> 太史令錢樂之、兼丞嚴粲奏曰：太子率更令領國子博士何承天表更改《元嘉曆法》，以月蝕檢今冬至日在斗十七，以土圭測影，知冬至已差三日。詔使付外檢署。以元嘉十一年被敕，使考月蝕，土圭測影，檢署，由來用偉《景初法》，冬至之日，日在斗二十一

度少。[40] 檢十一年七月十六日望月蝕，加時在卯，到十五日四更二唱丑初始蝕，到四唱蝕既，在營室十五度末。《景初》其日日在軫三度。以月蝕所衝考之，其日日應在翼十六度半。又到十三年十二月十六日望月蝕，加時在酉，到亥初始食，到一更三唱蝕既，在鬼四度。《景初》其日日在女三。以衝考之，其日日應在牛六度半。又到十四年十二月十六日望月蝕，加時在戌之半，到二更四唱亥末始蝕，到三更一唱食既，在井三十八度。《景初》其日日在斗二十五。以衝考之，其日日應在斗二十二度半。到十五年五月十五日望月蝕，加時在戌，其日月始生而已，蝕光已生四分之一格，在斗十六度許。《景初》其日日在井二十四。考取其衝，其日日應在井二十。又到十七年九月十六日望月蝕，加時在子之少，到十五日未二更一唱始蝕，到三唱蝕十五分之十二格，在昴一度半。《景初》其日在房二。以衝考之，則其日日在氐十三度半。凡此五蝕。以月衝一百八十二度半考之，冬至之日，日並不在斗二十一度少，並在斗十七度半間，悉如承天所上。

The Grand Scribe Qian Lezhi, and the Associate Scribe Yan Can presented: the Clepsydra Administrator to the Prince and serving as an Intendant of Imperial Academy He Chengtian submitted to change to the system *Yuan jia li*.[41] Checking using a lunar eclipse, on the winter solstice the sun is at 17 of the lodge Dou. By measuring the shadow with a gnomon to, it is proved that the winter solstice is three days off. Issue an edict to send it out to check and endorse. Instruct the 11th year of Yuanjia, to check a lunar eclipse, measure the gnomon shadow, check and endorse, to use Yang Wei's *Jing chu* system to make predictions, on the winter solstice day, the sun is at 21 1/4 *du* of Dou. To check the lunar eclipse on the full moon's day, the 16th day of the 7th month of year 11, the hour of *mao*. Eclipse begins on the 15th day, the second *chang* of the fourth *geng*, the beginning of *chou*, (and) totality happens at the fourth *chang*, at the end of 15 *du*, *yingshi*.[42] According to the *Jing chu*, on that day the sun is at 3 *du*, Zhen. To check it with the opposition of the lunar eclipse, on that day the sun should be at 16 1/2 *du* of Yi.[43] Then it is the eclipse on the full moon's day, the 16th day

40 The Zhonghua shuju edition *Song shu* has "土圭測影，檢署由來用偉《景初法》", I revised the marks as "土圭測影，檢署，由來用偉《景初法》." I think the text first "check and endorse" and then "to use Yang Wei's *Jing chu* system to check the context."

41 He Chengtian's formal job is the Clepsydra Administrator of the Prince. As an expert on astronomy, he also works as an Intendant of Imperial Academy temporarily.

42 See Stephenson (1997: 279–283) for the night-watches and their divisions.

43 According to the Zhonghua shuju edition *Song shu* notes, since the eclipse happens at the

> of the 12th month of Year 13, the time is at *you*. The eclipse begins at the beginning of *hai*, the totality happens at the third *chang* of the first *geng*, at 4 *du* of *gui*. According to the *Jing chu*, the sun is at 3 Nü on that day. Check it with the opposition, the sun should be at 6 and half *du* of Niu on that day. Then it is the lunar eclipse on the full moon's day, the 16th day of the 12th month of Year 14, the time is at half of *xu*.[44] The eclipse begins at the fourth *chang* of the second *geng*, the end of *hai*, (and) totality happens at the first *chang* of the third *geng*, at 38 *du* of *jing*.[45] According to the *Jing chu*, the sun is at 25 Dou on that day. Check it with the opposition, the sun should be at 22 and half *du* of Dou on that day.[46] To the eclipse on the full moon's day, the 15th day of the 5th month of Year 15, it is at *Xu*, when the sun and the moon first rose, the brightness of eclipse has come to one fourth, at a little over 16 *du* of Dou. According to the *Jing chu*, the sun is at 24 Jing on that day. Check it with the opposition, the sun should be at 20 of Jing on that day. Then it is the eclipse on the full moon's day, the 16th day of the 9th month of Year 17, the time is at 1/3 of *zi*. The eclipse begins at the first *chang* of the 2nd *geng* of *wei* on the 15th day, to the third *chang*, the sun was 12 / 15 eclipsed, at 1 and a half *du* of *mao*. According to the *Jing chu*, the sun is at 2 *fang* on that day. Check it with the opposition, the sun is at 13 and a half *du* of *di* on that day. All these five eclipses, check it with 182 and 1/2 *du* as the opposition of the moon, on the winter solstice day, the sun is not at 21 and 1/4 Dou, but around 17 and 1/2 *du* of Dou, all as Chengtian submitted.[47]

In the observational test described in this section, the astronomers used five lunar eclipses to check the position of the sun at the winter solstice, to see whether He Chengtian is correct about saying the sun's position predicted by the *Jing chu li* is off at the moment. Tab. 14.1 summarizes the data presented for the five eclipses.

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end of 15 *du*, *yingshi*, the opposite point is 16 1/2 *du* of Yi. "15 1/2 *du* of Yi 翼十五度半" should be "16 1/2 *du* of Yi. 翼十六度半".

44 The Zhonghua shuju edition *Song shu* has "the 16th of the 12th month of Year 14." According to its footnote, that month could not be eclipsed, it should be "the 16th of the 11th month of Year 14."

45 The Zhonghua shuju edition *Song shu* has "at 38 *du* of *jing*." *Jing* only has a total of 33 *du*. According to the Zhonghua shuju edition *Song shu* note 62, it should be 26 *du* of *Jing*.

46 The Zhonghua shuju edition *Song shu* has "the sun should be at 22 and half *du* of Dou on that day." According to the Zhonghua shuju edition *Song shu* note 63, it should be 21 and half *du* of Dou.

47 *Song shu*, chapter 12, 262–263.

TABLE 14.1 *The positions of the sun at winter solstices according to observation of lunar eclipses*[48]

Eclipse date	***Jing chu li* predicted time**	**Observed time (beginning)**	**Observed time (totality)**	***Jing chu li* predicted position of the sun**	**Observed position of the sun**	**Difference in position**
434 Sep 4	Year 11, month 7, day 16, hour *mao* (5 am)	day 15, 4th *geng*, 2nd *chang*, the beginning of *chou* (1 am)	4th *geng*, 4th *chang*.	3 Zhen	16 1/2 Yi	4 1/2 *du*
437 Jan 8	Year 13, month 12, day 16, hour *you* (5 pm)	beginning of *hai* (9 pm)	1st *geng*, 3rd *chang*	3 Nü	6 1/2 Niu	4 1/2 *du*
437 Dec 28	Year 14, month 11, day 16, half of *xu* (8 pm)	2nd *geng*, 1st *chang* (11 pm)	3rd *geng*, 1st *chang*	25 Dou	21 1/2 Dou	3 1/2 *du*
438 Jun 23	Year 15, month 5, day 15	hour of *xu* (19 pm).	–	24 Jing	20 Jing	4 *du*
440 Oct 26	Year 17, month 9, day 16, 1/3 of *zi* (5:40 pm).	day 15, 2nd *geng*, 1st *chang*, hour *wei* (1:30 pm)	12/15 eclipsed, 2nd *geng*, 3rd *chang*	2 Fang	13 1/2 Di	3 1/2 *du*

The differences between positions calculated by the *Jing chu li* and the observed positions are worth noting. The calculated positions are all around 4 *du* greater than those found by observation. Just as in the debate of Huangchu, five eclipses are used in the observational test. It seems possible, therefore, that five eclipses became a standard number which were believed to be sufficient to investigate the accuracy of a calendrical system.

48 See Steele (2000) Table 6.13 for predicted and computed times of these eclipses, a few columns including the predicted time, observed time and computed time are adopted from that table.

The text continues with a discussion of the dates of winter solstices:

> 又去十一年起，以土圭測影。其年《景初法》十一月七日冬至，前後陰不見影。到十二年十一月十八日冬至，其十五日影極長。到十三年十一月二十九日冬至，其二十六日影極長。到十四年十一月十一日冬至，其前後並陰不見。到十五年十一月二十一日冬至，十八日影極長。到十六年十一月二日冬至，其十月二十九日影極長。到十七年十一月十三日冬至，其十日影極長。到十八年十一月二十五日冬至，二十一日影極長。到十九年十一月六日冬至，其三日影極長。到二十年十一月十六日冬至，其前後陰不見影。尋校前後，以影極長為冬至，並差三日。以月蝕檢日所在，已差四度。土圭測影，冬至又差三日。今之冬至，乃在斗十四間，又如承天所上。

> Also starting from year 11, the gnomon was used to measure the shadow. According to the *Jing chu li*, in that year the winter solstice is day 7 of month 11, it was cloudy before and after and the shadow cannot be seen. As for the winter solstice on the 18th day of the 11th month in year 12, the shadow was at the longest on the 15th. As for the winter solstice on the 29th day of the 11th month in year 13, the shadow was at the longest on the 26th. As for the winter solstice on the 11th day of the 11th month in year 14, it was cloudy before and after, the shadow cannot be seen.[49] As for the winter solstice on the 21th day of the 11th month in year 15, the shadow was at the longest on the 18th. As for the winter solstice on the 2nd day of the 11th month in year 16, the shadow was at the longest on the 29th of the 10th month. As for the winter solstice on the 13th day of the 11th month in year 17, the shadow was at the longest on the 10th. As for the winter solstice on the 25th day of the 11th month in year 18, the shadow was at the longest on the 21th.[50] As for the winter solstice on the 6th day of the 11th month in year 19, the shadow was at the longest on the 3rd. As for the winter solstice on the 16th day of the 11th month in year 20, it was cloudy before and after and the shadow cannot be seen. Find and check before and after, winter solstice is when the shadow is at its longest, there is a three days difference. To use lunar eclipse to check where the

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49 The Zhonghua shuju edition *Song shu* has "其前後並陰不見 it was cloudy before and after, cannot be seen." It should be "其前後並陰不見影 it was cloudy before and after, the shadow cannot be seen."

50 The Zhonghua shuju edition *Song shu* has "二十一日影極長 at the longest on the 21th" It should be "二十二日影極長 at the longest on the 22th."

> sun is, there is already a four du difference. To use gnomon to measure the shadow, the winter solstice again has a three days difference. The winter solstice at present is around 14 Dou, again as stated by Chengtian.[51]

As we have already seen, in order to decide the accuracy of a calendrical system, the position of the sun at the winter solstice is an important standard. Two methods are used here in the test to calculate the sun's position. First, when lunar eclipse occurs, the moon and the sun are at opposition and so the sun's position can be determined from the moon's position. Second, since the shadow of gnomon is shortest at the winter solstice point, the time of winter solstice could be known. The data for the second method that is presented in the text is summarized in Tab. 14.2. Similar to the 4 *du* difference of the observed positions and the *Jing chu li* predictions of lunar eclipses, here the *Jing chu li* winter solstices are around 3 or 4 days late as compared with the winter solstice determined from observations using a gnomon. This systematic 3 or 4 *du* difference in the observed position of the sun and the equivalent 3 or 4 day difference in the date of the winter solstice are due to the length of the solar year used in the *Jing chu li*, in common with all early calendrical systems, not distinguishing between the tropical and the sidereal year. The *Jing chu li* year length is approximately 0.0094 days shorter than the length of the sidereal year, resulting in an accumulated error in the sidereal position of the sun of about 1 *du* per century. An argument for distinguishing between the tropical and sidereal years was made already by Yu Xi in the early fourth century and He Chengtian himself referred to this issue earlier in his discussion, comparing a (legendary) observation 2700 years earlier with observations from his own time: "Now in the last month of autumn the star of xu is at culmination. It has been more than 2700 years (since the time of *Yao dian*), check it with the star at culmination, the discrepancy is about 27 to 28 *du*." He Chengtian's comparison produced an accumulating difference between sidereal and tropical positions of 1 *du* per 100 years. However, this value was not included in his *Yuan jia li*.[52]

The text continues with some criticisms of He Chengtian's system:

> 又承天法，每月朔望及弦，皆定大小餘，於推交會時刻雖審，皆用盈縮，則月有頻三大、頻二小，比舊法殊為異。舊日蝕不唯在朔，亦有在晦及二日。《公羊傳》所謂“或失之前，或失之後”。愚謂此一條自宜仍舊。

51 *Song shu*, chapter 12, 263–264.

52 Zheng Cheng (2007).

TABLE 14.2 *Winter solstices according to measurement of the shadow cast by a gnomon*

***Jing chu li* winter solstice**	**Observed winter solstice**	**Time differences**
Year 11, month 11, day 7	cloudy	not applicable
Year 12, month 11, day 18	Year 12, month 11, day 15	3 days
Year 13, month 11, day 29	Year 13, month 11, day 26	3 days
Year 14, month 11, day 11	Cloudy	not applicable
Year 15, month 11, day 21	Year 15, month 11, day 18	3 days
Year 16, month 11, day 2	Year 16, month 10, day 29	3 days
Year 17, month 11, day 13	Year 17, month 11, day 10	3 days
Year 18, month 11, day 25	Year 18, month 11, day 21	4 days
Year 19, month 11, day 6	Year 19, month 11, day 3	3 days
Year 20, month 11, day 16	cloudy	not applicable

In the system by Chengtian, the new moon, full moon's day and the quarters in each month are all (calculated by) Velocity Major and Minor Remainder. Although it is prudent when predicting the moment of Cross Coincidence, it always refers to velocities, then the month is often three long in a row, and two short in a row. It is quite different to the earlier method. Earlier, the solar eclipses not only happen at *shuo*, but also at *hui* or the second day. This is what the *Gong yang zhuan* said "it either misses to before, or misses to after." I humbly think this rule should use the former way.

員外散騎郎皮延宗又難承天：“若晦朔定大小余， 紀首值盈， 則退一日， 便應以故歲之晦， 為新紀之首。” 承天乃改新法依舊術， 不復每月定大小余，如延宗所難，太史所上。

Associate Advisory Gentlemen Pi Yanzong as well argues against Chengtian: "To use the Velocity Major and Minor Remainder for the conjunctions, if the beginning of an era falls to positive, then retreat one day, and set with the last day of the previous year as the first day of the new era."[53] Chengtian therefore changed the new system following the previous method, without again use velocity major and minor remainder for each month, as argued by Yanzong and presented by the Grand Scribe.

53 Trying to say that in this situation, the first day of the year is not orthodox.

> 有司奏："治曆改憲，經國盛典，爰及漢、魏，屢有變革。良由術無常是，取協當時。方今皇猷載暉，舊域光被，誠應綜覈晷度，以播維新。承天曆術，合可施用。宋二十二年，普用《元嘉曆》。"詔可。
>
> Relevant bureau presented, "to reform the calendar, change the principles, govern the country, hold the grand ceremony. Therefore during the Han and Wei, reforms are frequent. It is because methods are not changeless, it needs to be tuned with the situation of the time. At the moment the imperial mind carries brightness, shines to cover the existing field, indeed should synthesize and check the measurement of gnomon, to spread and manage the new. The system and methods by Chengtian, are appropriate to be used. In the 22nd year of Song, *Yuan jia li* should be publicly issued." The emperor agreed.[54]

The text suggests that only the current system, the *Jing chu li*, was tested against observation. By the time of this test, the *Jing chu li* had been used for more than two hundred years, and as a result, discrepancies can accumulate to be quite apparent. In observations of lunar eclipses and gnomon shadow around winter solstice, the results were convincing enough for the Grand Scribes to agree with He Chengtian's arguments in his memorial. Even though it is difficult to say that the *Jing chu li* is intrinsically a bad system, it is easy to tell that the current system is not quite accurate. Thus, He Chengtian's suggestion of adopting a new system seems necessary, even though the accuracy of the *Yuan jia li* is not even tested. The Official astronomers Qian Lezhi and Yan Can, as well as a military official Pi Yanzong argued that when calculating the beginning of lunar cycle, if we take lunar velocity into consideration, it is possible to see three full months or two hollow months in a row. Pi Yanzong argued it is possible that the last day of the last year became the first day of the first year. This is not a convincing reason to make that decision from the perspective of astronomy. It looks like the astronomers and the attendant were all attempting to argue from the perspective of astronomy, while actually some valued reasons do not make astronomical sense. As a result, He Chengtian had to change the new method to follow some traditions of the previous method.

In AD 445, He Chengtian's *Yuan jia li* was finally accepted as the official calendrical system. Following the adoption of *Yuan jia li*, He Chengtian continued his work on astronomy and suggested to change the standards of clepsydra:[55]

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54 *Song shu*, chapter 12, 264.

55 See Chen Jiujin (1984) and (1992) for the details of He Chengtian's astronomical achievements.

> 元嘉二十年， 承天奏上尚書：“今既改用 《元嘉曆》 ， 漏刻與先不同，宜應改革。按《景初曆》春分日長，秋分日短，相承所用漏刻，冬至後晝漏率長於冬至前。且長短增減，進退無漸，非唯先法不精，亦各傳寫謬誤。今二至二分，各據其正。則至之前後，無復差異。更增損舊刻，參以晷影，刪定為經，改用二十五箭。請臺勒漏郎將考驗施用。”從之。
>
> In the 20th year of Yuanjia, Chengtian submitted to the minister: “We now have already changed to use the *Yuan jia li*, the clepsydra is different from before and should be reformed. If we follow the *Jing chu li*, the daylight would be long on the spring equinox and short on the autumn equinox. If keep following the clepsydra in use, after the winter solstice, the clepsydra of daylight is longer than before the winter solstice. In addition, the long and short will increase and decrease. The advances and retreats are not gradually. It is not only the earlier method is not accurate, but also mistakes happen in circulating and copying. Now the solstices and equinoxes, each takes up the right places. Then before or after the solstices, there are no more discrepancies. Even adjust the existing clepsydra, refers to the gnomon shadow, (after the) revision set it as the standard, change to 25 *jian*. Please order to let the clepsydra gentleman general to examine, test, and put to use.” (The minister) agreed.[56]

This section is a memorial He Chengtian submitted to the emperor about changing the standard of clepsydra. This was a follow-up to the official issue of the *Yuan jia li*. He Chengtian's proposal focused on the perspective of astronomy and it seems he did not forget his own job, which was as a clepsydra administrator. It is interesting that He Chengtian submitted this memorial to the minister, instead of the emperor. This suggests that changing the standard of the clepsydra was not as important as changing the calendrical system: after all, it is only a change on astronomy and it does not directly concern judicial astrology or politics. Thus, He Chengtian did not raise this issue in his memorial to the emperor or include it in his calendrical system when trying to get it adopted as the official system, but rather chose to do this after the calendrical system reform.

It is also worthwhile to notice the influence of the connections between people in calendrical reforms.[57] In the examples of calendrical reform in the Jin,

56 *Song shu*, chapter 13, 285.

57 See also Morgan (forthcoming).

there are titles such as the Palace Attendant, the Middle Rank Commissioner over the Army to the East of the Yangtze river, the Clepsydra Administrator to the Prince, the Administrator of Rare Documents, the Grand Scribe, the Associate Scribe, the Intendant of Imperial Academy and Associate Advisory Gentlemen. Among people who held these titles, some are astronomy specialists while others are only partially related to astronomy or advising. Grand scribes who work in astronomy are responsible for the observations in the test. Nevertheless, other seemingly unrelated officials not only participate in the calendrical reforms, and had the right to make their voice heard in the process of deciding the adoption of systems. The author of the *Yuan jia li*, He Chengtian had several official positions, but none of these positions were related to astronomy before AD 439.[58] He had shown talent during the time he was a military official and even wrote an article *An bian lun* 安邊論 (study on stabilizing the border area) on military strategy.[59] His fate changed when he met the prince Lü. He Chengtian first became the Clepsydra Administrator to the Prince and then obtained the temporary title "Intendant of Imperial Academy". He was able to work like an official astronomer and make suggestions on the reform of the calendrical system as an Intendant of Imperial Academy.

4 Conclusion

This article uses two examples to discuss the complexity of calendrical reforms in early imperial China. In the first example, a debate concerning the *Qian xiang li* and the *Huang chu li* was held from AD 220 to AD 227, including tests using solar eclipses and planetary positions. The Wei kingdom finally adopted a different system, the *Jing chu li*, in AD 237, instead of the *Qian xiang li* or the *Huang chu li*. In the second example, He Chengtian 何承天 constructed the *Yuan jia li* and persuaded the emperor to adopt his system after holding observational tests using lunar eclipses and the winter solstice. In this Song 宋 Dynasty system, He Chengtian invented the *tiaorifa* 調日法 (Day Divisor Regulation Method) to calculate the Day Divisor, and adopted a few better astronomical values such as a value for precession. The clepsydra table and gnomon shadow tables were also more accurate than in earlier systems.[60]

58 Chen Jiujin (1992).

59 *Song shu*, chapter 64.

60 Chen Meidong (2003: 261–266).

If we look at the big picture by taking debates, tests and reforms all together it is apparent that many factors need to be considered to an understanding of the construction of calendrical systems. As noted in the previous sections, theoretical development within astronomy is not the only reason that could affect the adoption of a system.

Among the other factors are things that become "traditional" and valued because they are the way that things have been done in the past. In astronomical debates and tests, a calendrical system was considered to be successful when it performed well in the traditionally valued theories, such as eclipse prediction and calculating the position of the sun at winter solstice. The ways these tests were conducted also seems to become fixed around certain traditional ideas such as the apparent criteria of considering five eclipses to be sufficient to judge the accuracy of eclipse theories when systems were tested against observations. Similarly, adherence to traditional philosophical views, discussing the astronomical theory behind certain "traditional" astronomical terms (eg the Dou fraction) was valued. In practice when an astronomer wanted to present a technical improvement in the astronomy of a system, he needed to find traditional ways to present this improvement, and to debate and to test systems according to what had become the traditional way, otherwise the new system will not be valued. Astronomical improvement irrelevant to the traditions may still be valued by an astronomer, but is not valued or connected to the Heavenly Mandate, which is the concerned of the ruler of the state.

What is valued in the traditions of astronomy also changes over time. In different periods, astronomers could have different views of the tradition. Some ideas might appear, some could be neglected and others be particularly valued. It will be too simple to think the model in this article could be applied to all examples of calendrical reforms in Chinese history. But it is also too simple to think astronomers only see the process of reform from the perspective of astronomical development, When an astronomer proposes a calendrical reform, he needs to revise his system and their proposal to the emperor according to not only political needs and cultural influences, but also what is valued in the traditions of astronomy. He needs to adjust his work and activity so that it has the best chance to be adopted as the official one.

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CHAPTER 15

The Twelve Signs of the Zodiac during the Tang and Song Dynasties: A Set of Signs Which Lost Their Meanings within Chinese Horoscopic Astrology

Shenmi Song

1 Introduction

The concept of the twelve signs of the zodiac entered China at the latest during the Qi dynasty (AD 479–502). The earliest Chinese source to mention the signs of the zodiac is the 56th text in the collection of Buddhist Scriptures *Dafangdeng dajijing* 大方等大集經 (hereafter *Dajijing*) translated by the Indian Buddhist Narendrayasas. This text lists the twelve signs:

> 所言辰者，有十二種。一名彌沙，二名毘利沙，三名彌偷那，四名羯迦吒迦，五名線呵，六名迦若，七名兜邏，八名毘梨支迦，九名檀尼毘，十名摩伽羅，十一名鳩槃，十二名彌那。

> What is called *Chen* 辰，there are twelve kinds. The first is Mesa, the second is Vrsabha, the third is Mithuna, the fourth is Karkataka, the fifth is Simha, the sixth is Kanyā, the seventh is Tulā, the eighth is Vrsika, the ninth is Dhanu, the tenth is Makava, the eleventh is Kumbha, the twelfth is Mina.[1]

This set of names is a transliteration of the Sanskrit names.[2] Chinese names for two of the signs, Scorpio and Libra, are found in an excavated fragment from Turpan dating to the Tang dynasty (AD 618–904).[3]

This paper examines the spread of the twelve signs of the zodiac in China during the Tang and Song dynasties (AD 618–1279). Previous scholars who have examined the transmission of the zodiac to China have mostly based their discussion on a comparison of the names for the signs of the zodiac found on

1 *Dafangdeng dajijing* (Vol. 56: 373).
2 Niu (2004: 195–196).
3 Hsia (1976: Fig. 4).

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Chinese star maps in comparison with their counterparts in ancient Greece and India.[4] However, because the zodiac was incorporated within the tradition of horoscopic astrology which developed in China during the Tang and Song dynasties, references to the twelve signs of the zodiac are also found in a variety of astrological texts. Chinese horoscopic astrology inherited, modified and syncretized the astrological and divine ingredients of both Chinese and foreign cosmological and divinatory systems. Evidence for the spread and application of the zodiac are scattered in a wide variety of Chinese Buddhist scriptures, Taoist scriptures, horoscopic-astrological books, and manuscripts from Dunhuang 敦煌 which contain many texts of Chinese horoscope astrology. In this paper, therefore, I will explore the twelve signs of the zodiac in these sources to discuss the function of the zodiac within Chinese horoscope astrology.

Firstly, I will analyze the Chinese names and the sequences of the twelve signs to trace the process of its reception into Chinese tradition. I will then explore how the signs worked in combination with the Chinese systems of Lunar Mansions, Luminaries and Earthly Branches in fortune-telling, blessing and exorcism. In Chinese horoscope astrology, the meaning of the twelve signs of the zodiac gradually changed to become another set of symbols for the Five Phases and the twelve Earthly Branches.

2 Chinese Names of the Twelve Signs of the Zodiac

Scholars such as Hsia Nai 夏鼐, Chen Meidong 陈美东, Niu Weixing 钮卫星 and Chen Wancheng 陈万成 have collected and analyzed the Sanskrit and Chinese names of the signs of the zodiac.[5] On the basis of these studies, I have searched for references to the signs of the zodiac in Chinese Buddhist scriptures, Taoist scriptures, horoscopic-astrological books, Dunhuang manuscripts and other ancient works. I have found twenty-seven sources which record, sometimes incompletely, the signs of the zodiac.[6] In Tab. 15.1 I have gathered the all of the

4 These researches include Hsia (1976), Yi (1990), Wei (2005), Tang (1986: 104–117), Chen (2003: 394–396), Chen (2010: 25–72), Li and Wang (1997), Ho (2001), Niu (2004: 194–198). Among these examples, Ho Peng-Yoke and Niu Weixing's research are mainly based on written sources.

5 Hsia (1976), Chen (2003), Niu (2004), Chen (2010).

6 The 27 recording materials are as follows: *Wenshu shili pusha ji zhuxian suoshuo jixiong shiri shan'e xiuyaojing* 文殊師利菩薩及諸仙所說吉凶時日善惡宿曜經 (hereafter *Shan'e*

names of the twelve signs of the zodiac found in these sources. These names can be divided into Chinese names, names transliterated from Sanskrit, and a set of names different from both the Chinese and the Sanskrit names that are found in the *Baibao kouchao*.[7]

Most of the Chinese names for the signs of the zodiac found in these sources refer to the same figures as in the corresponding western names, even when several names were used for the same sign. Thus we can conclude that although the Chinese names of the Twelve Signs were diverse in that they differ in how they were written their meanings were quite consistent across a wide variety of sources from the Tang and Song dynasties.

