Ziqpu-stars and Cuneiform Knowledge:
Meaning, Applications, Contexts

By

Gil Breger

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Near Eastern Studies

and the Designated Emphasis

in

Science and Technology Studies

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Francesca Rochberg, Chair
Professor Niek Veldhuis
Professor Maria Mavroudi
Professor John Steele

Summer 2022

Abstract

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This dissertation is a comprehensive study of a set of stars called *ziqpu*-stars in Babylonian astronomy. These stars were a tool devised and employed by astronomers during the first millennium BCE (or perhaps as early as the late second millennium BCE) in Mesopotamia. The culmination of the *ziqpu*-stars, or when they reach their highest point during their daily journey across the skies, was correlated with other celestial phenomena, such as a lunar eclipse or the first appearance of a star over the course of the year. In effect, these stars were used as a way to indicate or describe time of specific phenomena that were of interest to Babylonian astronomers.

The present study examines all known sources featuring the *ziqpu*-stars. It explores the different contexts in which *ziqpu*-stars were used as well as the developments that took place within this tradition. This dissertation also investigates the underlying practices that are reflected in the texts, and advocates that the primary method to producing and utilizing knowledge of the *ziqpu*-stars was by means of abstract models rather than empirical observation. Approaching the topic of *ziqpu*-stars by means of models highlights the similarities between these kinds of texts and texts that belong to the so-called mathematical or theoretical astronomy of the Late Babylonian period. It also brings the study of Babylonian astronomy closer to current discussions in the philosophy of science and reaffirms the place of Babylonian astronomy within the history of science.

Dedicated to Mollie

I could not have chosen a better partner for the journey that is life

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Acknowledgments

This dissertation represents the culmination of years of work at the University of California, Berkeley. It would not have been completed without the support of many individuals throughout the years, whether they provided it knowingly or unknowingly. No doubt I will neglect to mention some of them, but I am thankful to them nonetheless.

I am forever indebted to my advisor and mentor, Francesca Rochberg, and her continuous advice, guidance, support, advocacy, and dedication. I will always treasure the conversations we had, whether at her office or at a café, about Babylonian astronomy or the history and philosophy of science. My committee members, Niek Veldhuis, Maria Mavroudi, and John Steele, all provided indispensable insight and support in more ways that I can recount. Each contributed immensely not only to the present study but to my intellectual development as an academic as well. I am very grateful for the opportunity to have worked with all of them.

I am deeply thankful to the community at Berkeley for providing me with such a supportive and stimulating environment. Working with Laurie Pearce was a privilege and I am grateful for her advice, support, and friendship. Massimo Mazzotti broadened my scope, and appetit, for the history and sociology of science beyond the confines of Mesopotamia. My fellow students, past and present, made my experience in graduate school more rewarding than I had ever thought it could be: Terri Tanaka, Jay Crisostomo, Eduardo Escobar, Matthew Ong, Jason Moser, and Dylan Guerra. I am grateful to the departmental staff, without whom none of this would have been possible: Shorena Kurtsikidze, Deanna Kiser-Go, Rania Shah, and Sharlene Mulder.

I would also like to thank Jerry Cooper for always being willing to listen and to offer valuable advice and insight. Many thanks to my fellow denizens of the cuneiform dungeon, John Carnahan and Emmanuelle Salgues, who shared their knowledge and friendship with me, and to Adam Anderson for guiding me through the field of Digital Humanities. I am grateful to Leslie Freund, for being so welcoming and accommodating whenever I visited the Hearst Museum of Anthropology, and to Joanne Tan and Alexa Li for spending endless hours working with me on different projects related to my dissertation.

My work benefited tremendously from the Heidelberg Masterclass Keilschriftepigraphie and Forschungslabor Alter Orient. I would like to thank Stefan Maul, Betina Faist, Kai Lämmerhirt , the staff, and fellow participants for creating such an instructive and welcoming environment and for providing me with invaluable experience working with primary sources. I would also like to express my gratitude to the staff of the Middle Eastern Study Room at the British Museum for facilitating my visit, and in particular Christopher Walker, Irving Finkel, and Jon Taylor, on whose expertise I was able to draw. My visit to the British Museum was made possible with the generous support of the Stahl Endowment of the Archaeological Research Facility at the University of California, Berkeley, and the Subsidy for Cuneiform Studies by the International Association for Assyriology, as well as the sponsorship of the University of California Office of the President Multi-campus Research Programs and Initiative Funding and the University of California Humanities Research Institute.

I would be remiss not to mention my professors at Tel Aviv University and Bar-Ilan University, Ran Zadok and Jacob Klein, two giants of the field, Rafi Greenberg, Yoram Cohen, and Amir Gilan. In many ways, they have laid the foundations for the present study.

Finally, I would like to thank my family and friends, too numerous to list, for all the moral support they provided me and for enriching my life outside of academic work. In particular, I would like to thank my beloved parents, Fira and Baruch. They have always stood by my side and offered nothing but love and support. My children, Liam, Eve, and Sky, all of whom are younger than the present study, have added meaning to my life in ways only children can. Above all, I am eternally grateful to my loving wife, Mollie, without whom none of this would have happened. She has been my biggest fan, my anchor, and my sounding board, and now knows more about the *ziqpu*-stars than the vast majority of assyriologists and historians of science alike. I dedicate this study to her.

Abbreviations and Conventions

The present study follows the standard conventions for transliteration and uses the abbreviations found in the most recent volumes of The Assyriological Dictionary of the Oriental Institute of the University of Chicago, commonly known as the CAD. Additional abbreviations are listed below:

ADART	Astronomical Diaries and Related Texts from Babylon
CCP	Cuneiform Commentaries Project[1]
CDLI	Cuneiform Digital Library Initiative[2]
GKAB	The Geography of Knowledge in Assyria and Babylonia[3]
LAS	Parpola, Simo. 1970/1983. *Letters from Assyrian Scholars to the Kings Esarhaddon and Ashurbanipal*. Winona Lake, Ind: Eisenbrauns.

[1] https://ccp.yale.edu/
[2] https://cdli.ucla.edu/
[3] http://oracc.museum.upenn.edu/cams/gkab/index.html

Introduction

This dissertation is a study of a set of stars called *ziqpu*-stars in Babylonian astronomy. The term *ziqpu*-stars comes from several first millennium BCE sources from Mesopotamia that refer to certain stars by the term *ziqpu* or associate them with that term. Semantically, the meaning of the term *ziqpu* is undoubtedly related to the Akkadian verb *zaqāpu*, "to (be) erect, to stand upright." In the sources that explicitly use the term *ziqpu*, it is clear that it refers to the highest point a star can reach during its daily journey, figuratively standing upright. In modern terms this is called culmination, the moment when a star crosses the meridian. However, all stars traverse the sky in such a way that they culminate daily. Yet Babylonian astronomers singled out a number of stars to be used as *ziqpu*-stars, and it was their culmination that carried significance. The culmination of these stars was correlated to other celestial phenomena, such as heliacal risings. There are some sources that do not refer to the *ziqpu*-stars explicitly as such, but because these stars fulfill the same role and are the same stars that are referred to as *ziqpu*-stars elsewhere, it is possible to identify these cases as similar instances of *ziqpu*-stars.

It is important to note that the term star, written with the logogram MUL or MUL_2, was used in Babylonian astronomy to refer to a single star, a small group of stars, or even entire constellations. Some sources would even refer to constellations and their constituent stars as separate entities, such as in the case of MUL.APIN I ii 29-32, which counts the Scorpion and some of its constituent stars—the Chest of the Scorpion and the two stars that make up its tail—as three separate "stars."

The present study uses the term "set" of stars, rather than other terms often used such as group, category, or classification. First, the term group may create the incorrect impression that all stars belonging to one group are somewhat close to one another in the skies. While most sets of stars are located in a particular region of the sky, e.g. Stars in the Path of the Moon, this region is always expansive to such an extent that there is never a moment when all the stars of a set can be seen at the same time. Second, the terms category and classification imply a more rigid and formal definition that is hard to maintain in the face of evidence. A classification or category prescribes certain features that are shared by all its constituent members. Any entity that would share these features can and should be similarly classified. Yet that is not the case in cuneiform sources. Unlike the terms group, category or classification, the term set offers a more neutral and less strict definition, denoting a collection of stars that have an association or relationship with one another, potentially in several ways. Put another way, a set is a more inductive definition while a category or classification is a more deductive one.

Textual Corpus

The present study encompasses all sources that feature stars as *ziqpu*-stars. This includes texts that explicitly refer to the *ziqpu*-stars as such or that correlate stars with culmination, the defining characteristic of *ziqpu*-stars. It also includes sources in which it is possible to determine that the stars mentioned in them are there because they are *ziqpu*-stars. The majority of sources that make reference to the *ziqpu*-stars fall into three types of texts: the *ziqpu*-star lists, the rising time scheme texts, and the Astronomical Diaries. With the exception of MUL.APIN—which may date to the late second millennium BCE—the *ziqpu*-stars appear in first millennium BCE sources only. Most sources come from Babylonia, with only a few sources from Assyria.

Many *ziqpu*-stars appear in other sources, but in a capacity unrelated to them being *ziqpu*-stars. These kinds of sources have been excluded, since they do not relate to the concept of *ziqpu* or to the *ziqpu*-stars as a set. For example, the celestial omen series Enūma Anu Enlil contains protases with stars that are known as *ziqpu*-stars in other sources. However, there is no indication that their appearance in these omens has any relation with them being *ziqpu*-stars. Furthermore, since the focus of the present study is the *ziqpu*-stars, the three omen texts that refer to the culmination of planets have been excluded.[4]

Previous Scholarship

Early work on the *ziqpu*-stars began with the publication of AO 6478 (Thureau-Dangin 1913; Kugler 1914a), the most well-preserved *ziqpu*-star list, and the subsequent studies of this text (Kugler 1913, 77–87; 1914b, 182–92; Schaumberger 1935, 353–54). Schaumberger (1952) revisited the text along with two other *ziqpu*-star lists, VAT 16436 and VAT 16437. Shortly after, Schaumberger (1955) studied texts containing the rising time schemes, which feature the *ziqpu*-stars prominently. The

[4] LBAT 1593 refers to Jupiter approaching the *ziqpu* (Reiner 2000). See fn. 184 in Chapter 4 for a discussion of this text. LBAT 1606 is an unpublished text which refers to a planet in relation to *ziqpu*. The term *ziqpu* also appears once in a Venus omen in Enūma Anu Enlil: ¶ MUL *dele-bat ana ziq-pi iš-ta-na-qa-a*, "if Venus approaches the *ziqpu*" (K 3601 ln. 23; see also K 2346 ln. 13, ND 4362 ln. 7 and 15, and K 800 ln. 5). Reiner and Pingree (1998, 17–18) argued that this refers to Venus rising above a *ziqpu*-star on the same night, though above one of the stars found in the later *ziqpu*-star lists, not the ones found in MUL.APIN. Perhaps a more plausible explanation is that this refers to Venus approaching its highest point in the sky, i.e., the point where it is most erect, before turning back and losing altitude in subsequent days.

rising time scheme texts were studied comprehensively by Rochberg (2004a) and Steele (2017). A few other *ziqpu*-star lists received textual editions (Horowitz 1994; Horowitz and Al-Rawi 2001; Steele 2014; Fincke and Horowitz 2017; 2018), and MUL.APIN, which also features the *ziqpu*-stars, received two critical editions (Hunger and Pingree 1989; Hunger and Steele 2019). These publications mostly focused on textual editions, with the exception of Steele (2014), which studied the *ziqpu*-star lists as a whole. As noted above, many of the texts in the present study fall outside the categories of *ziqpu*-star lists or rising time scheme texts. While they have been studied individually or in relation to other texts of the same kind (e.g., the Neo-Assyrian letters), they were not incorporated into a singular, exhaustive study of the *ziqpu*-stars until now.

Aim of the Dissertation

Since the pioneering work of Epping, Kugler, and Strassmaier in the late 19th and early 20th century, our knowledge of Babylonian astronomy has progressed immensely. Owing to the large number of texts relating to the sun, the moon, and the planets, modern scholarship has mostly focused on aspects of astronomy pertaining to these celestial bodies. Investigations into the stars of Babylonian astronomy usually involved correlating them with modern identifications or the publication of textual editions. This dissertation accepts the identifications done by previous scholarship and does not attempt to offer new ones.

The aim of the present study is to improve our current understanding of Babylonian astronomy by providing a comprehensive study of the set of *ziqpu*-stars. It is the first such study to draw on all known sources of these particular stars, opening up for discussion possible developments and innovations within the millennium-long tradition of the *ziqpu*-stars. This dissertation also examines the underlying practices involved in producing and employing knowledge of the *ziqpu*-stars, particularly in regards to observation and model-making. By doing so, it will show that the previously established boundaries between different kinds of astronomies are more permeable than previous thought, and that texts belonging to seemingly different genres have similar underlying approaches.

Dissertation Overview

The present study consists of four main chapters and three appendices. Chapter 1 provides an overview of the sources of *ziqpu*-stars that forms the basis of the *ziqpu*-star tradition, in which these stars are directly linked with culmination. These are MUL.APIN, the earliest attested source for *ziqpu*-stars, the rising time schemes, sources in which *ziqpu*-stars are used to indicate specific, non-periodic moments in time, and the *ziqpu*-star lists, as well as texts that can be showed to be informed by these lists. The chapter analyzes the role of the *ziqpu*-stars in these texts and the development within this tradition.

Chapter 2 surveys the other sets of stars that are identifiable in Babylonian astronomy. These are sets that are either defined explicitly in the sources or can be inferred from their attestations. The purpose of this chapter is to contextualize the set of *ziqpu*-stars as one set among others. Because of its focus on other sets of stars, this chapter draws on textual sources and studies that are not part of the textual corpus of the dissertation itself.

Chapter 3 delves deeper into the textual attestation of the *ziqpu*-stars and investigates the underlying practices that these attestations reflect. It evaluates the role observation had in the production and usage of knowledge of the *ziqpu*-stars. The chapter shows that Babylonian astronomers were using the *ziqpu*-stars to model phenomena that were of interest to them, without the need to directly observe these stars. This investigation reveals that the tradition of the *ziqpu*-stars has more in common with the so-called mathematical astronomy of the ephemerides than has previously been recognized.

A few sources refer to the *ziqpu*-stars in ways that either expand on or are markedly different from the more common attestations discussed in Chapter 1. These so-called isolated texts are discussed in Chapter 4. Interestingly, many of these texts also place the *ziqpu*-stars in an astrological context.

Finally, the dissertation concludes with general observations on the *ziqpu*-star tradition, the implication of the present study on our understanding of Babylonian astronomy and its place in the study of the history of science, as well as directions for future research. Appendix A is a catalogue of all known *ziqpu*-star sources. Appendix B contains the text editions of some of these texts, either previously unpublished material or corrections to published texts. Appendix C provides brief explanations of the main astronomical and technical terms used in this dissertation.

Inventory of *ziqpu*-stars

As will be discussed in Chapter 1, the set of *ziqpu*-stars consists of twenty-five stars that show little variation.[5] Below is the list of the commonly attested names. The names are taken from AO 6478, the most well-preserved *ziqpu*-star list, and are

[5] See Chapter 1 for a discussion of the repertoire of *ziqpu*-stars.

supplemented with variant names or spellings found in other sources. The names are arranged according to the sequence adopted by Schaumberger (1952). Modern identification of these stars is based on the catalogue of stars by Hunger and Pingree (1999, 271–77).[6] Each name entry also includes the interval (in UŠ) to that star from the preceding star. These intervals are copied from AO 6478 and are thoroughly discussed in Chapter 1.

No.	Interval in UŠ	Modern Name	Cuneiform	Modern Identification
I	8	Yoke = ŠU.PA	ŠUDUN, ŠU.PA	α Boötis
II	9	Rear Harness	ŠUDUN.ANŠE EGIR-ti, na-dul-lum ar_2[7]	ε Boötis
III	12	Circlet = Star of Dignity	GAM-ti, kip-pat, MUL BAL.TEŠ$_2$.A	Corona Borealis
IV	15	Star from the Doublets	MUL ša$_2$ maš-a-ti	β, γ Herculis
V	5	Star from the Triplets	MUL ša$_2$ taš-ka-a-ti, MUL ša$_2$ tak-ša-a-ti	α, δ Herculis
VI	10	Single Star	MUL DELE, MUL e-du	μ / ρ Herculis
VII	10	Lady of Life = She-Goat	GAŠAN TIN, UZ$_3$	α Lyrae
VIII	20	Shoulder of the Panther	qu$_2$-ma-ri ša$_2$ UD.KA.DUH.A	β / γ Cygni
IX	10	Bright Star of Its Chest	MUL ni-bi-i ša$_2$ GABA-šu$_2$	α Cygni
X	20	Knee	kin-si	α/β Lacertae
XI	20	Heel	a-si-di	λ Andromedae
XII	10	4 Stars of the Stag	4 ša$_2$ LU.LIM, SI ša$_2$ LU.LIM	α Cassiopeia
XIII	15	Dusky Stars	um-mu-lu-ti	h, χ Persei
XIV	15	Bright Star of the Old Man	ni-bi-i ša$_2$ ŠU.GI	α/η Persei
XV	10	Naṣrapu	na-aṣ-ra-pi	b, c Persei
XVI	15	Crook	GAM$_3$, gam-lu	Aurigae
XVII	10	Hand of the Crook	KIŠIB GAM$_3$, rit-ti GAM$_3$	ρ, υ Aurigae
XVIII	30	Twins	MAŠ.TAB.BA, MAŠ.MAŠ, ma-a-šu	α Geminorum

[6] For the sake of space, the preceding determinative for star, MUL or MUL$_2$, has been omitted from the list when possible.
[7] The sign *ar*$_2$ is an abbreviation for *arkû*, "rear, behind," found extensively in late astronomical texts.

(XIX	5	The Rear Twin	MAŠ.TAB.BA EGIR-i	β Geminorum)[8]
XX	20	Crab	AL.LUL, ALLA	ε Cancri
XXI	20	2 Stars of the Head of the Lion	2 MUL^{meš} ša$_2$ SAG.DU UR.GU.LA / UR.A	ε, μ Leonis
XXII	10	4 Stars of Its Chest	4 ša$_2$ GABA-šu$_2$	α, γ, ζ, η Leonis
XXIII	20	2 Stars of Its Thigh	2 ša$_2$ GIŠ.KUN-šu$_2$	δ, ρ Leonis
XXIV	10	Single Star of Its Tail	DELE ša$_2$ KUN-šu$_2$	β Leonis
XXV	10	Frond, Eru	e$_4$-ru$_6$	γ Comae Berenices
XXVI	25	Harness	ŠUDUN.ANŠE, na-dul-lum	η, υ Boötis

[8] Schaumberger (1952) took the mention of the Rear Twin in AO 6478 as referring to a separate *ziqpu*-star. As will be discussed in Chapter 1, this is not the case, and the Rear Twin should not be taken as a *ziqpu*-star separate from the Twins, but rather one of its constituents. However, in order to remain consistent with previous scholarship, it is listed here on its own.

Chapter 1: The Set of *ziqpu*-stars

Introduction

Among all sets of stars in Babylonian astronomy, the *ziqpu*-stars are arguably the set of stars found across the most diverse kinds of sources, including star lists, the Astronomical Diaries and related texts, rising time schemes, letters, and natal omens. This chapter surveys the main attestations of *ziqpu*-stars and addresses their application, development, and purpose.

Attested in numerous first millennium BCE sources, the earliest source of the *ziqpu*-stars is the astronomical compendium MUL.APIN. Its earliest datable source is source HH (VAT 9412+11279), dated based on a colophon from the eponym year of Sennacherib (687 BCE), though this source does not preserve any lines pertaining to the *ziqpu*-stars. However, MUL.APIN was a very stable composition and reached its final form, including the sections on the *ziqpu*-stars, most likely in the early first or late second millennium BCE (Hunger and Steele 2019, 16–19). The latest datable source using the *ziqpu*-stars is BM 33562A, an Excerpt recording the lunar eclipse of 80 BCE, making the *ziqpu*-stars a long-lived tradition within Babylonian astronomy. Not only that, but it was productive in the sense that new applications of the *ziqpu*-stars were devised over its millennium-long existence.[9]

Ziqpu-stars in MUL.APIN

Already in their earliest attestation, in MUL.APIN, the *ziqpu*-stars are a distinct, coherent set. Interestingly, it is also MUL.APIN that defines and describes them in most detail, dedicating two consecutive sections to the *ziqpu*-stars.[10] The first section contains an introductory statement (MUL.APIN I iv 1-3), an enumeration of fourteen constituent stars (MUL.APIN I iv 4-6), and a concluding statement that largely repeats the introductory one (MUL.APIN I iv 7-9):[11]

---

[9] See in particular Chapter 4.

[10] Sources for MUL.APIN use a single horizontal ruling to demarcate different units of text. Several consecutive units can be often grouped together to form larger units of text that focus on a specific topic. Hunger and Steele (2019, 3–4) refer to these larger units of text as sections while their constituent units are called subsections.

[11] The first section on the *ziqpu*-stars is immediately preceded by a short section that contains two statements describing the apparent behavior of the stars, namely that they progress 1 UŠ each day:

DIŠ MUL^{meš} ša$_2$ ziq-pi ša$_2$ ina KASKAL šu-ut ^{d}en-lil$_2$ ina MURUB$_4$ AN-e ina IGI-et GABA ša$_2$ ŠEŠ AN-e GUB^{meš}-ma GI$_6$ KUR u ŠU$_2$-bi ša$_2$ MUL^{meš} ina lib$_3$-bi-šu$_2$-nu im-ma-ru

----

DIŠ ^{mul}ŠU.PA MUL BAL.TEŠ$_2$.A ^{mul}DINGIR.GUB.BA^{meš} ^{mul}UR.KU ^{mul}UZ$_3$ ^{mul}UD.KA.DUH.A ^{mul}lu-lim ^{mul}ŠU.GI ^{mul}GAM$_3$ ^{mul}MAŠ.TAB.BA.GAL.GAL ^{mul}AL.LUL ^{mul}UR.GU.LA ^{mul}e$_4$-ru$_6$ u ^{mul}ḫe$_2$-gal$_2$-la-a-a

----

PAP an-nu-tu MUL^{meš} ša$_2$ ziq-pi ša$_2$ KASKAL šu-ut ^{d}en-lil$_2$ ša$_2$ ina MURUB$_4$ AN-e ina IGI-et GABA-ka GUB^{meš}-zu-ma GI$_6$ SAR^{meš} u ŠU$_2^{meš}$ ša$_2$ MUL^{meš} ina lib$_3$-bi-šu$_2$-nu tam-ma-ru

¶ The *ziqpu*-stars that stand in the Path of Enlil, in the middle of the sky, opposite the chest of the observer of the sky, by means of which he observes at night the rising and setting of the stars.

¶ ŠU.PA, the Star of Dignity, the Standing Gods, the Dog, the Goat, the Panther, the Stag, the Old Man, the Crook, the Great Twins, the Crab, the Lion, Eru, and the Abundant One.

----

u$_4$-mu 1 UŠ$^{ta.am_3}$ MUL^{meš} ina šer$_3$-ti ana GE$_6$ KU$_4^{meš}$-ni
u$_4$-mu 1 UŠ$^{ta.am_3}$ MUL^{meš} ina li-la-a-ti ana u$_4$-me E$_3^{meš}$-ni

The stars enter into the night in the morning 1 UŠ each day.
The stars come out into the day in the evening 1 UŠ each day.
(MUL.APIN I iii 49-50; after Hunger and Steele 2019)

Hunger and Steele (2019, 186–187) take these two lines as statements facilitating the presentation of the *ziqpu*-stars that follow since this is the only place in MUL.APIN that uses UŠ as a celestial measurement, a unit that was frequently utilized by later sources in regards to the *ziqpu*-stars. Therefore, Hunger and Steele (2019, 4) include these lines as part of the first section on *ziqpu*-stars. Support for this idea can be found in BM 38369+, a Neo-Babylonian *ziqpu*-star list that includes similar statements, albeit after the list itself, not before it:

u$_4$-mu 1 UŠ$^{ta.am_3}$ MUL[^{meš} i-na šer-ti] a-na GE$_6$ KU$_4$[^{meš}-ni]

----

u$_4$-mu 1 UŠ$^{ta.am_3}$ MUL[^{meš}] i-na li-la-a-ti a-na [u$_4$-mu È^{meš}-ni]

The stars enter into the night in the morning 1 UŠ each day.

The stars come out into the day in the evening 1 UŠ each day.
(BM 38369+ ii’ 25-28; after Horowitz 1994)

All these are the *ziqpu*-stars of the Path of Enlil, that stand in the middle of the sky, opposite your chest, and by means of which you observe at night the risings and settings of the stars.
(MUL.APIN I iv 1-9; Hunger and Steele 2019)

The structure of this section is remarkably similar to the section in MUL.APIN concerning the Stars in the Path of the Moon (MUL.APIN I iv 31-39), which immediately follows the sections on the *ziqpu*-stars.[12] Much like with the Stars in the Path of the Moon, the concluding statement largely repeats the introductory statement but adds PAP *annûtu*, "all these," at its beginning.[13] However, unlike the Stars in the Path of the Moon, the concluding statement of the *ziqpu*-stars addresses the reader directly, using second person language instead of the introduction's third person language. This kind of second person language is commonly found in procedural texts or texts that provide instructions (Ossendrijver 2012, 15–16; Watson and Horowitz 2011, 169–70). The shift to directly addressing the reader was most likely influenced by the second section on the *ziqpu*-stars that immediately follows, as that section also addresses the reader directly.[14]

The second section of MUL.APIN devoted to the *ziqpu*-stars (MUL.APIN I iv 10-30) is divided into thirteen subsections or entries. Each of these entries provides a date, a star that stands in the middle of the sky (*ina* $MURUB_4$ AN-*e*), and another star that is said to rise. The dates given in this section match the dates of heliacal risings found earlier in MUL.APIN (I ii 36 - iii 12), so this section must be referring to heliacal risings as well. Continuing the use of second person language, each entry states that a given (*ziqpu*-)star would be "opposite your chest" (*ina* IGI-*et* GABA-*ka*). With the exception of the first entry, each entry begins with the DIŠ sign. For example, the second entry gives the date on which the constellation called the Stars rises while the Chest of the Panther stands in the middle of the sky:

DIŠ ina $^{iti}GU_4$ UD 1 KAM GABA $ša_2$ ^{mul}UD.KA.DUH.A ina $MURUB_4$ AN-e IGI-et GABA-ka GUB-ma MUL.MUL KUR-ha

¶ On the 1st day of Month II, the Chest of the Panther stands in the middle of the sky, opposite your chest, and the Stars rise.

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[12] See the discussion on the Stars in the Path of the Moon in Chapter 2.
[13] Note that the DIŠ sign that opens the introductory statement here (MUL.APIN I iv 1) is not found in the introductory statement in the Stars in the Path of the Moon. This DIŠ sign is absent from both closing statements. It is possible that the DIŠ sign of the introductory subsection here marks it as the beginning of the section on *ziqpu*, bracketing all three subsections. The second DIŠ sign would then mark the beginning of the enumeration.
[14] Note that source X of MUL.APIN (BM 32626) does not change to the second person, retaining the wording "the chest of the observer of the sky:" [... *t*]*i* $ša_2$ EN.NUN AN-*e* GU[B …] (BM 32626 iii 4').

(MUL.APIN I iv 15-16; Hunger and Steele 2019)

The first entry, however, omits the DIŠ sign and instead includes additional information.[15] In particular, it provides directions on how the reader must orient themselves, with west to their right, east to their left, facing south:

> BE-ma zi-iq-pa a-na a-ma-ri-ka ina ^{iti}BAR$_2$ UD 20 KAM ina šer$_3$-ti la-am ^{d}UTU KUR-ha GUB-ma ZAG-ka ^{im}MAR.TU GUB$_3$-ka ^{im}KUR.RA ni-iš IGI-ka ^{im}U$_{18}$.LU qu$_2$-ma-ru ša$_2$ ^{mul}UD.KA.DUH.A ina MURUB$_4$ AN-e ina IGI-et GABA-ka GUB-ma ^{mul}GAM$_3$ KUR-ha
>
> If you are to observe the *ziqpu*, on the 20th day of Month I, you stand in the morning before sunrise, your right to the west, your left to the east, your face directed towards the south; the Shoulder of the Panther stands in the middle of the sky, opposite your chest, and the Crook rises.
> (MUL.APIN I iv 10-14; Hunger and Steele 2019)

This evokes a sense of observational reality, but does not necessarily mean it, in particular due to its reliance on the schematic calendar.[16] The following table lists the dates and the stars mentioned in this section of MUL.APIN:

Date	*ziqpu*-star	Heliacally rising star
I 20	Shoulder of the Panther	Crook
II 1	Chest of the Panther	Stars
II 20	Knee of the Panther	Jaw of the Bull
III 10	Heel of the Panther	True Shepherd of Anu
IV 15	Dusky Stars (var. Bright Star) of the Old Man	Arrow
V 15 (var. 5)	Bright Star (var. Dusky Stars) of the Old Man	Bow
VI 15	Great Twins	ŠU.PA and Eridu
VII 15	Lion	Scales
VIII 15	Eru	Goat
IX 15	ŠU.PA	Panther

[15] The DIŠ signs that begin the second through twelve entries possibly refer back to the additional information found in the first section, obviating the writing of an otherwise redundant yet quite long phrase.

[16] See Chapter 3 for a discussion of the issue of observation, particularly in the context of the *ziqpu*-stars in MUL.APIN.

X 15	Standing Gods	Swallow
XI 15 (error for 5)	Dog	Field
XII 15	Goat	Fish

The stars featured in the second section are a subset of the stars found in the first section. ŠU.PA, the Standing Gods, the Dog, the Goat, the Panther, the Old Man, the Great Twins, the Lion, and Eru appear in both. Moreover, the Panther and the Old Man are broken down into smaller constituent parts, four for the Panther (the Shoulder, the Chest, the Knee, and the Heel) and two for the Old Man (the Dusky Stars and the Bright Star), all known from later sources of *ziqpu*-stars. Both the Panther and the Old Man are relatively large constellations. Since this section provides the dates of heliacally rising stars, it makes sense to use their constituent stars in order to avoid using the same (larger) constellations on distinctly different dates. The Star of Dignity, the Stag, the Crook, the Crab, and the Abundant One found in the first section are absent from the second. Hunger and Pingree (1999, 70) claim that the original aim here was to provide a culminating star for the 15th of each month, but for an unknown reason some of these dates were modified.[17] If this assumption is correct, it would explain the exclusion of these five constellations from the second section, since they would not fit the scheme of culminating at the appropriate date and time, namely, before sunrise on the 15th of a certain month.[18]

The two sections in MUL.APIN define the *ziqpu*-stars in slightly different terms. While both describe the *ziqpu*-stars as standing in the middle of the sky, the first section states that they stand in the Path of Enlil and the second section associates each of them with a heliacally rising star on a given date. Early interpretation of the term MURUB_4 AN-*e*, "middle of the sky," understood this as referring to the zenith and therefore the *ziqpu*-stars as zenith-stars, i.e., stars that pass through the zenith (Bezold, Kopff, and Boll 1913, 6). However, this interpretation was already critiqued by Kugler (1914b, 183) and again by Schaumberger (1952, 218), particularly after demonstrating how some of these stars, based on modern identifications, do not pass through the zenith at the expected terrestrial latitudes where they would have been potentially observed. The first critical edition of MUL.APIN departed from using the precise definition of zenith, noting that these stars cross the meridian, though also above the head of the observer (Hunger and Pingree 1989, 141). The most recent edition of the

[17] The reason to include the rising of the Stars on II 1 is without a doubt due to the constellation's pivotal role in determining intercalation. For a discussion of the major errors in this list, see Hunger and Pingree (1999, 70).

[18] The heliacal rising stars in MUL.APIN largely correlate with the ones found in the Late Babylonian rising time schemes. For a discussion of this, see Hunger and Steele (2019, 194). See below for the possibility that these correlations governed the selection criteria for the repertoire of *ziqpu*-stars in MUL.APIN.

text takes a stronger stance, rightfully pointing out that interpreting the middle of the sky as the zenith would contradict the instructions given as to how an observer should orient themselves (Hunger and Steele 2019, 187–88). Indeed, there is no evidence in the cuneiform record suggesting that the zenith was even conceptualized in any concrete manner. Instead, Kugler (1914b, 183) took the term "middle of the sky" as the meridian, although it is more likely that it refers to a band of the sky running along the meridian, analogous to the zodiacal band and the ecliptic. Like the ecliptic, the great circle of the meridian is first found in Greek sources and is unattested in Babylonian astronomy. The uncertainty in defining the middle of the sky is further exacerbated by the fact that it is unknown how the measurements that undergird the descriptions in MUL.APIN (as well as in other sources of Babylonian astronomy, e.g., the Diaries) were made.[19]

Another way that the first section defines the *ziqpu*-stars is by stating that they stand in the Path of Enlil, corresponding to declination of 17° and northward based on modern identification.[20] This statement is reiterated in STT 2, 340, a Neo-Assyrian list of blessing formulae from Huzirina, and BM 38369+, a Neo-Babylonian *ziqpu*-star list from Babylon:

> 12 KI.MIN 12 DANNA MUL^{meš} ⸢ziq⸣-pi ša$_2$ KASKAL šu-ut ^{d}EN.LIL
>
> 12, ditto. Twelve (are) the bēru of the *ziqpu*-stars of the Path of Enlil…
> (STT 2, 340, obv. 12; after edition in GKAB)[21]
>
> [PA]P$^{?}$ 12 DANNA kip-pat zi-[iq-pi] bi-rit MUL^{meš} ša KASKAL šu-ut ^{d}[en-lil$_2$]
> [A tota]l$^{?}$ of 12 *bēru* of the circuit of *ziqpu*(-stars) amidst the stars of the Path of [Enlil].
> (BM 38369+ ii' 20-21; after Horowitz 1994)

---

[19] It is interesting to note that the term *ziqpu*, which becomes the name for this set of stars, is rarely used in MUL.APIN, appearing only three times. The first two are found in the introduction and conclusion of the first section as a qualifier for these stars (MUL^{meš} *ša$_2$ ziqpi*, "the stars of *ziqpu*"). The third time is found in the second section, where it is the object to be observed in the first entry (BE-*ma ziqpa ana amārika*, "if you are to observe the *ziqpu*"). In fact, the stars mentioned there are only qualified as *ziqpu*-stars implicitly, since they are listed in the first section on the *ziqpu*, and are said to be located in the middle of the sky, a characteristic similarly attributed to the *ziqpu*-stars in the first section. Indeed, when MUL.APIN mentions these stars, it does so in the context of them standing in the middle of the sky using the logogram GUB, Akk. *izuzzu*, "to stand, be present." If the middle of the sky does refer to the meridian, then it would mean these stars are culminating.

[20] See the discussion on the Stars in the Path of Enlil, Anu, and Ea in Chapter 2.

[21] http://oracc.org/cams/gkab/P338655. See Chapter 4 for a discussion of this text, including the issue of the inclusion of *ziqpu*-stars in a list of blessings, and whether the text does, in fact, mention the *ziqpu*-stars.

Moreover, a nearly identical introduction to the one found in the first section on *ziqpu*-stars in MUL.APIN appears in AO 6478, a Late Babylonian text containing the most preserved and expansive list of *ziqpu*-stars, published originally by Thureau-Dangin (1913). Since the initial DIŠ was used in MUL.APIN to mark a new section of the composition, AO 6478 omits it. Instead, AO 6478 begins the introduction with the term *birīt*, "(intervals) between," reflecting the fact that the list includes (three types of) intervals between *ziqpu*-stars:

> bi-rit MUL^{meš} <ša$_2$> ziq-pi ša$_2$ i-na KASKAL šu$_2$-ut ^{d}en-lil$_2$ i-na MURUB$_4$ [ina] IGI-et GABA ša$_2$ ŠEŠ-ir AN-e GUB^{meš}-zu-ma GE$_6$ MU$_2$-hi u$_3$ [ŠU$_2$-bi] ša MUL^{meš} i-na lib$_3$-bi-šu$_2$-nu [im-ma-ru]
>
> The intervals between the *ziqpu*-stars that stand in the Path of Enlil in the middle of [sky] opposite the chest of the observer of the sky, and by means of which [he observes] the rising and [setting] of the stars at night.
> (AO 6478, obv. 2'-4'; translation mine)[22]

Although AO 6478 is a Late Babylonian text, it duplicates parts of K 9794, a Neo-Assyrian fragment from Nineveh. While K 9794 does not preserve an introduction, due to the similarities between the two texts, it is possible that K 9794 also contained such an introductory paragraph. It is worth noting that these sources, STT 2, 340, BM 38369+, and AO 6478/K 9794 refer to the *ziqpu*-stars in a quantitative fashion that is not found in MUL.APIN. Both STT 2, 340 and BM 38369+ explicitly describe the *ziqpu*-stars as amounting to 12 *bēru*, with the latter also providing intervals between individual stars, as does AO 6478, whose summation line amounts to 364 UŠ, or 12 *bēru* and 4 UŠ.[23] This quantitative approach to the *ziqpu*-stars is a departure from MUL.APIN's qualitative description and will be discussed below.

Lastly, the second section on the *ziqpu*-stars in MUL.APIN describes them in relation to heliacally rising stars on particular dates. As previously mentioned, the dates and names of heliacally rising stars are drawn from the list of heliacal risings in MUL.APIN I ii 36 - iii 12. The first section on the *ziqpu*-stars indeed states that by means of the *ziqpu*-stars one could observe the rising and setting of the stars (MUL.APIN I iv 1-3 and 7-9). While there is no further reference to setting stars in both sections on the *ziqpu*-stars in MUL.APIN, there is a list of simultaneous rising and

[22] Restoration based on MUL.APIN. While the conjugated verb is not preserved, a restoration to the third person conjugation is virtually certain, since the text refers to "the chest of the observer of the sky" rather than "your chest."
[23] The unusual value of 364 UŠ in the summation line in AO 6478 is discussed below.

setting stars earlier in the text (MUL.APIN I iii 13-33).[24] With the exception of the Crook and the Swallow, each rising star mentioned in the second section on the *ziqpu*-stars has at least one corresponding setting star in the section on simultaneous risings and settings:

Date[25]	Rising star[26]	Culminating star[27]	Setting star
I 20	Crook	Shoulder of the Panther	-
II 1	Stars	Chest of the Panther	Scorpion
II 20	Jaw of the Bull[28]	Knee of the Panther	ŠU.PA
III 10	True Shepherd of Anu	Heel of the Panther	Pabilsag
IV 15	Arrow (Snake, Lion)	Dusky Stars (var. Bright Star) of the Old Man	Great One, Eagle
V 15 (var. 5)	Bow (King)	Bright Star (var. Dusky Stars) of the Old Man	Goat
VI 15	ŠU.PA and Eridu	Great Twins	Panther (for Eridu), Field (for ŠU.PA)
VII 15	Scales (Wild Dog, Mouse)	Lion	Hired Man
VIII 15	Goat (Chest of the Scorpion)	Eru	Old Man, True Shepherd of Anu
IX 15	Panther (Eagle)	ŠU.PA	Great Twins, Small Twins
X 15	Swallow	Standing Gods	-
XI 15 (error	Field (Great One, Stag)	Dog	Lion, Snake, Mouse

[24] Note, however, the lack of complete agreement between the section on heliacal rising and the section on simultaneous rising and setting (Hunger and Steele 2019, 184). For the influence of MUL.APIN on Late Babylonian astronomy, see most recently Steele (2020b).
[25] For a discussion on the variation within the sources of MUL.APIN on the section on heliacal risings (I ii 36 - iii 12), see Hunger and Steele (2019, 179–82).
[26] Stars mentioned in parentheses appear in the simultaneous rising and setting section, but not as heliacally rising stars in the second section on the *ziqpu*-stars.
[27] The second section on the *ziqpu*-stars does not mention the Dog or the Standing Gods as heliacally rising stars, and have therefore been excluded from this list. The section on simultaneous risings and settings, however, does include these stars with the following correlations: the Scorpion and the Dog rise as Eridu and the Stars set; Pabilsag, Zababa, and the Standing Gods rise as the Arrow, Bow, and Crook set.
[28] The name of the heliacally rising star in the second section on the *ziqpu*-stars is the Jaw of the Bull, while the name used in the section on simultaneous risings and settings is the Bull of Heaven. This suggests that in this context they refer to the same star. For a discussion on this matter, see Hunger and Steele (2019, 169–70).

for 5)			
XII 15	Fish (Old Man)	Goat	Furrow, Wild Dog

Whether the implicit connection that can be drawn between the two different sections of MUL.APIN was the intent of the original editors is unknown. Hunger and Steele (2019, 4) remark that MUL.APIN is arranged in such a way that later sections mostly build upon and utilize earlier sections. The appearance of the simultaneous risings and settings before the section on *ziqpu*-stars does not contradict this proposed structure of MUL.APIN, but reversing the order of the sections would fit this structure as well.

Based on the connection to heliacal risings in both sections in MUL.APIN, it is possible that the main purpose of the *ziqpu*-stars within the context of MUL.APIN was to determine whether heliacal risings took place at the correct dates according to the schematic calendar. While the second section on the *ziqpu*-stars may be perceived as instructions on locating the *ziqpu*-stars in the sky, this section in fact uses the *ziqpu*-stars to identify stars that should be heliacally rising at the appropriate dates. Stars that are close to the horizon could be harder to spot due to a variety of conditions such as atmospheric refraction or visibility obstructions. The format of each of the entries in this section suggests that the focus is placed on the heliacal rising star: on date x, when *ziqpu*-star SN_1 crosses the meridian then star SN_2 should heliacally rise. If this event did not take place, i.e., on that date the expected star did not heliacally rise, this would be suggestive that intercalation may be required. Not only is this much more in line with the general calendrical theme of MUL.APIN, but in particular the first half of the composition, which seems to deal exclusively with heliacal risings and calendrics, with the exception of the catalogues of the stars in the Path of Enlil, Anu, and Ea. This would also explain why the *ziqpu*-stars are already a coherent set from their earliest attestation in MUL.APIN. Their conceptualization as a set was concretized in MUL.APIN as a means to help determine the need for intercalation based on heliacal risings at particular dates. The correlation of *ziqpu*-stars and heliacal rising stars is related to the rising time schemes later developed in the Late Babylonian period, albeit MUL.APIN has a qualitative approach while the rising time schemes do so in a more quantitative fashion (Hunger and Steele 2019, 192–94).

Ziqpu-stars in Rising Time Schemes

The rising time schemes have been treated recently and extensively by Steele (2017) and thus will not be fully explored here, but it is worthwhile to briefly summarize them and present the role the *ziqpu*-stars play in them.

The ecliptic describes the annual path of the sun in the sky. The day begins with the sun rising above the eastern horizon and setting below the western horizon. Because the ecliptic is a great circle, on any given day, half of it (or 180°) would rise over the course of a day. The amount of time required by a span of the ecliptic to rise, however, varies and depends on its location along the ecliptic. This is due to the oblique angle between the ecliptic and the celestial equator, caused by the tilt of Earth's rotational axis in relation to its orbit around the sun. Consequently, arcs on the ecliptic correspond to different lengths of arc on the celestial equator. Since arcs of similar lengths on the celestial equator always rise at the same rate, understanding the correlation between arcs on both great circles would allow to determine the length of time any given arc of the ecliptic would take to rise.[29] This issue, known as oblique ascension, has been a primary concern in Greek astronomy (Neugebauer 1975, 34). Babylonian astronomers devised the rising time schemes to address this issue, which served as an arithmetical solution, predating the Greek geometric approach to the problem.

There are two kinds of rising time schemes, those based on the schematic calendar and those based on the zodiac.[30] The calendar-based rising time schemes correlate the culmination of a *ziqpu*-star (or a point after one) with the rising and setting of the sun on specific days.[31] Thus, the culminating point is a function of the date.[32] Three texts, BM 34639, BM 38704, and W 22281a, give the culminating points on the 15th day of every month.

> ina ^{iti}GAN UD 15 ^{d}UTU ⸢ina UGU⸣ 10 ⸢UŠ ar$_2$⸣ [^{mul_2}kin-ṣi ŠU$_2$-ma] ina UGU ½ DANNA ar$_2$ ⸢^{mul_2}e$_4$-ru$_6$⸣ [KUR]

[29] This is also dependent on the geographical latitude in question.

[30] The zodiac itself is also schematic and is intrinsically tied to the 360-day schematic calendar.

[31] Note that the term "rising times" comes from the Greek term *anaphora*, and refers to the time it takes for arcs of the zodiac to rise. Therefore, in the stricter meaning of the term, the calendar-based scheme is not a rising time scheme. Yet the similarities between the Babylonian calendar-based and zodiac-based schemes, as well as the correlation between the schematic calendar and the zodiac, suggests that these two kinds of schemes were closely related from a Babylonian perspective.

[32] In other words, f(x) = y, where the independent variable x is the date and the resultant y is the culminating point.

Month IX, day 15, the sun [sets] at the culmination of 10 UŠ behind [the Knee and rises] at the culmination of ½ DANNA behind the Frond.
(BM 34639, obv. ii 9’-10’; after Steele 2017)

W 22281a also includes the names of additional stars that are said to be “in balance” (Akk. *šitqulu*), which seems to mean stars that culminate at the same time (Steele 2017, 31):

DIŠ ina ^{iti}ŠU UD 15 KAM KI KUR ša$_2$ ^{d}UTU SI ^{mul}LU.LIM ^{mul}a-ni-ni-tum u MURUB$_4$ ^{mul}KU$_6$ šit-qu-lu ina ^{iti}AB UD 15 KAM ina li-la-a-ti KI ŠU$_2$ ša$_2$ ^{d}UTU ŠU.BI.AŠ.AM$_3$

Month IV, day 15, with the rising of the sun, the Horn of the Stag, Anunitum, and the middle of the Fish are in balance. Month X, day 15, in the evening with the setting of the sun, it is the same.
(W 22281a, ln. 7’-8’; Steele 2017)

Unsurprisingly and due to the schematic nature of these texts, the same stars that are said to culminate at sunrise on Month *n* are said to culminate at sunset on Month *n*+6.

In addition to the three texts with the month-based scheme, A 3414+ lists the culminating point at sunrise and sunset on every day of the schematic year. Although extremely fragmentary, Steele (2017, 33–43) was able to restore it in its entirety due to its highly repetitive and schematic nature, as is demonstrated by the following excerpted lines:

⸢GU$_4$⸣ 1 ina muh-hi 7,20 ⸢ar$_2$⸣	[ŠU$_2$-ma ina muh-hi 10,40 ar$_2$	KUR]
…		
8 ina muh-hi 6,40 ar$_2$	ŠU$_2$-ma ina muh-hi ⸢5⸣,20 ar$_2$	⸢KUR⸣
9 ina muh-hi 8 ar$_2$	ŠU$_2$-ma ina muh-hi ⸢6⸣ ar$_2$	KUR
10 ina muh-hi 9,20 ar$_2$	ŠU$_2$-ma ina muh-hi 6,40 ar$_2$ SA$_4$ ša$_2$ ⸢GABA⸣-šu$_2$	KUR
11 ina muh-hi 10,40 ar$_2$	ŠU$_2$-ma ina muh-hi 7,20 ar$_2$	KUR

Month II, 1, at the culmination of 7;20 (UŠ) after (ditto) (the sun) [sets and at the culmination of 10;40 (UŠ) after (ditto) (the sun) rises.]
…
8, at the culmination of 6;40 (UŠ) after (ditto) (the sun) sets and at the culmination of 5;20 (UŠ) after (ditto) (the sun) rises.
9, at the culmination of 8 (UŠ) after (ditto) (the sun) sets and at the culmination of 6 (UŠ) after (ditto) (the sun) rises.

10, at the culmination of 9;20 (UŠ) after (ditto) (the sun) sets and at the culmination of 6;40 (UŠ) after the Bright Star of Its (= the Panther's) Chest (the sun) rises.
11, at the culmination of 10;40 (UŠ) after (ditto) (the sun) sets and at the culmination of 7;20 (UŠ) after (ditto) (the sun) rises.
(A 3414+, rev. ii 47 and 54-57; after Steele 2017)

The second type of rising time scheme is tied to the zodiac. The majority of these texts correlate a culminating point with the rising of the end of a microzodiacal sign on the eastern horizon. The microzodiac is the division of each zodiacal sign into twelve 2.5° portions, Akk. *zittu*, often written with the signs HA.LA, and known in Greek astronomy as *dodecatemoria*. These microzodiacal signs can be referred to by a number (e.g., 3-*tu*$_2$ HA.LA *ša*$_2$ ^{mul_2}MAŠ, "3rd portion of Gemini") or by one of the names of the zodiacal signs themselves.[33] Thus, the culminating point is a function of the point on the zodiac rising.[34] Five such texts (A 3427, BM 32276, BM 34664, BM 34713, and U 195) provide additional correlations, such as a month name, one of the three watches of the day corresponding with the 28th, 29th, and 30th day, and a name of a star that is said to expel a flare (Akk. *meš-hu im-šuh* ZI),[35] drawn from the list of stars found in texts from the Three Stars Each tradition. These texts also provide a summary statement on the culminating point for the beginning and end of each zodiacal sign and the distance in UŠ and NINDA for that sign and its constituent microzodiacal signs (Steele 2017, 48). The entries in these detailed microzodiacal texts follow a rigid format (Steele 2017, 55):

1 UŠ 40 NINDA ar$_2$ ^{mul_2}qu$_2$-mar ša$_2$ ^{mul_2}UD.KA.DUH ana ziq-pi DU-ma šamaš KI.MIN 7-tu$_2$ HA.LA ša$_2$ ^{mul_2}LU ^{mul_2}RIN$_2$ ša$_2$ ^{mul_2}LU DU$_6$ KUR ina DU$_6$ ina še-rim UD 28 ^{mul_2}NIN.MAH meš-hu im-šuh ZI

1 UŠ 40 NINDA after the Shoulder of the Panther culminates and the sun ditto (at) the 7th portion of Aries (which is) Libra of Aries (and corresponds to)

[33] The pattern of the names of the microzodiacal signs is dependent on the relevant zodiacal signs. The first microzodiacal sign of any zodiacal sign is called by the name of that zodiacal sign. For example, the first microzodiacal sign of Aries is called Aries of Aries, the first microzodiacal sign of Taurus is Taurus of Taurus. All subsequent microzodiacal sign names follow the standard order of sign names. For example, for the zodiacal sign Aries, the first microzodiacal sign is Aries of Aries, the second is Taurus of Aries, the third is Gemini of Aries, and so on.
[34] Much like the case with the calendar-based scheme, here f(x) = y, where independent variable x is the point of the zodiac that is rising (most often the end of a microzodiacal sign) and y is the resultant culminating point.
[35] For interpreting the ZI sign as part of this expression see Steele (2017, 53–54).

Month VII rises. In Month VII, in the morning (which corresponds to) the 28th day, Ninmah expels a flare.
(BM 34713 rev. 15-17; after Steele 2017)

Three other microzodiacal texts offer simplified versions of the scheme, omitting all the additional information and only including the corresponding culminating point for the microzodiacal signs. These are BM 35456, BM 46167, and BM 77242. For example, the following excerpt from BM 35456 simply gives the culminating point for each microzodiacal sign:

[... 8 U]Š 20 NINDA ar$_2$ rit-tu$_4$ GAM$_3$
[... 11 U]Š 40 NINDA ar$_2$ rit-tu$_4$ GAM$_3$
[... ½] DANNA ar$_2$ rit-tu$_4$ GAM$_3$
[...] ⌜1⌝8 UŠ 20 NINDA ar$_2$ rit-tu$_4$ GAM$_3$
[...] ⌜2⌝1 UŠ 40 NINDA ar$_2$ ⌜rit-tu$_4$ GAM$_3$⌝

[... 8 U]Š 20 NINDA behind the Hand of the Crook.
[... 11 U]Š 40 NINDA behind the Hand of the Crook.
[... ½] bēru behind the Hand of the Crook.
[...] 18 UŠ 20 NINDA behind the Hand of the Crook.
[...] 21 UŠ 40 NINDA behind the Hand of the Crook.
(BM 35456 obv. 1'-5'; after Steele 2017)

As stated above, the microzodiacal scheme texts also include a statement on the corresponding culminating point for the beginning and end of a zodiacal sign. The compendium text BM 36609+ contains two sections that provide the culminating points for zodiacal signs, though not microzodiacal signs. Section 7 (obv. iii 14-19) follows a more standard format, and section 4 (obv. ii 15-34) uses a slightly different format, referring to the zodiacal signs as "place of x" (e.g. KI *ša$_2$* ALLA).[36]

[TA 10] UŠ a-na 4 ša$_2$ ^{mul_2}LU.LIM
[EN 5 UŠ ar$_2$] um-mu-lut KI ša$_2$ ALLA
[TA 10 UŠ] a-na SA$_4$ ša$_2$ ^{mul_2}ŠU.GI
[EN 5 UŠ ar$_2$] GAM$_3$ KI ša$_2$ UR.A

[From 10] UŠ to the Four Stars of the Stag
[to 5 UŠ behind] the Dusky Stars: Place of Cancer.

[36] It is worth noting that a third section (obv. iii 1-13) contains statements on intervals between stars, the term *ziqpu,* and arithmetic instructions. Unfortunately, the text is too fragmentary to understand at this point.

[From 10] UŠ to the Bright Star of the Old Man
[to 5 UŠ behind] the Crook: Place of Leo.
(BM 36609+ obv. ii 15-18; Steele 2017)

TA a-si-du
EN 5 UŠ ar_2 um-mu-lut
AL[LA] ⌜TA SAG⌝-$šu_2$ EN TIL-$šu_2$ <KUR>[37]

From the Heel[38]
To 5 UŠ behind the Dusky Stars
Cancer, from its beginning to its end, rises.
(BM 36609+ obv. iii 23-25; Steele 2017)

It is worth noting that unlike the calendar-based rising time scheme, the schemes based on the microzodiac includes statements that sum up the intervals between microzodiacal signs, indicating that the *ziqpu*-stars were not only used to indicate a moment in time, namely, the moment of culmination, but also to measure a length of time. In this way, the Babylonian rising time schemes provided an arithmetic solution to the problem of oblique ascension, whereas later Greek astronomers addressed this problem in a geometric framework. Using the rising time scheme, Babylonian astronomers could have calculated the length of daylight by adding up the rising time for the 180° arc of the zodiac that would rise over the course of a day. The resultant ratio would be 2:1, a ratio already found in MUL.APIN (Rochberg 2004a, 90). However, whether this was the purpose of the rising time schemes is debatable. While it was possible to derive the length of daylight from the schemes, nowhere in the sources themselves is it made explicit. Steele has suggested that the rising time schemes were meant to describe celestial behavior, and that much like other texts of schematic astronomy, they are descriptive in nature rather than procedural (Steele 2017, 106–7). Yet if this is the case, there is an implicit assumption that readers of these texts would know how to use them, and one such use could be to determine the length of daylight.

[37] Earlier statements retain the KUR sign, which is dropped beginning with the current example.
[38] Note that the Heel is located 10 UŠ before the Four Stars of the Stag. Therefore, the statement found here is equivalent to the one in BM 36609+ obv. ii 15 given above.

Non-periodic Attestations of *ziqpu*-stars

The sources described thus far employ the *ziqpu*-stars in a constant relationship. For example, a given heliacally rising star or a microzodiacal sign would, according to the schemes outlined above, always correlate with a specific culminating point. These culminations are part of an abstract theme, rather than an actual event that took place at a particular moment in time. Other sources, however, use the *ziqpu*-stars to mark the time of an event whose relation to the culmination of a *ziqpu*-star is not fixed.[39]

The most common type of event, as well as the earliest one to use the *ziqpu*-stars in such a way, are lunar eclipses. Two Neo-Assyrian letters, SAA 10 134 (= LAS 80) and SAA 10 149 (= LAS 105), report a lunar eclipse and include the culmination of a *ziqpu*-star. The name of the star in the fairly broken SAA 10 134 is unfortunately missing, but SAA 10 149 preserves the name of the Shoulder of the Panther, one of the well-attested *ziqpu*-stars:

> [UD x KAM$_2$ ina EN].NUN AN.USAN$_2$ [^{mul}x x x] ziq-pu [^{im}x x x] DU-ak [^{d}30 AN.MI] ⌜is⌝-sa-kan
>
> [On day …, during the ev]ening watch, [star …] (was at) culmination, [the … wind] was blowing, [the moon was eclipsed].
> (SAA 10 134, obv. 7-10; after Parpola 1993)
>
> ina ^{iti}SIG$_4$ [UD] ⌜14 KAM⌝ 30 AN.MI [ina] EN.NUN UD.ZAL i-sa-kan … ^{mul}qu$_2$-ma-ru ša ^{mul}UD.KA.DUH.A ziq-pu
>
> On the 14th day of Month III, [during] the morning watch, the moon was eclipsed… the Shoulder of the Panther (was at) culmination.
> (SAA 10 149, obv. 3'-5' and rev. 2-4; after Parpola 1993)

In addition to the culmination of a *ziqpu*-star, both letters also report the watch of night in which the eclipse took place. Ominous phenomena were a recurring concern that comes up in the Neo-Assyrian letters. Lunar eclipses were of particular significance, because they were perceived to be immediately relevant to the life and wellbeing of the Neo-Assyrian king, tied to the celestial omens series Enūma Anu Enlil. In Enūma Anu Enlil, the time of a lunar eclipse is normally given with respect to the

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[39] Note that this does not necessarily mean these events were directly observed. The role and application of *ziqpu*-stars in observations and abstract schemes or models is the topic of Chapter 3.

three watches of the night (Rochberg-Halton 1988, 44). Stars, however, do not play a significant role in lunar eclipse omens (Rochberg-Halton 1988, 62–63).[40] Interestingly, only SAA 10 134, dated to 650 BCE (Parpola 1983, 84), and SAA 10 149, dated to 621 BCE (Parpola 1983, 90–93),[41] mention a culminating star at the time of the eclipse, while the majority of Neo-Assyrian letters that mention eclipses do not. Beyond these two letters, the *ziqpu*-stars re-emerge as a way to mark the time of an eclipse only three centuries later in the Astronomical Diaries. The earliest one is the Diary of the year 329 BCE:

> [... GE$_6$ 13 …] 20 SI MAŠ.MAŠ ziq-pi ⅔ HAB-rat ana SI šal-šu$_2$ HAB-[rat ana ULU$_3$ …]
>
> [Night of the 13th …] 20 fingers. When the Twins culminated, two-thirds of the lunar disk to the north, one third of the lunar [disk to the south …]
> (ADART 1, -328, rev. 6’-7’; after Sachs and Hunger 1988)

A number of later Diaries (and related texts) as well as eclipse reports mark the time of a lunar eclipse by means of a culminating *ziqpu*-star, with the majority of these attestations dating to the 2nd and early 1st century BCE.[42] Much like in the case of the Neo-Assyrian letters, however, marking the time of an eclipse by means of the *ziqpu*-stars in the Diaries was in addition to a more common method. For the Neo-Assyrian letters this method was the watch of night, and for the Diaries it was the number of UŠ from sunset or before sunrise. While some of these eclipse accounts are only partial due to breakage, when they are sufficiently preserved, they always include these additional time markers. For example, the following excerpt from the Diary of 215 BCE reports on an eclipse that started ½ *bēru* after sunset while the Bright Star of the Old Man was culminating:

> SA$_4$ ša$_2$ ^{mul_2}ŠU.GI a-[n]a ziq-pi GUB-uz ^{d}sin AN.⸢MI⸣ A$_2$ KUR.RA ki TAB-u$_2$ ina 21 GE$_6$ gab-šu$_2$ ŠU-im 16 GE$_6$ IR$_2$ ana ZALAG$_2$-ru ki TAB-u$_2$ ina 19 GE$_6$ TA KUR.RA

---

[40] Tablets 50-51 of Enūma Anu Enlil focus on stars and mention them in two ways: (a) as sets of correspondences, i.e., star X is for star Y; and (b) in protases either describing their appearance or mentioning their heliacal rising. Although some of the stars in tablets 50-51 are featured as *ziqpu*-stars in sources outside of Enūma Anu Enlil, there is no evidence to suggest that they appear in the celestial omen series because of their association with *ziqpu*. Rather, they are most likely featured in Enūma Anu Enlil because they are prominent constellations. The *ziqpu*-stars that are mentioned in tablets 50-51 are: AL.LUL, BAL.TEŠ$_2$.A, GAM$_3$, he$_2$-gal$_2$-a-a, LU.LIM, MAŠ.TAB.BA, MAŠ.TAB.BA.GAL.GAL, ŠUDUN, ŠU.GI, ŠU.PA, UD.KA.DUH.A, UR.GU.LA, UZ$_3$. See the catalogue of stars in BPO 2 for textual references (Reiner and Pingree 1981, 10–16).

[41] This date has been confirmed in an upcoming project by Gil Breger, Laurie Pearce, and Joanne Tan.