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xiuyaojing), *Nanni jishi moluotian shuo zhilunjing* 難儞計濕嚩囉天説支輪經 (hereafter *Zhilunjing*), *Dashengmiao jixiang pusa shuo chuzai jiaoling falun* 大聖妙吉祥菩薩説除災教令法輪 (hereafter *Falun*), *Dafangguang pusa zangwenshu shili genben yiguijing* 大方廣菩薩藏文殊師利根本儀軌經 (hereafter *Yiguijing*), *Qiyao Rangzai jue* 七曜攘災決, *Lingbao lingjiao jidu jinshu* 靈寶領教濟度金書, *Taishangshuo xuantian dasheng zhenwu benchuan shenzhou miaojing* 太上說玄天大聖真武本傳神呪妙經 (hereafter *Shenzhou miaojing*), *Daomen dingzhi* 道門定制, *Wushang huanglu dazhai lichengyi* 無上黃籙大齋立成儀, *Yuanyuan daomiao dongzhen jipian* 淵源道妙洞真繼篇, *Guangchen gxiansheng yuhan jing* 廣成先生玉函經, *Yuanshi wuliang duren shangpin miaojing sizhu* 元始無量度人上品妙經四注, *Shangqing beiji tianxin zhengfa* 上清北極天心正法, *Wujing zongyao* 武經總要, *Xiantian houtian liqi xinyin buzhu* 先天後天理氣心印補注, *Shilin guangji* 事林廣記, Dunhuang manuscript P.4071, Turpan fragment. The above 18 materials were made during the Tang and Song dynasties. The extant copy of *Zhangguo xingzong* 張果星宗 was of Ming dynasty, but the book was named after Zhangguo of Tang dynasty. *Zhangguo xingzong*, together with two other books *Xingping huihai* 星平會海and *Xingxue dacheng* 星學大成 also compiled in the Ming Dynasty, included the contents of *Xingming suyuan* 星命溯源of Tang and *Xingming zongkuo* 星命總括 of the Liao dynasty (907–1125). *Baibao kouchao* 白寶口抄, *Chengpu tiji* 成菩提集and *E'suo fuchao* 阿娑縛抄(Ogawa Shōchō, 1205–1282) although are Chinese Buddhist scriptures compiled after the Song dynasty by Japanese monks, preserved many Chinese Buddhist texts during the Tang and Song dynasties of China. *Dafangdeng dajijing* was translated before the Tang dynasty but spread in the later dynasties.

7 The names of Sagittarius, Wise Bottle, Two Fish, Cyan Ox, and Mandarin Duck were similar with their corresponding Chinese names. *Yang*-Extreme 陽極, *Yin*-Extreme 陰極 respectively corresponded to Leo, Cancer because the two signs were the respective beginning of *Yang* and *Yin* signs. But other names had no verifiable sources at present, and this topic needs further research.

TABLE 15.1 *Names of the Twelve Signs of the Zodiac*

Chinese names (found in many texts)	**Other names (found in *Baibao Kouchao "Beidoufa 3"*)**	**Names transliterated from Sanskrit (found in *Chengputiji, Dafangdeng Dajijing*)**
Lion 狮（师）子	Empire/*Yang*-Extreme 帝王宫/（阴）[阳]尊宫	Simha 僧伽深呵/綅呵
Female/Dual Famale/Little Female/Celestial Female/Virgin Female/Double/Favorite Female 女/双女/小女/天女/童女/双/嬖女	*Wen*/ *Hualin* 温宫/华林宫	Kanyā 迦若
Scales/Libra 秤（称）/秤量/天秤（称）	*Ding*/*Chan* 定宫/禅宫	Tulā 兜逻/金遮罗
Scorpion/Scorpio 蝎（虬）/蝎蟲/天蝎	*Fu* 覆宫	Vrsik 毘梨支迦/缚里湿缚
Bow, Sagittarius, Horse, Shooting, Horse and Bow, 弓/人马/马/射/弓马	Sagittarius/*Ke*/*Mo* 人马伴宫/殻宫/摩宫	Dhanu 坛尼毘/驮尾
Capricorn/ Capricorn Fish 磨（摩）竭（羯、蝎）/摩羯鱼	(None)	Makava 摩伽罗
Bottle/ Precious Bottle/ Aqua-Vessel 瓶/宝瓶（缾、缾）/水器	Wise Bottle/*Chi Yong* 贤瓶宫/持瓮宫	Kumbha 鸠槃/瞿摩多
Fish/ Dual Fish/ Celestial Fish 鱼/双鱼/天鱼	Shark/Disaster/Dual Fish 鲛宫/祸害宫/二鱼宫	Mina 弥那
Sheep/ Aries/ Celestial Sheep/ Special Sheep 羊/白羊/天羊/特羊	*Cheng Qian* 成乾宫	Mesa 弥沙
Ox/*Niu Mi*/Taurus/Special Ox/Celestial Ox 牛/牛密/金牛/特牛/天牛	Cyan Ox/Extreme 青牛宫/最尊宫	Vrsabha 毘利沙
Yin/Male & Female/Couple/*Yinyang*/*Yi*/Dual Birds 婬（淫、媱）/男女/夫妻/阴阳/夫妇/仪/双鸟	Mandarin Duck 鸳鸯宫	Vrsabha 弥偷那
Crab/Cancer 蟹/螃蟹/巨蟹（獬）	*Fan*/*Yin*-Extreme 翻宫/阴尊宫	Karkataka 羯迦吒迦

3 Sequences of the Twelve Signs Spread during Tang and Song Dynasties

Compared to the high consistency in the Chinese names, the sequences for the twelve signs of the zodiac differs greatly across the various sources. The twenty-seven written sources and the excavated figures and star-maps display at least ten kinds of sequences. These sequences are shown in Tab. 15.2. They

TABLE 15.2 *Sequences of the Twelve Signs of the Zodiac*

I	II	III	IV	V
Leo	Aries	Scorpio	Aquarius	Aquarius
Virgo	Taurus	Sagittarius	Capricorn	Sagittarius
Libra	Gemini	Capricorn	Sagittarius	Libra
Scorpio	Cancer	Aquarius	Scorpio	Leo
Sagittarius	Leo	Pisces	Libra	Gemini
Capricorn	Virgo	Aries	Virgo	Aries
Aquarius	Libra	Taurus	Leo	Capricorn
Pisces	Scorpio	Gemini	Cancer	Scorpio
Aries	Sagittarius	Cancer	Gemini	Virgo
Taurus	Capricorn	Leo	Taurus	Cancer
Gemini	Aquarius	Virgo	Aries	Taurus
Cancer	Pisces	Libra	Pisces	Pisces

differ either in which sign was considered the beginning of the system or in the order of the signs.

The first sequence begins with Leo. Niu Weixing has claimed that only the Chinese Buddhist Scripture *Shan'e xiuyaojing* (translated by Amoghavajra 不空, 758) records this sequence.[8] However, the Chinese Buddhist scriptures *Falun, Baibao kouchao-Beidoufa3* 北斗法*, Baibao kouchao-Beidoufa4, Chengpu tiji* and *E'suo fuchao* also present the signs of the zodiac beginning with Leo. Furthermore, a sequence very close to this one is displayed in the picture of Buddhist *Chisheng guangfoding daweide xiaozai jixiang tuoluonijing* 熾盛光佛頂大威德銷災吉祥陀羅尼經 (972) found in Nara, Japan.[9] The signs in this picture are arranged in a peach shape with Leo located at the top. The signs are then placed in anticlockwise order from the left to the right.[10] However, the order of Libra and Scorpio is reversed compared to the sequence in *Shan'e xiuyaojing*.

The second sequence begins with Aries. It is found in the Chinese Buddhist scriptures of *Zhilunjing* and *Yiguijing* (in which Virgo and Libra are reversed

8 Niu (2004:196).

9 Kazuaki (1995: Picture 11).

10 Chen Wancheng (2010: 35–36) also depicts the Twelve Signs of the picture with the beginning of Leo arranged in anticlockwise order. However, Wei (2005: 215) takes Aries as the beginning sign.

VI	VII	VIII	IX	X
Libra	Libra	Capricorn	Sagittarius	Sagittarius
Scorpio	Scorpio	Aquarius	Scorpio	Pisces
Sagittarius	Sagittarius	Pisces	Libra	Aquarius
Capricorn	Cancer	Aries	Virgo	Capricorn
Aquarius	Leo	Taurus	Leo	Scorpio
Pisces	Virgo	Gemini	Cancer	Aries
Aries	Aries	Cancer	Gemini	Libra
Taurus	Taurus	Leo	Taurus	Taurus
Gemini	Gemini	Virgo	Aries	Virgo
Cancer	Capricorn	Libra	Pisces	Gemini
Leo	Aquarius	Scorpio	Aquarius	Leo
Virgo	Pisces	Sagittarius	Capricorn	Cancer

in order), *Dajijing* Vol. 56, the star-map unearthed in the tomb M_1 of Liao Tianqing's 天慶 reign (1116) found in Xuanhua 宣化, and the figures on the big ferric bell of Kaiyuan 開元 Temple in Xingtai 邢台 (1184), the latter two of which arrange the twelve signs in a circular shape.[11]

The third sequence begins with Scorpio and is found in *Dajijing* Vol. 42:

> 八月滿者起胃終昴，其月如是。夜十五時，晝十五時，日午之影長六腳跡。 …… 是八月時蠍神主，當昴宿為業，前已說竟。
>
> The full one of the eighth month begins with Stomach [the name of a Lunar Mansion] and ends with Hairy Head, this month goes with it. Night is fifteen *Shi* 時, Daytime is fifteen *Shi*, the length of the shadow of the Sun in the midday is six footprints .... In the eighth month is the God of Scorpio governing, ends with Hairy Head Lunar Mansion, all of that are mentioned before.[12]

The passage takes Scorpio as the first sign, in order to match the tradition of taking Hairy Head as the first Lunar Mansion, a tradition which derived from

11 Scholars such as Hsia (1976: 35–58) and Yi (1990: 23) list the twelve signs beginning with Aries in the same order as the first sequence.

12 *Dafangdeng dajijing* (Vol. 42: 280).

India.[13] This sequence arranges the twelve signs in the same order as the first two sequences just described.

The fourth sequence begins with Aquarius with signs in the reverse order to the first three sequences. The sequence is found in sources including the horoscopic-astrological books *Zhangguo xingzong* and *Xingping huihai*, the Taoist scripture *Shenzhou miaojing*, and the Chinese Buddhist scripture *Qiyao rangzai jue*. The sequence is also presented in the figures of the twelve signs in the Taoist Sanqing 三清 cave of the Southern Song dynasty, which located in Sichuan 四川 Dazu 大足.

The fifth sequence also begins with Aquarius. The twelve signs are divided into left and right parts, and each part ranked alternately on the basis of the fourth sequence. The sequence is found in the Taoist Scripture *Lingbao lingjiao jidu jinshu* Vol. 7.

The sixth sequence begins with Libra, and the order is the same as the first three sequences. It is found in sources including the horoscope-astrological book *Xingxue dacheng*, the Taoist scripture *Daomen dingzhi* Vol. 3 and *Wushang huanglu dazhai lichengyi*.

The seventh sequence also begins with Libra, but associates the twelve signs with the four directions of East, West, South and North, and displays the signs running from East to South to West to North. It is found in the Chinese Buddhist scripture *Baibao kouchao-Beidoufa3, Baibao kouchao-Beidoufa4*.

The eighth sequence also associates the twelve signs with the four directions of East, West, South and North, but presents them running from North to West to South to East, and takes Capricorn as the first sign. It is found in *Baibao kouchao-Beidoufa3*.

The ninth sequence begins with Sagittarius and has the same reverse order as the fourth sequence. It is found in the Taoist scripture *Yuanyuan daoMiao dongzhen jipian*.

The tenth sequence also begins with Sagittarius. The twelve signs are divided into six pairs and arranged circularly on the basis of Aquarius and Capricorn. Each pair ranks one after another, but the pair of Sagittarius and Pisces ranks before the one of Aquarius and Capricorn. It is found in the Taoist scripture *Lingbao lingjiao jidu jinshu* Vol. 320.

In the excavated sources and star-maps, the Sanskrit edition of Buddhist *Dasuiqiu tuoluoni jing* 大隨求陀羅尼經 (1005) found in Ruiguang 瑞光 Temple of Suzhou 苏州 includes the Twelve Signs arranged in a U shape. The Twelve Signs are divided into the left, upper, and right groups. The left group are Aries,

13 Niu (2004: 57–61).

Scorpio, Gemini and Cancer going from top to bottom. The upper group are Libra, Leo, Aquarius, and Pisces going from left to right. The right group are Sagittarius, Taurus, Virgo and Capricorn.[14] Besides, the Twelve Signs on the murals of the both sides of the corridor in No. 61 cave of Thousand Buddha Cave of Dunhuang (1032–1227)[15] are ordered as: (South) Gemini, Libra, Scorpio, Capricorn, Aries, Leo, and the figures of the last two Signs drop off; (North) Taurus, Cancer, Virgo, Sagittarius, Aquarius and Pisces.[16] The Chinese medical book *Guangcheng xiansheng yuhan jing* records the Twelve Signs beginning with Scorpio followed by Taurus, Libra, Aries, Gemini, Sagittarius, Cancer, Capricorn, Aquarius, Leo, Virgo and Pisces. The sequences of the Twelve Signs in these three materials differ from the ten sequences discussed above, illustrating further the wide range of different ordering for the signs of the zodiac found in medieval Chinese sources.

From the preceding discussion, it may be seen that the first sequence is consistently found in Chinese Buddhist scriptures. In the second sequence the order of the twelve signs is the same as in the first sequence, but the beginning of the sequence is different. Aries is placed as the first sign, because it is related to the position of the sun in the ecliptic at the Vernal Equinox. The Babylonians, who developed the concept of the zodiac, began their year close to the Vernal Equinox and as a consequence set Aries as the first sign of the zodiac. The tradition was transmitted to Greece and India and was introduced into China alongside the spread of Buddhist doctrines. This second sequence is also found in Chinese Buddhist scriptures. The third sequence, which has the same order as the former two sequences, begins with Scorpio in accord with Indian tradition which took Hairy Head as the first lunar mansion. It can therefore be concluded that these three sequences which arrange the twelve signs in the standard order and take Leo, Aries or Scorpio as the first sign are all examples of typical foreign sequences of the signs of the zodiac. Some sources, such as *Shan'e xiuyaojing* further divide the signs given according to these sequences into two parts: those from Leo to Capricorn said to belong to the Sun, and those from Aquarius to Cancer which belong to the Moon.

The fourth and fifth sequences begin with Aquarius, which is related to the beginning (*Zi* 子) of the twelve Earthly Branches. Beginning in at least the Warring States Period (475–221 BC), Chinese astronomy and astrology divided the circle of the heavens into twelve parts which corresponded to the

14 Suzhou (1979: 25–26).

15 ShaWu (2006: 57–62).

16 Xie (1955:133); Hsia (1976: Fig. 2).

twelve Earthly Branches. The fourth sequence accords with the order of the Twelve Earthly Branches in Heaven. The fifth sequence divides the Twelve Signs into left and right parts and arranges them in alternating order following the direct arrangement of the Twelve Earthly Branches. The representative literatures of the two sequences are mostly Taoist Scriptures and horoscope-astrological books except for one Chinese Buddhist Scripture, *Qiyao rangzai jue*. Although this work was edited by the Indian Konkata 金俱吒 in 806, it includes traditional Chinese concepts such as the thriving, potential, tranquil, constrained and dead conditions of the Five Phases:

> 有五星與大歲五行王相合者， 必生貴人。 若與月五行合者， 亦生貴人。若月至休廢囚死宿，所生之處多為庸人。
>
> If any of the five planets matches to the thriving and potential conditions of the *Taisui*'s 大歲property with the regard to Five Phases, it must give birth to a noble person. If [any of the five planets] accords with the Moon in the aspect of their properties of the Five Phases, it also give birth to a noble person. If the moon moves to the tranquil, deserted, constrained or dead Lunar Mansions, the born are mostly mediocre persons.[17]

From this it is seen that the scripture combines Buddhist ideas with traditional Chinese concepts. The first sign of Aquarius-*Zi* and the direct order from the right to the left of the twelve signs show the tendency of localization in China.

The sixth and seventh sequences begin with Libra, which is related to the twenty-eight lunar mansions. Beginning at least during the Western Han (206 BC–AD 5), the twenty-eight lunar mansions began with the lunar mansion Horn, and Horn is located in the place of Libra. The sixth sequence orders the signs right to the left. The seventh sequence also gives the signs in reverse order, but the twelve signs are also distributed in accordance with four directions, each with three signs. The eighth sequence is similar to the seventh sequence but orders the four directions differently.

The ninth and tenth sequences begin with Sagittarius, and the celestial distribution of Sagittarius corresponds to that of the earthly branch *Yin* 寅 in the sky. The sequences are connected with the concept of *Jianyin* 建寅 in the Chinese calendrical argument of *Sanzheng* 三正 (Three kinds of First Month):

> 古以子為元，今以寅為首，則天道南行，其象在上為人馬官，在下為燕，其氣專在人之三焦。

17 *Qiyao rangzai jue* (Vol. 1: 426).

> The ancient took *Zi* as the beginning, today we take *Yin* as the first, thus the Heaven moves south, the appearance in the Heaven is Sagittarius, on earth is *Yan* 燕, the *Qi* 氣 lies in *Sanjiao* 三焦 (Triple Heater) of a person.[18]

The order of the ninth sequence follows that of the twelve earthly branches, arranged directly from the right to the left. The tenth sequence orders the Twelve Signs in pairs.

The representative literatures of the sixth to the tenth sequences are mostly Taoist Scriptures and horoscopic astrology books except for one work, *Baibao kouchao*. *Baibao kouchao* is a Chinese Buddhist Scripture edited by Japanese monks in the 15th and 16th centuries. The scripture preserves the trace of the localization of the twelve signs in China.

From all the above, the sequences of the twelve signs indicate two tendencies. The first one preserves the original foreign features, with the beginning of Leo, Aries or Scorpio and a reverse order. These features exist in Chinese Buddhist Scriptures with a strong foreign flavor. The second one is combined with traditional Chinese twelve earthly branches, twenty-eight lunar mansions, and the concept of *Jianyin*, with the beginning of Aquarius, Libra or Sagittarius and mostly a direct order in order to become more local. These features mostly exist in Taoist Scriptures and horoscopic astrology books.

The two tendencies suggest that after the introduction of the twelve signs of the zodiac into China, the Hellenistic and Indian astronomical, calendrical and astrological meanings of the zodiac was gradually replaced during the Tang and Song dynasties by traditional Chinese concepts.

4 Correspondence between the Twelve Signs with Twenty-seven/Twenty-eight Lunar Mansions and Seven Luminaries in Chinese Horoscopic Astrology

Several Chinese Buddhist Scriptures, Taoist Scriptures, horoscopic astrology books, Dunhuang manuscripts and other works written during the Tang and Song dynasties, record the correspondence between the twelve signs of the zodiac with the twenty-eight lunar mansions and the seven luminaries. These sources show that the properties of the twelve signs of the zodiac changed during this period.

18 *Yuanyuan daomiao dongzhen jipian* (Vol. 1:14).

TABLE 15.3 *Correspondence between the Twelve Signs and Twenty-eight Lunar Mansions*

The Twelve Signs	Source			
	Shan'e Xiuyaojing	***Shan'e Xiuyaojing "Picture1"***	***Shan'e Xiuyaojing "Picture2"***[19]	***Zhilunjing***
Leo	Star (*xing*, 星) four feet, Extended net (*zhang*, 张) four feet, Wings (*yi*, 翼) two feet	Turtle beak, Three stars, Well	Winnowing basket, Dipper	Each one cent of Star, Extended net, Wings
Virgo	Wings three feet, Chariot (*zhen*, 轸) four feet, Horn (*jiao*, 角) two feet	Gostes, Willow	Girl, Emptiness, Rooftop	Wings three cents, Each two cents of Chariot, Horn
Libra	Horn two feet, Neck (*kang*, 亢) four feet, Root (*di*, 氐) three feet	Star, Extended net	Encampment, Wall, Legs	Horn two cents, Each three cents of Neck, Root
Scorpio	Root one foot, Room (*fang*, 房) four feet, Heart (*xin*, 心) four feet	Wings, Chariot	Bood, Stomach	Each one cent of Root, Room, Heart
Sagittarius	Tail (*wei*, 尾) four feet, Winnowing basket (*ji*, 箕) four feet, Dipper (*dou*, 斗) one foot	Horn, Neck	Hairy head, Net	Each one cent of Tail, Winnowing basket, Dipper
Capricorn	Dipper three feet, Girl (*nv*, 女) four feet, Emptiness (*xu*, 虚) two feet	Root, Room	Turtle beak, Three stars, Well	Dipperthree cents, Each two cents of Ox (*niu*, 牛), Girl
Aquarius	Emptiness two feet, Rooftop (*wei*, 危) four feet, Encampment (*shi*, 室) three feet	Heart, Tail	Ghosts, Willow	Girl two cents, Each three cents of Rooftop, Encampment
Pisces	Encampment one foot, Wall (*bi*, 壁) four feet, Legs (*kui*, 奎) four feet	Winnowing basket, Dipper	Star, Extended net	Each on cent of Encampment, Wall, Legs

19 This picture contained the same contents with the "Twenty-seven and the Twelve Signs Picture" recorded in *Jixiongshiri Shan'e Xiuyaojing* 吉凶时日善恶宿曜经, just the form was a little different, so the correspondence between the Twelve Signs and Twenty-eight Lunar Mansions should include this literature, Chen (1934:8).

Source				
Yiguijing	***Zhangguo Xingzong***	***Xingping Huihai***	***Xingxue Dacheng***	***Guangchengxian-sheng Yuhanjing***
Star, Extended net	Willow three, Star, Extended net	Star, Extended net	Willow, Star, Extended net	Willow, Star, Extended net
Wings, Chariot	Extended net fifteen, Wings, Chariot	Chariot, Wings, Star	Wings, Chariot	Wings, Chariot
Horn, Neck, Root	Chariot ten, Horn, Neck, Root the primary	Chariot, Horn, Neck, Root	Horn, Neck,	Horn, Neck,
Room, Heart, Tail	Root two, Room, Heart, Tail	Room, Heart	Root, Room, Heart	Root, Room, Heart
Winnowing basket, Dipper	Tail three, Winnowing basket, Dipper	Tail, Winnowing basket, Dipper	Tail, Winnowing basket	Tail, Winnowing basket
Ox, Girl	Dipper four, Ox, Girl	Dipper, Ox	Dipper, Ox	Dipper, Ox
Emptiness, Rooftop	Girl two, Emptiness, Rooftop	Girl, Emptiness, Rooftop	Girl, Emptiness, Rooftop	Girl, Emptiness, Rooftop
Encampment, Net, Legs	Rooftop twelve, Encampment, Wall, Legs	Encampment, Wall, Legs	Encampment, Wall	Encampment, Wall

TABLE 15.3 *Correspondence between the Twelve Signs and Twenty-eight Lunar Mansions* (cont.)

The Twelve Signs	Source			
	Shan'e Xiuyaojing	***Shan'e Xiuyaojing "Picture1"***	***Shan'e Xiuyaojing "Picture2"***	***Zhilunjing***
Aries	Bond (*lou*, 娄) four feet, Stomach (*wei*, 胃) four feet, Hairy head (*mao*, 昴) one foot	Girl, Emptiness, Rooftop	Wings, Chariot	Whole cents of Bood, Stomach, One cent of Hairy head
Taurus	Hairy head three feet, Net (*bi*, 毕) four feet, Turtle beak (*zi*, 觜) two feet	Encampment, Wall, Legs	Horn, Neck	Three cents of Hairy head, Each two cents of Net, Three stars
Gemini	Turtle beak two feet, Three stars (*cen*, 参) two feet, Well (*jing*, 井) two feet	Bond, Stomach	Root, Room	Two cents of Three stars, Each three cents of Turtle beak, Well
Cancer	Well one foot, Ghosts (*gui*, 鬼) four feet, Willow (*liu*, 柳) four feet	Hair head, Net	Heart, Rooftop	Whole cents of Well, Ghosts, Willow

Tab. 15.3 summarizes the correspondence between the twelve signs of the zodiac and the lunar mansions found in these sources. The measurement units of foot (*zu* 足), cent (*fen* 分) and so on which are referred to in the texts have not been unified; my comparison concentrates on the lunar mansions alone.[20] From Tab. 15.3, we can see that the lunar mansion corresponding to the signs of the zodiac recorded in these sources are not always the same. For example,

20 The three records in *Shan'e xiuyaojing* do not include the lunar mansion Ox. Instead, only twenty-seven lunar mansions are names. The other six sources include all twenty-eight lunar mansions. The appearance of the twenty-seven lunar mansion system in *Shan'e xiuyaojing* is an indication that the text has its basis in Indian astronomy and astrology, where there were two traditions of twenty-seven and twenty-eight lunar mansions (see Niu 2004: 61–64). Many Chinese Buddhist Scriptures, and also the Dunhuang manuscripts, record both the twenty-seven and twenty-eight lunar mansions. Beginning at least during the Han dynasty, Chinese astronomy and astrology always used a twenty-eight lunar mansion system. Horoscopic astrology books and other ancient Chinese works such as *Guangcheng xiansheng yuhan jing* mostly record the Twenty-eight Lunar Mansions.

Source				
Yiguijing	***Zhangguo Xingzong***	***Xingping Huihai***	***Xingxue Dacheng***	***Guangchengxian-sheng Yuhanjing***
Legs, Bond, Stomach	Legs one, Bond, Stomach	Legs, Stomach	Legs, Bond	Legs, Bond
Hairy head, Net, Three stars	Stomach three, Hairy head, Net	Hairy head, Net	Stomach, Hairy head, Net	Stomach, Hairy head, Net
Turtle beak, Three stars, Well	Net six, Turtle beak, Three stars, Well	Net, Turtle beak, Three stars, Well	Turtle beak, Three stars	Turtle beak, Three stars
Ghosts, Willow	Well eight, Ghosts, Willow	Well, Ghosts, Willow	Well, Ghosts	Well, Ghosts

most texts associate Leo first with the lunar mansion Star Lunar, but *Zhangguo xingzong* and *Xingxue dacheng* associate it first with the lunar mansion Willow. In the three of the sources, Leo is associated with three lunar mansions: Willow, Star and Extended Net, but it is only associated with the two lunar mansions of Star and Extended Net in *Dafangguang pusa zangwenshu shili genben yiguijing* and *Xingping huihai*. Besides the texts, *Shan'e xiuyaojing* includes two pictures which paint the correspondence between the twenty-seven lunar mansions and the twelve signs, but the three kinds of correspondence in the scripture differ from each other. Although the same signs correspond to different lunar mansions in the two pictures, the twelve divisions of the twenty-seven lunar mansions are the same, which indicate a correspondence based on the same kind of rules.

The correspondences between the twenty-eight lunar mansions and the twelve signs in the first six sources in the Tab. 15.3 are similar to the first correspondence in *Shan'e xiuyaojing* (the difference at most exists in the assignment of two lunar mansions). Thus, whether in Chinese Buddhist Scriptures or horoscopic astrology books, the correspondence between the twenty-seven/twenty-

TABLE 15.4 *Correspondence between the Twelve Signs and the Seven Luminaries*

The Twelve Signs	Leo	Virgo	Libra	Scorpio	Sagittarius
Seven Luminaries	Sun	Mercury	Venus	Mars	Jupiter
Seven Luminaries (Another)[21]	Jupiter	Mars	Venus	Mercury	Moon

TABLE 15.5 *Correspondence between the Twelve Signs, the Seven Luminaries and Five Phases in* Qiyao rangzai jue

The Twelve Signs	Leo	Virgo	Libra	Scorpio	Sagittarius
Seven Luminaries	Sun	Mercury	Venus	Mars	Jupiter
Five Phases	Fire	Water	Metal	Fire	wood

eight lunar mansions and the twelve signs was highly consistent, and the two kinds of relatively different correspondence in the pictures might come from different origins or function differently.[22]

Tab. 15.4 shows the correspondences between the twelve signs and the seven luminaries found in different texts. A uniform set of correspondences are found across all but one source. According the research of Chen Wancheng, these correspondences have their origin in Ptolemy's astrology, which spread to India, and was then transmitted to China.[23] The only exception to this set of correspondences is found in the second picture in the *Shan'e xiuyaojing*. This picture displays a different kind of correspondence from the usual one. The difference is similar to the correspondence between the twelve signs and

21 *Shan'e xiuyaojing* (Vol. 2: 395).

22 The origin may be related with *Yusijing* 聿斯經. According to the records "About the Personal Destiny 本命 (*benming*) House 本命宮事" in *Baibao kouchao-Beidoufa4*, there are two kinds of correspondence between the Twelve Signs and the twelve months. The one came from *Xiuyaojing* 宿曜經(usually as a short name of *Shan'e xiuyaojing*, they might from the same origin), and the other came from *Yusijing*. The records in *Yusijing* accords with the correspondence between the Twelve Signs and the twelve months in the two pictures, thus the correspondence between the Twenty-eight Lunar Mansions and the Twelve Signs in the pictures may also come from *Yusijing*, and differ from the records of texts in *Shan'e xiuyaojing*. The unusual correspondence between the Twelve Signs and the Seven Luminaries might also be related with this.

23 Chen (2010: 62–66).

TABLE 15.4 (cont.)

Capricorn	Aquarius	Pisces	Aries	Taurus	Gemini	Cancer
Saturn	Saturn	Jupiter	Mars	Venus	Mercury	Moon
Sun	Mercury	Venus	Mars	Jupiter	Saturn	Saturn

TABLE 15.5 (cont.)

Capricorn	Aquarius	Pisces	Aries	Taurus	Gemini	Cancer
Saturn	Saturn	Jupiter	Mars	Venus	Mercury	Moon
earth	earth	wood	Fire	Metal	Water	Water

the twenty-seven lunar mansions found in this picture, and needs further exploration in the future.

In additional to the usual correspondences between the luminaries and the signs of the zodiac, the scripture *Qiyao rangzai jue* also records a different set of correspondences to the seven luminaries and five phases as shown in Tab. 15.5. The correspondences to the five phases are relatively simple: the five planets go the same as the corresponding luminaries, the Sun corresponds to fire, and the Moon to water. These later correspondences have a long tradition in China, recorded already in *Lingxian* 靈憲 by Zhang Heng 張衡 (AD 78–139):

> 夫日譬猶火，月譬猶水。
>
> The Sun is like fire, and the Moon is like water.[24]

The process of associating the twelve signs of the zodiac with traditional methods and concepts of Chinese divination may have been part of the process of adapting the foreign practice of horoscopic astrology to local needs and traditions. In addition to the evidence for the adaptation in the *Qiyao rangzai jue*, other Chinese works attest to attempts at localization of horoscopic astrology by incorporating the five-phase theory into it. In particular, the *Xingming suyuan* attempted to make a systematic association between the luminaries and the five phases:

24 *Houhanshu* (“*Tianwenzhi* 天文志 1”: 3216).

日火也，月水也。四日度坐命，晝生忌火羅。 …… 日月度坐命，夜生怕土計。

Sun is fire, and Moon is water. If the Destiny locates in the four degrees of Sun, those born in the daytime abstain from Mars and Rahu …. If the Destiny locates in the four degrees of Moon, those born in the night abstain from Saturn and Ketu.[25]

With the process of linking the twelve signs to the properties of the five phases, they lost their original horoscopic meanings. Each sign of the zodiac originally had different horoscopic meaning in Chinese Buddhist Scriptures:

第一， 星四足， 張四足， 翼一足。 大陽位焉。 其神如師子， 故名師子宮。 主加官得財事， 若人生屬此宮者， 法合足精神， 富貴孝順， 合掌握軍旅之任也。

……

第六， 斗三足， 女四足， 虛二足。 鎮星位焉。 其神如磨竭， 故名磨竭宮。 主鬥諍之事， 若人生屬此宮者， 法合心麁五逆， 不敬妻子， 合掌刑殺之任。

第七，虛二足，危四足，室三足。鎮星位焉。其神如瓶，故名瓶宮。主勝強之事，若人生屬此宮者，法合好行忠信足學問富饒，合掌學館之任。

The first, Star is four feet, Extended Net is four feet, Wings is one foot. It's Sun's place. Its god is like a lion, so named as Leo. [It] masters promotion and richness. If people are born belong to the house, they should be abundantly vigorous, rich and filial, take a position in the army.

…

The sixth, Dipper is three feet, Girl is four feet, Emptiness is two feet. It's Saturn's place. Its god is like [the animal of] Capricorn, so named as Capricorn. [It] masters fight and debate. If people are born belong to the house, they should be rebellious, not look up to his wife, and take a position about punishment.

The seventh, Emptiness is two feet, Rooftop is four feet, Encampment is three feet. It's Saturn's place. Its god is like a bottle, so named as Aquarius. [It] masters winning. If people are born belong to the house,

25 *Xingming suyuan* (Vol. 2: 53).

> they should have good manners, be loyal and learned, and take a position of teaching.[26]

Although according to the associations between signs of the zodiac and the luminaries just discussed, both Capricorn and Aquarius are associated with Saturn, in this text the horoscopic meanings of the two signs are different.[27] But in the books of horoscopic astrology, the meanings of the twelve signs are replaced by the properties of five phases, as appears, for example, in statements such as Wood beats Aquarius, Water drifts Aries, Fire burns Taurus, and Earth buries Virgo.[28] These examples are mostly punitive and taboo arguments: Aquarius belongs to Earth, and Wood constrains Earth; Aries belongs to Fire, and Water constrains Fire; Taurus belongs to Metal, and Fire constrains Metal; Virgo belongs to Water, and Earth constrains Water. The twelve signs here have already lost their own horoscopic meanings, and bear instead the divine meanings of the five phases, working in the principle of "promotion and constraint of five phases" 五行生克 (*wuxing shengke*). Furthermore, the lunar mansions also corresponded to the seven luminaries in both an indirect and direct way as Tab. 15.6 shows. From Tab. 15.6, we can see that in Chinese Buddhist Scriptures, the lunar mansions do not directly correspond to the seven luminaries, but indirectly corresponded to them through the twelve signs as an intermediary stage. Thus, one lunar mansion in some Chinese Buddhist Scriptures belongs to several different luminaries, and each degree of the lunar mansion corresponds to one luminary. For example, in *Shan'e xiuyaojing*, the former two feet of the lunar mansion Horn belong to Virgo, corresponding to Mercury and Water, and the latter two feet belong to Libra, corresponding to Venus and Metal.

26 *Shan'e xiuyaojing* (Vol. 1:387).

27 The horoscopic meanings of the twelve signs not only spread in Chinese Buddhist Scriptures, but were also used in the society. Wen Tianxiang 文天祥 (1236–1283) wrote in his poem: "In the house of Capricorn there is star of Dipper, Bumping and rising because the Winnowing Basket has a mouth. Changli 昌黎 accommodated the Body and Po 坡 located the Destiny, their lives were fully filled with slander 磨蠍之宮星見斗，簸之揚之箕有口。 昌黎安身坡立命， 謗毀平生無不有." (*Wenshan xiansheng quanji* (Vol. 1: 13B)). Capricorn masters fight and debate, which accords with the experiences of Han Changli 韓昌黎 (768–824) and Su Dongpo 蘇東坡 (1037–1101) who encountered much slander in their lives.

28 These phases describing horoscopic astrology could be seen in many horoscopic astrology books, such as *Xingming suyuan*, *Zhangguo xingzong*, *Bi'ao jing*, *Xingxue dacheng*.

TABLE 15.6 *The "Seven Luminaries" Property of the Lunar Mansions in Horoscope Astrology*

Twenty-eight Lunar Mansions		**Sources**	
Directions	**Lunar Mansions**	***Shan'e Xiuyaojing***	***Shan'e Xiuyaojing* "Picture 1,2"**
Eastern seven lunar mansions	Horn	Horn two feet, Mercury(Girl); Horn two feet, Venus(Libra)	Wood(Jupiter, Sagittarius)
	Neck	Neck, Venius(Libra)	Wood(Jupiter, Sagittarius)
	Root	Root three feet, Venus(Libra); Root one foot, Mars(Scorpio)	Earth(Saturn, Capricorn)
	Room	Mars(Scorpio)	Earth(Saturn, Capricorn)
	Heart	Mars(Scorpio)	Earth(Saturn, Aquarius)
	Tail	Jupiter(Sagittarius)	Earth(Saturn, Aquarius)
	Winnowing basket	Jupiter(Sagittarius)	Wood(Jupiter, Pisces)
Northern seven lunar mansions	Southern Dipper/Dipper	Dipper one foot, Jupiter(Sagittarius); Dipper three feet, Saturn(Capricorn)	Wood(Jupiter, Pisces)
	Altair /Ox		
	Xunü 須女/Girl	Saturn (Capricorn)	Fire (Mars, Aries)
	Emptiness	Two feet, Saturn(Capricorn); two feet, Saturn (Aquarius)	Fire (Mars, Aries)
	Rooftop	Four feet, Saturn (Aquarius)	Fire (Mars, Aries)

Sources		
Zhilunjing	*Zhangguo Xingzong*, *Xingming Zonggua*, *Xingxue Dacheng*, *Xingping Huihai*, **Shilin Guangji**	
Two cents, Water luminary(Girl); two cents, Metal luminary(Libra)	Water Flood dragon	(Chen, Metal Libra)
Three cents, Metal luminary(Libra)	Metal Dragon	(Chen, Metal Libra)
Three cents, Metal luminary; one cent, Fire luminary(Scorpio)	土貉Earth Racoon dog	Primary degree(Chen, Metal Libra); second degree and beyond(Mao, Fire Scorpio)
One cent, Fire luminary(Scorpio)	Sun Rabbit	(Mao, Fire Scorpio)
One cent, Fire luminary(Scorpio)	Moon Fox	(Mao, Fire Scorpio)
One cent, Wood luminary(Sagittarius)	Fire Tiger	Primary, first, second degrees(Mao, Fire Scorpio), third degree and beyond(Yin, Wood Sagittarius)
One cent, Wood luminary(Sagittarius)	Water Leopard	(Yin, Wood Sagittarius)
One cent, Wood luminary(Sagittarius); three cents, Earth luminary(Capricorn)	Wood Xie 獬	Primary, first, second, third degrees(Yin, Wood Sagittarius); Fourth degree and beyond(Chou, Earth Capricorn)
Two cents, Earth luminary(Capricorn)	Metal Ox	(Chou, Earth Capricorn)
Two cents, Earth luminary (Capricorn); two cents, Earth luminary (Aquarius)	Earth Bat	Primary degree (Chou, Earth Capricorn); second degree and beyond (Zi, Earth Aquarius) **(Beginning)**
	Sun Rat	(Zi, Earth Aquarius)
Three cents, Earth luminary (Aquarius)	Moon Swallow	Eleventh degree and before, (Zi, Earth Aquarius); twelfth degree and beyond (Hai, Wood Pisces)

TABLE 15.6 *The "Seven Luminaries" Property of the Lunar Mansions in Astrology* (cont.)

Twenty-eight Lunar Mansions		Sources	
Directions	**Lunar Mansions**	***Shan'e Xiuyaojing***	***Shan'e Xiuyaojing* "Picture 1,2"**
	Yingshi 营室/Encampment	Three feet, Saturn (Aquarius); One foot, Jupiter (Pisces)	Metal (Venus, Taurus)
	Eastern Wall/Wall	Jupiter (Pisces)	Metal (Venus, Taurus)
Western seven lunar mansions	Legs	Jupiter (Pisces)	Metal (Venus, Taurus)
	Bond	Mars (Aries)	Water (Mercury, Gemini)
	Stomach	Mars (Aries)	Water (Mercury, Gemini)
	Hairy head	One foot, Mars (Aries); three feet, Venus (Taurus)	Moon (Moon, Cancer)
	Net	Venus (Taurus)	Moon (Moon, Cancer)
	Zixi 觜觿/Turtle beak	Two feet, Venus (Taurus); two feet, Mercury (Gemini)	Sun (Sun, Leo)
	Three stars	Mercury (Gemini)	Sun (Sun, Leo)
Southern seven lunar mansions	Eastern well/ Well	Three feet, Mercury (Gemini); one foot, Moon (Cancer)	Sun (Sun, Leo)
	Yugui 輿鬼/Ghosts	Moon (Cancer)	

	Sources	
Zhilunjing	***Zhangguo Xingzong*, *Xingming Zonggua*, *Xingxue Dacheng*, *Xingping Huihai*, Shilin Guangji**	
Three cents, Earth luminary (Aquarius); One cent, Wood luminary (Pisces)	Fire Pig	(Hai, Wood Pisces)
One cent, Wood luminary (Pisces)	Water Yu 貐	(Hai, Wood Pisces)
One cent, Wood luminary (Pisces)	Wood Wolf	Primary degree (Hai, Wood Pisces); First degree and beyond (Xu, Fire Aries)
Fire luminary (Aries) **(Beginning)**	Metal Dog	(Xu, Fire Aries)
Fire luminary (Aries)	Earth Zhi 雉	Primary, first and second degrees (Xu, Fire Aries); third degree and beyond (You, Metal Taurus)
One cent, Fire luminary **(Aries, beginning);** three cents, Metal luminary (Taurus)	Sun Chicken	(You, Metal Taurus)
Two cents, Metal luminary (Taurus)	Moon Bird	Primary, first, second, third, fourth, fifth degrees (You, Metal Taurus); sixth degree and beyond (Shen, Water Gemini)
Three cents, Water luminary (Gemini) (Turtle beak lunar mansion was listed behind Three stars lunar mansion)	Fire Monkey	(Shen, Water Gemini)
Two cents, Metal luminary (Taurus); two cents, Water luminary (Gemini)	Water Yuan Ape	(Shen, Water Gemini)
Three cents, Water luminary (Gemini); The whole cents, Moon (Cancer)	Wood Han 犴	Primary, first, second, third, fourth, fifth, sixth, seventh degrees (Shen, Water Gemini); eighth degree and beyond (Wei, Moon Cancer)
Moon (Cancer)	Metal Sheep	(Wei, Moon Cancer)

TABLE 15.6 *The "Seven Luminaries" Property of the Lunar Mansions in Astrology* (cont.)

Twenty-eight Lunar Mansions		Sources	
Directions	**Lunar Mansions**	***Shan'e Xiuyaojing***	***Shan'e Xiuyaojing* "Picture 1,2"**
	Willow		Water (Mercury, Virgo)
	Seven stars/ Star	(Beginning) Star four feet, Sun (Leo)	Metal (Venus, Libra)
	Extented net	Extended net four feet, Sun (Leo)	Metal (Venus, Libra)
	Wings	Wings one foot, Sun (Leo); Wings three feet, Mercury (Virgo)	Fire (Mars, Scorpio)
	Chariot	Chariot four feet, Mercury (Virgo)	Fire (Mars, Scorpio)

In the books of horoscopic astrology, by contrast, the twenty-eight lunar mansions directly correspond to the seven luminaries. This correspondence is also found in some ancient Chinese works such as *Shilin guangji* 事林廣記 of the Song dynasty. Chen Wancheng has attributed the correspondence to Chinese tradition.[29] Chinese Buddhist Scriptures do not record the direct correspondence, which might further support his argument. Furthermore, the number of lunar mansions found in these correspondences is usually twenty-eight, the same as in the Chinese system of lunar mansions. However, Chen's discussion is based on the book *Xingming zongguo* and the author of that book indicated in the preface that the contents came from the foreign countries.[30] Thus, it is problematic to conclude only on the basis of this book that the correspondences are part of earlier Chinese tradition.

29 Chen (2010: 66–70).

30 *Xingming zongkuo* (Preface: 193–194).

	Sources	
Zhilunjing	***Zhangguo Xingzong*, *Xingming Zonggua*, *Xingxue Dacheng*, *Xingping Huihai*, Shilin Guangji**	
Moon (Cancer)	Earth Zhang 獐	Primary, first, second degrees (Wie, Moon Cancer); third degree and beyond (Wei, Sun Leo)
One cent, Sun (Leo)	Sun Horse	(Wu, Sun Leo)
One cent, Sun (Leo)	Moon Deer	Before fifteen degree (Wu, Sun Leo); fifteen degree and beyond (Si, Water Virgo)
One cent, Sun (Leo); three cents, Water luminary (Virgo)	Fire Snake	(Si, Water Virgo)
Two cents, Water luminary (Virgo)	Water Earthworm	Before tenth degree (Si, Water Virgo); tenth degree and beyond (Chen, Metal Libra)

An alternate possibility is that the direct correspondence might result from a syncretism between Chinese astrology and foreign horoscopic astrology. Chinese astrology was mainly used to predict war, disaster, harvest and the future of royal members and ministers, that is, state-level issues.[31] It divided the Twenty-eight Lunar Mansions into five parts, corresponding to the five phases, as Tab. 15.7 shows. The four astrological books in Tab. 15.7 date from the Tang dynasty and are compilation works of traditional Chinese astrology. Although the correspondence in these books is not in uniform, and the five phases property in Tab. 15.7 of each lunar mansion does not accord with the seven luminaries property shown in Tab. 15.6, the direct connection between the twenty-eight lunar mansion and five phases represents a Chinese astrological tradition. While Chinese Buddhist Scriptures and books of horoscopic astrology tried to equate the seven luminaries with the five Phases, the books of horoscopic astrology also attempted to combine the seven luminaries with the Chinese system of twenty-

31 Jiang (2005: 4).

TABLE 15.7 *Correspondence between the Twenty-eight Lunar Mansions and Five Planets-Five Phases in Chinese Astrology*

Twenty-eight Lunar Mansions		**Sources**
Directions	**Lunar Mansions**	***Kaiyuan zhanjing*** 开元占经
Eastern seven lunar mansions	Horn	In spring and summer is Wood, in autumn and winter is Metal
	Neck	In spring and summer is Fire, in autumn and winter is Water *Wuxingzhan* 五星占: Neck, is Fire.
	Root	In spring and summer belong Metal, in autumn and winter is Water *Wuxingruxiu Zhan* 五星入宿占: Root, is Wood.
	Room	In spring and summer is Water, in autumn and winter is Fire Also said: Room, is a Earth star.
	Heart	In spring and summer is Wood, in autumn and winter is Water Also said: Heart star, is Fire.
	Tail	In spring and summer is Fire, in autumn and winter is Water Also said Water star.
	Winnowing basket	In spring and summer is Metal, in autumn and winter is Earth People said: is a Metal star.
Northern seven lunar mansions	Southern Dipper/ Dipper	In spring and summer is Water, in autumn and winter is Metal *Wuxian Shiwuxingruxiu Yanxiongzhan* 巫咸释五星入宿言凶占said: These dippers, are Wood stars.
	Qianniu 牵牛/ Ox	In spring and summer is Wood, in autumn and winter is Fire Wu Xian 巫咸 said: is a Wood star.

Sources		
Guanxian gwanzhan 观象玩占	*Tongzhan daxian li xingjing* 通占大象历星经	*Tianwen yaolu* 天文要录
Metal	Metal, in spring and summer is Fire, in autumn and winter is Water	Metal Official
Fire	Fire, in spring and summer belong Water, in autumn and winter is Metal	
Earth	Wood, in spring and summer is Wood, in autumn and winter is Water[32]	
Water[33]	Fire, in spring and summer is Water, in autumn and winter is Fire	
Fire	Fire, in spring and summer is Wood, in autumn and winter is Water	
Water	Water	Water Official
Metal	Metal, in spring and summer is Metal, in autumn and winter is Earth	
Wood	Wood, in spring and summer is Wood, in autumn and winter is Water	
Wood	Wood, in spring and summer is Wood, in autumn and winter is Fire	

32 In *Tongzhan daxian li xingjing*, Root Lunar Mansion was described after Room, different from other literatures.

33 In another edition of *Guanxiang wanzhan* reserved in Institute for Research in Humanities, Water was recorded as “Wood”.

TABLE 15.7 *Correspondence in Chinese Astrology* (cont.)

Twenty-eight Lunar Mansions		Sources
Directions	**Lunar Mansions**	***Kaiyuan zhanjing*** 开元占经
	Xunv/ Girl	In spring and summer is Water, in autumn and winter is Fire *Wuxian Zhan* 巫咸占said: Xu Nv, is a Water star.
	Emptiness	In spring and summer is Water, in autumn and winter is Metal Wu Xian said: Emptiness, is a Metal star.
	Rooftop	In spring and summer is Water, in autumn and winter is Fire Wu Xian said: Rooftop, is a Earth star.
	Yingshi/ Encampment	In spring and summer is Water, in autumn and winter is Earth Wu Xian said: Ying Shi, is a Wood star.
	Eastern Wall/ *Dongbi* 东辟/ Wall	In spring and summer is Metal, in autumn and winter is Water Wu Xian said: Eastern Wall, is a Earth star.
Western seven lunar mansions	Legs	In spring and summer is Metal, in autumn and winter is Water Wu Xian said: Legs, is a Metal star.
	Bond	In autumn and winter is Fire, in spring and summer is Water Wu Xian said: Bond, is a Water star.
	Stomach	In spring and summer is Wood, in autumn and winter is Water Wu Xian said: Stomach, is a Metal star.
	Hairy head	In spring and summer is Fire, in autumn and winter is Metal Wu Xian said: Hairy head, is a Fire star.
	Net	In spring and summer is Metal, in autumn and winter is Water Wu Xian said: Net, is a Fire star; *Fu'er* 附耳, is a Water star.

Sources		
Guanxian gwanzhan 观象玩占	*Tongzhan daxian li xingjing* 通占大象历星经	*Tianwen yaolu* 天文要录
Water	Water, in spring and summer is Water, in autumn and winter is Fire	
Water	Metal, in spring and summer is Water, in autumn and winter is Metal	
Earth	Earth, in spring and summer is Water, in autumn and winter is Fire	
Wood	Wood, in spring and summer is Fire, in autumn and winter is Water	
Earth	Earth, in spring and summer is Metal, in autumn and winter is Earth	Earth Official
Metal		
Earth		
Metal		
Water		
Water		Water Official; Fu'er is a Wood Official

TABLE 15.7 *Correspondence in Chinese Astrology* (cont.)

Twenty-eight Lunar Mansions		Sources
Directions	**Lunar Mansions**	***Kaiyuan zhanjing*** 开元占经
	Zixi/ Turtle beak	In autumn and winter is Earth, in spring and summer is Water Wu Xian said: Turtle beak, is a Metal star.
	Three stars	In autumn and winter is Earth, in spring and summer is Water Wu Xian said: Three stars, is a Metal star.
Southern seven lunar mansions	Eastern well/ Well	In spring and summer is Fire, in autumn and winter is Water Wu Xian said: Eastern well, is a Water star.
	Yugui/ Ghosts	In spring and summer is Fire, in autumn and winter is Water Wu Xian said: Ghosts, is a Earth star.
	Willow	In autumn and winter is Fire, in spring and summer is Water Wu Xian said: Willow, is a Earth star.
	Seven stars	In spring and summer is Fire, in autumn and winter isWater Wu Xian said: Seven stars, is a Water star.
	Extended net	In spring and summer is Wood, in autumn and winter is Water Wu Xian said: Extended net, is a Water star.
	Wings	In autumn and winter is Earth, in spring and summer is Metal Wu Xian said: Wings, is a Metal star.
	Chariot	In spring and summer is Wood, in autumn and winter is Earth Wu Xian said: Chariot, is a Metal star.

Sources

Guanxian gwanzhan 观象玩占	*Tongzhan daxian li xingjing* 通占大象历星经	*Tianwen yaolu* 天文要录
Metal		
Metal		
Water		
Earth		
Fire Also said a Earth star.		
Water Also said a Fire star.		Fire Official
Fire		
Earth		
Water		

eight lunar mansions. This resulted in a direct correspondence between the twenty-eight lunar mansions and the seven luminaries. However, the direct correspondence of the seven luminaries to the twelve signs and the twenty-eight lunar mansions were not in agreement, which led to the so-called "Debate between House 宫 (*gong*) and Degree 度 (*du*)" in Chinese horoscope astrology.

5 The "Debate between House and Degree" in Chinese Horoscopic Astrology

The correspondence between the twelve signs of the zodiac and the seven luminaries originated in foreign horoscopic astrology and was then combined with traditional Chinese concepts. The direct correspondence between the twenty-eight lunar mansions and the seven luminaries, however, developed in the syncretism between foreign and Chinese cultures. These different backgrounds resulted in a conflict between the importance placed on the twelve signs and the twenty-eight lunar mansions in fortune telling during the Tang and Song dynasties. The so-called "Debate between House and Degree" in books of horoscopic astrology clearly reveals the changing stages in this conflict.

The term "House" is used to indicate the twelve signs of the zodiac, and is usually represented by the twelve Earthly Branches. The term "Degree" indicates the degrees of the twenty-eight lunar mansions. In a circular astrological chart for fortune telling, a person's Destiny 命 (*ming*) or Course 行限 (*xingxian*) is located somewhere corresponding to both a House and a Degree. Each House and each Degree of the lunar mansions respectively corresponds to a luminary, as the "seven luminaries" property of the House and the Degree, called "House Host 宫主 (*gongzhu*)" and "Degree Host 度主 (*duzhu*)": as explained in the *Zhangguo xingzong*, "The Sign belongs to House Host, and the Lunar Mansion belongs to the Degree Host 宮之所屬是宮主也， 宿之所屬即度主也"[34] Usually, the House Host and Degree Host are different, which caused the problem of which of the two Hosts were of greater importance. There were at least three views on the problem. The *Zhangguo xingzong* presents the first view as follows:

> 凡安命處有命宮之主， 有命度之主， 名雖有二， 其論則一。 如宮強而度弱者， 不美， 或度高而宮衰者， 不善。 必須要宮度二主皆強，

34 *Zhangguo xingzong* (Chapter 10: 53B).