[42] For a complete list of these sources, see Appendix A: Catalogue of Sources.

u SI a-na ⸢^{im}MAR$^{?}$⸣.TU ZALAG$_2$-ir 56 GAR IR$_2$ [u ZALAG$_2$-r]u$^{?}$ in 30 DANNA GE$_6$ GIN

The Bright Star of the Old Man stood in culmination, lunar eclipse; on the east side when it began, in 21° of night, all of it became covered; 16° of night (was its) totality; when it began to clear, it cleared in 19° of night from east and north to the west; 56° (in total were its) onset, totality, [and clear]ing; at 30 (UŠ = 1) bēru after sunset.
(ADART 2, -214, obv. 2-8; after Sachs and Hunger 1989)

It is unknown why the Astronomical Diaries started marking the time of an eclipse by the culmination of *ziqpu*-stars or the reason for their inconsistent use of the *ziqpu*-stars. Schaumberger (1952, 223) argued that by employing the *ziqpu*-stars, Babylonian astronomers were able to mark time more precisely, since the culmination of a star is independent of the season, while the time of day in which the sun rises or sets varies throughout the year and thus a certain number of UŠ from sunrise/sunset in the winter would yield a different time than the same number of UŠ from sunrise/sunset in the summer. Schaumberger's argument can be rejected for two reasons. First, it imposes modern scientific thinking onto Babylonian astronomers by assuming they had an underlying goal of attaining more precise and accurate measurements. The existence of the two contemporary systems in the so-called mathematical astronomy of calculating lunar and planetary positions, namely System A and System B, suggests that accurate depiction of empirical reality was not the primary concern of the texts that utilize them (Rochberg 2016, 263; 2018).[43] While they produced similar results, these results were not identical, yet both systems co-existed side by side. Second, it implies the existence of a fixed, homogenous framework of time for the day, in which the moment of sunrise and sunset change depending on the seasons, somewhat similar to equinoctial hours. While the length of daylight was one of the topics addressed in Babylonian astronomy, there is little evidence to suggest such a fixed framework of time was widely used.[44]

Lunar eclipses were not the only kind of event to have their time marked by means of a *ziqpu*-stars. Two Neo-Assyrian sources and several Astronomical Diaries employ the *ziqpu*-stars in such a way. The Neo-Assyrian letter from Nineveh, SAA 5 249, is fragmentary and the only part that is sufficiently preserved describes a fierce storm that wreaked havoc on the Assyrian camp. The author of the letter remarks that

[43] For a similar case in regards to *ziqpu*-star texts, see Chapter 3.
[44] For a discussion on the existence of seasonal hours, see most recently Steele (2020a, 116–17) with previous bibliography.

the storm began with the culmination of the Circlet and subsided with the culmination of Star from the Triplet:[45]

> ina GE$_6$ ša UD 4 KAM ša$_2$-a-⸢ru⸣ dan-nu ša a-dan-niš i-⸢zi⸣-[qa] ^{tug_2}maš-kan^{meš} gab-bu mi-[hu-u] i-ba-aš$_2$-ši u$_2$-ta-⸢si⸣-[hi] UN^{meš} ip-tal-hu a-dan-⸢niš⸣ ANŠE.KUR^{meš} ina ŠA$_3$-bi a-ha-[iš] it-ta-ad-bu-ku ina ⸢UGU⸣ ^{mul}kip-pi-te u$_2$-⸢sar⸣-[ri] ina UGU MUL taš-ka-[a-ti] ⸢it⸣-tu-u$_2$-ah
>
> On the night of the 4th day, an extremely strong wind was bl[owing]. The storm was so (strong) it tor[e off] all the tents. People panicked, horses piled together making a heap. It started at the culmination of the Circlet and subsided at the culmination of Star from the Triplet.
> (SAA 5 249, obv. 6’-15’; after Lanfranchi and Parpola 1990)

While the letter does not explicitly use the term *ziqpu*, both stars mentioned appear regularly in *ziqpu*-star lists (though not in MUL.APIN), but more importantly, the term *ina* UGU appears elsewhere as referring to the culmination of *ziqpu*-stars, particularly in the rising time schemes. While the letter cannot be dated with certainty, Lanfranchi and Parpola (1990) attributed it to the reign of Sargon, most likely due to the reference to the city of Šarru-iqbi it contains, a city located on the Mannaean border, and thus connected to the tensions between Assyria and Urartu at the time of Sargon. If the letter is indeed from the reign of Sargon, it would be the earliest surviving attestation to mention stars in their capacity as *ziqpu*-stars.

The Neo-Assyrian text BM 121206 is concerned with cultic activities for the god Aššur in the city of Aššur. The rather long text is divided into numerous sections whose relationship to one another is at times difficult to understand, suggesting that the tablet was composed of excerpts from different sources (van Driel 1969, 74–79). The mention of Sennacherib by name and references to the *šahūru*-building and the *Ostanbau* gate, both of which are attributed to the king’s building projects in Aššur, sets a terminus post quem for the tablet itself, though not necessarily for all of its constituent sections. The *ziqpu*-stars are used to describe the time when certain aspects of a ritual took place:

> mu-šu$_2$ ša$_2$ UD 4 KAM ša$_2$ ^{iti}BARA$_2$ ^{mul}e-du
> ša$_2$ KUN-šu$_2$ ziq-pu 5-su ^{dug}qa-bu-u-tu
> GAR-at A^{meš} e-⸢tar⸣-šu$_2$
> ---
> bir-ti ^{mul}e$_4$-ru$_6$ bir-ti ^{d}na-dul-lu

[45] Based on the distances attested in *ziqpu*-star lists, this would measure 20 UŠ, the equivalent of 80 minutes.

mah-ru-u 6-su qa-bu-tu_2 GAR-at
LUGAL ina E_2 aš-šur i-ta-rab

----

ina UGU ^{mul}na-dul-lu EGIR$^{!}$-u 7$^{!}$-tu_2 qa-<bu-tu> a-na
gam-mu-ri GAR LUGAL ina E_2 ^{d}nin-lil_2 e-ta-rab

----

ina UGU MUL taš-ka-ti 11$^{!}$-tu_2 qa-bu-a-ti
ana ga-mu-ri GAR-at LUGAL ina E_2.GAL i-ta-rab

----

^{mul}be-let TI.LA 10 UŠ^{meš} ⸢pa$^{?}$-li$^{!}$-i$^{!}$ ana$^{!}$ $^{d!}$UTU$^{!}$ i$^{!}$-na$^{!}$-kir$^{!}$⸣
1 DANNA GE_6 ⸢KUR⸣-ha …

On the night of the 4th of Month I, the Single Star of its (= the Lion's) Tail is at culmination, the fifth cup was placed: they requested water.

Between (the culmination of) the Frond and (the culmination of) the (Front) Harness, the sixth cup was placed; the king entered the temple of Aššur.

At the culmination of the Rear Harness, the 7th cup was placed for pouring out; the king entered the temple of Mullissu.[46]

At the culmination of Star from the Triplet, the 11th cup was placed for pouring out; the king entered the palace.

The Lady of Life … 10 UŠ … rises heliacally at the first bēru of the night.
(SAA 20 52, rev. ii 20'-31'; Parpola 2017)

The *ziqpu*-stars appear again in the following column, indicating when certain gods begin to set out, likely referring to a procession of the statues of the gods:

ina UGU taš-ka-ti ^{d}e_2-a i-ta-bi-a ina UGU ^{d}be-let TI.LA ^{d}GAM.KUR ta-tab-bi-a
^{d}ku-ta-ta-te ina BARAG.NAM^{meš} la ⸢tal⸣-lak ^{d}PA ^{d}LAL_2 ^{d}ku-ta-ta-te a-na E_2
a-ki-ti ina ⸢UKKIN⸣ DINGIR^{meš} la DU-ku ^{d}LAL_2 [UD x] KAM ina E_2 DINGIR DU-ak

Ea sets off at the culmination of (the Star from) the Triplet. Kippat-Mati sets off at the culmination of the Lady of Life. Kutatati does not go to the Dais of Destinies. Nabû, Tašmetu, and Kutatati do not go to the Akitu House, to the assembly of the gods. Tašmetu goes to the house of the god on the [xth day].
(SAA 20 52, rev. iii 4'-8'; Parpola 2017)

[46] Mullissu is the Assyrian name for Ninlil, often depicted as the spouse of the god Aššur.

While the Yoke is mentioned later in the text (rev. 55’-60’), the star appears there as part of a set of correspondences between gods and celestial bodies, and not in its capacity as a *ziqpu*-star.

Several Astronomical Diaries employ the *ziqpu*-stars to mark the time of an occultation. ADART 1, -289 obv. 16’ and ADART 3, -124B obv. 24’ refer to the occultation of Saturn, while ADART 2, -190B obv. 20’ refers to the occultation of Mars. [47] In all three cases the moment that the planet entered (KU$_4$) the moon is marked. Lastly, the three Astronomical Diaries published as ADART 3, -132B rev. 7, -132C obv. 15, and -132D$_1$ obv. 8 all describe the same event, namely the occultation of the King (LUGAL). Between these three sources, both the beginning of the occultation and its end are given in terms of *ziqpu*-stars. Mentions of occultation are not common in the Astronomical Diaries. Much like in the case of eclipses, the Astronomical Diaries are not consistent in describing the time of an occultation by means of *ziqpu*-stars, although occultations are much less common than eclipses in these texts (e.g., ADART 3, -234A, obv. 4-5).

Ziqpu-star Lists with Distance Intervals

Alongside the Astronomical Diaries and the rising time schemes, the third most prevalent source for *ziqpu*-stars are the star lists. The majority of *ziqpu*-star lists are Late Babylonian with two lists known from the Neo-Assyrian period. Steele (2014) defines three categories of *ziqpu*-star lists. Category 1 lists are the most common kind of *ziqpu*-star list. Typically, each entry in a list provides an interval, the distance from the star in the previous entry to the current one, measured in UŠ or *bēru*. Although not explicitly stated, the entries are organized on the principle of successive rising (or culmination).[48] In modern terms this would be equivalent to an increase in right ascension. For example, the following is an excerpt from the *ziqpu*-star list written on the reverse of the Sippar Planisphere. While the object itself is unusual due to its shape and the diagram on the obverse, the list on the reverse is representative of a typical *ziqpu*-star list:

⅔ DANNA ana		^{mul}a-si-du
10 UŠ ana	4 ša$_2$	^{mul}LU.LIM

[47] Additionally, it is possible that ADART 3, -85B, obv. 10’ refers to the occultation of the Jaw of the Bull by the moon (Sachs and Hunger 1996, 465).

[48] Since their position in the sky is fixed, as long as the focus is on the same phenomenon (i.e., rising, culmination, or even setting), the order in which these stars experience that phenomenon is fixed.

½ DANNA ana MUL um-mu-lu-ti
½ DANNA ana MUL ni-bu-u$_2$ ša$_2$ ^{mul}ŠU.GI

⅔ bēru to the Heel
10 UŠ to the Four Stars of the Stag
½ bēru to the Scintillating Stars
½ bēru to the Bright Star of the Old Man
(Sippar Planisphere, rev. 11-14; Horowitz and Al-Rawi 2001)

A slightly different format is attested in four *ziqpu*-stars lists: 1881-2-4, 413; AO 6478; BM 38369+; and K 9794. These lists are still organized along the principle of successive risings, but each of their entries consist of the names of two stars rather than one.[49] Unfortunately, the Neo-Assyrian fragment 1881-2-4, 413 does not preserve any intervals. For example:

[... 4 ša ^{mul}LU.L]IM ^{d}um-m[u-lu-ti (...)]
[... ^{d}um-mu-lu-t]i ^{d}ni-bu-u ša$_2$ ^{mul}[ŠU.GI (...)]
[... ^{d}ni-bu-u ša$_2$ ^{m}]^{ul}ŠU.GI ^{d}na-a[ṣ-ra-pi (...)]
[... ^{d}na-aṣ-r]a-pi ^{d}[gam-lu (...)]

[... (from) the Four Stars of the St]ag (to) the Scint[illating Stars (...)]
[... (from) the Scintilla]ting Stars (to) the Bright Star of [the Old Man (...)]
[... (from) the Bright Star of] the Old Man (to) na[ṣrapu (...)]
[... (from) naṣr]apu (to) [the Crook (...)]
(1881-2-4, 413, ln. 4’-7’; Fincke and Horowitz 2017)

The Late Babylonian AO 6478 is the most complete *ziqpu*-star list of all and due to its state of preservation has become the exemplary *ziqpu*-star list in modern scholarship (Steele 2014, 131). It is, however, exceptional in a few regards. As mentioned above, the preserved text begins with almost duplicating the introduction to the *ziqpu*-stars found in MUL.APIN (AO 6478 obv. 2’-4’). The text is then divided into

[49] Note that all of these except AO 6478 are dated rather earlier compared to other *ziqpu*-star lists. 1881-2-4, 413 and K 9794 are Neo-Assyrian fragments. The date of BM 38369+, found in Rassam’s excavation of Babylon, is uncertain and has been treated as either Neo-Babylonian (Horowitz 1994) or Neo-Assyrian (Britton 2002, 24; Horowitz 1998, 186). Lastly, the Late Babylonian AO 6478 is a near duplicate of K 9794 and thus preserves much of the stylistic format of the Neo-Assyrian fragment (the differences between the two are discussed below). Therefore, it seems that the format shared by these four texts, i.e., including the names of two stars in each entry, is found in the earlier *ziqpu*-star lists, while later ones only included the name of the star to which the distance is measured. Since the name of the first star in each entry (the one from which the distance is measured) appeared in the entry before (as the star to which the distance was measured), it was probably considered redundant to include it and was therefore omitted in later lists.

three columns, which roll over from the obverse to the reverse. Each entry consists of two lines. The first line lists the intervals between two successive stars in three different units of measurement. The left-hand column lists weights in mina, MA.NA KI.LA$_2$, presumably of water in a water clock (Steele 2014, 130).[50] The middle column lists the intervals in units of UŠ *ina qaqqari*, "UŠ on the ground." It is unclear if there is any difference between this unit and the more commonly attested unqualified UŠ found in other *ziqpu*-star lists, as the intervals in this column are consistent with the ones found in the other lists.[51] The right-hand column lists intervals in units of *bēru ina šamê*, "*bēru* in the sky," whose meaning is uncertain, but has been taken to refer to the physical distance between the stars in the Path of Enlil (Horowitz 1998, 183–88; Hunger and Pingree 1999, 88).[52] The ratio between the three columns is consistent: 1 mina = 6 UŠ *ina qaqqari* = 10,800 *bēru ina šamê*.[53] Yet, the standard ratio of an unqualified UŠ to an unqualified *bēru* is 30 UŠ = 1 *bēru*. In AO 6478, however, UŠ is the larger magnitude unit, and the ratio of UŠ ina qaqqari to *bēru ina šamê* is 1 UŠ = 1,800 *bēru*.[54] Since the intervals in UŠ are generally the same here as they are elsewhere in Babylonian astronomy, it is evident that *bēru ina šamê* is different from the unqualified *bēru*: 1 *bēru* (unqualified) = 30 UŠ (unqualified) = 30 UŠ *ina qaqqari* = 54,000 *bēru ina šamê*.[55] The names of two stars appear in the second line of each entry. The middle column contains the name of the star from which the interval is measured, and the

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[50] No material evidence of such devices survived, with the possible exception of BM 91283, a perforated bowl that may have served as such (Brown 2000b, 119–20). However, water clocks are known from textual sources and have been reconstructed according to them (Brown, Fermor, and Walker 1999; Fermor and Steele 2000).

[51] The term *qaqqaru* can also refer to a region of the sky, but that is unlikely in this context.

[52] This is unrelated to the earlier so-called Hilprecht Text (HS 229 = HS 245), which seemingly mentions *bēru* in denoting distances between stars. Rochberg-Halton (1983) has argued against such a claim, instead interpreting the text as a purely mathematical problem in which the names of celestial bodies are merely used as placeholders, without any astronomical or cosmological significance or relevance.

[53] Only the first two entries (obv. 5'-8') and the summation line (rev. 25) in AO 6478 include the full name of the units of measurement. The first two entries of the left-hand column have MA.NA KI.LA$_2$, followed by MA.NA MIN for all other entries, and again MA.NA KI.LA$_2$ in the summation line. The middle column has UŠ *i-na qaq-qa-ri* for the first two entries, followed by UŠ (or DANNA) *ina* KI.MIN, but the summation line changes to DANNA^{meš} ⸢*ša$_2$ qaq-qa*⸣-*ri*. The unit of measurement in the right-hand column is partially missing in the first two entries, but appears as DANNA *ina* KI.MIN in all other entries. The summation line of the right-hand column uses D[ANNA^{meš}] *ša* AN-*e*. Thus, based on the pattern of writing the unit of measurement in the middle column, the unit of measurement has been restored as *bēru ina šamê*.

[54] It is important to note that not only is the ratio different, it is inverted, where UŠ is the larger unit and *bēru* the smaller one. Note the implicit reference to a ratio of 30 *bēru* to 1 UŠ in Brown (2000a, 259) and Horowitz (1998, 184) that is clearly erroneous.

[55] Therefore 1 *bēru* = 54,000 *bēru ina šame*, or 15,0,0 in sexagesimal notation, though the meaning of this number remains unclear to me. This can explicitly be seen in rev. 5, where the middle column lists 1 *bēru* while the right column has 54,000 *bēru ina šamê*.

right-hand column contains the name of the star to which the interval is measured. For example, the following lines from AO 6478 give the intervals between Star from the Doublet to Star from the Triplet, followed by the intervals between Star from the Triplet to the Single Star:

obv. 11’	⌜⅔⌝ MA.NA MIN	5 UŠ i-na KI.MIN	9 LIM DANNA ina KI.MIN
obv. 12’		TA MUL ša$_{2}$ maš-a-ti	EN MUL ša$_{2}$ taš-ka-a-ti
obv. 13’	1 ⅚ MA.NA MIN	10 UŠ i-na KI.MIN	18 LIM DANNA ina KI.MIN
obv. 14’		TA MUL ša$_{2}$ taš-ka-a-ti	EN MUL DELE

obv. 11’	⅔ mina ditto	5 UŠ on ditto	9,000 bēru in ditto
obv. 12’		from Star from the Doublet	to Star from the Triplet
obv. 13’	1 ⅚ mina ditto	10 UŠ on ditto	18,000 bēru in ditto
obv. 14’		from Star from the Triplet	to the Single Star

(AO 6478, obv. 11’-14’; translation mine)

AO 6478 is also exceptional because it adds the Rear Twin as a *ziqpu*-star, thus containing twenty-six names, whereas almost every other *ziqpu*-star list does not include this star. The entry for the Rear Twin is, however, slightly different. Instead of following the format of TA SN_1 EN SN_2, found in all other entries, AO 6478 simply has “between the Twins” (Akk. *birit*). The entry that follows explicitly refers to the Rear Twin (^{mul}MAŠ.TAB.BA EGIR-*i*) and measures the distance from it to the next *ziqpu*-star in the sequence, the Crab:

rev. 5	[...]	1 DANNA i-na KI.MIN	54 LIM DANNA ina KI.MIN
rev. 6		TA ^{mul}KIŠIB GAM$_{3}$	EN ^{mul}MAŠ.TAB.BA
rev. 7	[...] ⌜MIN⌝	5 UŠ i-na KI.MIN	9 LIM DANNA ina KI.MIN
rev. 8		bi-rit	^{mul}MAŠ.TAB.BA
rev. 9	3 MA.NA ⌜⅓⌝ MA MIN	⅔ DANNA i-na KI.MIN	36 LIM DANNA ina KI.MIN
rev. 10		TA ^{mul}MAŠ.TAB.BA EGIR-i	EN ^{mul}AL.LUL

rev. 5	[...]	1 bēru on ditto	54,000 bēru in ditto
rev. 6		from Hand of the Crook	to the Twins
rev. 7	[...] ditto	5 UŠ on ditto	9,000 bēru in ditto
rev. 8		between	the Twins
rev. 9	3 ⅓ mina ditto	⅔ bēru on ditto	36,000 bēru in ditto
rev. 10		from the Rear Twin	to the Crab

(AO 6478, rev. 5-10; translation mine)

The inclusion of the distance between the Twins resulted in the third unusual feature of AO 6478, namely, that the total distances of the middle column amounts to 364 UŠ. One would expect 360 UŠ, based on the reference to the 12 *bēru* of the *ziqpu*-stars in STT 340 and BM 38369+ mentioned above, where 1 *bēru* equals 30 UŠ, and thus 12 × 30 = 360 UŠ, as well as the notion of 1 UŠ per day in the schematic calendar. Although several explanations for the 364 UŠ have been proposed (Horowitz 1998, 184–85; Hunger and Pingree 1999, 86; Koch 1997), most recently Steele (2017, 15–16) has convincingly argued that the unusual sum is in fact tied to the mention of the Rear Twin. The distance listed between the Hand of the Crook and the Twins is the distance between the Hand of the Crook and the Rear Twin, with the author of AO 6478 indicating the breadth in UŠ of the constellation of the Twins. Thus, the distance between the Hand of the Crook to the Front Twin would be 25 UŠ (not 30 UŠ), the distance between the Front and Rear Twins would be 5 UŠ, and the distance between the Rear Twin and the Crab would be 20 UŠ. This is consistent with the rising time scheme texts, where it is evident that the distance of 30 UŠ from the Hand of the Crook to the Twins refers to the distance from the former to the Rear Twin rather than the Front Twin (Steele 2017, 72–73). Therefore, the value of 364 UŠ is likely a summation error by the scribe of AO 6478, where they mistakenly took into account the 5 UŠ between the Twins as any other entry in the text.

This, however, creates yet another issue, namely, that the total number of UŠ would be 359 instead of 360. Here, Steele (2017, 15–16) suggests a correction of the distances between the Frond and the Circlet, which are not preserved in any other *ziqpu*-star list except the Sippar Planisphere, where they are poorly preserved and restored based on the distances in AO 6478. The rising time schemes, however, imply that the total distance between the Frond and the Circlet amount is not 54 UŠ, as preserved in AO 6478, but 55 UŠ. It is worth noting that the distances between the Harness and the Yoke (8 UŠ), the Yoke and the Rear Harness (9 UŠ), and the Rear Harness and the Circlet (12 UŠ) are the only distances that are not a multiple of 5. Steele suggests that either all three of these distances should be amended to 10 UŠ or only the distance between the Yoke and the Rear Harness, favoring the former due to its simplicity and its consistency with only using intervals that are multiplications of 5.

The only other *ziqpu*-star list that might also address the breadth of the constellation of the Twins is BM 38369+. Much like AO 6478, it lists the names of two *ziqpu*-stars per entry, followed by the distance between them. The general format of the entries in BM 38369+ is DIŠ TA SN_1 EN SN_2 x, where x is the distance between the SN_1 and SN_2, e.g., DIŠ TA ^{d}*ki-in-ṣi-šu* EN *a-si-di-šu₂* ⸢⅔⸣ [DANNA], "¶ from its Knee to its Heel, ⅔ *bēru*" (BM 38369+ col. ii' 4; translation mine).[56] However, col. ii' line 9, does

[56] In his edition of BM 38369+, Horowitz (1994, 92–93) omits the DIŠ signs at the beginning of the entries.

not begin with a DIŠ sign or contain the expected TA sign. Additionally, although the right-hand side of col. ii’ is missing, it seems unlikely that the missing segment of the column would have enough space to contain the signs for the second half of the entry, namely, EN and the second star name:

> DIŠ TA ^{mul}GAM$_3$ EN ^{mul}MAŠ.TAB.BA.GAL.[GAL …]
> 5 UŠ bi-rit ^{mul}MAŠ.TAB.BA.G[AL.GAL (…)]
> DIŠ TA ^{mul}MAŠ.TAB.BA.GAL.GAL EN ^{mul}a-lu-u[t-tum …]
>
> ¶ From the Crook to the Great Tw[ins …]
> 5 UŠ (is the distance) between the Great T[wins …]
> ¶ From the Great Twins to the Cr[ab …]
> (BM 38369+, col. ii’ 8-10; translation mine)

While these entries refer to the Great Twins, with no explicit mention of the Rear Twin, it seems that here, like in AO 6478, the 5 UŠ between (Akk. *birit*) refers to the breadth of the constellation. Following the same logic proposed by Steele (2017, 15) for AO 6478, the distance in line 8 would be from the Crook to the Rear Twin, and the distance in line 10 would be from the Rear Twin to the Crab. Unfortunately, these distances are not preserved.

The last *ziqpu*-star list to include the names of two stars in each entry is K 9794, a Neo-Assyrian fragment that is often cited as a duplicate of AO 6478 and treated as one.[57] This likely stems from Kugler’s edition (1914b, 116), though he only transliterates col. ii’, which is nearly identical to col. iii of AO 6478.[58] However, col. i’ of K 9794, although badly preserved, differs slightly from col. ii of AO 6478. Each other line ends with the expected *i-na* KIMIN also found in AO 6478, and col. i’ 11’ preserves part of a name of a star, thus affirming that each entry here did contain the names of two stars. Based on AO 6478 and the EN signs in col. ii’, this text no doubt also followed the format of TA SN$_1$ EN SN$_2$. However, in several places (col. i’ 8’, 10’, and 14’) the *i-na* seems to be preceded by a NA sign and in one place what appears to be MA.NA (col. i’ 12’):

col. i’ col. ii’

[57] See, e.g., Horowitz (1998, 182), Schaumberger (1952, 215), and Steele (2014, 130).

[58] These are minor variations between the rightmost column of both texts. AO 6478 obv. iii 12’ lists MUL *taš-ka-a-ti* while K 9794 ii’ 3’ has *tak-ša*$_2$-⸢*a*⸣-[*ti*], a metathesis that occasionally occurs in the content of *ziqpu*-stars. Additionally, AO 6478 obv. iii’ 17’, 21’, and 23’ write the interval as 36 LIM DANNA while K 9794 ii’ 8’, 12’, and 14’ write the interval as 30 LIM 6 LIM DANNA. The most substantial difference is that AO 6478 obv. iii’ 16’ lists the star as ^{mul}GAŠAN TIN whereas K 9794 seems to have traces of ^{mul}G[AM$_3^?$ UZ$_3$]. The She-Goat has been proposed as an alternative name for the Lady of Life (Roughton, Steele, and Walker 2004, 549), and it is possible that the Crook of the Goat, listed here, is yet another one (Steele 2014, 132 fn. 37).

1’	(broken)	EN MU[L …]
2’	(broken)	9 LIM DANNA ina [...]
3’	[...] (blank)	EN MUL tak-ša-⌜a⌝-[ti …]
4’	[...] KIMIN	18 LIM DANNA ina K[I.MIN …]
5’	[...] (blank)	EN MUL [...]
6’	[...] i-na KIMIN	⌜18⌝ LIM DANNA ina [...]
7’	[...] (blank)	EN ^{mul}G[AM$_3$? UZ$_3$ …]
8’	[...] ⌜x⌝-na i-na KIMIN	30 LIM 6 LIM DANN[A …]
9’	[...] (blank)	EN qu$_2$-ma-ru ša$_2$ ^{mul}UD.[KA.DUH.A …]
10’	[... n]a$^?$ i-na KIMIN	18 LIM DANNA ina K[I.MIN …]
11’	[... ^{mul}UD.KA.D]UH.A (blank)	EN MUL ni-bi-i ša$_2$ ⌜x⌝ [...]
12’	[... m]a-na ina KIMIN	30 LIM 6 LIM DANNA [...]
13’	[...] (blank)	EN ^{mul}ki[n-ṣi]
14’	[... n]a$^?$ i-na KIMIN	30 LIM 6 LIM DAN[NA …]
15’	[...] (blank)	EN ^{mul}a-s[i-di …]
16’	[...] i-na KIMIN	18 LIM DANN[A …]
17’	[...] (blank)	⌜EN⌝ [...]

(K 9794; translation mine)

Mina as a unit of measurement is used in AO 6478 col. i, though that text uses MIN, rather than *i-na* KIMIN, for the repetitive elements of the intervals in col. i. This could potentially indicate that K 9794 does not, in fact, list distances in UŠ, as in AO 6478 col. ii. Instead, K 9794 would have two columns: each entry in col i’ lists the weight in mina in the first line and the name of the star from which the interval is measured in the second line. Col. ii’ lists *bēru* (*ina šamê*) in the entry’s first line with the star to which the interval is measured in the second line. If so, this would mean that the author of AO 6478, while still basing it on K 9794, inserted a column between the two columns in K 9794 and populated it with the more prevalent distance intervals of UŠ. Unfortunately, due to the fragmentary nature of K 9794, it is impossible to determine if this was the case.

Other *ziqpu*-star Lists

K 9794 would not be the only such list without distance intervals. Referred to as category 2 lists by Steele (2014), these are lists that provide other numerical values or different information, and include VAT 16436, BM 34790, BM 36628+, BM 41570, and potentially BM 37373. Both VAT 16436 and BM 34790 obv. ii list the names of *ziqpu*-stars (or points behind or in front of one) with intervals whose meaning is still not understood. The values of these intervals, and therefore what they stand for, differ between the two texts.[59] Additionally, VAT 16436 and BM 37373 (as well as the obverse of the Sippar Planisphere) also provide the number of stars that make up each *ziqpu*-star (or more precisely here, constellation).[60] There is some disagreement between the texts as to how many stars make up some of these constellations. It is unclear if the texts are being exhaustive, trying to count every single star of a given constellation, only the bright ones, the significant stars for the authors of the texts, or if it is a matter of textual editing (Fincke and Horowitz 2018, 253). BM 36628+ is a compendium text and contains two separate sections dealing with the *ziqpu*-stars. The first (obv. i A1-A10) contains the names of *ziqpu*-stars with numbers, some of which seem to correlate to the expected intervals found in other lists, but the section is too poorly preserved (Steele 2015a, 205). The second section (obv. ii B8' - iii C15') groups two or three *ziqpu*-stars in an unusual way and is therefore further discussed in Chapter 4. Similarly, BM 41570 lists groups of *ziqpu*-stars by their correspondence to rising arcs of the zodiac (Steele 2014, 136). Each such group is prefaced with the term MUL^{meš}, and likely the reason why none of the star names have a determiner.

List-informed Sources

Lastly, Steele (2014) also defines a third category of *ziqpu*-star lists, which includes BM 78161 (the so-called GU text) as well as the two natal omen texts, AO 6483 and U 197. These will only be briefly presented as they relate to the *ziqpu*-star lists, but are further discussed in Chapter 4. All three texts are not lists in the same sense as the ones discussed above, but their structure suggests an underlying list that informed their construction.[61] BM 78161 contains groupings, or "strings," of several stars that are each headed by a *ziqpu*-star or a point several UŠ behind a *ziqpu*-star.

[59] The most recent attempt at understanding the numbers found in VAT 16436 is found in Fincke and Horowitz (2018, 260–61), where six different ways of reading the total are offered. To that, one might add that the scribal correction in line 22 is meant to be added to the total, thus amounting to 259,400 cubits. If the ratio proposed by Fincke and Horowitz of 21,600 $KUŠ_3$ to 1 *bēru* is accepted, 259,400 would equate 12.009 *bēru*, extremely close to the more familiar number of 12 *bēru*, or 360 UŠ. This may explain the total, but neither this suggestion nor the readings offered by Fincke and Horowitz address why each star in the text was assigned a given number. Also note that VAT 16436 switches the positions of the Harness and the Rear Harness within the sequence of stars.

[60] Due to its fragmentary nature, no distances are preserved on BM 37373 and it is unclear if it contained such information. Since it does list the number of constituent stars per entry, it would fit Steele's category 2 list.

[61] Following this definition, one could add the rising time schemes, since these are also informed by an underlying *ziqpu*-star list, and perhaps even MUL.APIN.

Generally speaking, all the stars along a given string have a somewhat similar right ascension and would thus culminate at the same time.[62] The sequence of the string heads, i.e. the *ziqpu*-stars, follow the same sequence that is commonly found in *ziqpu*-star lists.[63] The text does not contain all the *ziqpu*-stars known from lists and the text begins and ends in the midst of strings, suggesting that the tablet is only part of a set.