斯為盡美而盡善矣。……如宮度皆強者，不貴即富。或宮度皆弱者，非夭即貧。倘宮主度主一強一弱，則知得失於其中矣。

Where the Destiny locates, there are the Host of Destiny House and the Host of Destiny Degree, the names are two, but the essence is only one. If House is strong but Degree weak, not beautiful, or Degree is high but House low, not well. Should the two Hosts of House and Degree be both strong, then be completely beautiful and well …. If both House and Degree are strong, not noble but rich. If both House and Degree are weak, not abortive but poor. If House and Degree one strong, one weak, then we can see the gain and loss in them.[35]

The difference between the House Host and Degree Host takes about the Destiny, which decides the inborn destiny of a person. In the Course, which indicates the postnatal destiny of a person in each step of years, the importance between the two Hosts is also important:

夫限度主者，有限宮之主，有限度之主。二主皆要得地，不可失於偏廢，如看命宮主、命度主一樣。如限宮主受傷而限度主得生者，或限宮主得生而限度主受傷者，如此則知一吉一凶存焉。或限宮、限度主皆強者有之，或限宮、限度主皆弱者有之，如宮度兩強者必主發達，或宮度兩傷者定入幽冥。又有宮主受傷而度主得生者，亦死；又有宮主得生而度主受傷者，亦死，何也？蓋有刃星，非合于宮即合於度故也。經云：無殺刃，豈能傷乎？由此推之，則吉凶生死如反掌耳。如欲指命宮喜某星為恩以言福，如欲指命度怕某星為難以言禍，然此則百無一驗也。斯乃執滯之學，不識變通之理，豈可與語哉！

The Hosts of Course, have Host of Course House and Host of Course Degree. The two Hosts should be in good place, not in unbalance, as looking into the Host of Destiny House and Host of Destiny Degree. If a person whose Host of Course House is injured and Host of Course Degree is promoted, or whose Host of Course House is promoted and Host of Course Degree is injured, so it is known that there are one lucky and another inauspicious. Or there are people whose Hosts of Course House and Course Degree are both strong, or whose Hosts of Course House and Course Degree are both weak, people with the two strong should thrive, or people with the two injured will die. There are also people whose House Host is injured and Degree Host is promoted, also be dead;

35 *Zhangguo xingzong* (Chapter 10: 53B).

> there are also people whose House Host is promoted and Degree Host is injured, also dead, why? That is because there are destructive stars, not matching to House but matching to Degree. It says: No kill or destroy, how could injury? From this, it is easily known that which is lucky or inauspicious, live or dead. If somebody deduces the luckiness through which Destiny House likes some stars for its goodness, and deduces the disaster through which Destiny Degree fears some stars for its badness, there is not one truth in a hundred [issues]. He is just sticking to the stagnant knowledge, not realizing the principle of change, how could he be talked with?[36]

These two paragraphs both refer to the House Host and Degree Host with the same attitude that the two Hosts should be both strong and in good place, and not unbalanced, or else it does harm to the Destiny and Course. But these passages do not give a practical method of how to take into account both the House and Degree in fortune telling. However, other books of horoscopic astrology record the concrete methods such as "The minor and the central parts of the Twelve Signs 十二宮偏正之垣 (*shi'ergong pianzheng zhiyuan*)".[37] The method is described in the *Xingming zongkuo* as follows:

> 師曰："吾嘗以近世談星者言宮不知度， 言度不知宮， 二者胥失矣。吾於海上，異人授我以偏正之垣，於二十八宿之中分之，曰一太陽、五太陰、六木、六土、六水、二火、二金之說，學士曾聞之乎？"
> 曰："未也。"
> 國師曰："…… 故十二宮有偏正之垣，子宮以虛日鼠為正垣，鼠乃子垣之宮神， 非正垣而何也？ 丑宮牛金牛， 寅宮尾火虎， 卯宮房日兔，辰宮亢金龍，巳宮翼火蛇，午宮星日馬，未宮鬼金羊，申宮觜火猴，酉宮昴日雞，戌宮婁金狗，亥宮室火豬，皆本宮之正垣。 …… 所謂一太陽者，太陽君象，天無二日，民無二王。惟星日馬乃太陽之正垣。五太陰者，後妃之象，後妃嬪眾多，宜太陰之五也。故以鬼金羊為太陰之正垣，其餘張心危畢皆偏垣之月也。六木者，寅宮尾火虎，亥宮室火豬， 為木正垣， 其餘斗奎井角， 皆偏垣之木也。 六土者， 子宮虛日， 醜宮牛金， 為土正垣， 其餘女氐胃柳， 皆偏垣也。 六水者，巳宮翼火，申宮觜火，為水之正垣也，其餘箕壁參軫，水皆偏垣也。二火者， 卯宮房日， 戌宮婁金， 為火之正垣。 二金者， 辰宮亢金，酉宮昴日，為金之正垣。 ……"

36 *Zhangguo xingzong* (Chapter 16: 19A).

37 Chen (2010:66–70) also discussed this method.

Teacher says: "I think recent people who discuss stars talk about House but don't know Degree, talk about Degree but don't know House, the two [attitudes] are both wrong. When I was on the sea, foreign people taught me the minor and the central parts, dividing them in twenty-eight lunar mansions, taking about one Sun, five Moons, six Woods, six Earths, six Waters, two Fires, two Metals, have you heard of it?"
[I] say: "Not yet."
The Court Teacher says: "... So the Twelve Signs have the minor and the central parts, the Sign of *Zi* takes Emptiness [Lunar Mansion] Sun [One Luminary] Rat [Chinese zodiac] as the central part. Rat is the House God of *Zi*, if it is not the central part which else would be? The Sign of *Chou* 丑 is Ox Metal Ox, the Sign of *Yin* 寅 is Tail Fire Tiger, the Sign of *Mao* 卯 is Room Sun Rabbit, the Sign of *Chen* 辰 is Neck Metal Dragon, the Sign of *Si* 巳 is Wings Fire Snake, the Sign of *Wu* 午 is Star Sun Horse, the Sign of *Wei* 未 is Ghosts Metal Sheep, the Sign of *Shen* 申 is Turtle beak Fire Monkey, the Sign of *You* 酉 is Hairy Head [Lunar Mansion] Sun Chicken, the Sign of *Xu* 戌 is Bond Metal Dog, the Sign of *Hai* 亥 is Encampment Fire Pig, which are all the central parts .... So called the one Sun, the Sun is the symbol of King, the Heaven hasn't a second Sun, and people haven't a second King. Only Star Sun Horse is the central part of Sun Luminary. The five Moons, as the symbol of King's wives, the wives are many, suitable to the five of Moon. So it takes Ghosts Metal Sheep as the central part, and the left Lunar Mansions of Extended net, Heart, Rooftop and Net are all minor parts of Moon Luminary. Six Woods, Tail Fire Tiger of the *Yin* sign, Encampment Fire Pig of the *Hai* sign, are the central parts of Wood Luminary, the left Lunar Mansions of Dipper, Legs, Well and Horn are all minor parts of Wood Luminary. Six Earths, Emptiness Sun of the *Zi* Sign, Ox Metal of the *Chou* Sign, are the central parts of Earth Luminary, the left Lunar Mansions of Girl, Root, Stomach and Willow are all minor parts. Six Waters, Wings Fire of the *Si* sign, Turtle beak Fire of the *Shen* Sign, are the central parts of Water Luminary, the left Lunar Mansions of Winnowing basket, Wall, Three stars and Chariot are all minor parts of Water Luminary. Two Fires, Room Sun of the *Mao* Sign, Bond Metal of the *Xu* Sign are the central parts of Fire Luminary. Two Metals, Neck Metal of the *Chen* Sign, Hairy head Sun of the *You* Sign, are the central parts of Metal Luminary ..."[38]

38 *Xingming zongkuo* (Preface: 193–194).

The division of the minor and central parts aims to take both the Twelve Signs and Twenty-eight Lunar Mansions into consideration, but the method not only paid attention to the property of the seven luminaries, but also referred to Chinese zodiac 生肖 (*shengxiao*) and other ingredients, classifying the lunar mansions corresponding to each sign in order to guide the practical fortune-telling.

A second view thought that Degree Host had priority over House Host, as described in the following account in the *Xingming suyuan*:

> 前輩袁天綱號為善知天文象緯， 曾會諸星宿于竺羅， 察福禍猶病鳶魚，及得予旨，方知專用宮主為非，度主為是。
>
> The predecessor Yuan Tiangang 袁天綱 was announced as an expert in astronomy and astrology, once came across the stars and the lunar mansions in Zhuluo 竺羅, judging the luckiness and the disasters as distinguishing the birds and fish. But until he learned my knowledge, he had just known that the usage of House Host was wrong and Degree Host was right.[39]
>
> 命主即坐命處二十八宿之所屬是也。 …… 又曰： 宮主州也， 命主縣也， 莫不自縣而州。 愚常謂： 宮主猶人家也， 度主猶家之主也。 一宮之內， 大率有三等星度， 猶一家之中子父兄弟， 不同坐度之星， 猶家主一人獨掌家務，則凡家人親友隨一人之好惡為親疏。 故度主是木， 則以水為恩， 以土為仇， 以金為殺。 若度主不是木， 則又有別樣好惡，譬之家人之中，人殊則情亦殊。若只以一宮之主泛論禍福，必無切驗， 故知諸家論宮主而不論度主者， 皆不若果老之說為親切體要也。愚斷以果老書為經，以諸家為緯，以度主為先，以宮主為次，知所先後則近道矣。
>
> Destiny Host is something where Destiny is located in the Twenty-eight lunar mansions belonging to …. Also says: House Host is a state, Degree Host is a county, no never from county to state. I usually say: House Host is like a family, Degree Host is like the host of the family. Inside a House, there are about three kinds of degree, which like sons, father and brothers in the family. [Each] star in different degrees, like the host of the family, takes charge of the household, and the family members and the relatives go with the tastes of the host. If Degree Host is Wood, it takes Water as

39 *Xingming suyuan* (Vol. 2: 53).

> the family's favor, Earth as the enemy, Metal as the destruction. If Degree Host is not Wood, there are other kinds of favors and enemies, as in the family different members have different tastes. If only taking the host of House into consideration to generally deduce the luckiness or not, it can't be accurate. So we know [the principles] which only consider House Host but not Degree Host, are not accurate as Guolao 果老's theory. I am definitely based on Guolao's theory, and with the help of others, put Degree Host prior to House Host. Aware of the former and the latter, then it is close to the truth.[40]

The second paragraph is an annotation by Zheng Xicheng 鄭希誠 of the Yuan (AD 1206–1368) dynasty. He compared the host and the family as Degree Host and House Host, and thought the taste of the family host determined the choices of the whole family. If judging the good or bad luck only through House Host, it could not be confirmed despite that Houses were twelve and lunar mansions attached to Degree were twenty-eight. Compared to House Host, the division of Degree Host was more elaborate. Horoscope astrology would be more persuasive in the practical use if priority is given to Degree Host. He announced that the contents had come from the theory of Guolao, who firstly brought the concept of Degree Host into horoscopic astrology, considering both House Host and Degree Host. Afterwards, the second attitude of "The first is Degree Host and then the House Host" had gradually developed. If Zheng's account is true, it will further support the argument in the previous section that the direct correspondence between the twenty-eight lunar mansions and seven luminaries developed after the correspondence between the twelve signs and seven luminaries.

Furthermore, the two paragraphs indicate that there was a third view that only considered House Host, ignoring Degree Host. The statement that "The predecessor Yuan Tiangang was announced as an expert in astronomy and astrology, once come across the stars and the Lunar Mansions in Zhuluo" suggests a foreign origin of the view that House Host is all that matters. The name of the place Zhuluo 竺羅 includes the word *Zhu* 竺 which is part of the ancient Chinese name of India *Tianzhu* 天竺. This suggests that when the twelve signs came into China, Chinese astrologers initially paid much attention to the functions of House in horoscopic astrology, even to the extent of only considering House (i.e. the foreign concept of the zodiac) and not referring to the functions of Degrees (i.e. the Chinese tradition of the lunar mansions).

40 *Xingming suyuan* (Vol. 2: 70–71).

This primacy of House Host, which appeared earlier than views which took both the House Host and Degree Host into consideration, also led to a view in which both House Host and Degree Host were considered by not House Host was given priority. It is described in the *Zhangguo xingzong* as follows:

> 所謂宮主得生， 度主受傷， 有災不死； 又如度主得所， 宮主受傷，刃星合度，亦死。
>
> So called that House Host is promoted, Degree Host is injured, there are disasters but will not die; also as Degree Host is in good place, House Host is injured, the destructive stars is in the degrees of the same place, will die as well.[41]

A final view also presented in the *Zhangguo xingzong* states that:

> 居中則問宮神，隔界須觀度主
>
> In the middle should ask for House God, between adjacent places should look into Degree Host.[42]

If the Destiny or Course of a person is located within the range of a sign of the zodiac, and House Host is the same as Degree Host, House Host dominates. If the Destiny or Course is located where one lunar mansion spans two different signs, or a part of one sign spans two different lunar mansions, Degree Host dominates.

In sum, no matter whether House Host or Degree Host was considered primary, what was most important was the Host "seven luminaries". The seven luminaries functioned according to the traditional Chinese Five-Phase theory. During the Tang and Song dynasties, the importance of the astrological meanings of the twelve signs of the zodiac were gradually replaced by the seven luminaries (or Five-Phase theory through the correspondence to the seven luminaries with the phases). Through the creation of new relationship between the twenty-eight Lunar Mansions and the seven luminaries, together with the debate on the House Host and Degree Host, Chinese divination theories gradually grew in dominance over foreign methods within horoscope astrology. Chinese divinatory techniques during the Tang and Song dynasties absorbed

41 *Zhangguo xingzong* (Chapter 16:19B).

42 *Zhangguo xingzong* (Chapter 6:40A).

new foreign ingredients into the theories and systems of astrology and made them work in a traditional Chinese way.

Moreover, the "Debate between House and Degree" also shows how during the Tang and Song dynasties Chinese horoscopic astrology changed from using only the foreign horoscope astrological methods to gradually synthesizing the foreign astrological methods with Chinese culture. In the process, Chinese horoscope astrology created new relationships that are not found in either foreign horoscopic astrology or early Chinese tradition.

6 The Correspondence of the Twelve Signs of the Zodiac to the Twelve Earthly Branches in the Process of Localization

In addition to their association with the seven luminaries, the twelve signs of the zodiac further lost their original meanings through a correspondence with the twelve Earthly Branches. Yang Jingfeng 楊景風 of Tang dynasty wrote in his annotation of *Shan'e xiuyaojing*:

> 唐用二十八宿，西國除牛宿，以其天主事之故。十二宮猶唐十二次。
>
> Tang uses the twenty-eight Lunar Mansions, and the western country excludes Ox Lunar Mansion, for it is the Heaven which dominates. The twelve signs are as the twelve *Ci* 次 of Tang.[43]

The statement that the twelve signs are the twelve *Ci* is also found in the *Calendar Treatise* 曆志 (*lizhi*) of *Jiutangshu*[44] and *Xingtangshu*.[45] The twelve *Ci* were equated with the twelve *Chen* in the expression of the twelve Earthly Branches already in the Warring States period (475–221 BC),[46] for example, *Zi* was Sadalsuud, *Chou* was Altair, and etc. The details are shown in Tab. 15.8.

It is should be noticed, that the order of the twelve *Ci* and the twelve signs of the zodiac are from right to left, but the twelve Earthly Branches are from the left to the right. The correspondence between the twelve Earthly Branches and

43 *Shan'e xiuyaojing* (Vol. 2:394).

44 *Jiutangshu* (Vol. 34:1265), the annotation: "What the Indian say the Twelve Signs is Chinese twelve *Ci*. The saying of Yuche 郁車 sign, is the Chinese *Ci* of Hamal 其天竺所云十二宮，則中國之十二次也。曰郁車宮者，即中國降婁之次也."

45 *Xintangshu* (Vol. 38:673), the annotation, the contents are similar as in *Jiutangshu· Calendar Treatise Three*, just a few words are different.

46 Lu (2007:10–13).

TABLE 15.8 *Correspondence between the Twelve Signs, Twelve* Ci *and the Twelve Earthly Branches*

Twelve Earthly Branches	**Twelve *Ci* (次)**	**Twelve Signs**
Zi	Sadalsuud (*Xuanxiao*, 玄枵)	Aquarius
Chou	Altair (*Xingji*, 星纪)	Capricorn
Yin	Kaus Australis(*Ximu*, 析木)	Sagittarius
Mao	Antares (*Dahuo*, 大火)	Scorpio
Chen	Canopus (*Shouxing*, 寿星)	Libra
Si	Spica (*Chunwei*, 鹑尾)	Virgo
Wu	Regulus (*Chunhuo*, 鹑火)	Leo
Wei	Alhena (*Chunshou*, 鹑首)	Cancer
Shen	Rigel (*Shishen*, 实沈)	Gemini
You	Aldebaran (*Daliang*, 大梁)	Taurus
Xu	Hamal (*Jianglou*, 降娄)	Aries
Hai	Simmah (*Juzi*, 娵訾)	Pisces

the twelve signs is relatively stable. Although the first signs given in the Chinese Buddhist Scripture *Qiyao rangzai jue*, the Taoist Scriptures *Lingbao lingjiao jidu jinshu, Shenzhou miaojing, Yuanyuan daomiao dongzhen jipian*, and the books of horoscopic astrology *Zhangguo xingzong, Xingping huihai, Xingxue dacheng* differ, the correspondence with the twelve Earthly Branches are identical.

Through their correspondence to the twelve signs, the twelve Earthly Branches are also related to the seven luminaries and Five Phases as Tab. 15.5 shows. The twelve Earthly Branches were originally related to months, directions and the Five Phases at least since the Han dynasty, and each Earthly Branch favored, transformed, punished, and destroyed each other, in traditional Chinese divination.[47] These relationships and properties gave more meanings to the twelve signs of the zodiac and further reduced their original astrological meanings in Chinese horoscope astrology.

The twelve Earthly Branches began with *Zi*, with a direct order from the right to the left in heaven since the Warring States period.[48] As we have seen, the

47 The properties of the Earthly Branches were compiled in the Chinese divine book *Wuxing dayi* (Vol. 2: 16–30) of the Sui dynasty, indicating that they had developed before the Tang dynasty.

48 Lu (2007:11).

twelve signs in Taoist Scriptures and in books of horoscopic astrology mostly begin with Aquarius and *Zi*, with a direct order until Pisces and *Hai*. The conception of *Jianyin* in the *Sanzheng* theory made Libra the first sign. Besides, the divinatory meanings of the Earthly Branches were also incorporated into Chinese horoscopic astrology, such as that *Yin* and *Mao* represented the east, implying the image of sunrise, so when the Sun is located in the Houses of *Mao* and *Yin*, it would indicate:

> 日寅日居人馬號天桑，光照東升遍萬方。祿厚福高名必顯，也應補衮坐朝堂。
> 日卯太陽出卯曰天鳥，稟性英明大丈夫。多藝多才非俗士，一生榮顯祿盈餘。
>
> Sun in *Yin*. Which the Sun locates in Sagittarius is called *Tiansang* 天桑, light shines east with ascending and spreads everywhere. The salary is thick, the fortune is high and the name should be grand. He also should sit in the court with the complement of robe.
> Sun in *Mao*. Which the Sun emerges in *Mao* is called *Tianniao* 天鳥, it is a true man with a wise character. With much talents and gifts is not an ordinary person. The whole life is brilliant with plenty of richness.[49]

In addition, the book of horoscopic astrology *Xingming suyuan* of the Tang dynasty records:

> 戌垣之火取用與卯垣不同，酉宮之金行限與辰宮有異。
>
> The use of Fire in the *Xu* House is different from that in the *Mao* House, the course of Metal in the *You* House differs from the *Chen* House.[50]

Even if the different Houses belong to the same Fire or Metal property, they would not be taken equally, because *Chen* and *Xu* mastered the four third months in four seasons or the third month of summer, *Mao* mastered spring and *You* mastered autumn.

In addition, the twelve Earthly Branches had another "Five Phases" property of the Heavenly Stems within each Earthly Branch as Tab. 15.9 shows.[51]

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49 *Zhangguo xingzong* (Chapter 14:10B).

50 *Xingming suyuan* (Vol. 1: 49).

51 The property was earliest record in the Chinese divine book *Wuxing dayi* (Vol. 2: 83–84) *of* Sui dynasty.

TABLE 15.9 *Different "Five Phases" properties of the Twelve Earthly Branches*

Twelve Earthly Branches	Five Phases of Seven Luminaries	Traditional Five Phases	Five Phases of the Heavenly Stems within each Earthly Branch[52]
Zi子	earth	water	*Gui* 癸water
Chou丑	earth	earth	*Ji* 己earth
Yin寅	wood	wood	*Jia* 甲wood
Mao卯	fire	wood	*Yi* 乙wood
Chen辰	metal	earth	*Yi* 乙wood
Si巳	water	fire	*Bing* 丙fire
Wu午	sun/fire	fire	*Ding* 丁fire
Wei未	moon/water	earth	*Yi* 乙wood
Shen申	water	metal	*Wu* 戊earth
You酉	metal	metal	*Xin* 辛metal
Xu戌	fire	earth	*Ding* 丁fire
Hai亥	wood	water	*Ren* 壬 water

The Seven Luminaries-Five Phases property of the Twelve Earthly Branches corresponds to the twelve signs and differs from the traditional Five Phases property of the Twelve Earthly Branches, which was explained in the horoscopic astrology book *Zhangguo xingzong*:

> 客曰： 星盤十二宮既聞命矣， 然何以午未屬天， 子丑屬地， 寅亥屬木， 卯戌屬火， 辰酉屬金， 巳申屬水， 與五行地支十二之理不同？又何說與？
> 余曰： 五行以寅卯為木， 巳午為火， 申酉為金， 亥子為水， 辰戌丑未為土， 乃地支十二維也。 午與未合， 居於上而屬乾， 故以為天。子與丑合，居於下而屬坤，故以為地。上天下地，一定之體也。亥與寅合， 屬春， 故以為木。 卯與戌合， 屬夏， 故以為火。 辰與酉合，屬秋，故以為金。巳與申合，屬冬，故以為水。春夏秋冬，四時之序也。日月麗天，水金輔之，故喜金水。土石麗地，木火生之，故喜木火。此雖與地支十二維分佈不同，而其道理則相貫也。
>
> Guest says: The twelve Houses in the astral plate [a circular astrological chart for fortune-telling] have indicated the fate, *Wu* and *Wei* belong to

52 Hong and Jiang (2006:28).

> Heaven, *Zi* and *Chou* belong to Earth, *Yin* and *Hai* belong to Wood, *Mao* and *Xu* belong to Fire, *Chen* and *Si* belong to Metal, *Si* and *Shen* belong to Water, why is this different from the principle of Five Phases and the Twelve Earthly Branches? Is there any explanation?
> I say: Five Phases take *Yin* and *Mao* as Wood, *Si* and *Wu* as Fire, *Shen* and *You* as Metal, *Hai* and *Zi* as Water, *Chen*, *Xu*, *Chou* and *Wei* as Earth, which are the twelve of Earthly Branches. *Wu* matches *Wei*, they reside in the upper and belong to *Qian* 乾, so they are of Heaven. *Zi* matches *Chou*, they reside in the down and belong to *Kun* 坤, so they are of Earth. The upper is Heaven, and the down is Earth, which are fixed. *Hai* matches *Yin*, they belong to spring, so they are of Wood. *Mao* matches *Xu*, they belong to summer, so they are of Fire. *Chen* matches *You*, they belong to autumn, so they are of Metal. *Si* matches *Shen*, they belong to winter, so they are of Water. Spring, summer, autumn and winter, constitute the four seasons. Sun and Moon attach to Heaven, Water and Metal assist them, so they like Metal and Water. Earth and Stone attach to Earth, Wood and Fire promote them, so they like Wood and Fire. All that although differ from the distribution of the twelve of Earthly Branches, the natures are indeed consistent.[53]

The quoted six couples *Hai Yin*, *Mao Xu*, *Chen You*, *Si Shen*, *Zi Chou*, *Wu Wei*, were "what the ancient people called Matching Gods (*heshen*, 合神), also called them Matching Gods of Sun Passing through. The first month establishes *Yin* and matches *Hai*, the second month establishes *Mao* and matches *Xu*, etc 古人謂之合神， 又謂之太陽過宮合神者。 正月建寅合在亥， 二月建卯合在戌之類."[54]

The six couples used in the explanation indicate that the correspondence between the twelve signs, the twelve Earthly Branches, the seven luminaries and Five Phases was in the process of localizing foreign astrological ingredients with traditional Chinese ideas when this text was written.

Besides the different Five Phases properties, the twelve signs, together with the twelve Earthly Branches also represent different districts in Chinese Buddhist Scriptures, Taoist Scriptures, horoscope-astrological books and Dunhuang manuscripts during the Tang and Song dynasties.

A consistent set of correspondences between the twelve *Ci* and the Twelve Districts (十二分野, *shi'er fenye*) of China was set out by Ban Gu 班固 (32–

53 *Zhangguo xingzong* (Chapter 11: 61A).

54 *Mengxi bitan* (Vol. 7: 1B).

TABLE 15.10 *Correspondence between the Twelve Signs and the Twelve Districts of China*

The Twelve Signs	*Zhangguo xingzong*	*Yuanyuan daomiao dongzhen jipian*	Twelve Earthly Branches
Aquarius	*Qi Qing* State 齐青州	*Qi* 齐	*Zi* 子
Capricorn	*Yue Yang* State 越扬州	*Yue* 吴	*Chou* 丑
Sagittarius	*Yan You* State 燕幽州	*Yan* 燕	*Yin* 寅
Scorpio	*Song Yu* State 宋豫州	*Song* 宋	*Mao* 卯
Libra	*Zheng Yan* State 郑兖州	*Zheng* 郑	*Chen* 辰
Virgo	*Chu Jing* State 楚荆州	*Chu* 楚	*Si* 巳
Leo	*San He Zhou* State 三河周州	*Zhou* 周	*Wu* 午
Cancer	*Qin Yong* State 秦雍州	*Qin* 秦	*Wei* 未
Gemini	*Yi Wei* State 益魏州	*Jin* 晋	*Shen* 申
Taurus	*Zhao Ji* State 赵冀州	*Zhao* 赵	*You* 酉
Aries	*Lu Xu* State 鲁徐州	*Lu* 鲁	*Xu* 戌
Pisces	*Wei You* State 卫幽州	*Wei* 魏	*Hai* 亥

92). As a result, the twelve Earthly Branches also corresponded to the Twelve Districts,[55] and therefore the twelve signs of the zodiac inherited this correspondence as is shown in Tab. 15.10.

The correspondence was closely related to the correspondence between the twelve Earthly Branches and the twelve Districts, and was relatively stable. It also appears in the Dunhuang manuscript P.4071 (974):

> 太陰在翌，照雙女宮，楚分，荊州分野。太楊在角八度，照天秤宮，鄭分，兗州分野。木星退危三度，照寶瓶宮，齊分，青州分野。火星在軫，照雙女宮，楚分，荊州分野。主星在斗宿，照摩竭宮，吳越，楊州分野。金星在角亢，次殯疾，改照天秤宮，鄭分，兗州分野。水在軫，順行改照雙女宮，楚分，荊州分野。羅睺在井，照巨蟹，秦分，雍州分野。計都在牛三度，照摩竭宮，吳越，楊分州野。月勃在危，順行改照寶瓶宮，齊分，青州分野。紫氣在星宿，照師子宮，周分，洛州分野。

> Moon located in Wings, shines on Virgo, *Chu* 楚 district, *Jing* State 荊州 division. Sun located in the eighth degree of Horn, shines on Libra, *Zheng*

55 *Jinshu* (Vol. 11: 307–309).

> 鄭 district, *Yan* State 兖州 division. Jupiter regresses in the third degree of Rooftop, shines on Aquarius, *Qi* 齊 district, *Qing* State 青州 division. Mars located in Chariot, shines on Virgo, *Chu* district, *Jing* State division. Saturn located in Dipper Lunar Mansion, shines on Capricorn, *Wu Yue* 吳越, *Yang* State 揚州 division. Venus located in Horn and Neck, in *Moji* 瘼疾[56] changes to shine on Libra, *Zheng* district, *Yan* State division. Mercury located in Chariot, directly moves and changes to shine on Virgo, *Chu* district, *Jing* State division. Rahu located in Well, shines on Cancer, *Qin* 秦 district, *Yong* State 雍州 division. Ketu located in the third degree of Ox, shines on Capricorn, *Wu Yue*, *Yang* State division. Lilith (*yuebei*, 月勃) located in Rooftop, directly moves and changes to shine on Aquarius, *Qi* district, *Qing* State division. Purple Gas (*ziji*, 紫氣) located in Star Lunar Mansion, shines on Leo, *Zhou* 周 district, *Luo* State 洛州 division.[57]

The manuscript records the locations of the eleven Luminaries, referring to six signs corresponding to six districts and six divisions (the districts and the divisions are two different kinds of names for the same places). The six signs are Virgo which appears three times, Libra, Capricorn and Aquarius which respectively appear two times, Leo and Cancer. Each time the same Sign is referred to, the relevant districts and division are the same. The correspondence between the five Signs except Leo and their districts and divisions is the same as found in Tab. 15.10 lists. Leo, however, corresponds to *Zhou* which is the same as Tab. 15.10 shows, but *Luo* State is a new division name representing the same place.

It is apparent, therefore, that the twelve Earthly Branches had more than one meaning in divination. This made the practice of horoscopic astrology extremely complex, as the following example demonstrated:

> 子虛有土星，三冬人須卒。
>
> （注）子虛有土， 人以為土星居垣為吉， 殊不知三冬生人， 水星得令之時， 虛日中有火， 乃敗弱之火， 既被水制， 又以土星臨之，火又生土，全為洩氣，故主倒限。

> In Emptiness [Lunar Mansion] of *Zi* is located Saturn, people born in the three months of winter will die.
>
> [Annotation] In Emptiness of *Zi* is located Saturn, people think it is lucky that Saturn is located in the House belonging to the same seven

56 This may be a Chinese transliteration of Capricorn as *mojie*.

57 P.4071 (2005: 75).

> luminaries property, but they do not know people who born in the three months of winter when stars belonging to Water flourish, then Fire in the Emptiness Lunar Mansion belonging to Sun and is weak then. [The Fire is] already constrained by Water, and Saturn locates there. [Moreover,] Fire promotes Earth. All is losing *Qi*, so dominates regression.[58]

Zi House itself belonged to the Earth and the House was located by Saturn. The situation could be taken as a lucky sign saying "Saturn located in the House which belongs to the same seven luminaries property", but *Zi* also belonged to Water in the term of traditional Five Phases property, the seven luminaries property of Emptiness Lunar Mansion was Sun, Sun was a kind of fire, so there was Water constraining Fire. Also, because Fire promoted Earth, Earth consumed the *Qi* of Fire. Thus, the sign was not lucky but inauspicious. Five Phases promoted and constrained to each other originally, with the addition of the Five Phases properties of Twelve Earthly Branches, which further increased the complexity of the deduction whether luck or not. Moreover, the *Zi* House was actually Aquarius, but the divination excluded the original astrological meanings of the Zodiac Sign and even left out the Zodiac name. Thus, the function of the zodiac sign was completely replaced by the twelve Earthly Branches.

7 Conclusion

From the records of Chinese Buddhist Scriptures, Taoist Scriptures, books of horoscopic astrology, and Dunhuang manuscripts, we can see that during the Tang and Song dynasties the twelve signs of the zodiac spread widely within China. Initially, Chinese horoscope astrology almost accepted and used the foreign astrological ingredients including Hellenistic and Indian astronomy and astrology. The first phase of the development appeared in Chinese Buddhist Scriptures. In the first phase, Indian Buddhist monks such as Amoghavajra and Konkata had began to combine the foreign astrological ingredients with traditional Chinese culture in the Tang dynasty. Then, foreign astrological ingredients were gradually synthesized with traditional Chinese ideas such as the Five Phases, the twelve Earthly Branches and the *Jianyin* concept. Chinese diviners who understood both foreign astrology and traditional Chinese divination contributed much to the syncretism and creation of a new form of Chinese horo-

58 *Zhangguo xingzong* (Chapter 16: 22B).

scopic astrology. Finally, this developed into a mature divinatory system, which included foreign astrological ingredients but placed greater emphasis on concept and methods drawn from traditional Chinese divination. In the process, the twelve signs of the zodiac gradually lost their original astrological meanings from Indian and Hellenistic astrology as they acquired correspondences with the seven luminaries and the twelve Earthly Branches from Chinese divinatory traditions. With this loss, the twelve signs became an extra set of symbols for a variety of traditional Chinese concepts.

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CHAPTER 16

On the Dunhuang Manuscript P.4071: A Case Study on the Sinicization of Western Horoscope in Late 10th Century China

Weixing Niu

Background: Western Astrology in China

Indian astrology was introduced into China as early as in the third century AD with a translation of the *Śārdūlakarṇāvadāna*,[1] however it was not until the eighth and ninth centuries, i.e. in the middle and late Tang dynasty, that western astrology produced a real impact on Chinese daily life, following the introduction into China of a kind of Indian modified Hellenistic astrology along with the translation of Tantric Buddhist Sutras.[2] As a basic idea of Hellenistic astrology, the 12 signs of the zodiac were firstly introduced in the *Candra-garbha* translated into Chinese by Narendrayasas in the Gao-Qi dynasty (550–577).[3] In the middle of the Tang dynasty (618–907), a large quantity of Tantric

1 Two translations of the *Śārdūlakarṇāvadān* are included in the *Taisho Tripitaka*, which was compiled by Japanese scholars in 1924–1934 in Tokyo. One was numbered 1300, entitled *Modengjia Jing*, translated by an Indian Sramana Zulüyan (竺律炎) and a Chinese of Tokharian descent Ziqian (支謙) in 230 AD. This authorship was established by Zhisheng (智昇) in his *Catalogue of Buddhist Scriptures in Kaiyuan Reign* (開元釋教錄) in 730 AD, and was followed by the editors of the *Taisho Tripitaka* and some scholars such as Yabuuti (1969: 177) and Yano (1986: 21). However it was also argued by Zinkgräf (1940) that *Modengjia Jing* was probably translated later by someone else. Zinkgräf's point was followed by Liqun Zhou in her doctoral dissertation (The *Śārdūlakarṇāvadāna* and The Early Indian Astrology Coming to China, A Philological Study Based on Central Asian Sanskrit Manuscripts and Other Versions in Sanskrit, Chinese, and Tibetan, Beijing University, 2013). Another translation of the *Śārdūlakarṇāvadān* in the *Taisho Tripitaka* was numbered 1301, entitled *Shetou Jian Taizi Ershibaxiu Jing*, translated into Chinese in 308 AD by Dharmaraksa.

2 That the introduction of Indian modified Hellenistic astrology could have been occurred along with the translation of Tantric Buddhist Sūtras into Chinese, was because Buddhism had begun to absorb heretic ideas including once forbidden knowledge such as astrology, from Hinduism for example, in its late stage of Tantric Buddhism.

3 The *Candra-garbha* was compiled as the 46th to 56th fascicles of the *Daji Jing* (*Mahāsamni-*

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Buddhist Sūtras containing Hellenistic astrology were translated into Chinese. The most famous of these was the *Xiuyao Jing* (*Sūtras on Nakshatras and Grahas*), the full tile of which was *Wenshushili Pusha Ji Zhuxian Suoshuo Jixiong Shiri Shan'e Xiuxiao Jing* (*Sūtras preached by Manjusri Bodhisattva and the sages on auspiciousness or inauspiciousness of days and times, and goodness or evilness of Nakshatras and Grahas*),[4] translated by Amoghavajra and commented on by Yang Jingfeng in 759–764. The *Qiyao Rangzaijue* (*Warding off Calamities with the Seven Luminaries*, No. 1308 of *Taisho Tripitaka*), compiled by a Western Indian Brahmin Jin Jucha in China in the 9th century, was another important Tantric sutra containing a description of the elements of a horoscope, and ephemerides of Jupiter, Mars, Saturn, Venus, Mercury, Rāhu (lunar ascending node) and Ketu (lunar apogee, instead of lunar node, details see page 540 in this chapter), which could be used as handbook for diviners to determine the positions of celestial bodies at the time of birth. This kind of Indianized Hellenistic astrology was introduced originally as a part of the Buddhist sūtras, and triggered a strong interest in this subject in China, where genethlialogical astrology was quite new thing for ordinary people. Some scholars have pointed out that Hellenistic astrology could also have found its way to China via Persia at the same period.[5]

The result of these transmissions was that a kind of foreign originated planetary fortune-telling system was introduced, accepted and applied widely in China between the late Tang (618–907) and early Song (960–1279) dynasties. This system's main feature was to tell one's fortunes based on the relative positions of the planets (Sun, Moon, Jupiter, Mars, Saturn, Venus, Mercury, Rāhu and Ketu) and stars (27 or 28 *Xiu* "lodges" and 12 signs of the zodiac). Evidence of the popularity of this practice may be found in some works written by famous

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pata-sūtra, or *The Great Collection Scripture*), No. 397 of *Taisho Tripitaka*. An Indianized astrological system based on the Indian 28 nakshatras was also introduced in *Sūrya-garbha*, the 34th to 45th fascicles of the *Daji Jing*, translated also by Narendrayasas.

4 Included in *Taisho Tripitaka*, Vol. 21, No. 1299, pp. 387–399.

5 These discussions have mainly centered on the origin version of an imported foreign astrological text titled *Yusi Jing* (or *Duli Yusi Jing*, *Duli Jing*), which provided an outline of western horoscopic astrology according to its later version compiled in Ming dynasty by Wang Minying (1521–1603). Yabuuti (1969, pp. 186–189) concluded that *Yusi Jing* was a translation of Ptolemy's *Tetrabiblos*. Yano (1990) noted furtherly that '*Duli Yusi*' might be an approximate transliteration of Ptolemy's name in Pahlavi. Mak (2014) has recently argued that *Yusi Jing* was based instead on Dorotheus' *Carmen Astrologicum*. No matter whether the *Yusi Jing* was based upon Ptolemy of Dorotheus, it is thought that the *Yusi Jing* was brought into China by the East-Syrian Christians, which means directly from Persia to China. This path was also suggested by Ho (2003: 71).

historical figures, which often like to explain their calamitous fate using genethlialogical terms. For example, in Han Yu's (韩愈, 768–824) *Song on Three Stars*, he wrote,

> 我生之辰，月宿南斗，牛奮其角，箕張其口。 ... 名聲相乘除，得少失有餘。
>
> When I was born, the Moon was located in the South Dipper (南斗), the Ox (牛) raised its horn, and the Dustpan (箕) opened its mouth ... to 'multiply' and 'divide' the fame, little was got and more was lost.[6]

In Yuan Zhen's (元稹,779–831) *No. 5 of the Eight Poems written in Autumn of the Jinghen Year* (816, 《景申秋八首》之五) he wrote the following sentences:

> 三元推廢王，九曜入乘除。
>
> The three epochs were used in reckoning the rising and declining (of the dynasty), the nine luminaries were involved in multiplying and dividing (of one's fortune).[7]

And in Du Mu's (杜牧, 803–852) epitaph written by himself, he wrote,

> 予生于角， 星昴畢于角为第八宫， 曰病厄宫， 亦曰八殺宫， 土星在焉，火星繼木。
>
> My birth was in the Jiao (角) star. Mao (昴) and Bi (畢) are the eighth palace from Jiao, which is called the Palace of Sickness and Frustration. It is also called the Palace of Eight Killings. Saturn was stationed there. Mars followed after Jupiter.[8]

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6 Hanyu of Tang Dynasty, *Changli Xiansheng Wenji* (*Collected Works by Master Changli*, 昌黎先生文集), Vol. 4, Song Shu Ben (A block-printed edition in Sichuan of Song Dynasty, 宋蜀本).

7 Caoyin of Qing Dynasty, *Quan Tang Shi* (*A Complete Collection of Tang Poems*, 全唐詩), Vol. 410, included in the *Wenyuange Sikuquanshu* (*Complete Library in the Four Branches of Literature in Wenyuan Chamber*) of Qing Dynasty.

8 Zhuyi (朱翌) of Song Dynasty, *Yijueliao Zaji* (*Miscellanies of the Magnificent-Sense-Hut*, 猗覺寮雜記), Qing Zhibuzuzhai Congshu Ben (An Edition of Zhibuzuzhai Collection of Qing Dynasty).

The planetary fortune-telling system was also applied in the calendar of the time. In a "calendar with notes" (具注曆) of the 2nd year of Reign Zhonghe of the Tang dynasty (AF 882), which was compiled by Fanshang's family in Chengdu Prefecture in western Sichuan of Jiannan, a "Chart of Nine 'Planets' for reckoning the fortune of men and women (推男女九曜星圖)" was mentioned. For Rahu, it said,

> 年至羅睺星，求覓不稱情
>
> When meeting the year watched over by Rāhu, everything you expect will not satisfy you.[9]

However, popular as it was, very few a detailed natal horoscope charts from that period are preserved which allow us to determine how western astrology was manipulated in practice. A notable example of such a horoscope is found in the Dunhuang Manuscript P.4071, which I will discuss in this paper. I show that this text demonstrates several aspects of the sinicization of western horoscope, such as using 11 "planets" instead of 7 planets in examining planetary configurations and combining the 28 lodges with the 12 signs of the zodiac. This illustrates both the absorption and the adaptation of astronomical and astrological concepts when they transmitted from one civilization to another

The Dunhuang Manuscript P.4071 and Previous Studies

The manuscript is preserved in the Bibliothèque Nationale de France, catalogued as Pelliot Chinois Touen-houang 4071. It is composed of 28 pages with accordion binding, the first 15 pages is a transcription of astrological text (hereafter indicated as P.4071), the rest of the manuscript is a transcription of a Buddhist Sutra.[10]

P.4071 has drawn the attention of several scholars over the past few decades. Rao Zongyi paid attention firstly to the eleven luminaries (Sun, Moon, five planets, Rāhu (lunar descending node), Ketu (lunar ascending node), Ziqi (an invisible celestial body which takes 28 years to make a complete revolution around the earth) and Yuebei (lunar apogee)) which are used in P.4071, and considered

9 Or.8210/P.10, Dunhuang Mogao (Ch.), British Library.

10 Photographs of the complete manuscript are available online at http://gallica.bnf.fr/ark:/12148/btv1b83002045/f1.image.r=4071.langFR.

that the tradition of the eleven luminaries was introduced into China together with the translation of *Yusi Jing*,[11] which is quoted in the manuscript. Yan Dunjie summarized the main contents of the P.4071 and thought the manuscript consists of 5 parts.[12] Jiang Boqin discussed the similarity between the astrology in the P.4071 and that in a Persian book *Bundahishn*.[13] Huang Zhengjian analyzed the contents and structure of P.4071, and pointed out that P.4071 reflected the actual status of practical genethlialogy between the Tang and Song Dynasties, and therefore holds an important place in the history of Chinese genethlialogical astrology.[14] Chen Wancheng interpreted the genethlialogical astrology applied in Dumu's self-written epitaph, with a quotation of *Yusi Jing* in P.4071, and traced the origin of *Yusi Jing* and the natal horoscopes in China back to Hellenistic astrology.[15] Marc Kalinowski also summarized the contents of P.4071 in his book, divided the text into 11 parts.[16] Chen Yuzhu made a rather literal interpretation of P.4071 in his doctoral dissertation.[17] And most recently, Bill M. Mak has referred to the sentences from the *Yusi Jing* quoted in P.4071 in his study of the origin of *Yusi Jing*.[18]

All the previous works on P.4071 are helpful for a better understanding to the manuscript. However some of the conclusions reached in these earlier works are worth discussing further. Furthermore, some astronomical questions about P.4071, such as the precision of the positions of the eleven celestial bodies, are also worth addressing and will be answered in detail in this paper.

For the convenience of discussion, I also divide P.4071 into eleven parts although my divisions are slightly different to those proposed by Kalinowski.[19] They are: 1, a native's basic astrological data, including birth date, trine lords, length of day and night, accumulated days from birth date, etc.; 2, a list of positions of the eleven luminaries at birth time; 3, an overview of the auspiciousness or inauspiciousness of the combinations of planets and zodiacal signs; 4, a natal horoscope chart, which was declared but not provided; 5, general description of the house of fate; 6, general description of the house of body; 7, five pages of

11 Rao (1993: 592).

12 Yan (1998: 624).

13 Jiang (1990).

14 Huang (2001: 117, 202).

15 Chen (2002: 66).

16 Kalinowski (2003: 240–241, 271–272).

17 Chen Yuzhu, *A Study on Luming Books in Dunhuang from the Perspective of Regional Social History*, Lanzhou University, 2009, pp. 208–213.

18 Mak (2014).

19 Kalinowski (2003: 271–272).

yearly horoscope analyses, up to age 60; 8, reckoning of the possession of horses; 9, reckoning of descendants; 10, reckoning of the homestead; and 11, postscript and signature at the end of the manuscript.

Comparing P.4071 with a natal horoscope chart cast on 14 January 1113 which is found in a Japanese work called the *Zoku Gunsho Ruiju* (續群書類叢, *A Continuation of Classified Collection of Japanese Classics*),[20] it can be concluded that the text of P.4071 was very likely preserved completely from its head to end. It could also be roughly determined that the P.4071 is the earliest and most detailed Chinese natal astrological text so far.

Translation and Analysis of the Astrological Part of P.4071[21]

1 *Basic Astrological Data*

> (According to positions of) the Eleven Luminaries (calculated by) Futian,[22] (the native was) born in the Hour of Shen (申, 15:00–17:00), on the date of Jisi (己巳), the month of Bingxu (丙戌), and the year of Gengyin (庚寅), of which the guarding gods (of Constellation-Planets-Animals) were Fang (房), Sun and Rabbit, getting the Tai Ying Star (太陰星，the Moon), and the trine lords were Venus, Mars and Moon.
>
> The Time-Quarters (of the day and night). There were 48 quarters in daytime and 52 quarters at nighttime. Before the Hour of You (酉) and in the Hour of Shen the Moon was in the Fate House. The Total sum of Accumulated Days (積日) was 22073, and the sum of actual elapsed days was 15873.

At the very beginning of the P.4071, the manuscript gives the birth date of a native. It gives this date, that is day Jisi (己巳), month Bingxu (丙戌) and year Gengyin (庚寅), in the Chinese traditional way of Heavenly Stem and Earthly Branch, which was very popular in a lately formed Bazi (eight characters) fortune-telling system. The hour, however, was still provided with only one character of Earthly Branch Shen (申, 15:00–17:00), which seems to indicate that the Bazi system was not yet fully completed. It is not difficult to convert the

20 Editorial Board of the *Zoku Gunsho Ruiju, Zoku Gunsho Ruiju*, Vol. 908, Tokyo, 1926, pp. 429–437.

21 The section titles are given by the author of this paper.

22 *Futian*, literally means *According with Heaven*, was the title of a scattered and lost calendarial system made by Cao Shiwei between 780–783.

birth time recorded in Chinese traditional way into Julian calendar: the native was born at 15:00–17:00, on 3 October 930. In the postscript at the end of P.4071 it is stated that the horoscope chart was cast on the 11th day of the 12th Month, the 7th year of Kaibao reign (25 January 974). It can therefore be determined that the native was 44 years old when he asked for a fate prediction.

After the birthdate information, the text gives the combined guarding gods of Constellation-Planet-Animal of that day: Fang (房), Sun and Rabbit. This kind of combined guarding gods of Constellation-Planet-Animal system was essentially used as a dating system. Along with the translation of *Xiuyao Jing* (*Sutras on Nakshatras and Grahas*),[23] a dating system using the 27 nakshatras was introduced into China in the middle of the Tang Dynasty, and a nine grahas dating system was also used occassionally. Which nakshatra is on duty in a native's birthday is essential in Indian astrology, however the sum of 27 conflicts with the traditional Chinese system of 28 lodges. Finally as an imitation of the Indian dating system, an amended dating system of 28 lodges combined with 7 planets and 28 animals was developed in China (see Tab. 16.1). A complete list of the 28 triads of Constellation-Planet-Animal was first quoted by Ludian (陸佃, 1042–1102) in his *Piya* (埤雅). Previous scholars have studied the continuity of this dating system and have found the system was continuously used from 1182 until the present;[24] P.4071 provides earlier evidences of this continuity.[25]

The text also states that the trine lords of this natal chart were Venus, Mars and Moon. The trine lords are a western astrological concept. A Chinese list of trine lords was included in *Xingxue Dacheng* (*A Complete Collection of Genethlialogy*, 星學大成) compiled by Wan Yingmin (萬英民) in Ming dynasty, which was titled as *Three Limits of Zhuluo* (竹羅三限). It was said that *Zhuluo* was a mountain located in the north-west of the heaven, all the gods of planets and stars gather at the top of *Zhuluo* every midnight to judge the weal and woe of the human world. Li Chunfeng (李淳風, 602–670) and Yuan Tiangang (袁天罡[26]) were supposed to have been there and obtained the method of *Three Limits of Zhuluo* for calculating people's lifetime.[27] Comparing this

23 The full tile is *Wenshushili Pusha Ji Zhuxian Suoshuo Jixiong Shiri Shan'e Xiuxiao Jing*, included in *Taisho Tripitaka*, Vol. 21, No. 1299, pp. 387–399, translated by Amoghavajra, commented by Yang Jingfeng, in 759–764.

24 Deng (2000).

25 Kong (2009: 132–135).

26 Yuan Tiangang's dates of birth and death are unknown. He was a diviner and astrologer active in the late Sui (581–618) and Early Tang (618–907) dynasties.

27 Wan Yingmin of Ming Dynasty, *Xingxue Dacheng* (*A Complete Collection of Genethlialogy*),

TABLE 16.1 *Constellation-Planet-Animal dating system*

Thursday	1	Jiao 角- Jupiter木- Flood dragon 蛟	8	Dou 斗- Jupiter 木- Xie 獬	15	Kui 奎- Jupiter 木- Wolf 狼	22	Jing 井- Jupiter 木- Wild dog 豻
Friday	2	Kang 亢- Venus 金- Dragon 龍	9	Niu 牛- Venus 金- Ox 牛	16	Lou 婁- Venus 金- Dog 狗	23	Gui 鬼- Venus 金- Sheep 羊
Saturday	3	Di 氐- Saturn 土- Racoon 貉	10	Nǚ 女- Saturn 土- Bat 蝠	17	Wei 胃- Saturn 土- Pheasant 雉	24	Liu 柳- Saturn 土- Roebuck 獐
Sunday	4	Fang 房- Sun 日- Rabbit 兔	11	Xu 虛- Sun 日- Rat 鼠	18	Mao 昴- Sun 日- Chicken 雞	25	Xing 星- Sun 日- Horse 馬
Monday	5	Xin 心- Moon 月- Fox 狐	12	Wei 危- Moon 月- Swallow 燕	19	Bi 畢- Moon 月- Crow 烏	26	Zhang 張- Moon 月- Deer 鹿
Tuesday	6	Wei 尾- Mars 火- Tiger 虎	13	Shi 室- Mars 火- Pig 豬	20	Zui 觜- Mars 火- Monkey 猴	27	Yi 翼- Mars 火- Snake 蛇
Wednesday	7	Ji 箕- Mercury 水- Leoprd 豹	14	Bi 壁- Mercury 水- Ewe 羭	21	Shen 參- Mercury 水- Ape 猿	28	Zhen 軫- Mercury 水- Earthworm 蚓

Chinese version of the trine lords with the system from Ptolemy's *Tetrabiblos* I.18,[28] the two systems are mostly same with little differences (see Tab. 16.2).

Finally the manuscript gives the important information about the Time-Quarters (時刻數) separately in daytime and nighttime of the birthday, it says, 'there was 48 quarters in daytime and 52 quarters at nighttime. Before the Hour of You and in the Hour of Shen the Moon was in the Fate House.' According to the length of daytime and the hour of birth time, it is not difficult to determine that the native was born in daytime.

Vol. 7, included in the *Wenyuange Sikuquanshu* (*Complete Library in the Four Branches of Literature in Wenyuan Chamber*) of Qing Dynasty. (明·萬民英, 《星學大成》 卷七, 清文淵閣四庫全書本.)

28 Robbins 1940: 83–87.

TABLE 16.2 *A comparison of the Trine Lords between* A Complete Collection of Genethlialogy *and Ptolemy's* Tetrabiblos *1.18*

Signs	**Lords (Day/Night)**	
	A Complete Collection of Genethlialogy	***Tetrabiblos***
Sagittarius, Leo, Aries	Sun/Jupiter, Saturn	Sun/Jupiter, Mars
Pisces, Scorpio, Cancer	Venus/Mars, Moon	Venus/Moon, Mars
Gemini, Aquarius, Libra	Saturn/Mercury, Jupiter	Saturn/Mercury, Jupiter
Virgo, Taurus, Capricorn	Venus/Moon, Mars	Venus/Moon, Saturn

The text also states that the total sum of accumulated days (積日) was 22073 and the sum of actual elapsed days was 15873. The total sum of accumulated days was supposed to be counted from the epoch of *Futianli* (符天歷), which was 16 February 660,[29] just like the case in the *Zoku Gunsho Ruiju*. However in this case of P.4071 it was not from *Futianli*'s epoch. If we take the native's birthday (3 October 930) as the beginning of the accumulated days and the actual elapsed days, then the end of accumulated days is around the spring equinox of 991 when the native will be 60 years and 5 months old, and the end of actual elapsed days is around the spring equinox of 974, the year when this divination was undertaken.

2 *Positions of the Eleven Luminaries*

Moon was in Yi (翼), shone in Virgo, the Field Allocation was Chu (楚) and Jingzhou (荆州).

Sun was at 8 degree of Jiao (角), shone in Libra, the Field Allocation was Zheng (郑) and Yanzhou (兖州).

Jupiter retrograded at 3 degree of Wei (危), shone in Aquarius, the Field Allocation was Qi (齐) and Qingzhou (青州).

Mars was in Zhen (軫), shone in Virgo, the Field Allocation was Chu (楚) and Jingzhou (荆州).

Saturn was in Dou (斗), shone in Capricorn, the Field Allocation was Wuyue (吳越) and Yangzhou (揚州).

29 It was recorded that *Futianli*'s epoch was at the Solar Term of Yushui (Rain water), the fifth year (660 AD) of Xianqing reign.

Venus was in Jiao (角) and Kang (亢), moving faster, changed to shine in Libra, the Field Allocation was Zheng (郑) and Yanzhou (兖州).

Mercury progressed in Zhen (軫), changed to shine in Virgo, the Field Allocation was Chu (楚) and Jingzhou (荊州).

Rāhu (lunar descending node) was in Jing (井), shone in Crab, the Field Allocation was Qin (秦) and Yongzhou (雍州).

Ketu (lunar ascending node) was at 3 degree of Niu (牛), shone in Capricorn, the Field Allocation was Wuyue (吳越) and Yangzhou (揚州).

Yuebei (月孛, lunar apogee) progressed in Wei (危), changed to shine in Aquarius, the Field Allocation was Q i(齊) and Qingzhou (青州).

Ziqi (紫氣) was in Xing (星), shone in Leo, the Field Allocation was Zhou (周) and Luozhou (洛州)

In the second part of the manuscript P.4071, the positions of the eleven luminaries were provided in two ways, by means of lodges and zodiacal signs. The field allocations of the corresponding celestial areas were also listed giving the states and prefectures. The position and the field allocation of each celestial body was written in a separate line.

All the positions and field allocations of the eleven luminaries are summarized in Tab 16.3. The manuscript also gives the positions of Sun, Jupiter and Ketu in degrees (du) in a lodge. When Rāhu and Ketu are listed together with Ziqi and Yuebei, then Rāhu indicates the lunar descending node, Ketu is the lunar ascending node, Yuebei means the lunar apogee, Ziqi is defined as an invisible celestial body which takes 28 years to make a complete revolution around the earth. Rāhu, Ketu, Yuebei and Ziqi were together called the "four residuals", respectively the residual pneuma of Mars, Saturn, Mercury and Jupiter. This concept was most probably invented by local Chinese astrologers.[30] The four residuals plus five planets, sun and moon make the 11 luminaries.