The two natal omen texts, A 6483 and U 197, were published by Sachs (1952b). The former, not a complete tablet, contains three sections separated by double ruling.[64] Only the last four lines (obv. 1'-4') of the first section, on lunar visibility throughout the month, are preserved. The second and largest section begins with explicating parts of the microzodiac and zodiacal correlations (obv. 1'-27'). The section then continues with natal omens, whose protases are based on planetary phenomena, having two omens per line of text, most of which are separated by a glossenkeil (obv. 28' - rev. 28). The last section consists of only ten lines, whose only right-hand side is preserved, beforing the tablet breaks off (rev. 29-38). This section also contains natal omens, but the protases here are the coming out (E_3-*a*) of *ziqpu*-stars. Although the left-hand side of this section is not preserved, it is obvious that each line in this section also contained two omens. The glossenkeil in rev. 29-30 is still clear, and rev. 29-33 seem to contain complete omens, albeit without ^{lu_2}TUR *a-lid-ma*, "if a child is born," that appears in the previous section. Moreover, the surviving star names are *ziqpu*-stars known from other sources in the standard sequence, albeit seemingly skipping every other star. Therefore, it is doubtless that these "skipped-over" stars would have, in fact, appeared in the missing left-hand side of the section:

rev. 29 [The Yoke] The Rear Harness[65]

[62] Note, however, that they would neither rise nor set at the same time, because they have different declinations. In the northern hemisphere, stars with a more northern declination would rise earlier and set later than stars with a more southern declination.

[63] The author of this text had made a major error where, from a certain string onwards, the *ziqpu*-star that is the head of a string is listed along stars whose right ascension do not align with the right ascension of that *ziqpu*-stars, but rather align with the right ascension of the next *ziqpu*-star. See Pingree and Walker (1988) for a discussion on this issue, which has led them to conclude that the text is a compilation of two different sources, one being a *ziqpu*-star list and the other being a list of stars that culminate simultaneously.

[64] The handcopy of the tablet, TCL 6, 14, also has a single ruling between obv. 26 and 27 as well as between rev. 21 and 22. Although there is a thematic change in the text between these lines, it is difficult to see the single ruling between obv. 26 and 27. Since the lines on the tablet are remarkably straight, it is possible that what appeared as a single ruling is in fact a line drawn on the tablet to assist the author in keeping the lines straight. Unfortunately, collation of the tablet was not possible.

[65] Note that the text here actually has ^{mul_2}*na-ad-dul-lu*, "The Harness," and not the expected Rear Harness. It is possible that the author intended the Rear Harness but simply omitted its qualification as the Rear Harness, either intentionally or due to negligence. The interchange of the

rev. 30	[The Circlet]	Star from the Doublets[66]
rev. 31	[Star from the Triplet]	The Single Star
rev. 32	[Lady of Life]	Shoulder of the Panther
rev. 33	[Bright Star of its Chest]	The Knee
rev. 34	[The Heel]	[4 Stars of the S]tag
rev. 35	[Dusky Stars]	[Bright Star of the Old] Man
rev. 36	[Naṣrapu]	[The Crook]
rev. 37	[The Hand of the Crook]	[The Twins][67]
rev. 38	[The Crab]	[2 Stars of the Head of the Lion][68]

Similarly, U 197 is a small Seleucid era fragment from Uruk that contains natal omens. Only the beginning of nine lines are preserved, but much like A 6483, these include the names of *ziqpu*-stars in the standard sequence, again skipping every other star:

ln 1’	(2) Stars of (the Head of) the Lion	[4 Stars of its Chest]
ln 2’	2 Stars of its Thigh	[Single Star of its Tail]
ln 3’	The Frond	[The Harness]
======	======================	======================
ln 4’	[The Yoke]	[The Rear Harness][69]
ln 5’	The Circlet	[Star from the Doublets]
ln 6’	Star from the Triplets	[The Single Star]
ln 7’	Lady of Life	[Shoulder of the Panther]
ln 8’	Bright Star of [its] Ch[est]	[The Knee]

Harness and the Rear Harness appears in two other sources, VAT 16436 and BM 34790 obv ii, and is discussed below.

[66] The text has ^{mul_2}UD-*a-ta* here standing for the expected ^{mul_2}*maš-a-ta*. This is likely not an alternative writing of the name of Star from the Doublets, but rather a scribal error, where the MAŠ sign was written erroneously as the slightly similar UD sign. Sachs (1952b) rightfully interpreted this star as Star from the Doublets.

[67] Sachs (1952b) erroneously restored here *bi-rit* ^{mul_2}MAŠ.TAB.BA, “between the Twins.” This entry in the sequence of *ziqpu*-stars only appears in AO 6478 and BM 38369+. Following the format of two stars per line, the Twins would fit here better. For more on “between the Twins,” see the discussion on AO 6478 above.

[68] This line only preserves the end of the protasis and the beginning of the apodosis of the omen on the right-hand side. Sachs (1952b) restored the Crab as the star name for this partially preserved omen. This must be a mistake, since it would contradict the pattern established in the text of two stars per line, which follow the standard sequence of *ziqpu*-stars. The Crab should appear in this line, but in the first omen, i.e., on the left-hand side.

[69] This line preserved only the beginning of a natal omen: ^{lu_2}TUR *a-lid-ma* ^{m}[^{ul_2} …], “If a child is born (and) the st[ar …].” Since it follows a ruling, it would make sense to include this here. Following the pattern of using two stars per line, this line no doubt contained the names of the Yoke and the Rear Harness.

ln 9’ The He[el] [4 Stars of the Stag]

Although lines 5’-9’ match the expected star names missing from the right side of A 6483 rev. 30-34, the fact that lines 1’-3’, found above a double ruling but continuing the pattern of two stars per line in the standard sequence, eliminate the possibility that U 197 is a part of A 6483 (Sachs 1952b, 75). It is possible, however, that A 6483 excerpts U 197 lines 4’-9’ or that both draw from a third unknown source.

Repertoire and Sequence of *Ziqpu*-stars

The *ziqpu*-star lists are a prime source to establish the repertoire of the *ziqpu*-star set in Babylonian astronomy, though not the only one. Most *ziqpu*-star lists do not explicitly refer to their constituent stars as *ziqpu*-stars, with AO 6478 and BM 38369+ being the exception. This is partly due to the fact that the majority of *ziqpu*-star lists are not fully preserved. Yet, it is clear that these are lists of *ziqpu*-stars since these fragmentary lists attest to the same stars, listed in the same order, and often in the same format along with the same information, namely, the same distances between them. Other non-list sources use these same stars with a clear association to *ziqpu*, sometimes explicitly, e.g., several of the rising time scheme texts or the Astronomical Diaries. Based on all these sources, it is possible to compile a repertoire of twenty-five stars that is exceptionally stable.[70] There are different ways of writing their names, e.g., the Harness can be written with the logoram ŠUDUN.ANŠE or rendered syllabically as *na-dul-lum*, and a few of these stars have alternative names.[71]

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[70] These are the Yoke, the Rear Harness, the Circlet, Star from the Doublets, Star from the Triplets, the Single Star, the Lady of Life, the Shoulder of the Panther, the Bright Star of Its (=the Panther’s) Chest, the Knee (of the Panther), the Heel (of the Panther), the Four Stars of the Stag, the Dusky Stars, the Bright Star of the Old Man, Naṣrapu, the Crook, the Handle of the Crook, the Twins, the Crab, the Two Stars of the Head of the Lion, the Four Stars of Its (=the Lion’s) Chest, the Two Stars of Its (=the Lion’s) Thigh, the Single Star of Its (=the Lion’s) Tail, the Frond, and the Harness. See fn. 71 for variations, particularly in MUL.APIN. See also the Introduction chapter for an inventory of the *ziqpu*-stars.

[71] The Lady of Life is occasionally referred to as the She-Goat (Roughton, Steele, and Walker 2004, 549). While not an alternative name, the name of Star from the Triplet occasionally undergoes metathesis and is written variably as either takšati or taškati. MUL.APIN in particular uses several rare names that do not appear as *ziqpu*-stars elsewhere. The Star of Dignity (MUL BAL.TEŠ$_2$.A) is a rare name for the Circlet (Gössmann 1950, 13–14). The identity of the Standing Gods (^{mul}DINGIR.GUB.BA), the Dog (^{mul}UR.KU), and the Abundant One (^{mul}he$_2$-gal-la-a-a) is less secure. See the appendix in Hunger and Pingree (1999, 271–77) and Hunger and Pingree (1989, 137–38, 142) for a possible identification of the Standing Gods as ζ / η Herculis (but see also Gössmann 1950, 9), the Dog as the southern part of Herculis (also Gössmann 1950, 69), and the Abundant One as β

The sequence in which the *ziqpu*-stars appear is similarly stable. They appear in the lists and other sources that use them sequentially (e.g., the rising time schemes) in an order that is equivalent to an increase in right ascension. However, different lists start at different positions along the sequence. To account for the stable repertoire and sequence yet varied starting point, Steele (2014) suggests that *ziqpu*-star lists were written down from memory rather than copied from a written source, as the latter option would produce a more consistent starting point across multiple lists.

There are, however, several exceptions to the otherwise stable repertoire and sequence of *ziqpu*-stars. Four texts interchange the positions in the sequence of the Harness and the Rear Harness. When preserved, the sequence is the Frond, the Rear Harness, the Yoke, the (Front) Harness, and the Circlet rather than the more widely attested sequence of the Frond, the (Front) Harness, the Yoke, the Rear Harness, and the Circlet. Two of these texts, VAT 16436 and BM 34790 obv. ii, are two *ziqpu*-star lists which include intervals that are not yet understood. Like them, BM 36628+ col. i includes intervals, some of which match the standard distances found in other lists. While the text is badly broken in this part, it does list the Harness in place of the expected Rear Harness. The fourth text is the natal omen list, A 6483. As discussed above, each line in the section with *ziqpu*-stars contains two omens that employ the name of a *ziqpu*-star in their protases and follow the stable sequence, with the exception of using the Harness where one would expect the Rear Harness. Unfortunately, the tablet is broken part way through this section and any omen that may have used the Rear Harness (in place of the expected Harness) is missing. It is likely that the interchange between the (Front) Harness and the Rear Harness found in these four texts occurred due to the nearly identical star names, particularly if the *ziqpu*-star lists were written down from memory as suggested by Steele (2014).

Even in BM 38369+, an unusual *ziqpu*-star list that uses a subset of the well-attested twenty-five stars, the sequence is maintained. As mentioned above, this text is one of the few lists to include the names of two stars per entry alongside the interval between them. It does, however, skip over several of the well-attested stars that one would expect given the part of the sequence attested in the text. The following

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Comae Berenice (also Gössmann 1950, 73–74). The enumeration of the *ziqpu*-stars in MUL.APIN I iv 4-6 suggests they are organized along a principle that can be equated with an increase in right ascension. Therefore, the Standing Gods and the Dog must be located between the Star of Dignity (= the Circlet) and the Goat (= the Lady of Life), where *ziqpu*-star lists normally have three *ziqpu*-stars: Star from the Doublet, Star from the Triplet, and the Single Star. All three are identified as different constituent stars of Herculis (see the appendix in Hunger and Pingree 1999). Additionally, the Abundant One is located between Eru and the ŠU.PA (= the Yoke), where other sources usually have the Harness as a *ziqpu*-star. The list of the Stars in the Path of Enlil confirms the sequence of Eru, the Abundant One, ŠU.PA, and the Star of Dignity (MUL.APIN I i 11-14). Further work on identifying these stars lies beyond the scope of this dissertation.

table lists the intervals found in BM 38369+, along with the intervals found in other *ziqpu*-star lists, including the ones skipped in this text (written in parenthesis):

Standard distances[72]	Distances in BM 38369+	From	To
20 or 30 UŠ[73]	[...]	She-Goat	Panther
20 UŠ	⅔ DANNA	Bright Star of the Panther	Its Knee
20 UŠ	⅓ DANNA[74]	Its Knee	Its Heel
10 UŠ	[...]	Its Heel	Horn of the Stag
(15 UŠ)	(skipped)	(Horn of the Stag)	(Dusky Stars)
30 UŠ	[...]	Horn of the Stag	Bright Star of the Old Man
(10 UŠ)	(skipped)	(Bright Star of the Old Man)	(Naṣrapu)
25 UŠ	[...]	Old Man[75]	Crook
(10 UŠ)	(skipped)	(Crook)	(Hand of the Crook)
40 UŠ	[...]	Crook	Great Twins
-------------------- 5 UŠ between the Great Twins[76] --------------------			
20 UŠ	[...]	Great Twins	Crab
(20 UŠ)	(skipped)	(Crab)	(Head of the Lion)
10 UŠ	10 UŠ	Head of the Lion	Chest of the Lion

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[72] Note that when BM 38369+ skips over stars, the distance listed in this column would be the total distance, including the one of the skipped star. For example, the distance between the Horn of the Stag and the Dusky Stars is 15 UŠ and the distance between the Dusky Stars and the Bright Star of the Old Man is also 15 UŠ. Since BM 38369+ skips over the Dusky Stars, the distance listed in this column would be the total of 30 UŠ for the interval between the Horn of the Stag and the Bright Star of the Old Man.

[73] BM 38369+ only refers to the Panther here, without singling out whether it refers to the Shoulder or the Bright Star of Its Chest. The former would be 20 UŠ away from the She-Goat and the latter 30 UŠ. However, given that the next entry measures the distance from the Bright Star of the Panther, it is almost certain that the star referred to here is the Bright Star of the Chest, and therefore the distance as attested in other sources would be 30 UŠ. Note that BM 38369+ does something similar, albeit reversed, with the Old Man later in the list.

[74] Horowitz (1994) amends this distance to ⅔ DANNA based on the well-attested 20 UŠ interval between the two stars found elsewhere.

[75] Note that the previous entry measured the distance between the Horn of the Stag and the Bright Star of the Old Man, while here the star is simply called the Old Man.

[76] As discussed above, this entry is a note that the distance between the Front and the Rear Twins is 5 UŠ.

20	[...]	Chest of the Lion	Thigh of the Lion
10	½ DANNA	Thigh of the Lion	Cluster of Its Tail
(10 UŠ)	(skipped)	(Cluster of Its Tail)	(Frond)
(25 UŠ)	(skipped)	(Frond)	(Harness)
(8 UŠ)	(skipped)	(Harness)	(Yoke)
43 UŠ	1 DANNA	Cluster of Its Tail	Yoke

As can be seen in the table, BM 38369+ completely omits the Dusky Stars, Naṣrapu, the Hand of the Crook, the Frond, the Harness, and instead includes entries that skip over them, e.g., from the Horn of the Stag directly to the Bright Star of the Old Man, skipping over the Dusky Stars.

The entries around the transition from the Crab to the Lion are unusual. Firstly, the author did not include the distance from the Crab to the Head of the Lion. The distance between the Great Twins to the Crab is immediately followed by the distance from the Head of the Lion to the Chest of the Lion. Furthermore, as attested in the few entries that preserve the distances between stars, the format of each entry is TA SN_1 EN SN_2 x, where x is the distance, i.e., "from SN_1 to SN_2, (the distance is) x." However, the entry of the Head of the Lion and the Chest of the Lion is written differently, with a distance interval written between the two names: TA SAG.DU *ša* ^{mul}UR.G[U.LA] 10 UŠ *a-na* GABA *ša* ^{mul}UR.⸢GU⸣.[LA], "From the Head of the Lion (there are) 10 UŠ to the Chest of the Lion." The interval between these two stars as attested elsewhere is indeed 10 UŠ, so it is unclear why the author deviated from the way distances were written in the other entries of BM 38369+.

Out of the five preserved distances only two match the values attested in other sources, namely, the distance between the Head and Chest of the Lion and the distance between the Bright Star of the Panther and the Knee. The distance between the Knee and the Heel is normally 20 UŠ (= ⅔ *bēru*) and in BM 38369+ it is only ⅓ *bēru* (= 10 UŠ), though this might simply be a case where the scribe miswrote the sign. The distance between the Thigh of the Lion and the Tail of the Lion is attested as 10 UŠ (= ⅓ *bēru*) while here it appears as ½ *bēru* (=15 UŠ).[77] Lastly, the distance between the

[77] Note that BM 38369+ refers to the Tail of the Lion as *ishunnat* KUN-*šu*, the Cluster of Its Tail, which is unattested in other sources for *ziqpu*-stars. The meaning of the Akkadian word *ishunnatu* is "a cluster of grapes." The full name of the *ziqpu*-star at the Tail of the Lion is the Single Star of Its Tail (see, e.g., AO 6478, the Sippar Planisphere, and VAT 16437), so it seems less likely that the cluster mentioned here refers to a cluster of stars. Rather, it is more likely that it refers to the plume at the end of a lion's tail. Unfortunately, the uranology texts published by Bealieu et al. (2018) do not preserve any descriptive elements of the Tail of the Lion.

Tail of the Lion and the Yoke should be 43 UŠ[78] where BM 38369+ grossly understates it to be 1 *bēru* (=30 UŠ).[79]

It is almost certain that BM 38369+ did not begin with the first preserved entry, namely, that of the distance between the She-Goat and the Panther. After the list itself, the text includes a statement that the total distance of the *ziqpu*-stars is 12 *bēru* and mentions the distance from the Yoke to another star, whose name is broken:

> [PA]P$^{?}$ 12 DANNA kip-pat zi-[iq-pi] bi-rit MUL^{meš} ša KASKAL šu-ut ^{d}[en-lil$_2$]
>
> --
>
> TA ^{mul}ŠU.PA EN ^{m}[^{ul} …] ša ^{lu_2}EN.NUN AN-e i-na [GE$_6$] SAR^{meš} u$_3$ ŠU$_2$^{meš} ša M[UL^{meš} ina ŠA$_3$-šu-nu IGI-ru]
>
> [A tota]l$^{?}$ of 12 bēru of the circuit of *ziqpu*(-stars) amidst the stars of the Path of [Enlil]
>
> --
>
> From the Yoke to [...], by means of which the observer of the sky [observes] the rising and setting of the s[tars] at [night].
> (BM 38369+ ii' 20-24; Horowitz 1994)

Given that the Yoke is also the last star to appear in the list itself, it is likely that the list began with the distance from the Yoke to another star and concluded with the distance between the Tail of the Lion and the Yoke. The distances found in the preserved entries further support this, since the total distance between the She-Goat and the Yoke only amounts to 278 UŠ as attested in other sources. Even in if the distances broken in the what remains of BM 38369+ were 1 *bēru* each—however unlikely—and the amendation of the distance between the Knee and the Heel to ⅔ *bēru* suggested by Horowitz (1994) is accepted, the total distance in the preserved entries of BM 38369+ would still amount to only 10 *bēru* and 5 UŠ, or 305 UŠ, falling short of the 12 *bēru* (=360 UŠ) referred to in the text.

While MUL.APIN is the earliest source for *ziqpu*-stars, it is possible that even there, the text uses a subset of the *ziqpu*-stars attested in later sources, following the same sequence. As discussed above, most of the stars found in the first section are well-attested as *ziqpu*-stars elsewhere, namely, the Yoke (called ŠU.PA here), the Circlet (called Star of Dignity here), the Goat, the Panther, the Stag, the Old Man, the Crook, the Great Twins, the Crab, the Lion, and Eru. The Standing Gods and the Dog occupy the same positions in the sequence as Star from the Doublet, Star from the

[78] Or potentially 45 UŠ. See the discussion on AO 6478 above.
[79] Even the combined distance between the Thigh of the Lion and the Yoke in BM 38369+ would only amount to 45 UŠ, still noticeably less than the 53 UŠ found in other sources.

Triplet, and the Single Star, while the Abundant One occupies the place of the Harness. Thus, the distance between each two consecutive stars is no more than 30 UŠ at most, [80] with the exception of the distance between the Crook and the Great Twins, which measures 40 UŠ.[81]

The second section of the *ziqpu*-stars uses a subset of the stars found in the first. This section focuses on heliacal risings on specific dates and correlates them with culminating (*ziqpu*-)stars. The choice of which stars to select as culminating stars was almost certainly governed by this correlation, namely, that they would culminate on the listed date (and time). For this reason, this section omits several *ziqpu*-stars that would not fit into this criterion, and instead breaks apart the larger constellations of the Panther and the Old Man into smaller constituent parts that would culminate at the appropriate time. Thus, the Rear Harness, Naṣrapu, and the Hand of the Crook are the only stars attested in later lists that are completely absent in MUL.APIN as *ziqpu*-stars or have other stars occupy their relative position in the sequence, such as in the case of the Standing Gods and the Dog appearing where other lists have Star from the Doublet, Star from the Triplet, and the Single Star.[82]

It is worth mentioning that two other *ziqpu*-star lists, BM 36628+ and BM 61677, do not in fact contain a different set or a subset of the *ziqpu*-stars, but rather scribal errors. The badly preserved BM 36628+ col. i, discussed above, omits Star from the Doublet (Steele 2015a, 205). In BM 61677, the scribe skipped from the Bright Star of Its (=the Panther's) Chest to Naṣrapu.[83] Normally the distance to Naṣrapu is measured from the Bright Star of the Old Man. Since both begin with the term Bright Star (written *ni-bi-i*), this is a clear case of homoioarcton.[84]

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[80] The total distance between the Star of Dignity (= the Circlet) and the Goat (= the Lady of Life) is 40 UŠ in later *ziqpu*-star lists, with MUL.APIN listing the Standing Gods and the Dog between them. Given that the distances between *ziqpu*-stars are almost always a multiplication of 5, it is likely that the distance between the Star of Dignity, the Standing Gods, the Dog, and the Goat would also be a multiplication of 5. Even if a minimum of 5 UŠ is assumed, then within the sequence of the Star of Dignity, the Standing Gods, the Dog, and the Goat, the distance between any two would be no more than 30 UŠ at most.

[81] If the distance measured from the Crook to the Great Twins actually measures the distance to the Front Twin (as seems to be the case for the Panther, the Old Man, and the Lion, which are all sizeable constellations), then the distance would be 35 UŠ, since other sources attest to a breadth of 5 UŠ for the Twins.

[82] It is possible that the Crook in MUL.APIN actually includes the Hand of the Crook as well, much like MUL.APIN conflates the constituent stars of the Panther, of the Old Man, and of the Lion. Similarly, Naṣrapu might potentially be subsumed into the Old Man here.

[83] The author skipped over the Knee, the Heel, the Stag, the Dusky Stars, and the Bright Star of the Old Man.

[84] Note that the distance the scribe wrote for this entry is 10 UŠ, the distance between the Shoulder of the Panther to the Bright Star of Its Chest. The distance between the Bright Star of the Old Man to Naṣrapu is 15 UŠ. Thus, at least when the scribe was writing the beginning of the line, they had the former distance in mind.

Throughout all of the sources discussed above, the constituency that makes up the set of *ziqpu*-stars is remarkably stable. There is, however, a single text which uses the Foot of the Panther, a star not otherwise attested as a *ziqpu*-star.[85] W 22281a is a calendar-based rising time scheme from Uruk that provides the name of a *ziqpu*-star (or an interval away from one) that culminates at sunrise of the 15th day of the month (and again at sunset on the 15th day six months later), followed by the names of additional stars that are said to be in balance (Akk. *šitqulu*). The entry for Month III uses the Foot of the Panther as the culminating *ziqpu*-stars:

> DIŠ ina ^{iti}SIG$_4$ UD 15 KAM KI KUR ša$_2$ ^{d}UTU še-pe-e-ti ^{mul}UD.KA.DUH.A ^{mul}IKU u ^{mul}ŠIM.MAH šit-qu-lu ina ^{iti}GAN <UD 15 KAM> ina li-la-a-ti KI ŠU$_2$ ša$_2$ ^{d}UTU ŠU.BI.AŠ.A[M$_3$]
>
> ¶ In Month III, day 15, with the rising of the sun, the Foot of the Panther, the Field, and the Swallow are in balance. In Month IX, day 15, in the evening with the setting of the sun, it is the same.
> (W 22281a, 5'-6'; after Steele 2017)

The various rising time scheme texts agree with one another to such an extent that they all attested to the same scheme, whether they are calendar-based or zodiac-based (Steele 2017, 80–84, 88). Unfortunately, this part of the rising time scheme is broken in the other texts, although BM 34639 as well as A 3414+ strongly suggest that these texts use 10 UŠ behind the Knee (of the Panther) instead of the Foot of the Panther. Since BM 38704 duplicates BM 34639, it is most likely that it also uses the former culminating point rather than the latter.[86] Depending on the orientation of the constellation to the celestial equator, it is astronomically possible that the Foot would be located between the Knee and the Heel, as the distance intervals do indeed suggest (Steele 2017, 31).

It is worth discussing here BM 36609+, the Late Babylonian compendium text containing numerous short sections that use Normal Stars and *ziqpu*-stars, published by Roughton, Steele, and Walker (2004). While several *ziqpu*-stars appear on the obverse in sections dealing with rising time schemes, section 9 on the reverse contain intervals in UŠ between Normal Stars, leading Roughton, Steele, and Walker (2004,

[85] The DAL.BA.AN.NA text makes reference to the Right Foot of the Panther and the Toe of the Right Foot of the Panther. Unfortunately, the text is not well understood. See the edition and study by Walker (1995), the analysis by Koch (1995), and the critique and interpretation by Hunger and Pingree (1999, 100–111).

[86] BM 34639 obv. ii, 9': *ina* ^{iti}GAN UD 15 ^{d}UTU ⸢*ina* UGU⸣ 10 ⸢UŠ *ar$_2$*⸣ [^{mul_2}*kin-ṣi* ŠU$_2$-*ma*]; BM 38704 6': *ina* ^{iti}GAN UD.15.KA[M ^{d}UTU *ina* UGU 10 UŠ *ar$_2$* ^{mul}*kin-ṣi* ŠU$_2$-*ma*], "In Month IX, day 15, at the culmination of 10 UŠ behind [the Knee], the sun [sets]" (after Steele 2017). See in particular the daily rising time scheme text A 3414+ obv. iii 31 and rev. iii 28.

556) to claim that this section uses Normal Stars as *ziqpu*-stars, and later Steele (2014) conceptualized these stars as a different set of *ziqpu*-stars, namely Set C. However, this section does not present a new set of *ziqpu*-stars. It is true that the format of presentation in section 9 of BM 36609+ is similar to the format found in *ziqpu*-star lists. Moreover, when the stars in this list overlap with the known *ziqpu*-stars (i.e., the Twins, the Crab, the Head of the Lion, the Chest of the Lion, and the Thigh of the Lion), the intervals between them are those attested in other lists of *ziqpu*-stars, and thus can be correlated with intervals in right ascension. This, however, does not mean the stars listed here were conceptualized as *ziqpu*-stars, since they never appear in any context related to *ziqpu*, i.e., in contexts that use *ziqpu*-stars in their capacity as culminating stars. Rather, the author of BM 36609+ used the idea of intervals between stars to map out the intervals between Normal Stars.

Conclusion

In conclusion, the *ziqpu*-stars are a well-defined and stable set of stars that were employed in several distinct ways. A chronological reconstruction of the *ziqpu*-star tradition is challenging as many of the *ziqpu*-star texts are undatable. Early in their history, MUL.APIN uses them to determine whether heliacal risings took place on appropriate dates. Several Neo-Assyrian texts are dated to the 7th century BCE, where the *ziqpu*-stars are employed to indicate the time of a specific non-periodic event (namely, a storm, an eclipse, and an aspect of a ritual). During the Late Babylonian period, the use of *ziqpu*-stars became more widespread, with applications that harken back to the Neo-Assyrian period. On one hand, they are correlated to horizon phenomena, such as sunrise, sunset, or microzodiacal signs, which could potentially allow for the measurement of the length of daylight, though this is never explicitly stated in the texts themselves. These rising time scheme texts are intricately related to the numerous *ziqpu*-star lists, most of which provide the intervals, translatable to intervals in time, between the *ziqpu*-stars. It is likely that the rising time scheme texts drew on the *ziqpu*-star lists to construct the schemes, as there are two known *ziqpu*-star lists from the Neo-Assyrian period while the rising time schemes are Late Babylonian. On the other hand, the role of the *ziqpu*-stars to describe a non-periodic phenomenon reappears in the Astronomical Diaries, where they are used to describe the time of an eclipse, albeit not consistently, much like was the case during the Neo-Assyrian period. It is worth noting that the Astronomical Diaries that employ the *ziqpu*-stars can be concretely dated to the 4th through 1st century BCE, and it is unclear which texts that feature the *ziqpu*-stars, if any, hail from the intervening centuries between the Neo-Assyrian material of the 7th century BCE and the earliest such Diary from the 4th century BCE.[87]

Thus, the *ziqpu*-stars were a tool used by astronomers to indicate and describe specific moments in time for both periodic and non-periodic phenomena alike. The set of *ziqpu*-stars was remarkably fixed throughout its existence, with barely any deviation from the established twenty-five core stars, unlike the Normal Stars, which are discussed in the following chapter.

Additionally, there is a shift from the qualitative description of the *ziqpu*-stars in MUL.APIN and some of the Neo-Assyrian sources to a more quantitative approach, as exemplified in virtually all Late Babylonian sources, including the Astronomical Diaries. The production and application of both this qualitative and quantitative knowledge, however, is most likely based on a model of the behavior of the *ziqpu*-stars rather than direct observation. Before addressing this topic in Chapter 3, the following chapter surveys the other sets of stars in Babylonian astronomy vis-à-vis the *ziqpu*-stars.

[87] BM 78161, the so-called GU text, has been dated to the 7th to 5th century BCE (Pingree and Walker 1988) but this is speculative and cannot be securely established. See Chapter 4 for further discussion on this text.

Chapter 2: Other Sets of Stars

Introduction

In addition to the *ziqpu*-stars, several other sets of stars are attested in Babylonian astronomy. This chapter examines these other sets of stars with the goal of contextualizing the *ziqpu*-stars as one such set. For each set, questions that have been broached for the *ziqpu*-stars are similarly addressed, though examining each and every attestation of these sets or their constituent members (insofar as they appear in their role as part of these sets) lies beyond the scope of this dissertation. Instead, the different kinds of attestations are explored. Additionally, this chapter examines if and how each of these sets are defined, either explicitly or implicitly. Lastly, the chapter investigates the possible purpose that each set of stars had in the minds of Babylonian astronomers.

While the function of some sets is more apparent, such as in the cases of the Normal Stars, it is important to note that all sets must have had some kind of function in the eyes of those who conceptualized them. That function may have developed or even changed over time. Yet it is possible to say that some sets were tools used by astronomers in order to practice astronomy, in a more restrictive sense of the word. Other sets served functions that are harder to reconstruct, such as the Stars of Elam, Amurru, Akkad, and Subartu and do not seem to have an immediate astronomical application from a modern perspective. That is not, however, to say that these latter sets were any less significant than the former sets, nor does it reflect on their epistemological value, as an accurate depiction of nature was not a primary goal for most, if not all, of Babylonian astronomy. It is also important to note that a prominent characteristic that all the sets discussed below share is the lack of instructions on how to use them. Rather, there seems to be an implicit assumption that the user of these sets (or more precisely the user of the sources mentioning these sets) would know how to employ them.