In the *Qiyao Rangzaijue* (hereafter abbreviated as *QYRZJ*),[31] however Rāhu is the lunar ascending node and Ketu is the apogee of lunar orbit.[32] In Indian astrology Rāhu is the ascending and Ketu is the descending node.[33] Combined with the five planets, the sun and the moon they make the nine grahas.

30 Niu (2012).

31 Included in *Taisho Tripitaka*, Vol. 21, No. 1308, pp. 426–452, compiled by a Western Indian Brahmin Jin Jucha in China in the 9th century.

32 Niu (1994).

33 According to Rajesh Kochhar, this definite astronomical meaning of Rāhu and Ketu should not be earlier than Varahamihira. Cf. Kochhar (2010).

TABLE 16.3 *Positions and Field Allocations of the eleven luminaries in P.4071*

	Luminaries	Positions			Field Allocations	
		Lodges	du	Zodiacal signs	States	Prefectures
1	Moon	Yi (翼)	–	Virgo	Chu (楚)	Jingzhou (荆州)
2	Sun	Jiao (角)	8	Libra	Zheng (郑)	Yanzhou (兖州)
3	Jupiter	Wei (危)	3	Aquarius	Qi (齊)	Qingzhou (青州)
4	Mars	Zhen (轸)	–	Virgo	Chu (楚)	Jingzhou (荆州)
5	Saturn	Dou (斗)	–	Capricorn	Wuyue (吳越)	Yangzhou (揚州)
6	Venus	Jiao (角)、Kang (亢)	–	Libra	Zheng (郑)	Yanzhou (兖州)
7	Mercury	Zhen (轸)	–	Virgo	Chu (楚)	Jingzhou (荆州)
8	Rahu	Jing (井)	–	Crab	Qin (秦)	Yongzhou (雍州)
9	Ketu	Niu (牛)	3	Capricorn	Wuyue (吳越)	Yangzhou (揚州)
10	Yuebei	Wei (危)	–	Aquarius	Qi (齊)	Qingzhou (青州)
11	Ziqi	Xing (星)	–	Leo	Zhou (周)	Luozhou (洛州)

In Tab. 16.4, the planetary positions given in P.4071 are compared with the results calculated by the ephemerides preserved in *QYRZJ* (P-Q), and by a modern digital ephemeris *DE404*[34] (P-D). Except for the Moon, the accuracy of the planetary positions in P.4071 is quite good. It is most likely that the astrologer used an ephemerides similar to that preserved in the *QYRZJ* to calculate the planetary positions of a native's birth time. Although it is understandable that the accuracy of the lunar position would not be as good as for the planets, because a precise lunar ephemeris was not easy to achieve for early astronomers,[35] large error in the lunar position cannot be explained.

The position of Ziqi listed in the Tab. 16.4 is calculated according to a definition of Ziqi provided in the Vol. 19 of *Xingxue Dacheng*, and a known value

34 M. Standish, et al., Planetary and Lunar Ephemeris DE 404, JPL/NASA.

35 There is a *Song for An Approximate Method of Determining the Lunar Position* preserved in Vol. 1 of the *Xingxue Dacheng*. It says, Moon moves in the Lodge Jiao (Libra) at the beginning of the Ninth month, Moon moves two zodiac signs in five days. It is not difficult to determine Moon is in the Capricorn on the ninth day of the ninth month (the native's birthday in P.4071), that is the same result calculated by the DE404.

TABLE 16.4 *The planetary positions in* P.4071 *compared with the results of calculation by* QYRZJ (*T.1308*) *and the modern ephemeris* DE404

	P.4071	*QYRZJ*		*DE404*	
Planets	**Positions**	**results**	**P-Q**	**results**	**P-D**
Moon	Yi (翼)	–	–	Nü (女) 1°	>100°
Sun	Jiao (角) 8°	Jiao 9°	-1°	Jiao 7°	+1°
Jupiter	Wei (危) 3°	Wei 3°	0°	Wei 3°	0°
Mars	Zhen (軫)	Zhen	close	Zhen 7°	close
Saturn	Dou (斗)	Dou 12°	close	Dou 13°	close
Venus	Jiao (角), Kang (亢)	Zhen, Jiao, Kang	close	Zhen 15°	close
Mercury	Zhen (軫)	Zhen, Jiao, Kang	close	Zhen 9°	close
Rāhu	Jing (井)	Jing 29°	close	Jing 23°	close
Ketu	Niu (牛) 3°	Niu 3°	0°	Dou 20°	–6°
Yuebei	Wei (危)	Wei 4°	close	Wei 2°	close
Ziqi	Xing (星)	–	–	(Xing 1°)	close

of Ziqi given in a remaining calendarial chapter *Celestial Positions of the Four Residuals in the Tenth Year Xinmao of Jiajing Reign of the Great Ming Dynasty*.[36] The agreement between the position of Ziqi found in P.4071 and what can be calculated using this later source implies that the definition of Ziqi was kept unchanged from the 10th to the 16th century.

3 *Reckoning the Positions of the Five Planets and the Auspiciousness and Inauspiciousness of Relating Zodiac Signs and Lodges*

> While Saturn was in its own House, if born in daytime, he would mostly have a mild temperament, and also shall concern for others; if born at nighttime, he would experience much disaster and difficulties, would suffer foot-illness. Same as the aforementioned, if Saturn is in its own degree.

36 The chapter was photocopied in an *Astronomical Volume* of the *Zhongguo Keji Dianji Tonghui* (A General Collections of Classics for Science and Technology in China, edited by Bo Shuren, Zhengzhou: Henan Education Press, 1994). It gives the longitude of Ziqi is Dou 11° (284.6°) on Feb. 4, 1531.

> If Jupiter is in Saturn's House, he would be poor at home, however he would be wealthy and resourceful away from home, would satisfy everyone on everything, capable of mediating and persuading, all cherish each other, respect the propertied.
>
> If Mars is in Mercury's Degree, he would be charitable and generous in all his life, while the good deeds what he has done would turn to bad ones. Mars is in Mercury's House, Fire and Water meets each other, his inherent conduct would be insufficient, and there is a disparity between him and a good person.
>
> Sun was in Jupiter's Degree, he would be a local provincial governor, plenty of gold and treasures, and also many progenies.
>
> Venus was in Jupiter's Degree, he would be happy constantly, be successful in his career, be respected by noble person, be wealthy and plenty of meal.
>
> Mercury was in its own Degree, he would be happy constantly, eloquent, wealthy, honorary, especially respected by noble person. Or he would be in charge of government decree, and thus increasing his wealth, be fond of benefaction. As a common person, however, he would be in trouble because of women.
>
> It was also said, according to Yusi Jing (聿斯经), it would be extremely propitious when Mercury was in Virgo at someone's birth time, as it was so powerful that he who being born at that time would be very rich and obtain an official position of high rank.
>
> Three days after his birth, Venus would move into his Fate House, i.e. Libra, that means no worry about good fortune, and he would surely meet with someone who should help him promote his official rank.

In this part of the manuscript, P.4071 gives a general analysis of auspiciousness or inauspiciousness according to the configurations of planets and houses in the native's natal chart. For example, 'While Saturn was in its own house, if born in daytime, he would mostly have a mild temperament, and also should concern for others; if born at nighttime, he would experience much disaster and difficulties, would suffer foot-illness. Same as the aforementioned, if Saturn was in its own degree.' The text further speaks about the cases of Jupiter in Saturn's house, Mars in Mercury's house, Sun in Jupiter's house, Venus in Jupiter's house and Mercury in its own house. However, according to the planetary positions listed before, Sun should be in Venus' house, and Venus should be in Mercury's house. A reasonable explanation might be that some errors were made in transcription. The Chinese character used for Jupiter (wood, 木) is very easy to confuse with Mercury (water, 水), and Sun (日) is also easily be confused with Moon (月). According to the planetary positions listed before, Moon is in Virgo, which is Mercury's house.

In this part of the manuscript, the P.4071 quotes the *Yusi Jing* for the first time. It reads:

> 水居雙女最為靈，生時一宿皆臨照，即為豪貴處王庭。
>
> It would be extremely propitious when Mercury was in Virgo at someone's birth time, as it was so powerful that he who being born at that time would be very rich and obtain an official position of high rank.

The same sentence can be found in a chapter entitled *Western Yusi Jing* (西天聿斯經),[37] which is included in the 7th volume of *Xingxue Dacheng* (*A Complete Collection of Genethlialogy*, 星學大成).[38] Although the book was compiled in the Ming dynasty, the *Western Yusi Jing* could well have been composed in the late Tang dynasty. At the beginning of the *Western Yusi Jing*, it reads:

> 人命生來稟星算，歷數幽玄妙難斷，須識《西天都例經》，理義分明有條貫。
>
> People's life could be calculated by planets and stars, while it was very difficult to be done because of the mysteriousness and subtleness of calendrical and numerological problems, he must understand the Western Duli Jing, in which everything was stated clearly and systematically.

A book entitled *Duli Yusi Jing* in two volumes was recorded in the Biographical Chapters of *Xin Tang Shu* (*New Official History of the Tang Dynasty*). A brief note was also added to it, it reads, 'an astrologer from Duli (都利) named Li Migan (李彌乾) brought the book to China from western Indian. Someone named Qugong (璩公) translated it.'[39] Another book entitled *Yusi Simen Jing* in one volume was also recorded just after the *Duli Yusi Jing* in the same Chapter. Yabuuti Kiyoshi has proposed to identify the title *Simen Jing* (Book of Four

37 Mak (2014) gives a new translation of the *Western Yusi Jing* into English.

38 Wan Yingmin of Ming Dynasty, *A Complete Collection of Genethlialogy*, Vol. 7, *Wenyuan Ge Siku Quanshu* of Qing Dynasty.

39 Ouyang Xiu of Song Dynasty, Biographical Chapters of *Xin Tang Shu*, Vol. 59, *Twenty Five Dynastic Histories*, Vol. 7, Shanghai Ancient Book Publishing House, Shanghai, 1986, P. 165.

Departments) with the *Tetrabiblos* of Ptolemy,[40] and Yano Michio suggested that *Duli Yusi* was the Chinese transliteration of the name of Ptolemy.[41] Ho Peng Yoke summarized the work of these Japanese scholars and mentioned the possibility of western astrology being introduced into China via Iranian culture.[42] More recently, Bill M. Mak has argued that *Yusi Jing* was based upon Dorotheus' *Carmen Astrologicum* rather than *Tetrabiblos* of Ptolemy, and he considered further that Li Su (743–817), a Persian astronomer in the Tang Court, was the most likely translator of the *Duli Yisi Jing*.[43] However, the attribution to this translator may be questionable, because it can be determined that a quotation of *Yusi Jing* in a Buddhist sutras *Fantian Huoluo Jiuyao*[44] (梵天火羅九曜, Brahmahoranavagraha) was made already in 751AD,[45] when Li Su was only 8 years old and had not arrived in the capital city Chang'an of Tang Dynasty.

The manuscript P.4071 ends this part with a general prediction for the native that he should not worry about his fortune, he would surely meet with someone who could help him promote his official rank, because three days after his birth Venus moves into his Fate House.

4 *A Natal Horoscope Chart with Eleven Luminaries*

> *There is a horoscope chart*
>
> He would be prompted by imperial examination and get the official's salary if Saturn meets Mercury at his birth, he would be much intelligent and be changeable in mind. He would be a noble and powerful person if Jupiter meets Mars in the same House, he would have an agile mind and a quick action.

What did a natal horoscope look like in 10th Century China? P.4071 declares that there is a chart entitled 'Natal Horoscope Chart with Eleven Luminaries', but it was not provided. After the title of this section, there is a note which says 'there is a chart'. This may indicate that the manuscript P.4071 was copied from an original one in which a natal horoscope chart was provided.

40 Yabuuti (1969: 186–188).
41 Yano (1990).
42 Ho (2003: 71).
43 Mak (2014).
44 Yixing of Tang Dynasty, *Fantian Huoluo Jiuyao*, No. 1311 of *Taisho Tripitaka*.
45 Niu (2005).

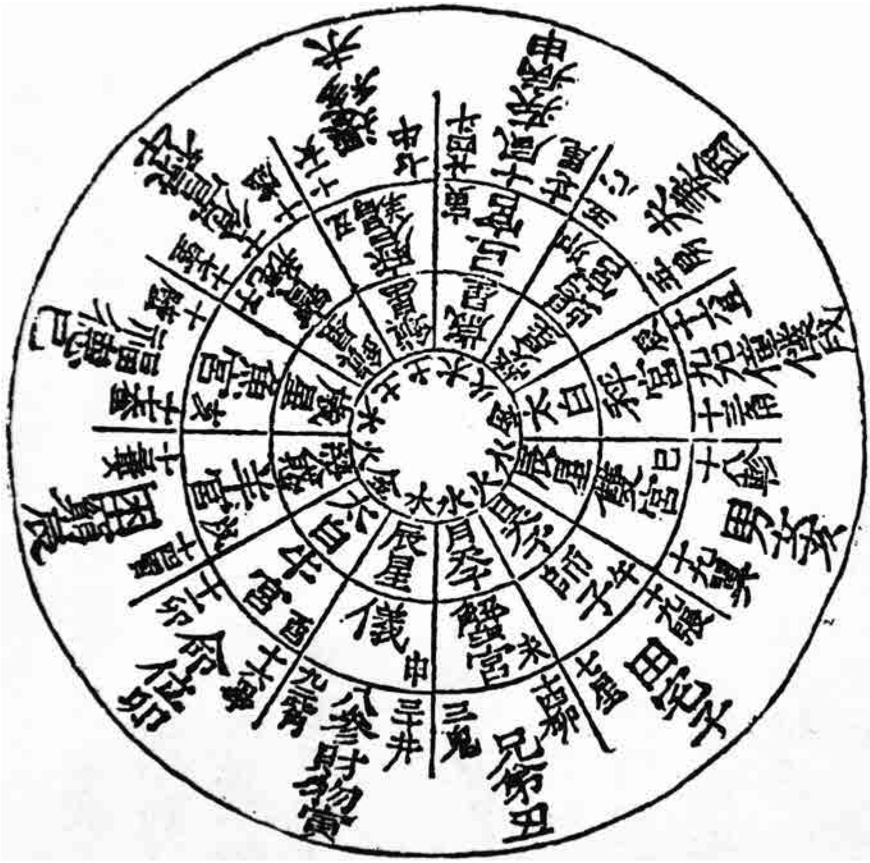

FIGURE 16.1 *A natal chart from* QYRZJ *of the 9th century* (*from* Taisho Tripitaka*, Vol. 21, No. 1308, Tokyo 1924–1934, p. 451*)

In the *QYRZJ* of the 9th century a kind of concentric circles chart (see Fig. 16.1) may be found. From the outermost circle to the innermost circle the chart lists respectively the 12 places, the 28 lodges, the 12 zodiacal signs and their lords of planet, and their attribute of the five phases of Earth, Water, Fire, Metal and Wood (see Tab. 16.5). The chart demonstrates the components of a natal chart in that time but does not given any actual planetary positions for a native's birth time; it can therefore be taken as a template of a natal horoscope chart in Tang Dynasty China.

TABLE 16.5 *Main compositions in a natal chart from* QYRZJ *of the 9th century*

Time Hour	**12 Places**	**28 lodges**	**12 zodiac signs with Chinese names and their lords of planet**	**Five phases**
Mao 卯	Life	Mao 昴, Bi 毕	Taurus, You 酉, Venus	Metal
Chen 辰	Impoverished	Lou 娄, Wei 胃	Aries, Xu 戌, Mars	Fire
Si 巳	Good Fortune	Bi 壁, Kui 奎	Pisces, Hai 亥, Jupiter	Water
Wu 午	Official Salary	Xu 虚, Wei 危, Shi 室	Aquarius, Zi 子, Saturn	Earth
Wei 未	Migration	Niu 牛, Nü 女	Capricorn, Chou 丑, Saturn	Earth
Shen 申	Illness	Wei 尾, Ji 箕, Dou 斗	Sagittarius, Yin 寅, Jupiter	Wood
You 酉	Marriage	Fang, 房 Xin 心	Scorpio, Mao 卯, Mars	Fire
Xu 戌	Servant	Jiao 角, Kang 亢, Di 氐	Libra, Chen 辰, Venus	Metal
Hai 亥	Children	Yi 翼, Zhen 轸	Virgo, Si 巳, Mercury	Water
Zi 子	Homestead	Xing 星, Zhang 张	Leo, Wu 午, Sun	Fire
Chou 丑	Brother	Gui 鬼, Liu 柳	Cancer, Wei 未, Moon	Water
Yin 寅	Gain	Zui 觜, Shen 参, Jing 井	Gemini, Shen 申, Mercury	Wood

An actual natal chart (see Fig. 16.2) which was cast on 14 January 1113 can be found in a Japanese text, the *Zoku Gunsho Ruiju*,[46] which is very similar to the chart in *QYRZJ* except for two differences: (i) The border lines between the zodiac signs usually intersect the lodges, which indicates a more precise consideration of the unequal width of the lodges being allocated to the zodiac signs in practical use. The lodges marked with a superscript (*) in Tab. 16.6 indicates its degrees were shared by the next zodiac sign, for example, the front part of the lodge Dou belongs to Sagittarius, the latter part belongs to Capricornus. (ii) The nature of five phases of the zodiac signs are omitted in the chart from the *Zoku Gunsho Ruiju*. While as an actual horoscope, the chart from the *Zoku Gunsho Ruiju* provides the actual positions of the planets, the sum of planets is nine, they are sun, moon, Mercury, Venus, Mars, Jupiter, Saturn, Rāhu (lunar ascending node) and Ketu (lunar descending node). The planets are listed in a concentric circle between the circles of lodges and zodiac signs.

46 Editorial Board of the Zoku Gunsho Ruiju, *Zoku Gunsho Ruiju*, Vol. 908, Tokyo, 1926, pp. 429–437.

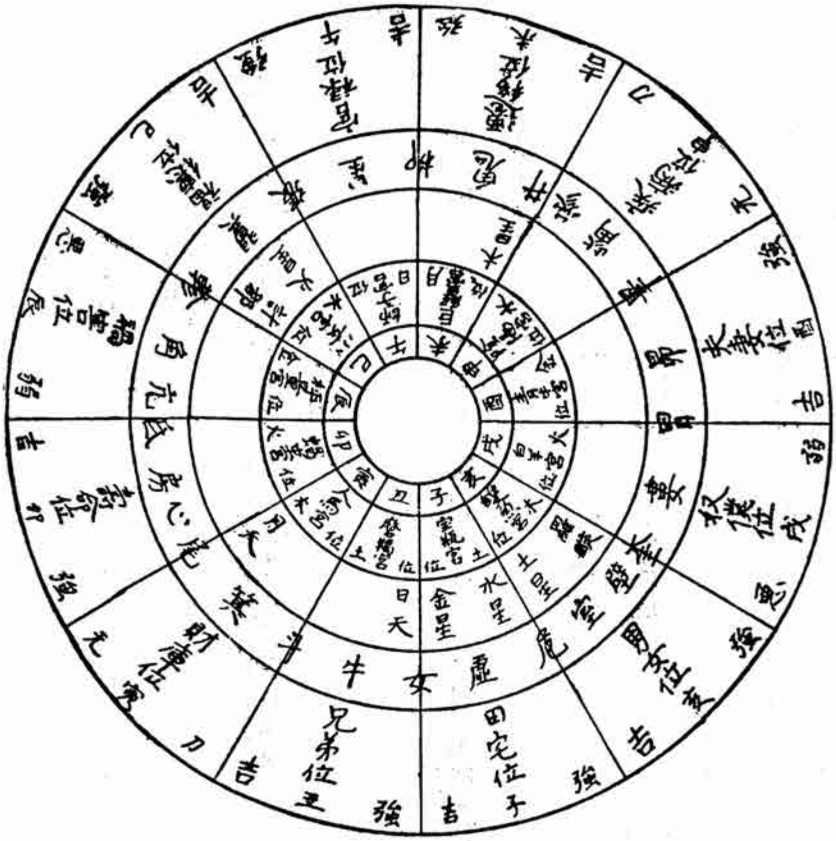

FIGURE 16.2 *A natal chart from the* Zoku Gunsho Ruiju (*from* Zoku Gunsho Ruiju, *Vol. 908, Tokyo, 1926, p. 430*)

TABLE 16.6 *Compositions in an actual natal chart on 14 January 1113 from* Zoku Gunsho Ruiju

Time Hour	**12 Places**	**28 lodges**	**Planets**	**12 zodiacal signs with Chinese names and their lords of planet**
Mao 卯	Life	Fang 房, Xin 心, Wei 尾*		Scorpio, Mars, Mao 卯
Chen 辰	Impoverished	Jiao 角, Kang 亢, Di 氐*		Libra, Venus, Chen 辰
Si 巳	Good Fortune	Yi 翼, Zhen 軫*	Mars Ketu	Virgo, Mercury, Si 巳
Wu 午	Official Salary	Xing 星, Zhang 張*		Leo, Sun, Wu 午
Wei 未	Migration	Jing 井, Gui 鬼, Liu 柳*	Jupiter	Cancer, Moon, Wei 未
Shen 申	Illness	Zui 觜, Shen 参		Gemini, Mercury, Shen 申

Time Hour	12 Places	28 lodges	Planets	12 zodiacal signs with Chinese names and their lords of planet
You 酉	Marriage	Mao 昴, Bi 畢*		Taurus, Venus, You 酉
Xu 戌	Servant	Lou 婁, Wei 胃*		Aries, Mars, Xu 戌
Hai 亥	Children	Shi 室, Bi 壁, Kui 奎*	Saturn Rāhu	Pisces, Jupiter, Hai 亥
Zi 子	Homestead	Xu 虛, Wei 危*	Venus Mecury	Aquarius, Saturn, Zi 子
Chou 丑	Brother	Niu 牛, Nü 女*	Sun	Capricorn, Saturn, Chou 丑
Yin 寅	Gain	Ji 箕, Dou 斗*	Moon	Sagittarius, Jupiter, Yin 寅

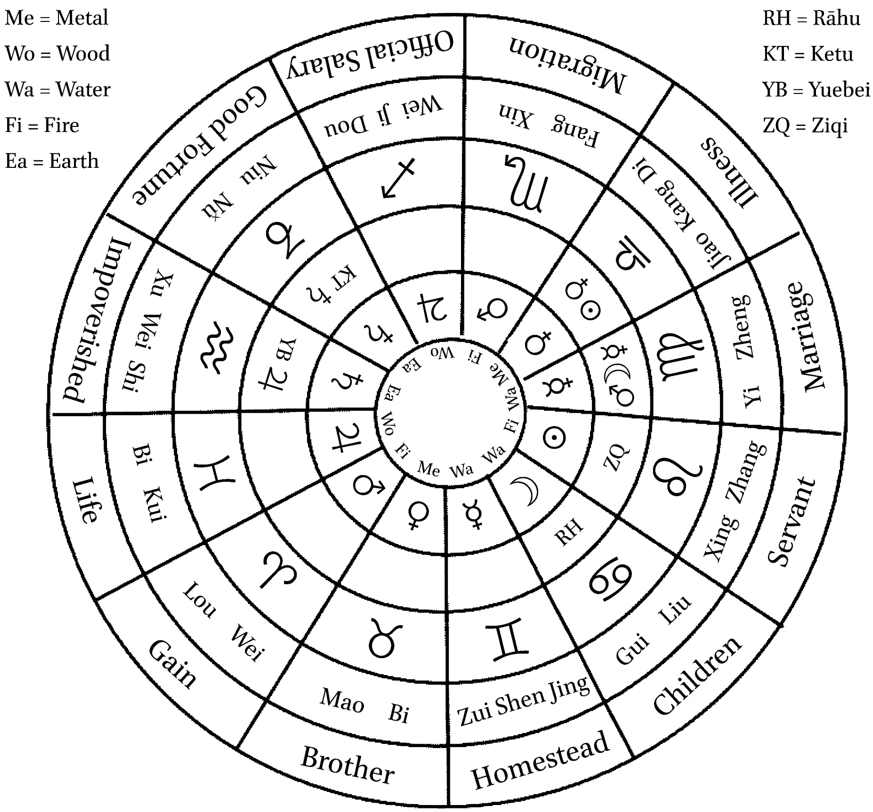

FIGURE 16.3 *A tentative reconstruction of the P.4071 natal chart*

The nativity in P.4071 was cast on 25 January 974, which was roughly the middle point of the time from the composition of the *QYRZJ* to the casting of the chart found in the *Zoku Gunsho Ruiju*. It is therefore reasonable to assume that the natal chart in P.4071 is not very different from that in the *QYRZJ* and the *Zoku Gunsho Ruiju*. Based on this assumption, a tentative reconstruction of the natal chart in P.4071 is given in Fig. 16.3. The main difference of the chart in P.4071 is that the sum of planets becomes eleven: sun, moon, Mercury, Venus, Mars, Jupiter, Saturn, Rāhu (lunar descending node), Ketu (lunar ascending node), Yuebei (lunar apogee) and Ziqi. This new development of the concept of Four Residuals from Rāhu and Ketu, and the exchanging of astronomical meaning between Rāhu and Ketu, seemed to occur only in China, for the sum of planets in the chart cast on 14 January 1113 found in the Japanese text *Zoku Gunsho Ruiju* remained nine.

5 *Date of the Fate House*

> He who was born (when Sun was) in Di (氐) and Fang (房), i.e. Scorpius, would be gentle and kind-hearted, admiring Buddhism or Taoism, adoring a monastic life, broad-minded, would be wealthy and happy in his whole life, suitable for making friends with honesty, living his life freely no matter good or evil. He would have a great appearance, there must be a miracle bone outgrown on his head. In his middle-age he would be average, after that he would become a Marquis, Duke, even King. His kin would be auspicious in public, average in private. When he was young he suffered from minor ailments frequently, while always turned calamity into blessing. He also would get an official salary of three thousand Dai (石). He would respect the teacher and monk, be fond of monasticism, be keen on the garden with water and bamboo, willing to repair monastic houses. He would relieve people far and near generously. He would hinder his younger brothers and sisters, be suitable for horses, slaves and maidservants. His taboo year is Mao (卯), he should pray for good fortune. His life expectancy should be 84 years. There should be no hardship. There must be birthmarks on his back, left rib and face. One more line said, an official salary of rank two perhaps is not destined for him. It is auspicious for him to be an official, Buddhist or Taoist priest. He should beware the people from the different clan in his private. There would be water disaster. He would observe justice, love his guest.
>
> It was also said, he who born in this sign would have a character of impatience, faithfulness and decisiveness, with daring and imposing manner. He would be destined to get his middle-aged official salary, most-

> ly from the government with a high rank of king, if not so, he would make his progress by his skill and knowledge.
>
> It was also said, he who born in this sign would be destined to be ranked high in a king's government, or to be honorable and noble in a foreign country. If born in daytime, his good fortune shall come later.
>
> A song said, he who born in this sign would be full of valor and vigor, his kindness to others cannot be exceeded, his wealth and rank would not be comparable, while disasters of water and fire should be vigilant.

This part of the P.4071 is entitled as the "Date of the Fate House" (命宫日), in which a general description of fate is provided corresponding to a zodiac sign where the Sun is located at a native's birthday. In this part of the text the House of Fate (Ming Gong, 命宫) seems to be defined as the zodiac sign where the Sun is located at a native's birthday. In the *Western Yusi Jing* a different definition of the same term Ming Gong is given:

> 但問生時日宿宮, 加向時辰廻視東, 天輪轉出地輪上, 卯上分明是命宮。
>
> (In order to determine the Fate House,) he should ask which zodiac sign the Sun is located at birth time, then count the hours from the birth time to look toward east, where the celestial wheel is just rotating out of the horizon line, that is the Hour Mao on which the Ming Gong (Fate House) locates.