Stars in the Paths of Enlil, Anu, and Ea

The tradition of associating numerous stars with the names of the three great gods, Enlil, Anu, and Ea, dates back to at least the middle of the second millennium

BCE.[88] KUB 4, 47, a prayer to the gods of the night found in the Hittite capital Boghazkoi, lists a number of stars mostly in the sequence of their heliacal rising (Horowitz 1998, 158). Although dated to the Middle Babylonian period, it is possible that the list of stars is copied from an Old Babylonian source (Reiner and Pingree 1981, 2). The list of stars is followed by an appeal to "those" of Ea, Anu, and Enlil, taken to refer to the aforementioned stars, using the Akkadian pronoun šūt:

> šu-u$_2$-ut ^{d}e$_2$-a nap-har šu-u$_2$-ut ^{d}a-ni ru-ṣa-ni šu-u$_2$-ut ^{d}en-l[il$_2$] ge$_5$-me-er-ku-nu iš$^{!}$(ZU)-ra-ni...
>
> Those of Ea, all those of Anu, help me, those of Enlil, all of you, make me prosper…
> (KUB 4, 47, rev. 47-48; translation mine)

More explicitly, a Middle Babylonian star catalogue from Nippur, HS 1897, lists three sets of ten stars, with each star preceded by a DIŠ sign and each set followed by a statement identifying them as "those of Ea," "those of Anu," and "those of Enlil."[89] HS 1897 parallels the star catalogue found in section II of VAT 9416,[90] though the latter adds two additional stars per group for a total of twelve stars per set (Horowitz 2014, 101–6). Section III that follows uses the same terminology, and associates each month with three stars, one star for each of the three great gods. Each of these stars is followed by šu-ut, "those of," and the name of one of the three gods. It is worth noting that šūt is a plural pronoun, even though the star name is singular, therefore its purpose is to associate a given star name with a particular set. For example, the star of Anu associated with the Month II is the Old Man: ^{mul}ŠU.GI *šu-ut* ^{d}*a-nim*, "The Old Man, (belonging to) those of Anu" (VAT 9416 III 2).

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88 The reason these three deities were chosen has to do with their position as the three cosmic deities. This is also reflected in the introduction to the celestial omen series Enūma Anu Enlil, where the three gods are said to organize the heavens. See, for example, Koch-Westenholz (1995, 77) for a transliteration and translation of the bilingual introduction. The three paths may be alluded to in Enūma Eliš, where Marduk establishes the order of heavens and sets up the shrines of Anu, Enlil, and Ea (Enūma Eliš IV 145-146) and sets up three stars for the twelve months (Enūma Eliš V 4). For the most recent critical edition of the text, see Lambert (2013).

89 BM 55502 is a Late Babylonian text that closely parallels HS 1897, also preserving a 30-star catalogue. For a study of these two texts, see Oelsner and Horowitz (1997).

90 VAT 9416 and similar texts are often referred to in modern scholarship as astrolabes (with VAT 9416 referred to as Astrolabe B, or Alb B, the most well-preserved text of its kind). The designation of astrolabe, however, is a misnomer, and stems from the fact that some of these texts are circular with diagrams of stars on them, artificially resembling the astrolabes of the Islamic period and later. The original name of these texts was Three Stars Each, as they associated three stars—one for each path—with each month.

The format of presentation used in VAT 9416 II is also found at the beginning of MUL.APIN (I i 1 - I ii 35), where MUL.APIN lists the stars of Enlil, Anu, and Ea. It enumerates the constituent stars of each association, followed by a tallying statement.[91] For example, the stars of Enlil end with: 33 MUL^{meš} *šu-ut* ^{d}*en-lil*$_2$ “33 stars of Enlil” (MUL.APIN I i 39). It is worth noting that MUL.APIN lists the stars of Enlil first and the stars of Ea last, thereby reversing the order found in the other aforementioned texts.

In two other places MUL.APIN adds the logogram KASKAL, Akkadian *harrānu* for “path” or “road,” before “those of” Enlil, Anu, and Ea.[92] The first case is in the introductory and concluding statements regarding the *ziqpu*-stars, where MUL.APIN states that the *ziqpu*-stars are in the Path of Enlil:

I iv 1-2 DIŠ MUL^{meš} ša$_2$ ziq-pi ša$_2$ ina KASKAL šu-ut ^{d}en-lil$_2$ ina MURUB$_4$ AN-e ina IGI-et GABA ša$_2$ ŠEŠ AN-e GUB-ma ...
I iv 7-8 PAP an-nu-tu MUL^{meš} ša$_2$ ziq-pi ša$_2$ KASKAL šu-ut ^{d}en-lil$_2$ ša$_2$ ina MURUB$_4$ AN-e ina IGI-et GABA-ka GUB^{me}-zu-ma ...

I iv 1-2 ¶ The *ziqpu*-stars that stand in the path of those of Enlil in the middle of the sky, opposite the chest of the observer of the sky...
I iv 7-8 All these are the *ziqpu*-stars of the path of those of Enlil that stand in the middle of the sky, opposite your chest…
(MUL.APIN I iv 1-2 and 7-8; Hunger and Steele 2019)

The second case of *ina* KASKAL *šūt* in MUL.APIN is in the section that details the changing position of the sun throughout the year, corresponding to the seasons:

II Gap A 1 [DIŠ] TA UD 1 KAM ša$_2$ ^{iti}ŠE EN UD 30 KAM ša$_2$ ^{iti}GU$_4$ ^{d}UTU ina KASKAL šu-ut ^{d}a-nim
II Gap A 2 GUB-ma zi-qu u UD.D[A]
- -
II Gap A 3 [DIŠ] TA UD 1 KAM ša$_2$ ^{iti}SIG$_4$ EN UD 30 KAM ša$_2$ ^{iti}IZI ^{d}UTU
II Gap A 4 ina KASKAL šu-ut ^{d}en-lil$_2$ GUB-ma BURU$_{14}$ u uš-šu$_2$
- -
II Gap A 5 [DIŠ T]A UD 1 KAM ša$_2$ ^{iti}KIN EN UD 30 KAM ša$_2$ ^{iti}APIN ^{d}UTU

[91] The number of DIŠ signs do not match the number of stars given in the tallying statements. There are only 31 DIŠ signs against 33 stars of Enlil, 20 DIŠ signs against 23 stars of Anu, and 13 DIŠ signs against 15 stars of Ea. For a discussion of this issue and a solution to this discrepancy, see Hunger and Steele (2019, 165–70).

[92] The term translated as “path” in scholarship is the logogram KASKAL, Akk. *harrānu*. The most common meaning of this word is that of a road, path, or main thoroughfare. By extension, it can also mean major undertakings that conceptually require some kind of journey, such as business trips or military campaigns, or related notions, such as corvée service or an expeditionary force. The semantic field of the term, then, pertains to something of significant length and/or duration.

II Gap A 6 ina KASKAL šu-ut ^{d}a-nim GUB-ma zi-qu u UD.DA

II Gap A 7 [DIŠ TA UD 1 K]AM ša$_2$ ^{iti}GAN EN UD 30 KAM ša$_2$ ^{iti}ZIZ$_2$ ^{d}UTU ina KASKAL

šu-ut ^{d}e$_2$-a GUB-ma EN.TE.NA

II Gap A 1 ¶ From the 1st day of Month XII until the 30th day of Month II, the sun stands in the path of those of Anu:
II Gap A 2 wind and warm weather.

II Gap A 3 ¶ From the 1st day of Month III until the 30th day of Month V, the sun
II Gap A 4 stands in the path of those of Enlil: harvest and heat.

II Gap A 5 ¶ From the 1st day of Month VI until the 30th day of Month VIII, the sun
II Gap A 6 stands in the path of those of Anu: wind and warm weather.

II Gap A 7 ¶ From the 1st day of Month IX until the 30th day of Month XI, the sun stands in the path of those of Ea: winter.

(MUL.APIN II Gap A 1-7; Hunger and Steele 2019)

The change in the sun's position in the sky also appears in K 4292, Text III of the assumed tablet 50 of Enūma Anu Enlil:

> KASKAL ^{d}UTU še-pi-it TUR$_3$ šu-ut ^{d}DIŠ KASKAL ^{d}UTU m[i-šil T]UR$_3$ šu-ut ^{d}a-nu
> KASKAL ^{d}UTU SAG E$_2$.TUR$_3$ šu-u[t ^{d}en-lil$_2$ … T]UR$_3$ ma ša$_2$ sin UD u KAL BU NU
>
> The path of the sun at the foot of the cattle-pen (contains) those of Ea; the path of the sun at the middle of the cattle-pen (contains) those of Anu; the path of the sun at the head of the cattle-pen (contains) those of Enlil …
> (BPO 2, Text III 24b, rev. 16-17; Reiner and Pingree 1981)

The text uses the imagery of a cattle-pen, the logogram TUR$_3$ for Akkadian *tarbaṣu*. Rochberg (2010b, 348–50) interprets the cattle-pen as representing the entire sky. However, Pingree (Reiner and Pingree 1981, 17–18; Hunger and Pingree 1989, 137) understood the cattle-pen as referring to the eastern horizon alone. He divided the cattle-pen into three arcs on that horizon, viewing these horizon arcs as the paths of Ea, Anu, and Enlil, though it seems that later he considered the paths to be arcs on the western horizon as well (Hunger and Pingree 1999, 61).[93] This differs from how most scholars understand the three paths, taking them as bands of declinations stretching across the skies (e.g., Bezold, Kopff, and Boll 1913, 8; Weidner 1915, 1:46–49; Schaumberger 1935, 321–22; van der Waerden 1949). The meaning of the term KASKAL is indeed more in line with this interpretation, due to its semantic meaning.[94] Based on the identification of these stars, the Stars of Enlil fall roughly north of circa 17° declination, the Stars of Anu fall between 17° to -17° declination, and the Stars of Ea are roughly south of -17° declination (see, e.g., Hunger and Steele 2019, 171). The underlying assumption is that the Stars of Ea, Anu, and Enlil and the Paths of Ea, Anu, and Enlil relate to the same concept.[95] In other words, the Stars of Ea, Anu, and Enlil lie in the Paths of Ea, Anu, and Enlil respectively. There is a certain caveat that comes with this assumption. If one assumes the paths are well-defined with clear lines of demarcation, one would expect to find full agreement between the sources as to which stars fall into which path. Yet there is no such agreement, even within the same source, as VAT 9416 section II and section III differ slightly.[96] The following table provides a comparison of associations between MUL.APIN, VAT 9416 II and III, and CT 33 9, a Neo-Assyrian list from Ashurbanipal's library:[97]

[93] K. 3601+Rm. 103, a manuscript belonging to Group F of the Venus omens explicitly mentions Venus appearing both in the east and west in the paths of Enlil, Anu, and Ea:

> DIŠ ^{mul}dele-bat ina ^{d}UTU.E$_3$ u ^{d}UTU.ŠU$_2$.A ina KASKAL šu-ut ^{d}en-lil$_2$ DU-ma SIG$_5$ ša$_2$ ^{kur}URI^{ki}
> [DIŠ ^{mu}]^{l}dele-bat ina ^{d}UTU.E$_3$ u ^{d}UTU.ŠU$_2$.A ina KASKAL šu-ut ^{d}a-nim DU-ma SIG$_5$ ša$_2$ ^{kur}NIM.MA^{ki}
> [DIŠ ^{mu}]^{l}dele-bat ina ^{d}UTU.E$_3$ u ^{d}UTU.ŠU$_2$.A ina KASKAL šu-ut ^{d}e$_2$-a DU-ma SIG$_5$ ša$_2$ ^{kur}MAR.TU^{ki}
>
> If Venus in the east or the west stands in the path of Enlil: good fortune for Akkad.
> If Venus in the east or the west stands in the path of Anu: good fortune for Elam.
> If Venus in the east or the west stands in the path of Ea: good fortune for Amurru.
> (K. 3601+Rm. 103, obv, 10-12; after Reiner and Pingree 1998, 214–21)

At the very least, this shows that for the author of this manuscript, the three paths were not exclusively restricted to the east.

[94] See fn. 92 above for the semantic meaning of KASKAL, Akk. *harrānu*.

[95] Note, however, the implicit acknowledgment that these many be separate yet related concepts in discussion of these stars in Hunger and Steele (2019, 171): "The three groups of stars, those of Enlil, Anu, and Ea *can be associated* with the three 'paths' (*harrānu*) of Enlil, Anu, and Ea mentioned elsewhere in MUL.APIN" (emphasis mine).

[96] See Hunger and Steele (2019, 172–77) for a discussion of the lack of agreement between MUL.APIN, VAT 9416 III, and CT 33 9.

[97] For an edition, discussion, and previous literature on CT 33 9, see Horowitz (2014, 209–14).

Star	MUL.APIN	VAT 9416 II	VAT 9416 III	CT 33 9[98]
Plow	Enlil	Enlil	Enlil	
Wolf	Enlil	Enlil	-	
Old Man	Enlil	Anu	Anu	
Great Twins	Enlil	Anu[99]	Anu	Enlil(?)[100]
Small Twins	Enlil	[Anu][101]	Anu	Enlil(?)[102]
Crab	Enlil	Anu	Anu	
Lion	Enlil	Anu	Anu	Enlil
King	Enlil	-	Enlil	
ŠU.PA	Enlil	-	Enlil	Enlil
Wagon	Enlil	Enlil	Enlil	
Fox	Enlil	-	Enlil	

---

[98] CT 33 9 is broken in such a way that only the names of four stars of Enlil are preserved. Therefore, I have chosen not to use "-" to mark a missing star that appears in MUL.APIN or VAT 9416, but instead to leave it blank.

[99] MUL.APIN identifies the Great Twins as Lugalirra and Meslamtaea. However, VAT 9416 II disassociates the two pairs. In VAT 9416 II, Lugalirra and Meslamtaea seem to be simply be referred to as "the Twins," while the Great Twins are identified as Šullat and Haniš:

1. DIŠ ^{mul}[MAŠ.TAB.BA ša$_2$ ina …] ⸢^{d}⸣a-nim GUB
2. ^{d}luga[l]-⸢ir$_9$-ra u ^{d}⸣mes-lam-ta-e$_3$

----

3. DIŠ ^{mul}MAŠ.TAB.BA.GAL.GAL ša$_2$ ina IGI-it ^{d}a-nim GUB
4. ^{d}PA u$_3$ ^{d}LUGAL

(VAT 9416 II, rev. ii, after Horowitz 2014)

This is in contrast to MUL.APIN, which lists Šullat and Haniš as stars of Ea: DIŠ 2 MUL^{meš} *ša$_2$* EGIR-*šu$_2$-nu* GUB-*zu* ^{d}PA *u* ^{d}LUGAL ^{d}UTU *u* ^{d}IM (I ii 22). For a discussion of this discrepancy, see Horowitz (2014, 114).

[100] Since CT 33 9 only preserves part of this star name, it is unclear which of the two pairs of twins, the Great Twins or the Small Twins, are listed here: [...] ^{mul}MAŠ.TAB.B[A …] (rev. 3').

[101] See fn. 99 above.

[102] See fn. 100 above.

ṭurru of the Wagon[103]	Enlil(?)	Enlil	-	
Sitting Gods of Ekur	Enlil	-	-	Anu[104]
Goat	Enlil	Enlil	Enlil	Enlil
Panther	Enlil	Anu	Anu	
Pig	Enlil	Enlil	Enlil	
Ford	Enlil	Anu	Anu	
Jupiter	Enlil	Enlil	Enlil	
Field	Anu	Ea	Ea	Anu
Swallow	Anu	Anu	Anu	Anu
Anunitu	Anu	Enlil	Enlil	Anu
The Stars	Anu	Ea	Ea	Anu
Bull of Heaven[105]	Anu	Ea	-	Anu
True Shepherd of Anu	Anu	Ea	Ea	Anu
Rooster	Anu	-	-	Ea
Arrow	Anu	Ea	Ea	Anu

[103] The identity of the star of Enlil listed in VAT 9416 section II between the Wagon and the Goat is somewhat elusive: DIŠ MUL *ša i-na ṭu-ri-ša* GUB-[*zu*] SA_5 *i-na pu-ut ni-ru* ^{d}*e*[*n-lil₂*], "The star that stan[ds] in its ṭurru, the red one at the front offside of the Yoke, (the Yoke being) Enlil" (VAT 9416 II obv. iii 11-12). MUL.APIN lists six stars between the Wagon and the Goat. One of them uses a similar phraseology: DIŠ MUL *ša ina ṭur-ri-šu₂* GUB-*zu* ^{mul}IBILA.E_2.MAH DUMU *reš-tu-u₂* ^{d}*a-nu-um*, "The star that stands in its *ṭurru*, the Heir of the Sublime Temple, the first-ranked son of Anu" (MUL.APIN I i 21). However, ṭurru in VAT 9416 relates back to the preceding Wagon constellation, while ṭurru in MUL.APIN relates back to the preceding Wagon of Heaven constellation. The term ṭurru itself refers to some kind of astronomical feature, often a part of wagon constellations. Yet a Neo-Assyrian incantation associates the Heir of the Sublime Temple with the Wagon, not the Wagon of Heaven:

> EN_2 IBILA.E_2.MAH IBILA.E_2.MAH *aplu rabû ša* Enlil *attama*
> *ištu* Ekur [*t*]*uridamma ina qabal šamê itti* ^{mul}MAR.GID_2.DA *tazzaz*
>
> Incantation: Heir of the Sublime Temple, Heir of the Sublime Temple, great heir of Enlil are you.
> From the Ekur [you] come down here, and in the midst of the heavens you stand with the Wagon.
> (BAM 542 iii 13-16 and dupl. ND 5497/21+ ii 4'-9'; after Reiner 1995, 20, fn. 71)

While it is possible that the ṭurru of the Wagon from VAT 9416 II is not listed in MUL.APIN, if MUL.APIN does include it, it seems that the Heir of the Sublime Temple is the most likely candidate. For an attempt to identify the Heir of the Sublime Temple, see Beaulieu et al. (2018, 58–60).

[104] $[^{mu}]^{l}$DINGIR.TUŠ.A^{meš}, without the addition of *šu-ut* e_2-kur that appears in MUL.APIN.

[105] The name of this star is written in MUL.APIN as DIŠ ^{mul}GU_4.AN.NA ^{d}*is le-e* AGA ^{d}*a-nim*, "The Bull of Heaven, the Jaw of the Bull, the crown of Anu" (MUL.APIN I ii 1). VAT 9416 II and CT 33 9 only list parts of this identification: ^{mul}*is le-e a-gi* ^{d}*a-nim* (VAT 9416 II obv. i 8) and [^{mul}G]U_4.AN.NA (CT 33 9 rev. 10').

Bow	Anu	Ea	Ea	
Snake	Anu	Enlil[106]	Enlil	
Raven	Anu	Anu	Anu	Anu
Furrow	Anu	-	-	Anu
Scales	Anu	Anu	Anu	Anu
Eagle	Anu	Enlil	Enlil	Anu
Venus	Anu	Anu	Anu	
Mars	Anu	Ea	Ea	
Fish	Ea	Ea	Ea	Ea
Great One	Ea	-	Ea	Ea
Eridu	Ea	-	-	Ea
Ninmah	Ea	Ea	Ea	Ea
Mouse	Ea	Ea	Enlil[107]	
Šullat and Haniš	Ea	Anu(?)[108]	-	Ea
Numušda	Ea	-	Ea	Ea
Mad Dog	Ea	Ea	Ea	
Scorpion	Ea	Anu	Anu	
Šarur and Šargaz	Ea	-	-	Ea
Pabilsag	Ea	-	-	Ea
Goat-fish	Ea	-	-	Ea
Crown/Yoke of the South [109]	-	Enlil	-	
The Planet at its Tail[110]	-	-	-	Ea
^{d}u$_3$-ge-e[111]	-	-	-	Ea

[106] The third Enlil-star in VAT 9416 section II is ^{d}MUŠ *u* ^{d}*nin-giš-z*[*i-da*]. The third Enlil-star in section III is ^{mul}MUŠ. See Horowitz (2014, 116) for a possible amendation and suggested identification.
[107] Out of the constellations listed in section II and section III of VAT 9416, the Mouse is the only one that differs in its association. In section II it is an Ea-star and in section III it is an Enlil-star.
[108] See fn. 99 above.
[109] DIŠ MUL SA$_5$ *ša ina* ZI IM.KUR.R[A] IGI-*it* AGA/ŠUDUN$^{!}$ GUB AGA/ŠUDUN$^{!}$ IM.ULU$_3$$^{⌜lu⌝}$, "The red star that stands at the rising of the eastwind facing the Crown/Yoke is the Crown/Yoke of the South (VAT 9416 II rev. iii 7-8). The identity of this star is uncertain, as its name is a hapax. See Horowitz 2014: 117-118 for a discussion on this star.
[110] CT 33 9 begins the list of the stars of Ea with the Great One and a star simply identified as the Planet at its Tail: ^{mul}GU.LA ^{mul}UDU.IDIM *ša$_2$ ina* KUN^{meš}. It is unclear what this refers to, though Horowitz (2014: 222) suggests it refers to the tail of the constellation of the Swallow.
[111] This star only appears in CT 33 9 and the partially preserved astronomical table Nv. 10. For a discussion of this star name, see Horowitz (2014, 222).

As can be seen from the table above, there is greater agreement between MUL.APIN and CT 33 9, and with the exception of the Mouse, section II and III of VAT 9416 agree with each other, though they sometimes mention different stars. The differences in association suggest that the sets of the Stars of Ea, Anu, and Enlil were neither strict nor based purely on empirical observation.

It is also worth noting the inclusion of planets as Stars in the Path of Enlil, Anu, and Ea.[112] Like the sun and moon, the planets can appear in any of the three paths. Hunger and Steele (2019: 177-8) have suggested that the names of the planets in these lists actually refer to the planets' *bīt niṣirti*. They note the exception of Mars, namely that its *bīt niṣirti* falls in the Path of Ea while MUL.APIN refers to it as a star of Anu.[113] However, only Mars has a different association in VAT 9416, where it appears as a star of Ea. It is possible that other texts which refer to the planets' *bīt niṣirti* are more closely related to the Three Stars Each tradition than to MUL.APIN.

Regardless, the question still remains whether the designation *Stars* of Enlil, Anu, and Ea is the same as the designation of the *Stars in the Path* of Enlil, Anu, and Ea. In almost all cases, sources tend to favor one or the other. For example, sources for the Venus and Jupiter omens of Enūma Anu Enlil published in BPO 3 and 4 respectively either use *ina šūt* or, more often, *ina* KASKAL *šūt* with few exceptions.[114] Similarly, Neo-Assyrian letters and reports exclusively make use of *ina* KASKAL *šūt*, most often when referring to the position of Venus and Jupiter.[115] However, there are two sources

[112] MUL.APIN lists Mercury and Saturn as stars of Anu.

[113] The *bīt niṣirti* or *ašar niṣirti*, "house of secret" or "place of secret" respectively, are the precursors to the Greek hypsomata, and refer to positions in the sky in which a planet exerts its most substantial influence and may reveal secret knowledge to the astrologer. See Hunger and Pingree (1999, 28–29), and more recently Reynolds (2019, 32–33, 271–84) and Fincke and Horowitz (2017).

[114] The exceptions are K. 800 (BPO 3, 82-83), K. 7936+ (BPO 3, 210-211), K. 3601 (BPO 3, 220-221), and K. 2346+ (BPO 3, 244-245). Yet even in these cases, the sources use *ina* KASKAL *šūt* in all but one or two lines.

[115] SAA 8, 5, obv. 8: [DIŠ] ⸢^{mul}⸣*dele-bat ina* KASKAL *šu-ut* ^{d}*e$_2$-a*; SAA 8, 54, obv. 3: DIŠ ^{mul}SAG.ME.GAR *ina* KASKAL *šu-ut* [^{d}*en-lil$_2$* KUR-*ha*]; SAA 8, 115, rev. 5: DIŠ ^{d}SAG.ME.GAR *ina* KASKAL *šu-ut* ^{d}*a-nim* IGI; SAA 8, 144, obv. 6': DIŠ [x *ina* KASKAL] *šu-ut* ^{d}*en-lil$_2$ ib-il-ma*; SAA 8, 170, rev. 5: DIŠ ^{mul}SAG.ME.GAR *ina* KASKAL *šu-ut* ^{d}*a-nu* IGI; SAA 8, 175, obv. 4: DIŠ ^{d}*dele-bat ina* KASKAL *šu-ut* ^{d}*en-lil$_2$* IGI-*ir*; SAA 8, 211, obv. 1: [DIŠ] ^{mul}SAG.ME.[GAR] *ina* KASKAL *šu*-[*ut* ^{d}*en-lil$_2$* KUR-*ḫa*]; SAA 8, 323, obv. 4: DIŠ ^{mul}SAG.ME.GAR *ina* KASKAL *šu-ut* ^{d}*en*-[*lil$_2$*] ⸢GUB⸣-*ma*; SAA 8, 326, obv. 3: [DIŠ ^{mul}]SAG.ME.GAR *ina* ⸢KASKAL⸣ [*šu-ut* ^{d}*a-nu*] IGI; SAA 8, 339, obv. 1-2: [DIŠ] *ṣal-lum-mu*-[*u ina* KASKAL *šu-ut* (x)] ^{d}*a-num*; SAA 8, 349, rev. 2: [DIŠ ^{d}*dele*]-⸢*bat*⸣ *ina* KASKAL *šu*-[*ut* ^{d}]⸢*en*⸣-*líl* IGI-*ir*; SAA 8, 456, obv 1: DIŠ ^{mul}*ṣal-lum-mu-u$_2$ ina* <KASKAL> *šu-ut* ^{d}*a-nu* IGI; SAA 10, 65, ln. 2': [x x x x KASKAL *šu-ut* ^{d}]*a-nim* [x]; SAA 10, 79, rev. 8-9, rev. 12-14, rev. 18-20: ^{d}*ša$_2$-maš ina* KASKAL *šu-ut* ^{d}*a-num ša$_2$-ru-ri-šu$_2$ ma-aq-tu$_2$* … ^{d}*ša$_2$-maš ina* KASKAL *šu-ut* ^{d}*a-num ip-pu-ha-am-ma šum-qut ša$_2$-ru-ru-šu$_2$* … *ina* KASKAL *šu-ut* ^{d}*a-num* ⸢*lum*⸣-*nu ša* ^{kur}NIM.MA^{ki} [*šu*]-*u*; SAA 10, 100, obv. 5-6: [^{mul}*ṣal*]-*bat-a-nu ina* KASKAL *šu-ut* ^{d}*en-lil$_2$ it-ti* GIR$_3$^{meš} [^{mul}]ŠU.GI *it-tan-mar*; SAA 10, 362, obv. 14'-15': DIŠ ^{mul}SAG.ME.GAR *ina* KASKAL

that make explicit use of both classifications, MUL.APIN and CT 33 9. As previously discussed, MUL.APIN begins with a list of the Stars of Enlil, Anu, and Ea (MUL.APIN I i 1 - ii 35). But when dealing with the position of the *ziqpu*-stars in the sky (MUL.APIN I iv 1-3 and 7-9) and the seasonal position of the sun (MUL.APIN II Gap A 1-7), MUL.APIN adds the term KASKAL.

Similarly, CT 33 9 seems to refer to these stars as one and the same. The beginning of the obverse addresses them as Stars in the Path of Anu, Enlil, and Ea in a bilingual introduction, first in Sumerian and then in Akkadian:

1 MUL ⸢SAR⸣ GUB.BA.NAM KASKAL <AN> ^{d}EN.<LIL$_2$>.LA$_2$ ^{d}EN.KI
2 DINGIR.GAL.GAL.E.NE 3.A.BI$^{!}$ AN.NA NAM.SUKUD.DA
3 IGI.BAR.RA.ZU.ŠE$_3$$^{!}$ LU$_2$ MUL.BI DINGIR.RE.E.NE
4 [GI]Š.HUR.RU DIŠ.GIM HE$_2$.EN.<<erasure>>.IB$_2$.ZAL.ZAL.LA
5 [MU$^{?}$.U]N$^{?}$.GI.NE.EŠ.AM$_3$

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6 [kakkabū u niphātu ša] AN-e KASKAL šu-ut ^{d}a-nim šu-ut ^{d}en-lil$_2$
7 [šu-ut ^{d}e$_2$-a D]INGIR.MEŠ GAL.MEŠ še-lal-tu-šu-nu
8 [x x x] a-⸢na⸣ nap-lu-si-ka
9 [ša$^{?}$ DINGIR.MEŠ G]A[L.ME]Š ina u$_2$-ṣur-tu
10 [x x x x x x] x ku-un-[nu]

The rising stars that stand (in) the Paths of <Anu>, Enlil, and Enki, the Great Gods, the three of them, which you observe up high in the sky, which the gods, according to plan, keeping these stars present as a unit, [have f]ixed in place.

[The stars and rising of] the sky of the Path of Anu, of Enlil, [of Ea,] the Great [G]ods, the three of them [...] that you observe [which$^{?}$ the Gr]ea[t Gods], according to plan [... …], are fix[ed] in place.
(CT 33 9; Horowitz 2014: 210)

Unfortunately, the rest of the obverse is broken. The reverse, however, contains three lists of twelve stars, beginning with the Stars of Enlil, followed by the Stars of Anu, and then the Stars of Ea. Due to their location on the lower part of the reverse, most of the Stars of Enlil are lost, while the Stars of Anu are mostly preserved and the Stars of Ea fully preserved. The constituent stars are listed in two columns of six

šu-ut ^{d}*a-nim* IGI-*ir*; SAA 10, 363, b.e. 17 - rev. 2, rev. 5, rev. 9-10, rev. 13-14: *ina* KASKAL *šu-ut* ^{d}*a-nim ina qaq-qar* ^{mul}SIPA.ZI.AN.NA *it-ta-mar … ina* KASKAL *šu-ut* ^{d}*a-nim šu-u$_2$ … šap-la* ^{mul}GIŠ.GIGIR *ina* KASKAL *šu-ut* ^{d}*en-lil$_2$ iz-za-az …* ^{mul}SAG.ME.GAR *ša ina* KASKAL *šu-ut* ^{d}*a-nim*.

names each, followed by a ruling and a tallying statement which refers to them simply as Stars of Enlil, Anu, or Ea:

Rev.

1’ [^{mul}x x x] ^{m}⸢^{ul}...]
2’ [^{mul}x x x] ^{mul}[...]
3’ [^{mul}x x x] ^{mul}MAŠ.TAB.B[A.(GAL.GAL/TUR.TUR)]
4’ [^{mul}x x x] ^{mul}UR.GU.[LA]
5’ [^{mul}x x x] ^{mul}ŠU.P[A]
6’ [^{mul}x x x] ^{mul}UZ$_3$

7’ [12 MUL^{me}]^{š} šu-ut ^{d}en-lil$_2$

8’ [^{mul}SIM].MAH ^{mul}IKU
9’ [^{mul}a-n]u-ni-tum MUL.MUL
10’ [^{mul}G]U$_4$.AN.NA ^{mul}SIPA.ZI.AN.NA
11’ [^{mul}K]AK.SI.SA$_2$ ^{mul}UGA^{mušen}
12’ [^{mul}]AB.SIN$_2$ ^{mul}zi-ba-ni-tu$_2$
13’ [^{mu}]^{l}DINGIR.TUŠ.A.MEŠ ^{mul}TI$_8$^{mušen}

14’ [1]2 MUL^{meš} šu-ut ^{d}a-nim

15’ ^{mul}GU.LA ^{mul}UDU.IDIM ša$_2$ ina KUN^{meš}
16’ ^{mul}NU.MUŠ.DA ^{mul}KU$_6$
17’ $^{mul\ d}$u$_2$-ge-e ^{mul}⸢DAR⸣.LUGAL^{mušen}
18’ ^{mul}NUN.KI ^{mul}nin-mah
19’ ^{mul}PA⸢-al⸣ u ^{d}LUGAL ^{mul}šar$_2$-ur$_2$ ^{d}šar$_2$-gaz
20’ ^{mul}PA.[B]IL.SAG ^{mul}SUHUR.MAŠ$_2$^{ku_6}

21’ 12 MUL^{meš} šu-ut ^{d}e$_2$-a

(CT 33 9; Horowitz 2014: 210)

As discussed above, CT 33 9 shares more in common with MUL.APIN than with VAT 9416, as the designation of these stars is more in line with the one found in MUL.APIN. Additionally, CT 33 9 rev. presents the paths in the same order that they appear in MUL.APIN, namely Enlil, Anu, and Ea, as opposed to the order in VAT 9416, namely Ea, Anu, and Enlil. The reason why Anu is fronted in the introduction to CT 33 9 is most likely related to the similarly bilingual introduction to Enūma Anu Enlil, in which the order of the three gods is the same, i.e., Anu, Enlil, and Ea.[116] Thus, it is clear that at least for the author of CT 33 9, the Stars in the Path of Enlil, Anu, and Ea are the same as the Stars of Enlil, Anu, and Ea. Along with the fact that the two designations are attested in the same contexts with what appears to be the same usage, it is possible to conclude that the Stars of Enlil, Anu, and Ea are shorthand for the Stars in the Paths of Enlil, Anu, and Ea.

Given that, for the most part, the three paths fall within certain bands of declinations, it seems possible that these sets were used to describe celestial positions in a broad sense. Unlike the other methods used to give celestial positions for the sun, moon, and planets, namely the zodiac and the Normal Stars, the three paths were focused on locating stars. This is the case in the uranology text VAT 9428 from Aššur, where the Path of Anu is uniquely used to describe the positions of stars that are adjacent to it:

> u_3 6 MUL$^{\text{meš}}$ bit sak-ki-i i-ti K[ASKAL$^{?}$ MUL$^{\text{meš}}$ š]u-ut $^{\text{d}}$a-nim li-me-tam
>
> and 6 are the stars of Bit Sakki adjacent (to) the P[ath of the Stars o]f Anu, (but) outside (of it).
> (VAT 9428, rev. 13; after Beaulieu et al. 2018)

At the very least, knowing which path a star falls into would help an astronomer narrow their search to a particular stretch of the skies. While in theory, any star could have been designated as a star of one of the three paths, those stars that were indeed part of these sets were likely the most prominent ones, either being visually distinct or being culturally significant.

It is important to note that the usage of this set diminished over time. While it was quite prominent during the second and first half of the first millennium BCE, by the Late Babylonian period this set was rarely used. With the exception of late copies of MUL.APIN, such as BM 34814+35708 (=LBAT 1496+1497) and AO 6478, the *ziqpu*-star list which repeats the introductory statement for the *ziqpu*-stars found in MUL.APIN and itself copies parts of the Neo-Assyrian fragment K 9794, the only other attestation of the paths are found in the Astronomical Diaries in references to the observation of comets, whose records are exceedingly rare.[117] For example, the two diaries from 164 BCE make use of the paths to position a comet, presumably Halley's comet:

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[116] See Koch-Westenholz (1995, 76–78) for the introduction to Enūma Anu Enlil, where she notes the similarity between the introductions of Enūma Anu Enlil and CT 33 9.

[117] Stephenson and Walker (1985, 17) also mention the Neo-Assyrian fragment from the library in Nineveh, K. 250, an astrological compendium that may contain a description of a comet. Note also TU 11 studied by Brack-Bernsen and Hunger (2002) which gives a set of predictive rules, one of which predicts the reappearance of a comet every 72 years (rev. 27-28).

[... ṣal-la]m-mu-u_2 $ša_2$ ina IGI-ma ina ^{d}UTU.E_3.A ina KASKAL šu-ut ^{d}DIŠ ina KI MUL_2.MUL_2 u ^{mul_2}⸢GU_4⸣.AN.NA IGI ana $ŠU_2$ ⸢x⸣ [...] … ⸢x⸣ u ina KASKAL šu-ut ^{d}BE DIB.DIB-iq

[... the co]met which previously had been seen in the east in the path of Anu in the area of the Pleiades and Taurus, to the west … [...] … and passed along in the path of Ea.
(ADART 3, -163B, obv. 16-17; Sachs and Hunger 1996)

[... ina KASKAL š]u-⸢ut⸣ ^{d}BE ina KI PA 1 $KUŠ_3$ ina IGI MUL_2.BABBAR 3 $KUŠ_3$ ana SI ⸢NIM⸣ [...]

[... in the path] of Ea in the area of Sagittarius, 1 cubit in front of Jupiter, (the comet) being 3 cubits high to the north, … [...]
(ADART 3, -163C_1, obv. 9'; Sachs and Hunger 1996)

The Astronomical Diaries do not refer to the comets as Stars in the Path of Enlil, Anu, or Ea, but simply use the path to describe their position. This is in line with the usages of the paths in the Neo-Assyrian correspondences[118] and Enūma Anu Enlil, supporting the idea suggested above that these classifications were used for celestial geography. It is likely that scarce usage of these classifications in the Late Babylonian period was due to an increased interest in positioning the sun, moon, and planets by means of the zodiac or the Normal Stars.

Stars of Elam, Akkad, Amurru, and Subartu

The lands of Elam, Akkad, Amurru, and Subartu appears in omen literature, often as the land affected by an omen's apodosis or as a way to designate direction, somewhat similar to the cardinal directions of south, north, west, and east respectively.[119] More abstractedly, these names of lands were also used to describe the direction of the apparent movement of the eclipse shadow across the face of the moon in the lunar

[118] Note Parpola (2017), where the paths are mentioned in a cultic context with no direct relevance to their usage as an astronomical term: SAA 20 42, rev. iii 17; SAA 20 49, ln. 191; SAA 20 52 rev. iii 43.
[119] See Horowitz (2014, 205) for primary and secondary sources, particularly Rochberg-Halton (1988, 51–55). It is worth mentioning that Ptolemy discusses the relationship between stars and countries in Book II.3 of the *Tetrabiblos*, though it bears no similarity to the stars of Elam, Akkad, Amurru, and Subartu of Babylonian tradition.

eclipse omens of Enūma Anu Enlil, which in turn relates to the land affected by the eclipse's omen (Rochberg-Halton 1988, 20–21). Associating the quadrants of the moon to the names of these lands continued well into the first millennium, though there are variations in the correlation of a given land name with a given quadrant (Rochberg-Halton 1988, 51–55; but see also Parpola 1983, 406–7).

Relevant to the notion of sets of stars, these land names were also used in certain texts to qualify specific stars as Stars of Elam, Akkad, Amurru, or Subartu. For example, the Neo-Assyrian report SAA 8 383 qualifies Mars as an Amurru-star and Saturn as an Akkad-star:

> ^{mul}ṣal-bat-a-nu MUL KUR MAR.TU^{ki} HUL ša$_2$ KUR MAR.TU^{ki} u NIM.MA[^{ki}]
> ^{mul}UDU.IDIM SAG.UŠ MUL KUR URI^{ki} SIG$_5$ ša$_2$ LUGAL be-li$_2$-[ia]
>
> Mars is an Amurru-star; evil for Amurru and Elam. The planet Saturn is an Akkad-star; It is good for the king, [my] lord.
> (SAA 8 383, rev. 5-8; Hunger 1992)

These qualifications, however, are not consistent across the corpus. For example, another Neo-Assyrian report, SAA 8 491, designates Mars as a Subartu-star, and Saturn as an Amurru-star:

> ^{d}ṣal-bat-a-[nu MUL ša$_2$] KUR SU.BIR$_4$^{ki} ba-ʾi-il u$_3$ ša$_2$-ru-⸢ru⸣ na-ši SIG$_5$ ša$_2$ KUR SU.BIR$_4$^{ki} šu-u$_2$ u$_3$ ^{mul}UDU.IDIM SAG.UŠ MUL ša$_2$ KUR MAR.TU un-nu-ut u$_3$ ša$_2$-ru-ru-šu$_2$ ma-aq-tu HUL ša$_2$ KUR MAR.TU^{ki} ti-ib <<KUR>> KUR$_2$ ⸢a⸣-na KUR MAR.TU^{ki} ib-ba-aš$_2$-ši
>
> Mar[s], a Subartu-[star], is bright and carries radiance; it is good for Subartu. And the planet Saturn, an Amurru-star, is faint, and its radiance diminished; it is bad for Amurru; an enemy attack against Amurru will take place.
> (SAA 8 491, rev. 7-12; Hunger 1992)

Of particular note is the Neo-Assyrian composition known as the Great Star List (hereafter abbreviated GSL), a seemingly eclectic astronomical and astrological work. Three exemplars of the GSL from the library of Aššurbanipal include sets for Elam-stars, Akkad-stars, and Amurru-stars.[120] The names of the twelve Akkad- and

[120] These are Source A (K 250+), Source C (K 8067), and Source E (K 11267). A critical edition of the Great Star List remains a desideratum. A preliminary edition is presented in Koch-Westenholz (1995, 187–205), which lists the sources of the Great Star List known at the time. See also Weidner (1915: 9–20; 1959). The lines after the Amurru-stars in the Great Star List enumerates seven *tikpu*-stars, seven *lumāšu*, seven constellations that are conceptualized as twins, seven alternative names for Mars, and seven planets (moon, sun, and the five observable planets). The scarcity of

Amurru-stars and four Elam-stars are preserved across the three manuscripts. The GSL presents these stars by enumerating the names of the constituent stars, two stars per line, followed by a tally and the name of the classification itself (GSL ln. 201-221).[121] This presentation format is similar to the presentation of the Stars of Ea, Anu, and Enlil in section II of VAT 9416[122] and in MUL.APIN I i 1 - ii 35.[123] Yet, greater similarity exists between the Elam-, Akkad-, and Amurru-stars and section III of VAT 9416.[124] Section III lists thirty-six stars, three stars per month, one star each for the Path of Ea, Anu, and Enlil, and these parallel the repertoire of the preserved twenty-eight Elam-, Akkad-, and Amurru-stars. As the table below shows, each trio of Ea-, Anu-, and Enlil-star in one line is identical to the trio of Elam-, Akkad-, and Amurru-stars in the same line:[125]

	VAT 9416 III			Great Star List		
	Ea	Anu	Enlil	Elam	Akkad	Amurru
I	^{mul}IKU	^{mul}dele-bat	^{mul}APIN	[^{mul}dele-bat]	^{mul}APIN	^{mul}IKU
II	MUL.MUL	^{mul}ŠU.GI	^{mul}a-nu-ni-tum	[MUL.MUL]	^{mul}a-nu-ni-tum	^{mul}ŠU.GI
III	^{mul}SIPA.ZI.AN.NA	^{mul}UR.GU.LA	^{mul}MUŠ	[^{mul}UR.GU.LA]	^{mul}SIPA.ZI.AN.NA	^{mul}MUŠ

---

references pertaining to these groups of seven beyond the Great Star List prevents any meaningful discussion of them in the context of this chapter.

121 The line numbers follow the composite in Horowitz (2014, 200–201) and Koch-Westenholz (1995, 196–99). These editions follow the layout of Source A. Sources C and E have slight variations, most likely due to the physical constraints of the tablets. See Horowitz (2014, 202) for a discussion on the layout of sources and *ibid* p. 208-9 for separate editions of the three sources.

122 Note that the order of presentations of the three paths in the Three Stars Each tradition is Ea, Anu, and Enlil, while the order in MUL.APIN is reversed, i.e., Enlil, Anu, and Ea.

123 Note, however, that the GSL lists two names of stars in the same line, divided by a vertical ruling, similar to CT 33 9, though this text lists stars of Enlil, Anu, and Ea. The vast majority of star names in MUL.APIN, however, are listed on separate lines beginning with a DIŠ sign. Similarly, VAT 9416 does not list numerous star names in the same line. Instead, each entry of a star name usually takes 2-3 lines and is separated from the other entries by a horizontal ruling. Each entry in this section of VAT 9416 also begins with a DIŠ sign.

124 There are differences between the thirty-six stars listed in section II of VAT 9416 and the thirty-six stars listed in section III of the same composition: several stars that appear in one section are absent from the other; some stars are associated with different paths in different sections; and certain stars are placed in a different position along the sequence of a given path between the two sections. For a comparison, see the section in this chapter on the stars in the Paths of Enlil, Anu, and Ea.

125 Note that four star names have variant spellings:

Great Star List			VAT 9416	
Akkad IV	^{mul}UD.AL.TAR	=	^{mul}ŠUL.PA.E$_3$	Enlil IV
Amurru VI	^{mul}BIR	=	^{mul}ka-li-tum	Ea VI
Amurru X	^{mul}AL.LUL	=	^{mul}al-lu-ut-tum	Anu X
Akkad XII	^{mul}ni-bi-rum	=	$^{mul\ d}$AMAR.UTU (for Nēberu)	Anu XII

IV	^{mul}KAK.SI.SA$_2$	^{mul}MAŠ.TAB.BA	^{mul}ŠUL.PA.E$_3$	[^{mul}MAŠ.TAB.BA]	^{mul}UD.AL.TAR	^{mul}KAK.SI.SA$_2$
V	^{mul}PAN	^{mul}MAŠ.TAB.BA GAL.GAL	^{mul}MAR.GID$_2$.DA	[^{mul}PAN]	^{mul}MAR.GID$_2$.DA	^{mul}MAŠ.TAB.BA GAL.GAL
VI	^{mul}ka-li-tum	^{mul}UGA	^{mul}ŠU.PA	[^{mul}UGA]	^{mul}ŠU.PA	^{mul}BIR
VII	^{mul}NIN.MAH	^{mul}zi-ba-ni-tum	^{mul}EN.TE.NA.BAR. HUM	^{mul}EN.TE.NA.BAR. HUM	^{mul}zi-ba-ni-tum	^{mul}NIN.MAH
VIII	[^{mu}]^{l}UR.IDIM	^{mul}GIR$_2$.TAB	^{mul}LUGAL	^{mul}GIR$_2$.TAB	^{mul}UR.IDIM	^{mul}LUGAL
IX	[^{mu}]^{l}ṣal-bat-a-nu	^{mul}UD.KA.DUH.A	^{mul}UZ$_3$	[^{mul}UD.KA.DUH.A]	^{mul}UZ$_3$	^{mul}ṣal-bat-a-nu
X	[^{mu}]^{l}GU.LA	^{mul}al-lu-ut-tum	^{mul}TI$_8^{mušen}$	^{mul}GU.LA	^{mul}TI$_8^{mušen}$	^{mul}AL.LUL
XI	[^{mu}]^{l}NU.MUŠ.DA	^{mul}SIM.MAH	^{mul}da-mu	^{mul}NU.MUŠ.DA	^{mul}da-mu	^{mul}SIM.MAH
XII	[^{mul}K]U$_6$	$^{mul\ d}$AMAR.UTU	^{mul}KA$_5$.A	[^{mul}KU$_6$]	^{mul}ni-bi-rum	^{mul}KA$_5$.A

Thus, the order of the Elam-, Akkad-, and Amurru-stars matches the order of the Ea-, Anu-, and Enlil-stars in VAT 9416 III. For example, the *seventh* Elam-, Akkad-, and Amurru-stars are the same stars that appear in VAT 9416 III as the Stars in the Path of Ea, Anu, and Enlil for the *seventh* month. However, there is no one-to-one correspondence between the land names and the paths. For example, the seventh Akkad-star is ^{mul}Zibanitum, which is the Anu-star of month VII, but the eighth Akkad-star, ^{mul}UR.IDIM, is the Ea-star for month VIII. On the basis of this parallelism, Horowitz (2014: 201-2) has restored the missing eight Elam-stars. The following table lists the distribution of Ea-, Anu-, and Enlil-star as Elam-, Akkad-, and Amurru-star. The leftmost column denotes the position in the listed sequence of Elam-, Akkad-, and Amurru-stars:[126]

Position in Sequence	Elam	Akkad	Amurru
1	[Anu I]	Enlil I	Ea I
2	[Ea II]	Enlil II	Anu II
3	[Anu III]	Ea III	Enlil III
4	[Anu IV]	Enlil IV	Ea IV
5	[Ea V]	Enlil V	Anu V
6	[Anu VI]	Enlil VI	Ea VI
7	Enlil VII	Anu VII	Ea VII
8	Anu VIII	Ea VIII	Enlil VIII
9	[Anu IX]	Enlil IX	Ea IX
10	Ea X	Enlil X	Anu X
11	Ea XI	Enlil XI	Anu XI
12	[Ea XII]	Anu XII	Enlil XII

[126] This table follows the one presented in Horowitz (2014, 202), which is modeled after Kugler (1914b, 201).

There is no discernible pattern that seems to govern the distribution of Elam-, Akkad-, or Amurru-stars to the Paths of Ea, Anu, or Enlil. Horowitz (2014: 205) suggested that the only rule that can be gleaned is that the sequence of Elam-, Akkad-, and Amurru-stars cannot mirror the sequence of Ea, Anu, and Enlil, which is the order of the paths in the Three Stars Each tradition (unlike MUL.APIN's Enlil, Anu, and then Ea). For example, it cannot be the case that Ea I = Elam I, Anu I = Akkad I, and Enlil I = Amurru I. Horowitz noted the exception with the twelfth set, which seem to violate this rule, but pointed to the fact that in first millennium Three Stars Each sources, the two stars ^{mul}nēberu and ^{mul}KA$_5$.A switch paths, with the former assigned to the Path of Enlil and the latter to the Path of Anu. If this explanation is accepted, another pattern emerges. For the first ten stars, no same path-to-land assignment repeats itself consecutively, i.e., if Elam = Enlil, Akkad = Anu, and Amurru = Ea in set *n*, then in set *n+1* the path-to-land assignment will be different. If we accept the interchange of ^{mul}*nēberu* and ^{mul}KA$_5$.A suggested by Horowitz, then the eleventh and twelfth set repeat the same path-to-land assignment as the tenth set. This may be related to a tradition of catalogues with only thirty stars for the Paths of Ea, Anu, and Enlil, preserved on HS 1897 and BM 55502. Horowitz (2014: 101-2 and *passim*) suggests that these texts are related to VAT 9416 II. It is possible that a similar development took place with the Elam-, Akkad-, and Amurru-stars, in which originally only ten sets of stars were drawn from the Paths of Ea, Anu, and Enlil. Two additional sets of stars were then added and assigned the same Ea, Anu, and Enlil association as the last set, namely the tenth set. Perhaps by that time, the pattern of not repeating a distribution was discarded or forgotten.

A relationship between the Elam-, Akkad-, and Amurru-stars and the Stars in the Path of Ea, Anu, and Enlil can also be found in a Neo-Assyrian fragment from Nineveh, 1881-7-27, 81. According to the colophon on the reverse, this text is a commentary to Enūma Anu Enlil belonging to Nabû-zuqup-kēnu, a well-known scribe.[127] The badly damaged obverse preserves the names of stars that appear as Elam-, Akkad-, and Amurru-stars in the GSL. Line 4 explicitly qualifies MUL.MUL as an Elam-star, and the preserved sections of lines 5' and 6' begin with traces of what appears to be a KI sign, the final element in the names of Elam, Akkad, and Amurru:

1' [...] (traces) [...]
2' [...] x KUR URI^{ki} ⌜KASKAL⌝ šu-ut ^{d}e[n$^{?}$-lil$_2$$^{?}$ …]

3' [...] ^{mul}dele-bat MUL [KUR ELAM.MA^{ki} …]
4' [...] MUL.MUL MUL KUR ELAM.MA^{ki} ^{mul}ŠU.G[I …]

[127] See Horowitz (2014, 207) for an edition of the reverse and for literature on the colophon. For the activities of Nabû-zuqup-kēnu, see Frahm (2011).

5’ [...]$^{\ulcorner \text{ki?} \urcorner}$ $^{\text{mul}}$SIPA.ZI.AN.NA [...]
6’ [...]$^{\ulcorner \text{ki?} \urcorner}$ $^{\text{mul d}}$MUŠ [...]
7’ [... $^{\text{mu}}$]$^{\text{l}}$MAŠ.TAB.BA [...]
8’ [... $^{\text{mu}}$]$^{\text{l}}$PAN [...]
9’ [... $^{\text{mu}}$]$^{\text{l}}$MAR.GID$_2$.[DA …]
10’ [... $^{\text{mu}}$]$^{\text{l}}$U[GA$^{\text{mušen}}$ …]
11’ [... $^{\text{m}}$]$^{\text{ul}}$nin-m[ah …]
12’ [... $^{\text{mu}}$]$^{\text{l}}$EN.TE.[NA.BAR.HUM …]

1’ …
2’ [...] land of Akkad, the Path of E[nlil? …]

3’ [...] Venus, [an Elam]-star [...]
4’ [...] the Stars, an Elam-star, the Old M[an …]
5’ [...] True Shepherd of Anu [...]
6’ [...] the Snake [...]
7’ [...] Twins [...]
8’ [...] the Bow [...]
9’ [...] the Wagon [...]
10’ [...] the Ra[ven …]
11’ [...] Ninm[ah …]
12’ [...] the Mo[use …]
(1881-7-27, 81 obv. 1’-12’; Horowitz 2014, 207)

Horowitz (2014, 208) suggests that the stars in 1881-7-27, 81 are presented first by their name, followed by their qualification as Elam-, Akkad-, or Amurru-stars. Based on the physical dimensions of the fragment, Horowitz reconstructs that each line presents two stars, with the exception of line 4’. If this reconstruction is accepted, then the stars in 1881-7-27, 81 are organized in a sequence based on their affiliation to the Paths of Ea, Anu, and Enlil (as found in VAT 9416 III) rather than their qualification as Elam-, Akkad-, or Amurru-stars. The following table, adapted and corrected from Horowitz (2014, 208) shows that the sequence is Ea *n*, Anu *n*, Enlil *n*, Ea *n+1*, Anu *n+1*, Enlil *n+1*, and so on:

3’.	Ea I	Anu I	[...]
4’.	Enlil I]	Ea II	Anu II
5’.	Enlil] II	Ea III	[...]
6’.	Anu] III	Enlil III	[...]
7’.	Ea IV]	Anu IV	[...]
8’.	Enlil IV]	Ea V	[...]
9’.	Anu V]	Enlil V	[...]

10’.	Ea VI]	Anu VI	[...]
11’.	Enlil VI]	Ea VII	[...]
12’.	Anu VII]	Enlil VII	[...]

With the exception of line 4’, it is unclear what each of the lines contained after the two star names. Because this text organizes the Elam-, Akkad-, and Amurru-stars found in the GSL according to their associations found in the Three Stars Each tradition, Horowitz (2014, 206–7) called this text “a missing link” between the two traditions.

This apparent relationship between the Elam-, Akkad-, and Amurru-stars and the Stars in the Path of Ea, Anu, and Enlil found in VAT 9416 has led van der Waerden (1974, 67–68) to suggest an evolution of the associations these stars had. He reasoned that the Elam-, Akkad-, and Amurru-stars were the earliest of these associations, dating back to the Old Babylonian period, since the names Elam, Akkad, and Amurru better reflect the geo-political reality of that period. Afterwards came the association with the Paths of Ea, Anu, and Enlil when an attempt was made to rearrange these stars along more scientific lines, classifying them based on their position in the sky vis-à-vis the three paths. This hypothesis, however, cannot be accepted. Firstly, the names Elam, Akkad, and Amurru were still being used in the first millennium, specifically in the context of astronomy and astrology (Horowitz 2014, 203). More importantly, van der Waerden’s suggestion assumes a linear progression of knowledge and implies that the motivation behind the arrangement and supposed rearrangement of these thirty-six stars was to produce a more accurate, even scientific, description of the phenomenal world. Horowitz (2014, 203) rightfully disagrees with van der Waerden’s assumption and advocates that the Three Stars Each tradition was the source of the Elam-, Akkad-, and Amurru-stars, and not the other way around.

The purpose and motivation behind qualifying stars as Elam-, Akkad-, and Amurru-stars remains uncertain. It is also unclear how these qualifications impacted their application. While they do appear in omens, omens also make use of many other stars that do not belong to these sets. Their appearance in omens and the GSL, however, as well as the expansive usage of the land names in astrological context, suggests that the set of Elam-, Akkad-, and Amurru-stars is astrological in nature. This notion may be supported by BM 34387 (=LBAT 1500), a Late Babylonian fragmentary star list preserving the names of nine stars. The names and their sequence match the fourth to twelfth Amurru-stars found in the GSL:

1’ [DIŠ $^{\text{mu}}$]$^{\text{l}}$⌜KAK.SI⌝.[SA …]
2’ DIŠ $^{\text{mul}}$MAŠ.TAB.BA.[GAL.GAL …]
3’ DIŠ $^{\text{mul}}$BIR a-n[a ...]
4’ DIŠ $^{\text{mul}}$nin-m[ah …]
5’ DIŠ $^{\text{mul}}$LUGAL a-[na …]

6’ DIŠ ṣal-bat-a-nu ⌜a⌝-[na …]
7’ DIŠ $^{\text{mul}}$AL.LU[L …]
8’ [DIŠ] $^{\text{mul}}$SI[M.MAH …]
9’ [(x)] DIŠ KUR DIŠ SA[L …]
10’ [DIŠ $^{\text{mu}}$]$^{\text{l}}$⌜KA$_5$.A⌝ [...]

1’ [The] Arro[w …]
2’ The [Great] Twins [...]
3’ The Kidney, fo[r …]
4’ Ninm[ah …]
5’ The King, f[or …]
6’ Mars, f[or …]
7’ The Cra[b …]
8’ The Sw[allow …]
9’ [(...)] … [...]
10’ [The] Fox [...]
(BM 34387; Horowitz 2014, 206)

The preserved section does not explicitly mention any qualification, though line 9’ has what appears to be a KUR sign. However, the Amurru-stars found in the GSL are the only stars in Babylonian astronomy to include this particular collection of stars in this specific order. One possibility, then, is that BM 34387 is a Late Babylonian manuscript of the GSL. However, traces of what may be *ana* follows the names of the stars in lines 3’, 5’, and 6’. The word *ana* could serve to associate the name of a star with another correspondent. Furthermore, line 9’ does not seem to contain any star name. These differences suggest that BM 34387 is not merely a Late Babylonian copy of the GSL. Rather, it is either a different recension or an altogether different composition, perhaps a commentary. Due to the poor condition of the fragment, it is not possible to determine if the Late Babylonian scribe was even aware that these stars were classified as Amurru-stars in the Neo-Assyrian GSL.

In conclusion, the set of Elam-, Akkad-, and Amurru-stars seems to be limited either to omens and a scant few star lists, with the GSL being the most well attested source that also explicitly enumerates the constituent stars. These attestations, along with van der Waerden’s observation that this set was not empirical, strongly suggests that these stars were used in an astrological context. Their significance and the role they had in astrology, however, remains obscure.

Stars in the Path of the Moon

The Stars in the Path of the Moon are a number of constellations which MUL.APIN explicitly defines as the set of stars through which the moon travels.[128] An introductory statement provides the common characteristic of the set (MUL.APIN I iv 31-32). It is then followed by an enumeration of the names of the constituent stars (MUL.APIN I iv 33-37). Finally, the section concludes with a closing statement (MUL.APIN I iv 38-39) which is nearly identical to the introductory statement:

DINGIR^{meš} ša i-na KASKAL ^{d}sin GUB^{meš}-ma ^{d}sin e-ma ITI
<<ina>> pi-rik-šu$_2$-nu DIB^{meš}-ma TAG^{meš}-šu$_2$-nu-ti

MUL.MUL ^{mul}GU$_4$.AN.NA ^{mul}SIPA.ZI.AN.NA ^{mul}ŠU.GI
^{mul}GAM$_3$ ^{mul}MAŠ.TAB.BA.GAL.GAL ^{mul}AL.LUL ^{mul}UR.GU.LA
^{mul}AB.SIN$_2$ ^{mul}zi-ba-ni-tu$_4$ ^{mul}GIR$_2$.TAB ^{mul}pa-bil-sag
^{mul}SUḪUR MAŠ$_2$ ^{mul}GU.LA KUN^{meš} ^{mul}SIM.MAḪ
^{mul}a-nu-ni-tu$_4$ u ^{mul} ^{lu_2}ḪUN.GA$_2$

PAP an-nu-tu$_4$ DINGIR^{meš} ša$_2$ ina KASKAL ^{d}sin GUB^{meš}-ma ^{d}sin e-ma ITI
[pi-rik-šu$_2$-nu DIB]^{meš}-ma TAG^{meš}-šu$_2$-nu-ti

The gods who stand in the path of the Moon, through whose region the Moon during a month
passes repeatedly and keeps touching them:

The Stars, the Bull of Heaven, the True Shepherd of Anu, the Old Man,
the Crook, the Great Twins, the Crab, the Lion,
the Furrow, the Scales, the Scorpion, Pabilsag
the Goat-fish, the Great One, the Tails of the Swallow,
Anunitu, and the Hired Man.

All these are the gods who stand in the path of the Moon, through whose region the Moon during a month
[passes repeatedly] and keeps touching them.
(MUL.APIN I iv 31-39; Hunger and Steele 2019)

[128] For the term "path," written with the logogram KASKAL, see fn. 91 above.

The only difference between the introductory statement and the closing statement that bracket the list of names is that the latter begins with the words PAP *annûtu*, “all these (are),” before repeating the introductory statement verbatim. This bracketing format is also found elsewhere in MUL.APIN, in the first section on the *ziqpu*-stars discussed in Chapter 1.[129] Source E of MUL.APIN uses the term DINGIR, “god,” in the introductory and closing statements when referring to these stars, albeit not when the source enumerates their individual names. The only other source to preserve this part of the section, Source F, uses the determinative MUL, “star,” in the opening statement. The term Source F uses in the closing statement is unfortunately broken, but it almost certainly used the determinative MUL there as well. Regardless, DINGIR and MUL could be used interchangeably as determinatives for stars and planets (Reiner 1995: 5).

The enumeration of the names of the stars bracketed by the introductory and closing statements begins with MUL.MUL (Akk. *zappu*), “the Stars,” the name of the Pleiades in cuneiform sources.[130] It is not surprising that a list of the Stars in the Path of the Moon begins with the Stars constellation, as the conjunction of the two play a significant role in the intercalation schemes, including one found in MUL.APIN. Hunger and Steele (2019, 209–10) divide the rules governing the first intercalation scheme in MUL.APIN into two groups, one of which is based on the “balancing” of the moon and the Stars (see MUL.APIN II Gap A 8-11 and II ii 1-2).[131] Hunger and Steele have convincingly argued that the term “balancing” refers to having the same celestial longitude, i.e., the moon located against the backdrop of the Stars. The relationship between the moon and the Stars is also featured in intercalation schemes found outside of MUL.APIN (Hunger and Steele 2019, 212–13).