In this definition, a Ming Gong (Fate House) is the ascendant sign at birth time, which should be the Life, the first of the 12 Places in a standard western natal horoscope chart, just as it was in the natal chart from the *QYRZJ* and the *Zoku Gunsho Ruiju*. Thus, Ming Gong (Fate House) sometimes indicates the ascendant sign at a native's birth time, but in P.4071 the Fate House mostly seems to mean the Sun sign at a native's birthday.

Another problem in this part of the text is that, according to the listed positions of the eleven luminaries, 'the Sun was at 8 degree of Jiao, shone in Libra', so Libra should be the native's Fate House, not the Scorpio as described in this part. Possible explanations of this difference could be that the two neighboring signs might be confused when the text was copied from an astrological handbook, or that the text was mixed with a divinatory text of someone else when this part of the text was copied from an original manuscript.

6 *Date of the Body House*

The Body House was also called Taurus. He who was born in this sign would be an official, and would have an overstepped promotion. Or he could make a living by his skill and artistry, or by his salary. He should be generous, daring and vigorous. He would have a distinguished manner to deal with the matters. As a man, he would be a noble person and be favorable to his parents. Born in the Hour of Shen (申) in daytime, he might mostly lost his property, and should experience unusual success and failure.

A song said, the gentleman's honorable fame would be known all over the country, if his body house was located in the sign of Taurus, he would be destined to be helped by noblemen, he should have a good eloquence and an outstanding appearance.

It was also said, he who born in this sign, and met the Huagai (華盖), should be a general. Musha (墓煞) was a heavenly noble god, which contained gracious kindness innerly, and cherished nurturing pneuma outerly. It would reside often on the third month of the four seasons, which contains the situation of all the things on the world. He who was born in this sign would be the senior minister of the great Tang Empire with extremely glory and honor. As a general, he should achieve unusual success. As a civil officer, he would have a profound and glorious successful career. He would play a psaltery accompanied by cloud and cranes. He would be good at numerology and astrology. He would also be skillful in the art of healing. He would become very famous like Bianque (扁鵲) and [Guo] Jingchun (郭景純). He would comply strictly with social etiquette in interpersonal relationship. With a purified mind he would live abstinently and solitarily. Also he might live in Buddhist and Taoist temples. Or make a living from his skill. He might be an official but would not hold power over somebody's life, the region where he should hold a post would not that of strategic importance. He also could be poor and lonely, be harmful to his parents, and there would be no way to enhance his social status. Or fortunately encountering a gentleman, his hypocritical nature would not make him to be trusted. If he stayed at his native place, he would suffer lots of misfortune and calamity. There was a saying like this, being born in Grave means longevity, because ghosts do not take people from grave. If his fate progressed into this House, he would get a great promotion, if it was not a district governor, it must be a senior officer in council. He also could be a Buddhist or a Taoist, making living by his skill. Being civil or military officials, he would make a name for himself,

> and should win honor and distinction for his families and kin. He also could encounter wagging of tongues and rumors of shameful secrets, and he could be sick, and lost money and goods. Or he could be harmful to his parents and separated from his brothers. His money would be lost and his property would be divided. A gentleman should follow his fate, and accept the preciousness of the magic art.
>
> A song said, he who was born in this Sign and House, he would be a master of arts even as common people, and he would be wealthy and noble as a gentleman, He would be so venerable a man that ghosts and gods should show their high respect for him.

A Body House is traditionally defined to be the sign where the moon is located at a native's birth time according to some Chinese astrological texts. For example, Su Shi (蘇軾, 1037–1101) once commented on Han Yu's *Song on Three Stars*, 'when Han Yu was born, the Moon was located in the South Dipper, so Capricorn is his Body House, which is also my Fate House. That is why he and I both experienced so much defamation in our life.'[47]

In this part of the manuscript P.4071, the text begins with the statement that, 'The Body House was also called Taurus', followed by a general description of fate. However according to the definition of Body House and the moon's position as given in the text, Virgo should be the Body House. While the native's birth hour of Shen was emphasized in the description, so it did not look like that the text was confused with someone's divination text when it was transcribed. The confusion may be caused by different definition of Body House, or by using different lunar ephemeris, after all it was not easy to calculate the lunar position of more than 40 years ago, and there should also be other different answers.

In another longer description of fate in this part, the text mentioned, 'He who was born in this sign would be the senior minister of the great Tang Empire with extremely glory and honor.' This demonstrates a typical kind of sinicization when the western astrology was applied in China.

7 *Yearly Horoscope Analyses*

> When he was born, he offended the Tianluo (天羅) even in his mother's womb. When he was three years old he must have experienced a great disaster, from water, or from fire, or from death of kindred, or of adversity.

47 Sushi of Song Dynasty, *Dongpo Zhilin* (東坡志林, *Notes Taken by Dongpo*), Vol. 1, the reverse side of page 1, A block-printed edition of Ming Dynasty.

At four years old he would have suffered a trauma of his body. At five years old he encountered the fate of Dinghai (丁亥), it was annotated as stagnation and adverseness. Until fifteen years old his fate would have gradually become auspicious. Then he would have had an average fortune till twenty-one years old.

At twenty-one years old Jupiter retrograded in his Fate House, Mars shone in his Body House. He must have suffered calamities of somebody's separation, injury or death. It would have changed to good fortune until the eleventh month. From his twenty-two to twenty-six years old, Saturn guarded Fang (房), which indicated stagnation and adverseness. It would turn good until the fourth month of his twenty-seven years old when Saturn began to retrograde. At twenty-eight years old, the second lord Mars entered the Body House, it would be extremely auspicious to travel outside for seeking money, there would also have happy event occurred if stay at home. After his thirty-eight years old, he would be fortune enough and everything would be successfully completed with great auspiciousness. Even though there would be disasters to be encountered after thirty-eight, it still would be alright.

At thirty-nine years old Jupiter shone in the Body House, and Rāhu shone in the Fate House, destined to be worried first and happy later, and there should be a tongue wagging.

At forty years old, annual god moved into the House above Mao (卯), Chen (辰) was the Fate House, Mars was in the House of Wealth, he would have certainly met some small difficulties, and suffered the uncertainty of body and mind.

At forty-one years old, Venus and Mars shone in the Body and Fate Houses. In this year he should encounter a separation of families, scattering of belongings, average for travel.

At forty-two years old, the Annual Sign was Aries, Saturn shone in the annular House, and Jupiter was in the Fate House. In the sixth month of this year there would be little calamity occurred. This would gradually become auspicious when met the Section of the eighth month.[48]

At forty-three years old, the annual god went into the Body House, there will be average for the Fortune and Wealth Houses. Ketu shone, fearing of culprits' destroying property and blocking things.

At forty-four years old, the Annual Sign would be Gemini, in which Jupiter shone, Venus was in the Body House, in which Mercury also shone,

48 In the 24 solar terms, if Yushui is the section of the first month, then the section of the eighth month is the autumn equinox.

destined to be great happy, while it would turn to be inauspicious when met the Section of the Eighth month.

At forty-five years old, the Annual Sign would be Cancer, Mars will be in Capricorn, opposite to the annual House, Jupiter will shine in the Fate House, it is destined to be happy first and worried later, certainly damaging of property, trouble of wagging tongues, precautions should be taken.

At forty-six years old, the Annual Sign would be Leo, Mercury shine in it, Rāhu would be in the Body House, destined to be depressed and lose money. Fortune can be changed by travel. It will be auspicious to move.

At forty-seven years old, Jupiter guards the Fate House, the Annual Sign is Virgo, Venus and Mercury move into Virgo in the fifth month, emphasizing on meeting joyful things from someone. How to know that? Venus is the first Lord, Mercury moves into this House, it must meet the King of Wenshu (文書). However a little bit adversity will be encountered in this House after the Section of the eighth month.

At forty-eight years old, the Annual Sign is Libra, Mars enters into the Body House in the eleventh month, destined to lose money and livestock, while death can be avoided.

At forty-nine years old, annual god goes into the Fate House, Jupiter shine in the Wealth House, destined to be auspicious for seeking money, everything will be successful and propitious.

At fifty years old, the Annual Sign is Sagittarius, the Great Fate is in Mao(卯), while the Little Fate is also in Mao, it is destined to meet catastrophe in this year, which will be relieved and turn to be good fortune when Jupiter moves into Taurus.

At fifty-one years old, the Annual Sign is Capricorn, Rāhu is in the Body House, it is also destined to be depressed and lose money in this year, while it will be auspicious when Venus enters into the annual House in the Section of the eighth month.

At fifty-two years old, the Annual Sign is Aquarius, Mercury enters into it in the fifth month, it is destined to be auspicious in sixty days, or will be exalted by the officials, or money will come. Mercury is originally the fortune star.

At fifty-three years old, the Annual Sign is Pisces, Venus enters into it in the third month, the King is in Shi (室), destined to be double happy, move out after 13 days, it is called Taibai (太白) by common people.

At fifty-four years old, the Annual Sign is Aries, Saturn enters into the Body House, destined to be auspicious in the Fortune House smoothly. It will be stagnant and depressed in the Wealth House. There are causes that lead to disaster. The Great Fate move into Chen (辰), it will always aid the Fortune House, that is auspicious.

At fifty-five years old, the Annual Sign is Taurus, Mars enters into it in the fourth month, destined to be little wagging of tongues, it will not become big things. If frightened by water and fire in this year, it will finally be relieved. Saturn will move out Taurus in the eleventh month.

At fifty-six years old, the Annual Sign is Gemini, it is destined to seek money by travel around. Achievement can be acquired by changing the plan, because Mercury and Jupiter will guard this House for 40 days and will retrograde then.

At fifty-seven years old, the Annual Sign is Cancer, Jupiter shine in the annual House. Because Fate moves into Xu (戌), Chen (辰) and Xu are at the opposite places, which must bring calamity, while this can be relieved by the shining of Jupiter.

At fifty-eight years old, the Annual Sign is Leo, Mars enters into Fang (房) of the Fate House, and Jupiter enters into the annual House, destined to be joyous and auspicious.

At fifty-nine years old, the Annual Sign is Virgo, Mercury shine in this House in the seventh month, which is highly auspicious. Venus stays in Scorpio for 16 days, which also is joyous and highly auspicious.

At sixty years old, the Annual Sign is Libra, and Jupiter guards its own degree in Jiao (角), It will be average with the Fortune House.

In this part of P.4071, the manuscript gives the native's yearly analyses from his first year to his sixtieth year. Before the thirty-eighth year, some general descriptions of outcomes are only provided for the first, third, fourth, fifth, fifteenth, twenty-first, twenty-sixth, and twenty-eighth year. A relatively detailed yearly analysis based on the configuration of planets and signs in each year is provided from the thirty-ninth to the sixtieth year.

According to the listed Annual Sign from the thirty-ninth to the sixtieth year, it is not difficult to determine that the Annual Sign for the first year is Scorpio. So in this text the first Annual Sign is defined to be identical with the Fate House, which is Scorpio in this case based on the description given in the section 'Date of the Fate House'. Thus, in the manuscript P.4071, the first Annual Sign starts from the Sun sign at a native's birth time. However, there is also a different definition of the first Annual Sign, which is identical to the ascendant sign at a native's birth time. For example, in the Chapter 12 of *Good or Bad Fortune by Annual Sign* in *Lingtai Jing* (靈台經, *Canon of the Imperial Observatory*), it says, 'the ascendant sign is the first annual sign, it shall be changed to the next sign every one year, it should be noted that the year is

TABLE 16.7 *The frequency of a certain configurations of planet and house mentioned in P.4071*

	Jupiter	Mars	Saturn	Venus	Mercury	Rāhu	Ketu
Fate House	4(2)	2	2	2	–	1(1)	–
Body House	2	3(2)	1(1)	2	2	2(2)	–
Annual Sign	5(5)	1	1(1)	2	4(1)	–	–
Counter Annual Sign	–	1	–	–	–	–	–
Gain	1	1	–	–	–	–	1(1)
Total	12(7)	8(2)	4(2)	6	6(1)	3(3)	1(1)

counted from birthday to birthday. The annual signs is usually used as a main method to tell auspiciousness or inauspiciousness.'[49] Though the definition of the annual sign used in the P.4071 is different from that given in the *Lingtai Jing*, the rule when to change the annual sign should be the same, i.e., the annual sign changes after birthday.

In the sixty years of yearly analyses, some configurations of planets and houses are frequently mentioned in the native's different ages, such as Jupiter in Fate House, Mars in Body House, and Mercury in Annual Sign, etc. The frequency of a certain configuration of planet and house mentioned in the text is listed in Tab. 16.7, the numbers in parentheses indicate the times when the corresponding combination of planet and house cannot be verified by a modern planetary ephemerides. For example, 4(2) for Jupiter in Fate House indicates that this configuration are mentioned in the text 4 times, but that 2 of them are not true according to the modern planetary ephemerides. It is worth emphasizing that the positions of Rāhu (descending node) and Ketu (ascending node) are all incorrect. It should also be noted further that Yuebei and Ziqi are absent form this part of the manuscript. So it is quite possible that when the astrologer produced this part of yearly analyses, he referred to a different handbook from which the positions of the eleven luminaries were provided at the beginning of the manuscript.

It seems the yearly analyses of favorable and unfavorable outcomes is mainly based upon the configuration of planets in Fate House, Body House and Annual Sign. Eleven occasions of a planets in Fate House, twelve ocassions of planets in Body House and thirteen occassions of planets in Annual Sign are mentioned in

49 The anonymous *Lingtai Jing* was believed to be compiled between Tang and Song Dynasty, it was included in the *Zhengtong Daozang*(正統道藏) of the Ming Dynasty.

the text of yearly analyses. Besides, the second place Gain is mentioned 6 times in the text of yearly analyses, with 3 times combined by planets. The eleventh place Good Fortune is also mentioned 5 times with no mention of combined planets. The names of the rest 10 places do not appear in the yearly analyses text. It looks like the wealth and good fortune are two main items of outcome concerned by the native or the astrologer in this yearly analyses report.

8 *Reckoning the Possessing of Horses*

Comment: it was said in the Wuxing Jing (五星經, Canon of Five Planets) about the post-horses that, for the horses as one of the six domestic animals, if the raiser could not operate and manage the things properly, he would certainly suffer an extra financial loss.

A song said, post-horse met the King and Huagai (華蓋), the general, Taoist and Buddhist were assembled, a gentleman would be promoted to a high rank official, a common people should make living by his knowledge and skill far away from home.

9 *Reckoning the Descendants*

Comment: it was said in the Wuxing Jing (五星經, Canon of Five Planets) that, if the Descendants House was one of the trine Houses, its place was on the rise, the descendants would surely have no heart of gratitude, and finally only one of them could be benefited from.

A song said, because it was in a Trine House when he was born, all the descendants were likely not be good, even if he had seven of them, there would be no gratitude from them and finally he would leave far away from home.

10 *Reckoning the Homestead*

Comment: Yusijing (聿厮经) said, Zi (子, Lower Midheaven), Wu (午, Midheaven), Mao (卯, Ascendant) and You (酉, Descendant) were called the four centers. If Yuebei (月孛, Lunar apogee) was in the (fourth) House of Patrimony when he was born, he could inherit the field and houses but could not keep them longer.

A song said, to divine the field and houses according the birth day in four seasons, if Yuebei was progressing in the (fourth) House of Patrimony, what he should do is to travel into the mountains to study the Taoist arts, it also would be highly auspicious for him to seek an official career.

After the annual analyses, P.4071 gives further three very brief divinations on the possessing of horses, on descendants, and on the homestead. They are all formed only by a quotation and a song of four sentences. The outcomes of this three fortunes are all unfavorable ones. It appears that a final caution is made at the end of this divination text. All the three divinations indicate that the native should make a living far from his hometown, so the divinations also could be taken as a conclusion of the native's life.

In the divinations concerning horses and descendants the text quotes the *Wuxing Jing* (五星經, *Canon of Five Planets*), which was most possibly compiled in the Tang Dynasty. About the descendants, a song says, 'the Descendants House was in the Trine Houses when he was born, all the descendants would not likely be good.' According to the foregoing tentative casting of the P.4071 natal chart, the Children House (Cancer) is a Trine House of Scorpio which is taken as the Fate House.

In the divination concerning the homestead, the text quoted again the *Yusi Jing*, which says, 'Zi (子, Lower Midheaven), Wu (午, Midheaven), Mao (卯, Ascendant) and You (酉, Descendant) were called the four centers. If Yuebei (月孛, Lunar apogee) was in the (fourth) House of Patrimony when he was born, he do could inherit the field and houses but could not keep them longer.' The fourth House of Patrimony is precisely the lower midheaven sign, so the four centers are emphasized here. But Yuebei is actually located in the twelfth House of Impoverished in this particular case, so it is not clear why this is quoted here.

11 *Postscript and Signature*

> Above is a text of divination which was reverently operated. All about the 28 lodges, longitudes of 11 luminaries, 12 gods of zodiac signs, Jiugong Bagua (九宮八卦, Nine Squares and Eight Trigrams), and 12 Field Allocations, are included in this magic calendric text. If someone's fortune and misfortune are calculated from it, the result must be respected and valued. The text is provided piously. I am here prostrating myself to be identified from talented people.
>
> Sincerely described,
>
> and reckoned by civilian diviner Kangzun of Lingzhou the Great Dudufu, on the 11th day of the 12th Month, the 7th year of Kaibao (開寶七年十二月十一日靈州大都督府白衣術士康遵課).

At the end of the manuscript, a postscript is tagged to emphasize the sacredness of this divination. It is pointed out that the divination is based on the twenty-eight lodges, the longitudes of eleven luminaries, the twelve gods of zodiac signs, the Jiugong Bagua (九宫八卦, Nine Squares and Eight Trigrams), and the twelve Field Allocations. The items in this list represent a mixture of western and traditional Chinese astrology. The text also stresses that if someone's fortune or misfortune are calculated from it, the result must be respected and valued.

Finally the astrologer's signature together with a date is signed at the end of the text. It reads, "sincerely described and reckoned by civilian diviner Kang Zun of Lingzhou, the Great Dudufu, on the 11th day of the 12th Month, the 7th year of Kaibao."[50] Kang was one of the most popular family names in the western part of China during Tang Dynasty. It is believed that people with the surname Kang most probably migrated from Samarkand which was once the center of a Kingdom Kang.[51] The migration of people for trade and other purpose from western countries to China became the most important intermediary of culture exchange including astrology and astronomy. Dunhuang, where the text was found, was one of the famous gathering places of western immigrants, and is located about 1200 kilometers to the west of Lingzhou.

Conclusion

According to the above analysis of P. 4071 as well as from consideration of the background to the text, it may be concluded that: (i) western astrology was became popular in Chinese daily life during late Tang and early Song Dynasties; (ii) most of the principles of western astrology including Indian astrology were transmitted to China via the translation of Buddhist Sutras and non-Buddhist materials such as *Duli Yusi Jing*; and (iii) these western astrological principles were mainly followed by Chinese native astrologers as it was demonstrated in the P. 4071. Nevertheless, many adaptations and additional inventions were made when the imported western astrology were practically used in China, such as: (i) using the Chinese 28 lodges not the Indian 27 lunar mansions; (ii) allocating the Chinese traditional five phases, i.e. Metal, Wood, Water, Fire and Earth to the 12 signs; (iii) adopting a different definition of Fate House; (iv) emphasizing the importance using of Body House; and (v) creating an eleven body system (neither the western seven planets nor the Indian nine grahas), together with a development of the Four Residuals

50 Kaibao was a reign title of Zhao Kuangyin, who was the first emperor of the Song Dynasty.

51 Rong (2001).

system. All these aspects of the Sinicization of western horoscopic astrology may be recognized in P.4071, which effectively illustrates the absorption and adaptation of alien astronomical and astrological concepts when they diffused from one civilization to another.

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CHAPTER 17

Were Planetary Models of Ancient India Strongly Influenced by Greek Astronomy?

Dennis Duke

The title question has been debated for well over two centuries. During the late 18th and the entire 19th century the debate was primarily between various British and French scholars who had learned Sanskrit and studied the surviving Indian astronomy texts. From the beginning there was broad agreement about the many similarities between ancient Indian and Greek astronomy. For example, Burgess (1893: 746–748), in reviewing the history of these early investigations, summarizes the many Sanskrit names that are transliterations of the Greek. Thus for Aries the Greek is Κριός and one Sanskrit version is Kriya, for Taurus we have Ταύρος and Tâvuri, etc. Similarly, for the names of the visible planets we have for Saturn Κρόνος and Koṇa, for Jupiter Ζεύς and Jîva, etc. And for technical terms we have for declination ἀπόκλιμα and âpoklima, for a minute of arc λεπτή and liptâ, etc. Similarly, in the *Romaka Siddhanta*, whose Greco-Roman origin is strongly suggested by the title name alone, is found the relations 1,040,953 days in 2850 years, so the year length is exactly the Hipparchan value 365;14,48 days, and for the moon 110 anomalistic months in 3031 days, thus a Greek model using Babylonian zig-zag structure.[1] However, if one was willing to accept that the Indian culture was much older that the Greek and even the Babylonian cultures, then there was room for argument about the claims for originality on both sides of the debate.[2]

In the 20th century the debate continued, now primarily between western scholars and a growing number of scholars from India. The lines of the debate were more or less predictable, the western side pointing to the many similarities and concluding that ancient Indian astronomy was developed largely from the transmission of Greek astronomy, and to a lesser degree Babylonian astronomy filtered through Greco-Romans; the eastern side claiming that the

1 Neugebauer and Pingree (1970–1971).

2 For a detailed and accessible study of a typical Indian astronomy text see Burgess (1858), and particularly the extensive technical notes, commentary and appendix by William D. Whitney. For a broader overview of the history of the study of Indian astronomy in the 18th and 19th centuries see Burgess (1893).

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similarities could just as well result from original development in India followed by transmission to the west. In addition, the Indian scholars pointed out that there appear to be many features in Indian astronomy that are not seen at all in Greek astronomy, and are certainly not present in the culminating Greek text, Ptolemy's *Almagest*, thus supporting the idea of a significant amount of original Indian contribution to astronomy. However, western scholars countered this argument by pointing out that the transmissions to India could just as well consist of Greek astronomy developments from the centuries before Ptolemy, and that the texts that brought this pre-Ptolemaic astronomy to India have been lost.[3]

Much of the 20th century debate regards the Greek and Indian planetary models. In broad terms the models are similar. The planets orbit the Earth with mean motions specified by period relations. The planetary true speeds differ from the mean values due to two anomalies. The zodiacal anomaly, common to all seven planets, is the variation of speed as the planet circles through the zodiacal constellations. The solar anomaly, shared by five of the planets, is the occurrence of a retrograde motion when the planet is near opposition to the Sun. Finally, each of the planets has a latitude to account for the fact that their orbits are generally not in the plane of the ecliptic. It is, of course, not surprising that these fundamental features are shared by both Greek and Indian planetary models, since the features in fact reflect what is observed in the sky.

On the other hand, the Greek and Indian models differ dramatically in the way these features are implemented. For example, the mean motions are specified in the *Almagest* by period relations involving small numbers.[4] Thus, for Saturn, Ptolemy suggests that Hipparchos knew the integral relation two revolutions in longitude in 59 years, but he is going to use the corrected relation two revolutions in longitude plus 1;43° in 59 years plus 1¾ days. In addition, Ptolemy's epoch positions are specified at noon on -746 Feb 26, and the mean longitude of Saturn, for example, is 296;43° on that date.

In contrast, in the *Aryabhatiya* Saturn is said to make 146,564 revolutions in longitude in 4,320,000 years while the *Paitamahasidddhanta* gives the even

3 Shukla (1960), Somayaji (1971), Billard (1971), Chatterjee (1972), and Shukla (1976) are typical presentations from the point of view of many 20th century Indian scholars and some western scholars. Neugebauer (1956), Pingree (1971), and Pingree (1976) discuss the connection of Indian astronomy to pre-Ptolemaic Greek astronomy. For a broader perspective on Indian astronomy and mathematics see Plofker (2009).

4 For an overview of the mathematical basis of Greek astronomy see Neugebauer (1975) or the more accessible Thurston (1996).

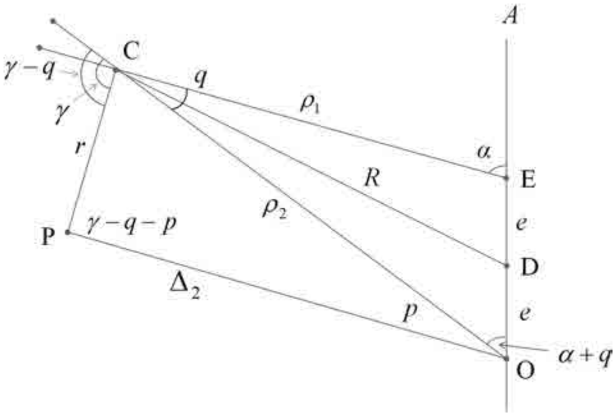

FIGURE 17.1 *The* Almagest *equant plus epicycle for an outer planet. The Earth is at* O*, the equant point is at* E*, the center of the deferent is at* D *(the midpoint of* OE*), the center of the epicycle is on the deferent at* C*, and the planet is at* P*. Calculation of the lengths* ρ_1*,* ρ_2*, and* Δ_2 *in terms of* e, r*, and the angles* α *and* γ*, and application of the law of sines to the triangles* OEC *and* OCP*, yield the equations* q *and* p.

larger 146,567,298 revolutions in 4,320,000,000 years. Furthermore, in these texts the mean longitudes of all the planets are assumed to be in conjunction at 0° on –3101 Feb 18.[5]

In the *Almagest* the single anomaly of the Sun is modeled with a simple eccentric (or equivalent epicycle). The Moon at syzygy, i.e. in opposition or conjunction to the Sun, so at full or new moon with a possibility of an eclipse, is modeled with the same simple eccentric or equivalent epicycle.[6] For the five planets that display retrograde motion, the two anomalies are accounted for with an equant plus epicycle (see Fig. 17.1). The equant model accounts for the zodiacal anomaly with the Earth positioned at an offset e from the center of the deferent, and a mirrored offset for the center of uniform motion of the epicycle around the deferent. The solar anomaly is implemented with the planet rotating counterclockwise around an epicycle of radius r. Thus, in terms of the angles and line segments shown in Fig. 17.1, the equation of center q for the zodiacal anomaly of the equant is

5 A definitive overview of the Indian planetary models is Pingree (1978).

6 Away from syzygy a second lunar anomaly is modeled with a form of the concentric equant (the Earth is at the equant point).

$$\sin q(\alpha) = \frac{-2e \sin \alpha}{\rho_2}$$

and the equation p for the solar anomaly arising from the epicycle is

$$\sin p(\gamma - q) = \frac{r \sin(\gamma - q)}{\Delta_2}$$

In the above equations the denominators are given by

$$\rho_2 = \sqrt{(\rho_1 + 2e \cos \alpha)^2 + (2e \sin \alpha)^2}$$

and

$$\Delta_2 = \sqrt{(\rho_2 + r \cos(\gamma - q))^2 + (r \sin(\gamma - q))^2}$$

where

$$\rho_1 = \sqrt{1 - (e \sin \alpha)^2} - e \cos \alpha$$

Then if $\bar{\lambda}$ is the mean longitude the true longitude is $\lambda = \bar{\lambda} + q + p$.