The names that follow the Stars are enumerated by the order of the constellations through which the moon passes over the course of a month. The order presented effectively equates an order of increasing celestial longitude. While the constituent star names are not clearly demarcated, recently Hunger and Steele (2019: 195-6) have convincingly shown that there are seventeen such stars.[132] This implies

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[129] MUL.APIN continues with a second section on *ziqpu*-stars, while the text follows the Stars in the Path of the Moon with a section on the planetary and solar passages. See below for a discussion on this.

[130] Note that CAD, under *zappu* meaning 3, gives “the star cluster Pleiades (conceived as the ‘mane’ of the constellation Taurus)” without explicating the idea of a mane. It is likely that it stems from the base meaning of the word *zappu*, “bristle, (animal) hair,” perhaps taken by the editors of the CAD volume Z to refer to the mane of a bull (for Taurus).

[131] The other revolves around the first visibility or acronychal rising of a star (MUL.APIN II Gap A 12-18 and II ii 3-6).

[132] The crux of this ambiguity is in MUL.APIN I iv 36: ^{mul}SUḪUR MAŠ$_2$ ^{mul}GU.LA KUN^{meš} ^{mul}SIM.MAḪ. One way of interpreting KUN^{meš} ^{mul}SIM.MAḪ is to read this as two separate names, the Tails and the Swallow (see, e.g., Horowitz 1998, 170–71), leading to a total of eighteen Stars in the Path of the Moon. Alternatively, these signs can be read as two separate names, the Tails and the Swallow. Doing so would bring the number of constituent stars to eighteen. Hunger and Steele (2019: 195-6) have

that MUL.APIN offers here a descriptive map of what one sees when tracking the movement of the moon. This differs from the later zodiac, which uses abstract mathematical entities to describe positions rather than where the moon can be physically observed within a given constellation. Therefore, the Stars in the Path of the Moon are not simply an early version of the zodiac. They are descriptive in nature and, unlike the zodiac, were not meant to plot celestial positions based on mathematical considerations. It is worth noting, however, that the two reference systems developed and used later in the first millennium to describe the positions of the sun, moon, and planets, namely the zodiac and the Normal Stars, share much of the same repertoire of stars with those in the Path of the Moon.[133]

As mentioned above, the Stars in the Path of the Moon in MUL.APIN neither explicitly states their purpose nor provides instructions on how to use them. In all likelihood, these constellations were a way to describe the position of the moon qualitatively, unlike the much later quantitative way of the zodiac. Out of all celestial bodies, the moon was arguably the most important one throughout Mesopotamian history. However, since the trajectories of the sun and the planets run closely to that of the moon, the Stars in the Path of the Moon could also be useful in describing the positions of these other celestial bodies. Perhaps unsurprisingly, then, MUL.APIN follows the Stars in the Path of the Moon with stating that the sun and the five planets travel along the same path:

DIŠ KASKAL ^{d}sin DU-ku ^{d}UTU DU-ak
DIŠ KASKAL ^{d}sin DU-ku ^{d}šul-pa-e$_{3}$-a DU-ak
DIŠ KASKAL ^{d}sin DU-ku ^{d}dele-bat DU-ak
DIŠ KASKAL ^{d}sin DU-ku ^{d}ṣal-bat-a-nu DU-ak
DIŠ KASKAL ^{d}sin DU-ku ^{mul}UDU.IDIM.GU$_{4}$.UD ša$_{2}$ ^{d}nin-urta MU-šu$_{2}$ DU-ak
DIŠ KASKAL ^{d}sin DU-ku ^{mul}UDU.IDIM.SAG.UŠ DU-ak

PAP 6 DINGIR^{meš} ša$_{2}$ 1-en NA^{meš}-su-nu MUL^{me} AN-e
TAG^{meš} NA^{meš}-su-nu KUR$_{2}$.KUR$_{2}$-ru

¶ The sun travels the (same) path the moon travels.

convincingly argued that KUN^{meš} refers here not to the constellation of the Tails, but rather describes a part of the constellation of the Swallow. The fact that KUN^{meš} is the only term in the list that does not have a MUL determinative lends some support to this idea. Note that KUN^{meš} is a name used for Pisces in many Late Babylonian texts, such as the Astronomical Diaries, where it appears without a determinative for star. However, names of both constellations and zodiacal signs are consistently written without such determinatives in these later texts, in contrast to MUL.APIN, where the determinative is consistently used.

[133] For a recent attempt at plotting the relationship between the Stars in the Path of the Moon, the Normal Stars, and the zodiac, see Kurtik (2021).

¶ Jupiter travels the (same) path the moon travels.
¶ Venus travels the (same) path the moon travels.
¶ Mars travels the (same) path the moon travels.
¶ Mercury whose name is Ninurta travels the (same) path the moon travels.
¶ Saturn travels the (same) path the moon travels.

Together six gods whose places are one (and) who touch the stars of the sky (and) repeatedly change their positions.
(MUL.APIN II i 1-8; after Hunger and Steele 2019)

In terms of presentation and order, this is again reminiscent of the *ziqpu*-stars in MUL.APIN, where the text continues with yet another section on the *ziqpu*-stars, correlating them with heliacally rising stars.

Hunger and Steele (2019, 4–5) have noted that the compilers of MUL.APIN arranged the composition in such a way that one section utilizes information given in earlier sections. This fits well here, where knowledge of the moon's path would also allow one to position the sun and the planets in a similar way. In fact, one may consider the statements about the trajectory of the sun and planets as conceptually being a part of the section dealing with the Stars in the Path of the Moon.

The reasons why these constellations were called Stars in the Path of the Moon, rather than stars in the path of the sun, for example, are cultural and practical. First of all, as mentioned above, the moon was arguably the most significant celestial body throughout Mesopotamian history, resulting in a large amount of astronomical texts devoted to it. Secondly, it is by far the celestial body whose movement is easiest to observe and track. Lastly, it is the fastest moving observable celestial object, traveling through the sky on average about 13° per day. The rapid change in its position would provide skywatchers easier access to observing and conceptualizing its path.

While MUL.APIN is the only extant source to explicitly provide a definition for the Stars in the Path of the Moon, other texts that predate the invention of the zodiac and the Normal Stars make use of them to describe lunar and planetary positions (though never solar). Several Neo-Assyrian letters report lunar and planetary positions,[134] such as SAA 10 224, reporting that Venus is approaching the Furrow:

^{mul}dele-bat a-na ^{mul}AB.SIN$_2$ i-kaš-šad

Venus will reach the Furrow.
(SAA 10 224, obv. 10-11; translation mine)

[134] See SAA 10 texts no. 8, 12, 51, 63, 72, 73, 88, 100, 104, 113, 160, 172, 224, 362, 364. All of these use the Stars in the Path of the Moon to describe celestial positions.

The celestial omens series Enūma Anu Enlil occasionally makes use of the Stars in the Path of the Moon when describing the position of the moon or the planets, most often Venus and Jupiter.[135] For example, the protasis of the following omen describes Venus positioned against the backdrop of the Stars:

> DIŠ ^{mul}dele-bat ⌜ana MUL.MUL UD 2-KAM DU⌝-ma DIB-iq GALGA KUR MAN-ni
>
> If Venus stands within the Stars for two days and then passes (them): the mood of the land will change.
> (VAT 10218, ln. 61; after BPO 2, p. 46)

Similarly, the Stars in the Path of the Moon are mentioned in Enūma Anu Enlil, often correlating the position of the eclipsed moon with a geographical region or event, such as the following Neo-Assyrian text from Nineveh:

> DIŠ UD.DUG$_4$.GA EN.NUN AN.USAN$_2$ ana ITI.3.KAM UD.[10.KAM] BE-ma ina KI ^{mul}PA.BIL.SAG a-dir EŠ.BAR ^{uru}⌜mu-ta⌝-bal // KA$_2$.DINGIR.R[A]
>
> ¶ The period (of an eclipse) of the evening watch is three months and ten days; if in the region of Pabilsag, it (= the moon) is eclipsed, it pertains to Mutabal, alternatively Babylon.
> (1882-5-22, 77, rev. 10; Rochberg-Halton 1988, EAE 20 text g)

Arguably the clearest attestation of the Stars in the Path of the Moon in an astrological context is MNB 1849, a Neo- or Late Babylonian tablet that correlates between regions of the sky in which the moon is eclipsed with cities or events, published by Weidner (1963) and recently treated by Steele (2015b). After an introductory statement (rev. 37), the text offers the list of correlations, referring to the regions of the sky as KI SN, "region of SN," where SN is one of the stars belonging to the

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[135] For planetary positions in relation to the Stars in the Path of the Moon attested in Enūma Anu Enlil, see BPO 2, pp. 20, BPO 3, pp. 6-13, and BPO 4, pp. 1-18 and 29-32. For the position of the moon during a lunar eclipse in Enūma Anu Enlil, see BM 38164; BM 47447; UET 6, 413; VAT 7825; 1880-7-19, 103; 1882-5-22, 77; 1883-1-18, 499. Note, however, the lunar eclipse in Enūma Anu Enlil 17, VI.7: DIŠ *ina* ^{iti}KIN UD.15.KAM AN.MI GAR-*ma ana* ŠA$_3$-*šu$_2$* ^{d}*nin-urta* TU HI.GAR *ana* LUGAL, "If an eclipse occurs in Ulūlu on the 15th day and Sirius enters within it; rebellion against the king" (after Rochberg-Halton 1988, 133). This seems to refer to the occultation of Sirius by the eclipsed moon, an astronomical impossibility, as Sirius is too far from the moon's path to be occulted. Unsurprisingly, Sirius is not one of the Stars in the Path of the Moon. The verb in this phrase, TU (Akk. *erēbu*), can mean "to enter" but also "to set." Therefore, another interpretation is that this refers to the setting of Sirius. In such a case, the prepositional phrase ana ŠA$_3$-*šu$_2$*, "within in," would potentially refer to the time of Sirius's setting, namely during (i.e., within the time of) the eclipse.

Stars in the Path of the Moon. It then concludes with another statement that seems to reiterate the introduction, though it is somewhat broken:

37 KI$^{\text{meš}}$ MUL$^{\text{meš}}$ ša ina ŠA$_3$-bi $^{\text{d}}$sin AN.MI GAR-nu EŠ.BAR a-na IRI$^{\text{meš}}$ ŠUM-nu

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38 DIŠ ina KI MUL.MUL u$_2$-lu $^{\text{mul}}$ŠU.GI a-dir EŠ.BAR BAD$_3$.AN$^{\text{ki}}$ DUR.AN.KI : ŠEŠ.UNUG$^{\text{ki}}$

39 DIŠ ina KI $^{\text{mul}}$GU$_4$.AN.NA a-dir EŠ.BAR ŠEŠ.UNUG$^{\text{ki}}$ u BAD$_3$.AN$^{\text{ki}}$: DUR.AN.KI

40 DIŠ ina KI $^{\text{mul}}$SIPA.ZI.AN.NA u$_2$-lu $^{\text{mul}}$zi-ba-ni-tum a-dir EŠ.BAR $^{\text{iri}}$si-par u UD.UNUG$^{\text{ki}}$

41 DIŠ ina KI $^{\text{mul}}$MAŠ.TAB.BA.GAL.GAL.LA a-dir EŠ.BAR GU$_2$.DU$_8$.A$^{\text{ki}}$

42 DIŠ ina KI $^{\text{mul}}$GIR$_2$.TAB a-dir EŠ.BAR A.AB.BA u NI.TUK$^{\text{ki}}$: bar$_2$-sipa$^{\text{ki}}$

43 DIŠ ina KI $^{\text{mul}}$PA.BIL.SAG a-dir EŠ.BAR $^{\text{iri}}$mu-ta-bal u KA$_2$.DINGIR.RA$^{\text{ki}}$

44 DIŠ ina KI $^{\text{mul}}$GU.LA u$_2$-lu $^{\text{mul}}$SUḪUR.MAŠ$_2^{\text{ku}_6}$ a-dir EŠ.BAR NUN$^{\text{ki}}$ u$_2$-lu IRI $^{\text{d}}$id$_2$

45 DIŠ ina KI $^{\text{mul}}$UR.GU.LA a-dir EŠ.BAR LUGAL UŠ$_2$-ma UR.MAH$^{\text{meš}}$ IDIM$^{\text{meš}}$

46 DIŠ ina KI $^{\text{mul}}$AB.SIN$_2$ a-dir EŠ.BAR AB.SIN$_2$ AB.SIN$_2$ GUN-sa$_3$ i-har-ra-aṣ SU.GU$_7$ ŠE u IN.NU

47 DIŠ ina KI MUL$^{\text{meš}}$ IGI$^{\text{meš}}$ ša$_2$ $^{\text{mul}}$AL.LUL a-dir EŠ.BAR $^{\text{id}_2}$MAŠ.GU$_2$.GAR$_3$ $^{\text{id}_2}$i$_3$-diq-lat ILLU-ša$_2$ LA$_2$-ṭi

48 DIŠ ina KI MUL$^{\text{meš}}$ EGIR$^{\text{meš}}$ ša$_2$ $^{\text{mul}}$AL.LUL a-dir EŠ.BAR $^{\text{id}_2}$pu-rat-tu$_4$ $^{\text{id}_2}$pur-rat-tu$_4$ ILLU LA$_2$-ṭi

49 DIŠ ina ⸢KI⸣ [$^{\text{mu}}$]$^{\text{l}}$AL.LUL a-dir EŠ.BAR UD.KIB.NUN$^{\text{ki}}$

50 DIŠ ina [KI $^{\text{mu}}$]$^{\text{l}}$a-nu-ni-tu$_4$ a-dir EŠ.BAR $^{\text{id}_2}$MAŠ.GU$_2$.GAR$_3$ u EŠ.BAR a-ga-de$_3^{\text{ki}}$

51 DIŠ ina [KI $^{\text{mul}}$S]IM.MAḪ a-dir EŠ.BAR $^{\text{id}_2}$pu-rat-tu$_4$ u EŠ.BAR A.AB.BA : NI.TU[K$^{\text{ki}}$]

52 DIŠ ina ⸢KI⸣ $^{\text{m}}$[$^{\text{ul}}$L]U$_2$.ḪUN.GA a-dir EŠ.BAR UNUG$^{\text{ki}}$ u kul-aba$_4^{\text{ki}}$

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53 [...] x KI$^{\text{meš}}$ MUL$^{\text{meš}}$ ša$_2$ ki-i $^{\text{d}}$sin AN.MI ina ŠA$_3$-šu$_2$-nu ša$_2$ GAR$^{\text{meš}}$ u EŠ.BAR $^{\text{d}}$si[n …]

54 [...] ša$_2$ KA UM.ME.A

37 The regions of the stars within which an eclipse of the moon occurs, (and) the decision given to the (corresponding) cities.

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38 ¶ (The moon) eclipsed in the region of the Stars or the Old Man (corresponds to) a decision (for) Dēr (or) Nippur, alternatively Ur.

39 ¶ (The moon) eclipsed in the region of the Bull of Heaven (corresponds to) a decision (for) Ur and Dēr, alternatively Nippur.

40 ¶ (The moon) eclipsed in the region of the True Shepherd of Anu or the Scales (corresponds to) a decision (for) Sippar and Larsa.

41 ¶ (The moon) eclipsed in the region of the Great Twins (corresponds to) a

decision (for) Kutha.

42 ¶ (The moon) eclipsed in the region of the Scorpion (corresponds to) a decision (for) the Sea(land(?)) and Dilmun, alternatively Borsippa.

43 ¶ (The moon) eclipsed in the region of Pabilsag (corresponds to) a decision (for) Mutabal and Babylon.

44 ¶ (The moon) eclipsed in the region of the Great One or the Goat-fish (corresponds to) a decision (for) Eridu or …[136]

45 ¶ (The moon) eclipsed in the region of the Lion (corresponds to) a decision (that) the king will die and lions will rage.

46 ¶ (The moon) eclipsed in the region of the Furrow (corresponds to) a decision (for) the furrow, the furrow will reduce its yield, scarcity of barley and straw.

47 ¶ (The moon) eclipsed in the region of the Front Stars of the Crab (corresponds to) a decision (for) the Tigris; the Tigris, its water will diminish.

48 ¶ (The moon) eclipsed in the region of the Rear Stars of the Crab (corresponds to) a decision (for) the Euphrates; the Euphrates, (its) water will diminish.

49 ¶ (The moon) eclipsed in the region of the Crab (corresponds to) a decision (for) Sippar.

50 ¶ (The moon) eclipsed in the region of Anunitum (corresponds to) a decision (for) the Tigris and a decision (for) Akkad.

51 ¶ (The moon) eclipsed in the region of the Swallow (corresponds to) a decision (for) the Euphrates and a decision (for) the Sea(land(?)), alternatively Dilmun.

52 ¶ (The moon) eclipsed in the region of the Hired Man (corresponds to) a decision (for) Uruk and Kullaba.

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53 [...] the regions of the stars which as the moon is eclipsed within them, and the decisions … the mo[on …]

54 [...] by the word of an expert.

(MNB 1849 rev. 37-54; translation mine)

With the exception of the Crook, all the Stars in the Path of the Moon appear in MNB 1849. The reason for this omission is unclear. Furthermore, the sequence of the

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[136] The name of this city, IRI ^{d}id$_{2}$ (literally "City of the Divine River") is unattested anywhere else, and thus its identity unknown. Since the city of Eridu is mentioned in the same line, it may be the case that IRI ^{d}ID$_{2}$ is a form of learned writing for the name of Eridu, perhaps to be read phonetically as eri-^{d}id$_{2}$ for Eridu (Weidner 1963, 119). Having two different orthographies in the same phrase is also evident in rev. 47, where the text has both ^{id_2}MAŠ.GU$_{2}$.GAR$_{3}$ and ^{id_2}i$_{3}$-diq-lat for the Tigris river. Somewhat similar is rev. 46, where the first AB.SIN$_{2}$ in the apodosis would probably be read as Akkadian *absinnu* ("furrow") to mirror the name of the constellation in the protasis, and the second AB.SIN$_{2}$ that immediately follows would be read as Akkadian *šer'u* (also "furrow"), which is more commonly attested with the following GUN-sa$_{2}$. Against this interpretation, however, is the fact that the two names in rev. 44 are separated by the Akkadian conjunction *ūlu*, "or," which would not be expected if the two names refer to the same place.

stars mentioned in MNB 1849 is reminiscent of the sequence of the Stars in the Path of the Moon, but has some major differences. With the exception of the Scales, which is noticeably out of place, it is possible to divide these stars into four clusters containing stars that are found along a continuance.[137] The following table lists the stars mentioned in MNB 1849 rev. 37-54, with their position in the sequence from MUL.APIN noted in parenthesis, as well as their clusters:

Cluster	(Place in Sequence in MUL.APIN) Star Name
A	(1) the Stars or (4) Old Man
	(2) Bull of Heaven
	(3) True Shepherd of Anu or (10) Scales
	(6) Great Twins
B	(11) Scorpion
	(12) Pabilsag
	(14) Great One or (13) Goat-fish
C	(8) Lion
	(9) Furrow
	(~7) Front Stars of Crab[138]
	(~7) Rear Stars of Crab[139]
	(7) Crab
D	(16) Anunitum
	(15) Swallow
	(17) Hired Man

This suggests that the same organizing principle used in MUL.APIN, namely what is effectively equivalent to increasing celestial longitude, was not the primary concern here. While the organizing principle is unclear, it is doubtless that the author of MNB 1849 had in mind the Stars in the Path of the Moon. Whether these stars were drawn directly from MUL.APIN or both sources reflect a shared tradition of qualitative description of the moon's path is unknown.[140]

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[137] The reason for the Scales being so out of place is unclear to me.

[138] The Front and the Rear Stars of the Crab do not appear in MUL.APIN, but the Crab as a whole does.

[139] See the footnote above on the Front Stars of the Crab.

[140] Some of the correlations in MNB 1849 are based on a similarity between constellation and event. For example, an eclipse in the Lion foretells rampaging lions, while an eclipse in the Furrow warns of famine. Others are based on associative references, such as an eclipse in the Great One or the Goat-fish, both associated with water, would impact the city of Eridu (as well as the unidentified city

It is important to note that omen protases cannot be equated with observational statements. Omen literature includes both observable and unobservable phenomena, phenomena that are physically impossible, such as an eclipse shadow traveling on the face of the moon from west to east (Rochberg 1999). Instead, the description of phenomena in omens follows certain schemes or paradigms (Rochberg 2016, 199). However, the widespread usage of the Stars in the Path of the Moon to describe the position of the moon and the planets, even in omen literature, in pre-zodiacal times demonstrate the recognition in Assyrio-Babylonian thought that these celestial bodies traveled through these particular constellations. Moreover, it makes it clear that, at least in this case, both MUL.APIN and Enūma Anu Enlil drew from the same body of knowledge.

In summation, the presentation format of the Stars in the Path of the Moon in MUL.APIN and the *ziqpu*-stars in MUL.APIN is very similar. Both are defined with an opening statement, a list of constituent star names, and a closing statement that is almost identical to the opening statement. Neither is given an explicit purpose or instructions on how they can be used. Yet these can be deduced from references made by other sources, as illustrated by the examples above. Thus, the Stars in the Path of the Moon were a coherent set, clearly defined in MUL.APIN, though this concept likely predates the compilation of MUL.APIN, as evident from their references in Enūma Anu Enlil. The purpose of this set was a practical and qualitative one, namely as a way to describe the position of the sun, the moon, and the planets.

Zodiacal Constellations

The zodiac is a mathematical system of reference defined by the 360 degrees of a circle developed in Babylonia and standardized in the late fifth century BCE (Britton 2010). It is the band of the skies through which the sun, moon, and planets travel,

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of IRI $^{d}ID_2$, whose literal translation is "City of the Divine River"), which is also associated with water, much like the city's chief god Ea/Enki. Additionally, while the Crab itself is associated with Sippar for an obscure reason, the constellation is also divided into Front and Rear Stars to cover the diminishing water of both the Tigris and the Euphrates rivers respectively (these two rivers are also associated with Anunitum and the Swallow constellations for unknown reasons). Lastly, the association of an eclipse in the constellation of Anunitum with the city of Akkad is surprisingly straightforward, since the goddess Anunitum was the patron goddess of the city of Akkad. Additionally, it is worth noting that earlier sections of MNB 1849 contain excerpts from Enūma Anu Enlil tablets 20 (obv. 4-13) and 21 (obv. 14 - rev. 15) and the last line of the text contains the catchphrase for tablet 22 (rev. 55). Thus, the section to feature the Stars in the Path of the Moon is located between excerpts from tablets 21 and 22. Furthermore, rev. 44-52 are duplicated in K 2311 + K 3624 (ACh 1, Suppl. I, ln. 1-8 in Virolleaud 1905; see also Verderame 2002, 54), where these lines are located between sections of Enūma Anu Enlil tablets 2 and 3.

centered on the ecliptic.[141] The zodiac is divided into twelve segments of thirty degrees each, nowadays referred to as zodiacal signs and *lumāšu* in cuneiform sources. In cuneiform texts, zodiacal signs could be referred to in one of three ways (Steele 2018b, 101–3). One way was by using the names of months associated with zodiacal signs. Since the schematic year was conceptualized as having twelve months of thirty days each, there was a correlation between the division of the schematic year and the division of the zodiac (Brack-Bernsen and Hunger 1999). According to this scheme, during the first month of the year, the sun would be located in the first zodiacal sign; during the second month of the year, the sun would be located in the second zodiacal sign; and so on. Thus, the first zodiacal sign of the year could be called after the first month of the year and so on. For example, BM 36609+ rev. iv 1'-22' list the position of Normal Stars by providing their position within zodiacal signs. Specifically, lines 14', 16', and 20'-22' use the name of a month for the name of the zodiacal sign:

14'.	⸢4-AM$_2$ IGI$^{\text{meš}}$ ša$_2$ PA⸣	E$_2$ 30 (error for 9) GAN
	…	
16'.	SI MAŠ$_2$	E$_2$ 11,30 AB
	…	
20'.	⸢qup⸣-pu ar$_2$	E$_2$ 7,30 ŠE
21'.	DUR SIM.MAH	E$_2$ 26$^{?}$,[1]5 ŠE
22'.	DUR MUL$_2$ nu-nu	E$_2$ 3,20 BAR

(BM 36609+, rev. iv; after Roughton, Steele, and Walker 2004, 551–52)

Another way of referring to zodiacal signs was by using sequential numbers from one to twelve, starting with Aries as the first zodiacal sign. For example, BM 96258 and BM 96293 published by Brack-Bernsen and Steele (2004) express zodiacal signs by their number, much like the related calendar texts (*Kalendartexte*) identified by Weidner (1967, 41).

But by far the most common way to refer to zodiacal signs was by using the name of a constellation located partially or wholly within the zodiacal sign (Steele 2018, 100). The constellations that lent their names to the twelve zodiacal signs are conventionally called in modern scholarship the zodiacal constellations. Most zodiacal signs are named after a single constellation, but Taurus, Gemini, and Pisces were sometimes referred to by the names of several constellations (Steele 2018: 102-3).

Unsurprisingly, all of the constellations that lent their names to the zodiacal signs are found in MUL.APIN under the set of Stars in the Path of the Moon, except for one. The zodiacal constellation of the Field, an alternative name for the twelfth sign

[141] The great circle of the ecliptic as we know it is an innovation of Greek spherical astronomy. It is unknown if Babylonian astronomers recognized or used the ecliptic (Steele 2007).

(i.e. Pisces), does not appear as one of the Stars in the Path of the Moon (Steele 2018: 103). Whether the zodiacal constellations were directly derived from MUL.APIN is uncertain. If they were, then some kind of cognitive process was undertaken to select twelve of the seventeen constellations in MUL.APIN. Unfortunately, it is not currently possible to fully reconstruct this process and what led to the selection of these particular twelve constellations over others.[142] An alternative is that the zodiacal constellations were not drawn from MUL.APIN directly, but instead both the zodiacal constellations and the Stars in the Path of the Moon drew on the same repertoire of stars that were known to astronomers.

It is important to note that there is no evidence to suggest that the zodiacal constellations, as opposed to the zodiacal signs, were ever conceptualized as a coherent set in cuneiform sources. The only source to enumerate all twelve signs of the zodiac is BM 34566 (=LBAT 1591):[143]

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[142] See Kurtik (2021) for an attempt at plotting out this process.

[143] The Late Babylonian BM 34566 (= LBAT 1591) lists the names of the planets in the standard order (obv. 1), the names of the twelve zodiacal signs beginning with Aries and progressing through the zodiac (obv. 2-4), and several planetary synodic phenomena and in which zodiacal signs they take place (obv. 5 - l.e.):

u.e. ina a-mat ^{d}EN u ^{d}GAŠAN-ia$_2$ liš-lim
obv. 1 MUL$_2$.BABBAR dele-bat GU$_4$.UD GENNA AN
obv. 2 HUN MUL$_2$.MUL$_2$ MAŠ.MAŠ ALLA A
obv. 3 ABSIN RIN$_2$ GIR$_2$.TAB PA MAŠ$_2$
obv. 4 GU zib^{me}
obv. 5 MUL$_2$.BABBAR ina ALLA IGI dele-bat ina zib^{me} IGI
obv. 6 GU$_4$.UD ina ABSIN IGI GENNA ina RIN$_2$ IGI
obv. 7 [A]N ina MAŠ$_2$ IGI
rev. 1’ MUL$_2$.BABBAR ina HUN UŠ dele-bat ina MUL$_2$.MUL$_2$ UŠ
rev. 2’ GU$_4$.UD ina MAŠ.MAŠ UŠ GENNA ina ALLA UŠ
rev. 3’ AN ina A UŠ
rev. 4’ MUL$_2$.BABBAR ina HUN ana ME E-a GENNA ina A ana ME E-<a>
rev. 5’ AN ina MAŠ$_2$ ana ME E!(ERIN$_2$)-a
rev. 6’ MUL$_2$.BABBAR ina HUN ŠU$_2$ dele-bat ina MUL$_2$.MUL$_2$ ŠU$_2$
rev. 7’ GU$_4$.UD ina MAŠ.MAŠ ŠU$_2$ GENNA ina ALLA ŠU$_2$
rev. 8’ AN ina A ŠU$_2$ MUL$_2$.BABBAR HUN KUR-ad$_2$
rev. 9’ dele-bat MUL$_2$.MUL$_2$ KUR-ad$_2$ GU$_4$.UD MAŠ.MAŠ KUR-ad$_2$
l.e. GENNA ALLA KUR-ad$_2$ AN A KUR-ad$_2$

The transliteration above follows the handcopy by Pinches in LBAT. It differs from the edition by Kugler (1907, 39–41) in two places. Kugler transliterated an A sign for the expected *ana* ME E-*a* at the end of rev. 4’, where the LBAT copy has none. Additionally, Kugler’s rev. 5’ ends with the expected *ana* ME E-*a*, where LBAT has ana ME ERIN$_2$-*a*. It is possible that the tablet had deteriorated in the intervening decades between Kugler’s work and Pinches’ copy, making the signs harder to discern.

The synodic phenomena listed in this text are heliacal risings (obv. 5-7), first station (rev. 1’-3’), opposition (rev. 4’-5’), heliacal setting (rev. 6’-8’), and “reaching” (rev. 8’-l.e.). With the exception of opposition, BM 34566 lists these phenomena for all five planets. For opposition, the

HUN MÚL.MÚL MAŠ.MAŠ ALLA A ABSIN RÍN GÍR.TAB PA MÁŠ GU *zib*[me]

The Hired Man, the Stars, the Twins, the Crab, the Lion, the Furrow, the Scales, the Scorpion, Pabilsag, the Goat-fish, the Great One, the Tails
(BM 34566, obv. 2-4; translation mine)

There is some ambiguity whether these refer to the zodiacal signs or the zodiacal constellations, since the most common way of referring to the zodiacal signs was by the name of the constellations. However, since texts from the Late Babylonian period use this repertoire of names for the names of zodiacal signs, and no other cuneiform source explicitly refers to zodiacal constellations, it is more plausible that BM 34566 lists the twelve signs, rather than the constellations. It is worth noting that the lack of a MUL determinative cannot be taken as evidence that these indeed are zodiacal signs, as many Late Babylonian astronomical texts often omit this determinative when referring to stars or constellations. Thus, it seems that there was no coherent set of zodiacal constellations—as opposed to signs—in Babylonian astronomy. Rather, modern scholarship recognizes a number of constellations whose names were used for the zodiacal signs.

Normal Stars

Within the scope of Babylonian astronomical texts, there is a corpus of non-mathematical texts that include the Astronomical Diaries and texts that are derived from them, namely the Goal-Year texts, the Almanacs and Normal Star Almanacs, and the Excerpts (also called lunar and planetary texts).[144] These texts

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text only gives the signs for Jupiter, Saturn, and Mars, since opposition is not possible for Mercury and Venus due to their inferior orbit. The purpose of KUR-*ad*$_2$ here is unclear. KUR-*ad*$_2$ standing for Akkadian *kašādu*, "to reach," is a common term in astronomical and astrological texts. It is used to refer to planets crossing over to the next zodiacal sign. This interpretation, however, would make little sense here. Also, it is worth noting that the zodiacal signs given for UŠ, ŠU$_2$, and KUR-*ad*$_2$ are identical. They all begin with Aries and incrementally progress through the zodiac: Jupiter in Aries, Venus in Taurus, Mercury in Gemini, Saturn in Cancer, and Mars in Leo.