In the early Indian texts the anomalies of the Sun and Moon are both modeled with a concentric equant (the Earth is at the center of the deferent).[7] For the five planets the two anomalies are accounted for with the simpler equations q' and p' given by

$$\sin q' = -2e \sin \alpha$$

$$\sin p' = \frac{r \sin \gamma}{\rho}$$

where $\rho = \sqrt{(1 + r \cos \gamma)^2 + (r \sin \gamma)^2}$.

7 In some later Indian texts, dating to around 900 CE, a second anomaly of the Moon is included. Once again there is no discussion of any geometric background, but the underlying model was very likely a concentric equant with an equant point rotating on a small epicycle. This gives a second anomaly that agrees much better with modern theory than the *Almagest* second lunar anomaly does. The Indian version is also closely related, at least mathematically, to the later Arabic version of al-Shatir (1340 CE) and the identical version given by Copernicus (1540 CE). There is no direct evidence to date of any transmission of ideas from India to Syria. For details see Duke (2007).

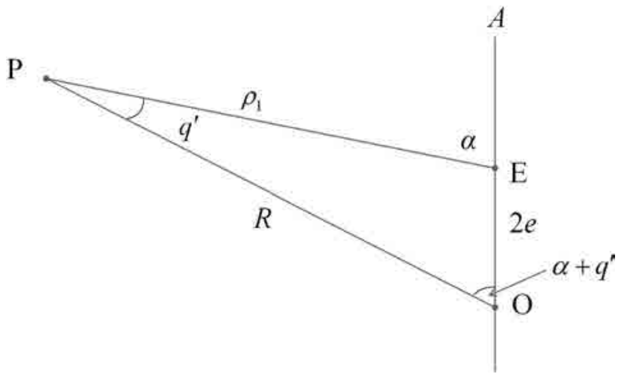

FIGURE 17.2 *The concentric equant model. The Earth and the center of the deferent are at* O, *and the equant point is at* E. *The planet is at* P.

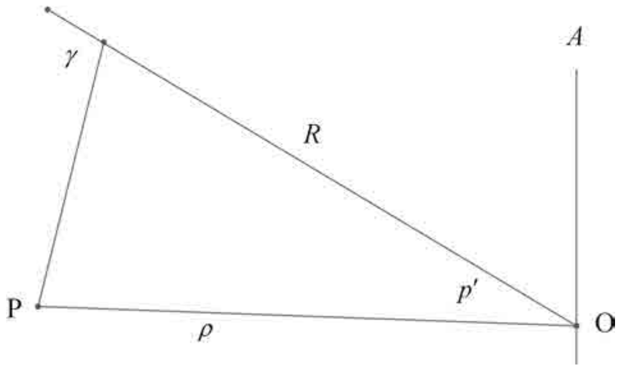

FIGURE 17.3 *The epicycle model. The Earth and the center of the deferent are at* O, *and the equant point is at* E. *The planet is at* P.

The texts do not mention any geometrical background for these terms, but they are easily recognized to follow from Fig. 17.2 and Fig. 17.3. The most intriguing aspect of the Indian models is how the two anomalies are combined to give the true longitude from the mean longitude. A typical algorithm is, with mean longitude $\bar{\lambda}$ and longitude of apogee λ_A leading to the true longitude λ in step 4:

1) with argument $\alpha = \bar{\lambda} - \lambda_A$ compute $v_1 = \bar{\lambda} + \frac{1}{2} q'(\alpha)$
2) with argument $\gamma = \lambda_S - v_1$ compute $v_2 = v_1 + \frac{1}{2} p'(\gamma)$
3) with argument $\alpha' = v_2 - \lambda_A$ compute $v_3 = v_2 + q'(\alpha')$
4) with argument $\gamma' = \lambda_S - v_3$ compute $\lambda = v_3 + p(\gamma')$

Finally, the planetary latitudes in the *Almagest* are quite complicated. For the outer planets the deferent is inclined at an angle i_0 while the epicycle is inclined at another angle i_1, the result being that the epicycle is not parallel to the ecliptic except when the epicycle is at the nodes of the deferent. For the inner planets Ptolemy makes the epicycle rotate around two axes, neither of which is fixed in space, to effectively approximate an epicycle tilted about a line of nodes in a direction fixed in space. Thus, counting a small flip-flop of the deferent, Ptolemy uses three angles of inclination for each inner planet.

In contrast, the latitude models in the Indian texts are quite simple. At the final step of the computation of longitudes the distance from the Earth to the planet is simply

$$\rho = \sqrt{(1 + r\cos\gamma')^2 + (r\sin\gamma')^2}\,.$$

and so the planet's latitude is given by

$$\sin\beta = \frac{\sin i \sin\omega}{\rho}$$

where ω is the argument of latitude, and for an outer planet i is the inclination of the deferent, the epicycle being parallel to the ecliptic, while for an inner planet i is the inclination of the epicycle, the deferent being parallel to the ecliptic.

Finally, usage of the Greek and Indian models also differs in major ways. For the equant plus epicycle model, given a sufficient set of measurements of true longitudes, the task of finding the values of the underlying mean longitudes, and the parameters e and r, is the most technically demanding application of applied mathematics in the entire *Almagest*, and using the equant for calculations of true longitudes requires either a huge two-dimensional table or a sophisticated interpolation scheme such as we find in the *Almagest*. For the Indian models, there is no known procedure other than trial-and-error for determining the mean longitudes and parameters from observed true longitudes, and in strong contrast to the *Almagest*, the calculation of true longitudes in the 4-step model requires only two simple table lookups.

In spite of the many apparent differences between the Greek equant plus epicycle and Indian 4-step planetary models, several investigations in the first decade of the 21st century suggest that the models have much more in common than previously realized by either the western or Indian scholars debating the issue in the prior centuries.[8] Thus the mean motions, the treatment of the two

8 See Duke (2005, 2009, 2014).

anomalies, the latitudes, the true daily speeds, and the planetary distances all are, regardless of appearances, closely linked to Greco-Roman astronomy. Let us examine each in turn.

Regarding the mean motions, the time periods of millions or billions of years and the supposed conjunction of all mean longitudes at sunrise on -3101 Feb 18 is in reality simply a scheme to specify mean longitudes at a date 3600 years later, which is noon on 499 March 21. This is easily seen from an example. Consider again the case of Saturn, which in the Indian texts is said to complete 146,564 revolutions in longitude in 4,320,000 years, so its speed in revolutions per year is

$$\omega = \frac{146,564}{4,320,000} = 0;2,2,8,12^{rev/yr}$$

Since the mean longitude is 0° in -3101, multiplying ω by 3600 years gives the mean longitude in 499 as

$$\bar{\lambda} = 60,60 \times 0;2,2,8,12 = 2,2;8,12^{rev}$$

which is 122 full revolutions plus an additional 0;8,12 revolutions, and so a net mean longitude of $49;12^\circ$. In addition, the Indian scheme requires that the numerator 146,564 must be divisible by four, and adding or subtracting 4 to the numerator changes the resulting mean longitude after 3600 years by $\pm 1;12^\circ$. Therefore, what the Indian scheme is telling us, and *all* that it is capable of telling us, is that at the epoch date noon on 499 Mar 21, the person (Aryabhata, in this case) who created the scheme thought that the mean longitude of Saturn was somewhere between $48;36^\circ$ and $49;48^\circ$. Furthermore, since the third and fourth digits in the sexagesimal expansion of the mean motion ω are required to deliver the assumed mean longitude, they cannot, except by accident, be the digits that would result from using a simple period relation such as

$$\omega = \frac{2}{59} = 0;2,2,2,2,\ldots^{rev/yr}$$

The result is that the Indian mean motions, in spite of the large numbers of years and revolutions involved, are inherently imprecise, and after a few decades from the epoch date 499 Mar 21 the computed mean longitudes become increasingly inaccurate. In any event, it is clear that the Indian scheme for mean motions and mean longitudes is in fact very similar to, albeit less accurate than, the Greek scheme.

There are also other similarities in ancient Greek texts to the Indian scheme for mean motions. First, there is a long tradition in Greek philosophy, starting at least with Plato, of the Great Year period, a huge expanse of time with planetary conjunctions at both the beginning and end.[9] Two explicit examples of the Great Year in Greek astronomy are known from just before and just after the turn of the millennium from BCE to CE, thus between Hipparchos and Ptolemy. The Keskintos Inscription, found on an engraved stone dating to about 100 BCE, contains planetary period relations over a common interval of 29,160 years.[10] The papyrus *P. Fouad 267A*, dating to about 130 CE, expounds a model of solar motion based on a Great Year of 37,500 years.[11] Note that $4{,}320{,}000 = 2^8 3^3 5^4$, $29{,}160 = 2^3 3^6 5$, and $37{,}500 = 2^2 3^1 5^5$ are all regular numbers (the only prime divisors are 2, 3, and 5), a property naturally required of any workable Great Year interval.

Regarding the anomalies in the planetary motions, the true longitudes computed using the Greek equant and the 4-step Indian algorithm using the same mean longitudes and parameters, agree nearly exactly for small to moderate values of e and r. One way to see this is to expand $q+p$ for the Greek equant plus epicycle model and $q'+p'$ for the Indian 4-step model in power series in e and r. It turns out that through second order, i.e. through terms of $O(e^2, r^2, er)$, the power series for $q+p$ and $q'+p'$ are identical, even though $q \neq q'$ and $p \neq p'$. Thus, for the Greek equant we have

$$q = -2e\sin\alpha + 2e^2\sin\alpha\cos\alpha + O(e^3)$$
$$p = r\sin\gamma - r^2\sin\gamma\cos\gamma - er\cos\alpha\sin\gamma + 2er\sin\alpha\cos\gamma + O(e^3, e^2r, er^2, r^3)$$

while for the Indian model we have

$$q' = -2e\sin\alpha + 2e^2\sin\alpha\cos\alpha - er\cos\alpha\sin\gamma + O(e^3, e^2r, er^2, r^3)$$
$$p' = r\sin\gamma - r^2\sin\gamma\cos\gamma + 2er\sin\alpha\cos\gamma + O(e^3, e^2r, er^2, r^3)$$

Another way to see that the Indian model very closely approximates the Greek model is to plot the resulting true longitudes over time for equal values of e, r, and mean motions. The comparison is shown in Fig. 17.4 for Jupiter, with $2e \approx 0.09$ and $r \approx 0.19$, and the approximation is so close that it is impossible

9 For a thorough study of the Great Year see de Callataÿ (1996). For a review of the Great Year in Indian literature and astronomy see González–Reimann (2002).

10 Jones (2006).

11 Tihon and Fournet (2014) and Jones (2008: 43, fn 46).

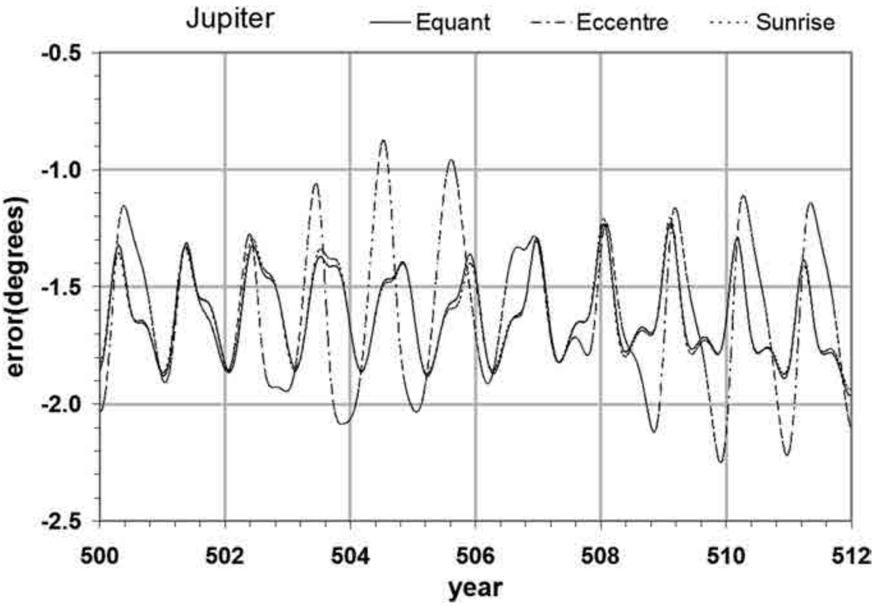

FIGURE 17.4 *The difference between the longitudes of Jupiter predicted by modern theory and those predicted by the equant model (solid line), the eccentre plus epicycle model (dot-dashed line), and the Indian (sunrise) model (dotted line), using the same* (Almagest) *parameters for all three ancient models. The equant and Indian models are very nearly coincident in the figure, while the eccentre model differs significantly from both.*

to distinguish the two curves except in a few places. For Mars, with $e \approx 0.2$ and $r \approx 0.66$, Fig. 17.5 shows that the agreement is worse because the higher order terms in r are not so small. However, in both cases the Greek eccentric plus epicycle model, which was widely supposed throughout the 19th and 20th centuries, at least by western scholars,[12] as the basis of the Indian model, differs substantially from both the equant and the Indian 4-step model.

Regarding the planetary latitudes, the simple latitude models found in the Indian texts are also found in Ptolemy's *Planetary Hypotheses*. This work, ostensibly written later than the *Almagest*, thus establishes at the very least that the simple planetary latitude models were known to Ptolemy.

An important application of the planetary models in both Greek and Indian astronomy was the computation of the time of conjunction or opposition of a pair of planets, for example the Sun and the Moon for eclipses, or Jupiter and the Sun for retrograde motion. To compute the time, the standard method

12 Neugebauer (1956: 12–24), Pingree (1971), Pingree (1976).

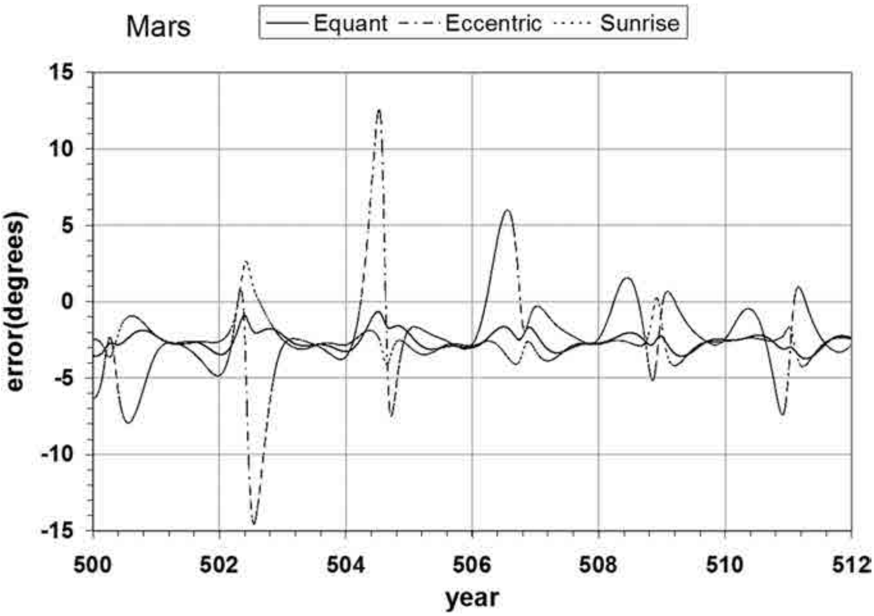

FIGURE 17.5 *As in Fig. 17.4 except for Mars. Note that for Mars the Indian model now differs noticeably from the equant, but is an even poorer match to the eccentre.*

was to begin with the (easily computed) time of conjunction of the mean longitudes, and then to determine at that moment the difference of the true longitudes. Then, if you know the true speeds of each planet, as opposed to the mean speeds, it is easy to estimate when they will be in true conjunction. To do this you need what we call the time derivative of the two anomaly terms, and it is remarkable that we find in the *Almagest* explicit estimation of these derivatives using finite difference approximations. Even more remarkable is the fact that the anomaly terms are functions of a second function, and so the computation of the derivative requires the chain-rule of differential calculus, and this is also estimated correctly by finite differences in the *Almagest*.[13] Finally, these same finite difference approximations are found in many later Indian texts such as the *Suryasiddhanta* (ca. 1250 CE), but not in the earlier *Paitamahasiddhanta* or *Aryabhatiya*. A badly garbled version might be present in the *Brahmasphutasiddhanta* (ca. 628 CE), but this is uncertain.

Finally, the distances of the planets in Indian astronomy are specified using a Greek principle dating to Plato, namely, that all planets travel in their orbits

13 Duke (2011).

at the same absolute speed. Thus the time required to complete an orbit is proportional to the circumference, and hence the radius, of that orbit. Assuming that the distance to the Moon is about 64 Earth radii, itself a number familiar from early Greek astronomy, and comparing the orbital period of the Moon with the orbital periods of each planet, gives the distance to all the planets. This scheme is not found in the *Almagest*, but it was apparently familiar to earlier Greek astronomers and ultimately used in all Indian texts.

With all of this as background, let us now consider the question posed in the chapter title: were ancient Indian planetary models strongly influenced by Greek astronomy? In particular, was the equant invented in the Greco-Roman empire or in India? And was the 4-step model invented in the Greco-Roman empire or in India?

In light of the discussion above, the suggestion that the equant was first invented in India seems, for a number of reasons, extremely unlikely. First, it is unlikely that the equant was the *first* model to explain the two anomalies of planetary motion. All plausible suggestions regarding the origin of the equant are motivated, in one way or another, by the failure of a predecessor model, for example the eccentric plus epicycle.[14] However, this 'failure' is not necessarily a strongly glaring shortcoming, but is more likely a somewhat subtle effect which requires a program of good observational evidence to even establish. Yet there is no hint in Indian texts of any model preceding the 4-step model, nor any hint that the 4-step model is in any way related to what we know as the equant, nor even any evidence that the equant exists.

Second, the development of any planetary model would definitely require a substantial number of detailed planetary observations, for example the dates and positions of oppositions with the mean Sun. Yet the position of any planet is known primarily from its relative distance to a neighboring star or the Moon, and there is no hint in any Indian text that any accurate positions of the stars and Moon (for which the second anomaly is neglected in all texts before about 900 CE), were known in India.

Third, there is no hint in any early Indian text of a sufficient analytical skill to determine the mean longitudes and internal parameters e and r using the equant model, even if it was known in India.

Therefore, the balance of the evidence strongly supports the view that the equant was invented outside India, and clearly the best alternative is in the Greco-Roman empire.

14 Several proposals have been made to explain the empirical origin of the equant. See Evans (1984), Swerdlow (2004), Jones (2004), Duke (2005).

Could the derivation of the 4-step model from the equant have been accomplished in India at some date prior to 500 CE? First, according to D.A. Somayaji, “All interpreters of Indian astronomy pronounced that [4-step] procedure as peculiar and irrational.”[15] For example, Bhaskara, writing in about 628 CE in one of the earliest commentaries on the early Indian texts, after explaining the calculation of the 4-step model, declares, “It is really curious; tradition has it; so it must be respected; accordance with observations alone is proof.” Similarly, Jnanaraja, writing in about 1503 CE in one of the final siddhantas of classical Indian astronomy, concludes his explanation of the 4-step method with the rhetorical question, “What is strange in this procedure?”[16] Thus it seems reasonable to surmise that whatever the history of the 4-step method is, it was not known to either the earliest commentators in India, or to any of the large number of later commentators. This then obviously raises the question: did anyone in India in 450–500 CE know the origin of the 4-step method?[17]

We now know with some confidence that the 4-step method was derived from the equant plus epicycle, but we cannot be sure exactly how the derivation was done. One possible method involves starting with the law of sines applied to the geometrical diagram of the equant plus epicycle and proceeding with systematic approximations. This derivation then explains the degradation of agreement with increasing e and r discussed and illustrated above. There is no evidence in Indian texts of skill in trigonometry at the required level to derive the 4-step method from the equant plus epicycle. On the contrary, various Indian texts suggest solutions to some problems using numerical iteration involving a significant amount of complicated arithmetic when a very simple geometrical derivation is an obvious alternative, provided the underlying geometry of the problem is known. This point is demonstrated explicitly in Bhaskara's *Mahabhaskariya*[18] (A.D. 629) which is a commentary on the *Aryabhatiya*[19] (A.D. 499), the primary text of Aryabhata. Bhaskara explains the

15 Somayaji (1971).

16 Knudsen (2014: 195).

17 Even among western scholars the relationship between the equant and the 4-step model has an uneven history. A direct relationship was first suggested by van der Waerden (1961), but his justification was unsystematic. Thurston (1992) focused primarily on the disagreement between the equant and the 4-step method for large r and also used an (incorrect) eccentric model for the intial q'.

18 Shukla (1960).

19 Shukla (1976).

equivalence of the concentric equant and an oscillating eccentric model by directly computing one from the other, as follows:[20]

> IV 19. Subtract (the Sine of) the final equation from (the Sine of) the *koti* or again add it, depending on the quadrant; the square-root of the sum of the square of that and the square of the *bahu* is the hypotenuse.
> IV 20. Multiply (the Sine of) the final equation by the hypotenuse (and) divide (the product) by the Radius; add (the quotient) to or subtract it from the previous *koti* (repeatedly) until the hypotenuse is equal (to the hypotenuse obtained in the immediately preceding computation).
> IV 21. Multiply the Radius by the Sine of the *bahu* (and) divide (the product) by the (final) hypotenuse. Add the arc (corresponding to that quotient) to (the longitude of) the apogee according to the quadrant of the argument.

However terse this may appear to us, it is actually rather verbose in comparison to many early Indian astronomical texts. In any event, the execution of the algorithm is as follows (see Fig. 17.6).

Let OS = DT = R and adjust point D so that DT is parallel to OS and triangles OES and ODT are similar. The mean centrum α (angles DES and FDT) and the eccentricity EO = e of the concentric equant are given. The algorithm finds OD and OT = h = 'the hypotenuse', and uses those to compute the true centrum (angle EOS). First, drop a perpendicular line from T to a point F on the apsidal line, then

Step 1. (verse 19) assume OD = e
Step 2. then OF = OD + R cos(α) and TF = R sin(α). Here R cos(α) and R sin(α) are the Sine of the koti and the Sine of the bahu, respectively.
Step 3. then $OT = \sqrt{OF^2 + TF^2} = h$
Step 4. (verse 20) by similar triangles $OT / OD = R / e$, so we have a new estimate for $OD = eh / R$.
Step 5. go to step 2 with the new estimate of *OD* and recompute *OF, TF,* and *h*. When *h* stops changing, go to step 6.
Step 6. (verse 21) compute angle $DOT = c = \arcsin\left(R \sin \alpha / h\right)$ which, added to the longitude of apogee, gives the longitude of the planet.

20 Pingree (1974).

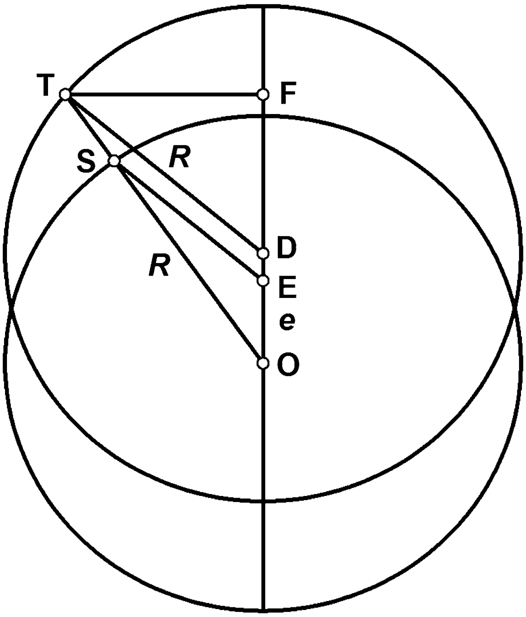

FIGURE 17.6 *The concentric equant has the Earth at* O, *the planet at* S *on a deferent of radius* R, *and the equant at* E. *The equivalent simple eccentric has an eccentric deferent also of radius* R *but centered at* D, *and the planet is now at* T. *Since* ES *and* DT *are parallel both models have the same mean centrum (angles* FDT *and* DES*), and since* OST *is a straight line, the* S *and* T *have the same position as seen from the Earth and so both models have the same true centrum (angles* EOS *and* DOT*).*

Thus the algorithm solves $h_{n+1} = \sqrt{(eh_n + R\cos\alpha)^2 + (R\sin\alpha)^2}$ by iteration beginning with $h_0 = R$ as the first trial value. The angle computed in Step 6 will, of course, be the same value you could have gotten directly from $c = \alpha + q = \alpha + \arcsin(-(e\sin\alpha)/R)$ with a much simpler calculation (dropping a perpendicular from *O* to the extension of *SE*), so it is not clear why the iterative solution was used.

A similar demonstration, solving a problem similar to Bhaskara's, comes from Brahmagupta and his *Brahmasphutasiddhanta*. Effectively, Brahmagupta wants to start with the equation for an eccentric that, given the eccentricity *e*, relates the mean centrum α to the true centrum γ,

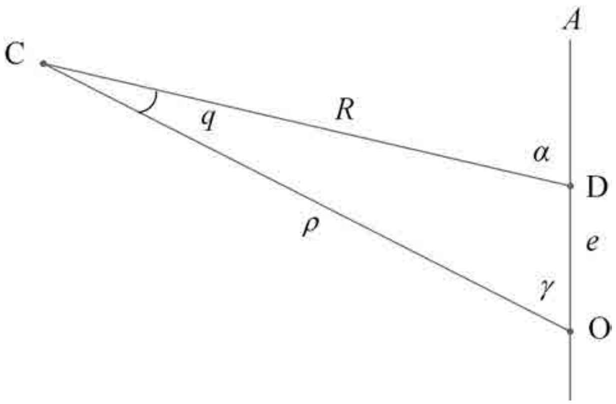

FIGURE 17.7 *The eccentric has a deferent circle of radius* R *centered at* D *with the Earth at* O *and the Sun or Moon at* C. *Assuming* $R = 1$, *the distance* $\rho = \sqrt{(e\sin\alpha)^2 + (1 + e\cos\alpha)^2}$. *By convention* $\gamma = \alpha + q$, *so in the configuration shown* $q < 0$. *Then the law of sines gives* $\frac{-\sin q}{e} = \frac{\sin\alpha}{\rho} = \frac{\sin\gamma}{R}$.

$$\alpha_{n+1} = \gamma - \sin^{-1}\left(\frac{-e\sin\alpha_n}{\sqrt{(e\sin\alpha_n)^2 + (1 + e\cos\alpha_n)^2}}\right)$$

and given e and γ, solve for α. Iteration will converge, but the arithmetic involved is enormous, while a simple answer

$$\alpha = \sin^{-1}(-e\sin\gamma)$$

is immediate if you realize that the underlying geometrical diagram for both equations is simply Fig. 17.7.

In addition, the 4-step method has a very useful practical feature that the equant plus epicycle lacks. Namely, routine calculation of planetary positions of planetary longitudes can be performed with two simple table look-ups in the 4-step method, but, as mentioned above, the same calculation using the equant is much more complicated.

Thus the balance of the evidence suggests that the 4-step model was derived from a previously established and calibrated equant plus epicycle model. The motivation for the derivation might well have been the relative simplicity of the routine calculation of true longitudes from two simple table look-ups. It is very unlikely that the 4-step model was developed independent of any knowledge of the equant, and no one has suggested a way to accomplish that task using the 4-step model, no doubt because there is no geometrical diagram that underlies the 4-step model. Altogether, then, the lack of any evidence from Indian texts for knowledge of the equant, or the geometrical basis of the equant, or the analytical skill to approximate the equant with the 4-step method, suggests that, like the equant, the 4-step method was derived outside of India, and clearly the best alternative is, once again, in the Greco-Roman empire.

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