[144] This corpus has been referred to with the abbreviated terms GADEx (Neugebauer 1975, 351) or NMAT (Aaboe 1980, 15). Other than the Excerpts, these genres follow the classification by Sachs (1948), whose primary distinction was based on the format of the texts, namely tabular and non-tabular texts. At that time, there were insufficient sources available for Sachs to distinguish the Excerpts as their own genre. Instead, the only text mentioned by Sachs that now is identified as an Excerpt is A 3405, which Sachs calls an "isolated text," since it did not fit any of the other classifications formulated by Sachs.

largely, but not exclusively, reflect practices reliant on observations. Consequently, when these texts describe the position of the moon and the planets, they do so by means of a set of stars, used as references, with the exception of the Alamancs, which do not concern themselves with such information. Modern scholarship refers to this set of stars as Normal Stars. This reflects the German term Normalsterne, first coined by Epping (1889, 115), who described the positions of these stars by means of lines that are perpendicular—or normal per the geometric term—to the ecliptic:

> Sie konnten sich den betreffenden Fixstern– wir wollen ihn Normalstern nennen – durch eine auf die Ekliptik soviel als möglich senkrechte Gerade (kürzeste Bogen) mit einem andern Stern oder mehreren, wo es sich traf, verbunden denken. Dann hatten sie nur anzugeben, in welcher Nacht der Planet diese Linie passirte und wo, d.h. in welcher Entfernung vom Normalstern; wobei allerdings noch angemerkt werden musste, ob bei gewöhnlicher Planetenbeobachtung (das Gesicht gen Süden gewandt) der fragliche Planet unterhalb oder oberhalb des Normalsterns durch die markirte Gerade ging.

While retaining the use of Epping's term, modern scholarship has moved away from his definition of stars measured perpendicularly to the ecliptic. Instead, the term has been redefined to refer to norming or standardizing planetary and lunar positions. For example, Jones (2004, 476) remarks that "'normal' meaning 'standard,' reflecting the original German terminology Normalstern, introduced by Epping." This departure from Epping's ecliptic-based definition is appropriate, as there is no evidence that the Babylonians recognized the ecliptic or had an ecliptic-based coordinate system. Rather, each planet was given its own distinct path across the sky, albeit with some overlap (Steele 2007). Although Huber (1958) has shown that, at least in the case of Gemini, Cancer, and Aquarius, the beginning of these zodiacal signs coincides with certain Normal Stars, it seems that "[t]he Normal Star texts and the ephemerides appear to be two unrelated approaches to planetary theory" (Neugebauer 1975, 547).

The stars identified by modern scholarship as Normal Stars have three common features. First and foremost, these stars are used by Babylonian astronomers to describe the position of the moon and the planets. This is the defining characteristic of this set, with which modern scholarship classifies a given star as a Normal Star. Related to this is the fact that they lie close to the ecliptic, as the moon and the planets travel along this trajectory. The celestial longitude of the Normal Stars falls roughly between +10° and -7;30°. Lastly, the majority of these stars are fairly bright, with most having a magnitude between 2 and 4, making them somewhat easier to spot in the night sky than dimmer stars.

As mentioned above, the sources that make use of the Normal Stars are the Astronomical Diaries and their derivative texts. The Diaries employ the Normal Stars in two kinds of cases, which can be called "passages" and "positional" (Jones 2004, 477). Passages are the most common and describe the passage of the moon or a planet by one of the Normal Stars. For example, the following diary entries give the position of Venus and the moon as they pass in the vicinity of a nearby Normal Star:

> GE$_6$ 21 USAN dele-bat e SI$_4$ ⸢6⸣ SI dele-bat 2 SI ana ŠU$_2$ LAL
> Night of the 21st, first part of the night, Venus was 6 fingers above Lisi, Venus being 2 fingers back to the west.
> (ADART 1, -321, rev. 21'; Sachs and Hunger 1988)

> GE$_6$ 10 SAG GE$_6$ 30 SIG SAG UR.⸢A⸣ 2 ⅔ KUŠ$_3$ 30 8 SI ana NIM DIB
> Night of the 10th, beginning of the night, the moon was 2 ⅔ cubits below the Head of the Lion, the moon having passed 8 fingers to the east.
> (ADART 1, -322D, rev. 23; Sachs and Hunger 1988)

> [GE$_6$ 4] SAG GE$_6$ … dele-bat ar$_2$ GIR$_3$ ar$_2$ ša$_2$ UR.A 2 SI dele-bat 2 SI ana ULU$_3$ SIG
> [Night of the 4th], beginning of the night ... Venus was 2 fingers behind the Rear Foot of the Lion, Venus being 2 fingers low to the south.
> (ADART 1, -324B, rev. 2; Sachs and Hunger 1988)

> GE$_6$ 25 ina ZALAG$_2$ 30 ina IGI SAG UR.A 2 KUŠ$_3$
> Night of the 25th, last part of the night, the moon was 2 cubits in front of the Head of the Lion.
> (ADART 1, -324B, rev. 19; Sachs and Hunger 1988)

The examples above are representative of the two different formats in which the Normal Stars are encountered. The first two examples show the more common format, in which the distance "above" (*e*) or "below" (SIG) the Normal Star is given. This statement is occasionally followed by another statement that details how far the moon or planet in question was "back to the west" (*ana* ŠU$_2$ LAL) or has "passed to the east" (*ana* NIM DIB). The second format, seen in the two latter examples, first describes how far the moon or planet was "in front of" (*ina* IGI) or "behind" (*ar$_2$*) the Normal Star. Similar to the first format, this can be followed by a statement on how far "high to the north" (*ana* SI NIM) or "low to the south" (*ana* ULU$_3$ SIG) the moon or planet was in relation to the Normal Star. These distances are given in cubits (KUŠ$_3$) and fingers (ŠU.SI, often abbreviated to SI).[145] While the terms "behind" and "in front" are easily understood to refer to being eastward or westward of the point of reference (as is exemplified by their variants "passed to the east," and "back to the west"), the

[145] Jones (2004, 520) approximates the cubit to be equivalent to 2.27°, very close to an earlier estimation by Graßhoff (1999, 137–39) of about 2.5°. In the context of Late Babylonian astronomy, the number of fingers to a cubit is 24, though the number in other contexts may be 24 or 30 (Steele 2003, 283–86).

terminology of "above" and "below" posed greater challenge, as it did not align precisely with a fixed ecliptical positioning system (Neugebauer 1975, 546–47). However, Jones (2004, 477–78) affirms that "in front," "behind," "above," and "below" do roughly correspond to increased celestial longitude, decreased celestial longitude, increased celestial latitude, and decreased celestial latitude respectively. This, however, is by no means an indication of a Babylonian ecliptical coordinate system, since, as previously mentioned, there is no evidence to support the notion that the Babylonians recognized the ecliptic.

The other kind of cases in which the Astronomical Diaries utilize the Normal Stars is to provide the position of the moon or planets at the time of certain phenomena, namely lunar eclipses for the moon and stations (and rarely first visibility) for the planets (Jones 2004, 477). For example, the following diary entry gives the position of Saturn at first station in relation to a nearby Normal Star:

> EN 2 GENNA ana NIM ki UŠ-u$_2$ 8 SI e MUL$_2$.TUR ša$_2$ 4 KUŠ$_3$ ar$_2$ LUGAL 4 SI ana ŠU$_2$ LAL UŠ
>
> Around (the night of) the 2nd, when Saturn became stationary to the east, it became stationary 8 fingers above the Small Star which is 4 Cubits behind the King, being 4 fingers back to the west.
> (ADART 2, -232, obv. 26; after Sachs and Hunger 1989)

Another genre that makes use of the Normal Stars is referred to by modern scholarship as the Excerpts or lunar and planetary texts. These texts list observations or data related to the moon and planets over the course of several consecutive years, such as Lunar Six parameters and eclipses for the moon, and synodic phenomena and passages by Normal Stars for the planets. Most of the Excerpts are published in Hunger (2001), with the eclipse texts also appearing in Huber and de Meis (2004). As this data was mostly excerpted from the Diaries, these texts give the position of the moon and the planets in the same way that the Diaries do:

> APIN 14 … 1 ½ KUŠ$_3$ ar$_2$ ŠUR GIGIR ša$_2$ ULU$_3$ ad$_2$ …
>
> Month VIII, the 14th … it (= the moon) was eclipsed 1 ½ cubits behind the Southern Rein of the Chariot…
> (ADART 5, No. 2, rev. iii 2'-7'; Hunger 2001)
>
> 28 GU$_4$ 14 SIG MUL$_2$ KUR ša$_2$ DUR nu-nu 2 KUŠ$_3$ AN ½ KUŠ$_3$ ana NI[M D]IB SIG
> 27 SIG MUL$_2$.MUL$_2$ 2 ½ KUŠ$_3$ ⸢ŠU⸣ 19 e [is l]e$_{10}$ 1 ⅔ KUŠ$_3$ …

(Year) 28, Month II, the 14th, it (= Mars) was 2 cubits below the Bright Star of the Ribbon of the Fish, Mars having passed ½ cubits to the east. Month III, the 27th, it was 2 ½ cubits below the Stars. Month IV, the 19th, it was 1 ⅔ cubits above the Jaw of the Bull…
(ADART 5, No. 61, obv. iii 15'-17'; Hunger 2001)

Similarly, the Goal-Year texts, also derived from the Diaries, utilize the Normal Stars. These are texts that contain raw data on the occurrence of planetary and lunar phenomena that can be used to predict these phenomena for a specific year, the so-called Goal-Year (Sachs 1948, 282), albeit with corrections (Hunger 2006, XII; Gray and Steele 2008; 2009). The Goal-Year texts contain Greek-letter phenomena,[146] planetary (though not lunar) passages, Lunar Six data, eclipses, and occasionally zodiacal crossings. The colophon of these texts aptly reflect their content: UD.1.KAM IGI.DU$_8$.A$^{\text{meš}}$ DIB$^{\text{meš}}$ *u* AN.MI$^{\text{meš}}$ *ša ana* MU x *kunnu*, "first days, appearances, passages, and eclipses that are established for year X." These are usually arranged into eight sections in the following order: two for Jupiter (one for Greek-letter phenomena and one for passages), one each for Venus, Mercury, and Saturn, two for Mars (one for Greek-letter phenomena and one for passages), and one for the moon.

Relying on the periodic nature of these phenomena, the Goal-Year texts draw this data from earlier Diaries that list these phenomena when they took place a certain number of years prior to the Goal-Year itself. The number of years depends on the celestial body and the phenomena in question:

Jupiter: 71 years for Greek-letter phenomena, 83 years for passages
Venus: 8 years
Mercury: 46 years
Saturn: 59 years
Mars: 79 years for Greek-letter phenomena, 47 years for passages
Moon: 18 and 19 years for Lunar Six, 18 years for eclipses

For example, for the Goal-Year *n*, the text would extract information on Venus from a diary written *n*-8 years prior, on Mercury from a diary written *n*-46 prior, and so on. This would require numerous Diaries from different years in order to produce a single Goal-Year text as pointed out by Sachs (1948). Half a century later Hunger (1999) would reconsider the relationship between the Diaries and the Goal-Year texts and conclude that the evidence is still insufficient to reach a firm conclusion, an opinion he reiterates with the publication of the Goal-Year texts (Hunger 2006, XIII). However, a few years later, Gray and Steele (2008; 2009) would successfully

[146] The term Greek-letter phenomena was used by Sachs (1948) and Neugebauer (1955) to refer to planetary synodic phenomena and later scholarship has continued to use it.

demonstrate how the Goal-Year texts did in fact derive the relevant information from the Diaries.

As derivatives of the Astronomical Diaries, the Goal-Year texts use the same phraseology as the Diaries in their use of Normal Stars. For example, the following Goal-Year text records the passage of Mars by one of the Normal Stars:

> GU_4 GE_6 12 USAN AN SIG SAG A 4 1/2 $KUŠ_3$
>
> Month II, night of the 12th, first part of the night, Mars was 4 ½ cubits below the Head of the Lion.
> (ADART 6, No. 6, rev. 15'; Hunger 2006)

It is important to note that the numerous mentions of NU PAP, "I did not watch," in the Goal-Year texts make it clear that, much like the Diaries themselves, these texts are a compilation of observational and calculated data.[147] Babylonian astronomers were then able to use the information in the Goal-Year texts to make predictions and produce the Almanacs and Normal Star Almanacs by applying minor corrections (Gray and Steele 2008).

Indeed, the Normal Star Almanacs contain the predicted data for a given year. The term Normal Star Almanac follows the classification by Sachs (1948, 281–82), though according to their colophon, they were called *meš-hi ša₂* MU x, "measurements of the year x." Each Normal Star Almanac is divided into twelve sections (or thirteen, in the case of an intercalated year), one section per month. Among the information predicted in the Normal Star Almanac are the passages of the planets by the Normal Stars.[148] As derivatives of the Diaries, the Normal Star Almanacs employ the Normal Stars the same way, such as the following example:

> GE_6 5 ina $ZALAG_2$ dele-bat SIG SAG A 3 $KUŠ_3$
> Night of the 5th, last part of the night, Venus was 3 cubits below the Head of the Lion.
> (ADART 7, No. 30, obv. 18'; Hunger 2014)

As pointed out by Sachs (1948, 284) and re-affirmed by Hunger (2014, XI–XII), the Normal Star Almanacs never mention that the phenomena were not observed (i.e., the Normal Star Almanacs do not contain any entry with NU PAP) nor any mention of adverse weather conditions. This is indicative of their predictive, rather than observational, nature.

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[147] For a discussion about taking the phrase NU PAP to mean that the data was computed, rather than a simple admission of laxity on part of the scribe, see Rochberg (1991b, 327–239).

[148] For a description of the information found within the Almanacs and Normal Star Almanacs, see Hunger (2014, X–XII).

Beyond the corpus of the Astronomical Diaries and their derivatives, the Normal Stars also appear in two surviving catalogues, BM 46083 and BM 36609+.[149] BM 46083 is a poorly preserved fragment originally published by Sachs (1952a). In his edition, Sachs only included a full transliteration of the star catalogue found in the right-hand column, making several remarks on the contents of the left-hand column, to which he concluded that he has "nothing but the vaguest idea of what is actually said in the left-hand column" (Sachs 1952a, 149). The text was later re-published by Roughton, Steele, and Walker (2004, 562–65), where the authors were able to make improvements on the earlier edition as well as include an edition of the left-hand column. This was done as part of their publication of the better preserved catalogue, BM 36609+ (Roughton, Steele, and Walker 2004). The obverse of BM 36609+ deals with *ziqpu*-stars as part of rising times schemes (Steele 2017, 77–79, 91–95), while the reverse deals with the Normal Stars.

Both catalogues give the names of Normal Stars and their position within their zodiacal signs, expressed either as sign name (BM 46083) or associated month name (BM 36609+). BM 36609+ also inserts the sign E_2, Akk. *bīt*, "house", between every Normal Star name and its position (Steele 2015a, 191).[150] Most of the stars listed in both catalogues are the same, with only a handful of variants. Additionally, the column to the left of the catalogue seems to be the same in both texts, suggesting that they were both based on the same source (Roughton, Steele, and Walker 2004, 564–65). While both catalogues are not fully preserved, it is abundantly clear that these are indeed catalogues of Normal Stars, as the listed stars are those used as Normal Stars in the Astronomical Diaries and their derivatives. Thus, by examining the Normal Stars attested in these sources, modern scholarship was able to reconstruct a more comprehensive list of Normal Stars.[151] In particular, the publication of the Astronomical Diaries by Sachs and Hunger (1988, 17–19) contains a list of the thirty-two Normal Stars, based on their attestation within the corpus. The stars included in the Sachs-Hunger list are not evenly distributed along the ecliptic. Of note are two large gaps in the areas of Sagittarius and Aquarius of over 40° and over 60° respectively where the diaries seem to contain no records that employ the Normal Stars. Addressing this gap, Roughton and Canzoneri (1992) revisited the observational records and suggested two Normal Stars in the region of Sagittarius. Roughton, Steele, and Walker (2004, 552–53) reiterate this suggestion and add three additional Normal

[149] The Babylonian horoscopes make rare mentions of the Normal Stars to describe the position of the moon, which seem to have also been excerpted from the Astronomical Diaries (Rochberg 1998, 30–33).
[150] The E_2 sign has been previously read as $MULU_4$ (Roughton, Steele, and Walker 2004), a reading with an unknown meaning.
[151] The earliest attempt at reconstructing the list of Normal Stars was done by Epping (1889, 117–33). For a review of the history of the reconstruction, see Hunger and Pingree (1999, 148–49).

Stars that fill in the gap in Aquarius. Yet attestations of these Normal Stars are exceedingly rare, and the reason for the gaps is unknown.

The most recent and comprehensive reconstructed list is found in Jones (2004). Jones lists a set of twenty-eight commonly used “core” stars (all of which appear in the Sachs-Hunger list), and a set of thirteen rarely-used “additional” stars (four of which appear in the Sachs-Hunger list), for a total of forty-one Normal Stars.[152] Jones (2004, 480) notes that even though the practice of describing celestial positions by using the Normal Stars can be found as early as the 7th century BCE, the constituent stars were standardized in the mid-5th century BCE, with minor refinements taking place in the late 4th century BCE.

It is important to note that the Astronomical Diaries also often report the relative distance between the moon or a planet to another planet, with identical phraseology to the one used to describe positions in relation to Normal Stars discussed above. For example, the following entry gives the distance between the moon and Saturn:

> [APIN … GE_6 2 sin … x]+1 ½ $KUŠ_3$ ina IGI GENNA 2 $KUŠ_3$ ana $ŠU_2$ GUB sin 1 $KUŠ_3$ ana SI NIM SI GIN
>
> [Month VIII, … night of the 2nd, the moon] stood [x]+1 ½ cubits in front of Saturn to the west, the moon being 1 cubit high to the north; the north wind blew.
> (ADART 3, -160, obv. 4’; Sachs and Hunger 1996)

Despite the similar phraseology, however, these entries do not reflect the same line of inquiry evident in the entries that give the positions of planets by means of the Normal Stars. As discussed above, Babylonian astronomers were able to use Normal Star observations to make the predictions found in the Normal Star Almanacs by means of Goal-Year methods. These relied on Goal-Year periods and the notion of period relations, the relationship between a certain period of time and the number of occurrences of a certain phenomenon, which were central to Babylonian astronomy (Aaboe 1965; Rochberg 2010a).[153] Furthermore, observations must have influenced, at

[152] Jones (2004, 484–85) also points to a handful of “alternate” Normal Stars which were not included in his reconstruction.

[153] This may be the reason why the astronomical diaries contain data on the river level and the value of commodities, namely, as an attempt to determine their periodicity. Note, however, that the diaries also record historical events, such as Alexander the Great entering the city of Babylon (ADART 1, -330; Sachs and Hunger 1988). These are qualitative descriptions, unlike the rest of the material in the diaries (such as astronomical events, water levels, value of commodities) which are quantitative. The reason for including historical events in the diaries is less clear. Periodicity is based on

least to some extent, the development of mathematical astronomy. Although this process is still unclear, two approaches have been put forth, a longitudinal one and one based on dates. The former, by Aaboe (1980), suggests that Babylonian astronomers mined the Diaries and extracted the positional data of synodic phenomena when these took place near Normal Stars. This data, in turn, was worked into the planetary schemes found in mathematical astronomy, albeit with corrections, as there is a mismatch between the observational and arithmetical data (see most recently de Jong 2019a; 2019b; 2021). The second approach, advocated by Swerdlow (1998, 73–78), is that the data in the ephemerides was derived from the date of the synodic phenomena found in the Diaries rather than from the longitudinal data.

Contrarily, planetary conjunctions do not feature in mathematical astronomical texts or any of the texts derived from the Astronomical Diaries, with the exception of one Excerpt (ADART 5, No. 52; Hunger 2001). Other than the Diaries, planetary conjunctions only appear in a handful of omen protases in Enūma Anu Enli (Reiner and Pingree 1998, 3–6; 2005, 1–18). The fact that both the Astronomical Diaries and Enūma Anu Enlil mention planetary conjunctions is not indicative of a direct connection between the two, and it remains unclear if and what kind of relationship the two had (Rochberg-Halton 1991b, 330–31). However, references to planetary conjunctions in these texts suggest that the recurrence of all manner of (celestial) phenomena were of importance to the Babylonians.

At this point it is important to reiterate that the term Normal Stars is a modern definition. However, it is clear that the Babylonians did in fact conceptualize this set of stars, particularly in light of the Normal Star Almanacs and the two surviving Normal Star catalogues. The Babylonian term for these stars in all likelihood was MUL$_2$.ŠID^{meš}, "counting/reckoning stars," found in two surviving texts, BM 45745 and BM 41004 (Sachs and Hunger 1988, 17; Neugebauer and Sachs 1967, 204). The first is an Astronomical Diary dated to 137 BCE which states that the counting stars were visible during a solar eclipse:

> 29 24 ME NIM-a šamaš$_2$ AN.MI A$_2$ ⸢ULU$_3$⸣ [u] ⸢MAR⸣ ki-i TAB-[u$_2$ … dele]-bat GU$_4$.UD u MUL$_2$.ŠID^{meš} IGI^{meš} MUL$_2$.BABBAR u AN ša$_2$ ina bi-ib-lu ina AN.MI-šu$_2$ IGI^{me}[^{š} …]
>
> The 29th, at 24° after sunrise, solar eclipse; when it began on the south and west side, [... Ve]nus, Mercury, and the counting stars were visible, Jupiter and Mars, which were in their period of invisibility, were visible in its eclipse [...]
> (ADART 3, -136B, rev. 13-14; Sachs and Hunger 1996)

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arithmetic procedures, and thus attempting to establish the periodicity of historical events would be much more difficult than doing so with quantitative data.

On its own, this is insufficient to establish a connection between the term MUL$_2$.ŠID^{meš} and the modern term Normal Stars. A total solar eclipse would reveal all the stars (and planets) that are above the horizon at the time, not just those that modern scholars classify as Normal Stars. However, the second text that uses MUL$_2$.ŠID^{meš}, BM 41004, known as Atypical Text E and published by Neugebauer and Sachs (1967), provides stronger support for understanding the term counting stars as correlating to the Normal Stars. Atypical Text E is a procedural text that deals with the latitudes and periods of the moon and the planets as they pass by the counting stars. Each planetary section on the reverse begins with DIB^{meš} *ša$_2$* x *ki* MUL$_2$.ŠID^{meš}, "passings of x (by) the area of the counting stars," where x is the name of one of the planets (rev. 1, 5, 10, 13, 16) or the moon, in the case of the lunar section on the reverse of the tablet (rev. 18-23).

The counting stars mentioned in Atypical Text E clearly serve in the same capacity as the Normal Stars, thus demonstrating that this was the term used by the Babylonians for this set of stars. The extent of the correlation between the constituent members of the modern Normal Stars and the Babylonian counting stars is less clear, such as whether they included only the twenty-eight so-called core Normal Stars or all forty-one stars identified by modern scholarship (Jones 2004). Since there are only two surviving partially-preserved catalogues, it is impossible to determine at this point. It seems that the counting stars were a designation that refers to the capacity to serve in the way modern scholarship conceptualizes the Normal Stars. In other words, the term counting stars did not necessarily pertain to specific stars, but was rather a function that could be applied to any star that was used in this capacity, though there was a tendency to pick particular stars due to their brightness or ease of recognition. It is these stars that have come to be called Normal Stars in modern scholarship.

Given this, as well as their attestation almost exclusively in Astronomical Diaries and their derivatives, it is clear that the Normal Stars (or counting stars) were a convenient tool devised by Babylonian astronomers for describing the positions of the moon and the planets against the background of the fixed stars on particular dates. In doing so, they facilitated the construction of Goal-year methods. It is possible that part of the motivation for this, at least initially, was related to omens, as divination was so ingrained in Babylonian scholarship and celestial observation, though this conjecture remains speculative at this time.

Conclusion

This chapter surveyed the different sets of stars in Babylonian astronomy in order to contextualize the *ziqpu*-stars as one such set. It is clear that no common thread connects all of these sets of stars. However, the *ziqpu*-stars do share some commonalities, specifically with the Stars in the Path of the Moon and the Normal Stars.

Both the Stars in the Path of the Moon and the *ziqpu*-stars are clearly defined as sets in MUL.APIN. In particular, the first section on *ziqpu*-stars (MUL.APIN I iv 1-9) has the same format as the section on the Stars in the Path of the Moon (MUL.APIN I iv 31-39), with an introductory statement, an enumeration, and a closing statement that repeats the introduction practically verbatim. As discussed above, the enumeration of the Stars in the Path of the Moon seems to be a description of what one might see if one tracks the movement of the moon across the skies. It may be that the same notion is similarly used in the first section on *ziqpu*-stars. This may explain why this section lists the constellations of the Panther, the Old Man, and the Lion, where almost all other sources of *ziqpu*-stars break these apart into smaller constituent stars—including MUL.APIN's second section on *ziqpu*-stars, which does so for the Panther and the Old Man, though not for the Lion.

The later set of Normal Stars arguably has more conceptual similarities with the *ziqpu*-stars. The Normal Stars were a tool used in the Astronomical Diaries and related texts and provided a way to reckon the positions of the sun, the moon, and the planets, just as the *ziqpu*-stars were a tool to indicate the specific moment certain phenomena took place. Furthermore, it is interesting to note that Babylonian astronomers referred to both the Normal Stars and the *ziqpu*-stars by their function. The Normal Stars were called MUL_2.ŠID$^{\text{meš}}$, "reckoning/counting stars," because they were used to reckon the positions of the sun, moon, and planets. The *ziqpu*-stars were called as such because of their relationship to culmination, referred to by the term the *ziqpu*.

The next chapter examines the thought process that underlies the production and usage of knowledge of the *ziqpu*-stars as well as examines the possible role observation played in textual reference to the *ziqpu*-stars.

Chapter 3: Modeling Practices Relating to *ziqpu*-stars

Introduction

Chapter 1 examined the main sources that employ the *ziqpu*-stars and their role in these texts. This chapter turns to the practices that underlie the textual references to *ziqpu*-stars and addresses the question of the purpose Assyro-Babylonian astronomers had in using the *ziqpu*-stars. As will be shown below, in most cases, observation was not part of the practices involving the *ziqpu*-stars. Instead, these astronomers constructed models that employed the *ziqpu*-stars in order to address issues and questions that were of interest to them.

Examining this material from the perspective of models and model-making provides new insights into the thought process behind the utilization and production of astronomical knowledge and the approach taken by Assyro-Babylonian astronomers in referring to the *ziqpu*-stars. This investigation can further shed light on the way modern scholarship has divided and classified the corpus of astronomical texts, using terms such as observational and theoretical. Considering the practices behind the knowledge evident in the texts, rather than reading the texts at face value, underscores the sometimes misleading nature of these modern labels. This analysis shows that many of these labels were brought into the study of Babylonian astronomy in the mid-20th century and have mostly not been revisited, despite developments and critiques leveled at some of these notions. This examination allows the study of Babylonian astronomy to be implicated in ongoing discussions in the philosophy of science, similar to other recent endeavors (see, e.g., Rochberg 2016; 2018).

What is a Model?

In a recent article, Rochberg (2018) analyzed Late Babylonian mathematical astronomy, published by Neugebauer (1955) and Ossendrijver (2012), through the lens of models and model-making. To some extent, this chapter follows in her footsteps, though instead of focusing on a particular textual genre, this investigation focuses on a specific aspect of Babylonian astronomy, namely the *ziqpu*-stars.[154] In order to do so,

[154] In the case of the rising time scheme texts, they can be viewed as their own subgenre.

the concept of models and model-making must be first elucidated.

There are different ways of defining a model. Nersessian loosely defines a model as a representation of a system (Nersessian 2008, 12). Models can be physical, such as a globe, abstract, such as mathematical, or a combination thereof. More specifically, scientific models aim to represent empirical phenomena and inform the model users about the empirical world (Bailer-Jones 2003). It is important to note that "denotation is the core of representation and is independent of resemblance" (Goodman 1968, 5). Thus, parts of a model (using Nersessian's terms) represent features of the world by virtue of their ability to denote, or serve as a reference to, these features. Whether the parts of the model resemble or replicate these features has no impact on the capacity of the model to represent a target phenomenon.

Of particular relevance to this investigation is the definition of a model by the cognitive scientist Marvin Minsky. Minsky (1965, 1) defined a model in such a way that "[t]o an observer B, an object A* is a model of an object A to the extent that B can use A* to answer questions that interest him about A." This definition highlights the ternary relationship between the target phenomenon A, the model A*, and the observer B (or community of observers), be it model-maker or model-user. The model is shaped by the observer for a specific purpose. The resultant model A* reflects the observer's understanding of the target phenomenon, since the observer must first conceptualize what is to be modeled. Furthermore, the model also illuminates which aspects of the target phenomenon are of interest to the observer, since the observer must select what to include in the model. Thus, examining a model can reveal the cognitive process and selection criteria that played a role in the making of the model. For the purpose of this chapter, then, a model is a construct that corresponds to a feature of the world, or more precisely, represents a target phenomenon, and is shaped by the model-maker to address questions or interests they have of the target phenomenon.

The value of a model is not intrinsic to the model itself, but rather conferred by the observer. This is contingent on the standards of the scientific community in which the model operates. For example, modern scientific standards place the highest value in models that accurately reflect the empirical world, almost exclusively by mechanical or mathematical means. This, in turn, colors our own perception of what a model is and how it should operate. However, another way that a model can be deemed valuable is by providing access to the target phenomenon. Doing so allows a community of observers to have meaningful discussions and answer questions about the modeled phenomenon. For example, the Late Babylonian ephemerides did not mean to resemble empirical reality, but did provide access to the phenomena of interest, namely the periodicity of synodic phenomena (Rochberg 2018).

Herein lies the advantage of considering the textual references to *ziqpu*-stars in terms of models. Many of the sources featuring the *ziqpu*-stars fall under what Steele has referred to as schematic astronomy (Steele 2017, 10–12), which do not fall into the traditional classification of the astronomical corpus as discussed below. However, approaching the material pertaining to the *ziqpu*-stars from the perspective of models brings to light the underlying similarity, rather than the difference, between the various kinds of astronomical texts, namely the interest in determining the moment of a given phenomenon and (potentially) its next occurrence, without a concern for the intervening period.

The Schematic Calendar

Several of the types of sources that feature the *ziqpu*-stars are based upon the schematic calendar, itself a model. These are MUL.APIN, the rising time scheme texts, and by extension the *ziqpu*-star lists and other texts that utilize these lists.[155] The length of the year in the schematic calendar is 360 days, divided into 12 months of 30 days each. The dates of the equinoxes and solstices are always placed on the 15th day of certain months, and MUL.APIN uses Months I, IV, VII, and X for the vernal equinox, summer solstice, autumnal equinox, and winter solstice respectively.[156] The rising time schemes do not mention the cardinal points of the year explicitly, but nonetheless begin with day 15th of Month IV, i.e., the summer solstice (Steele 2017, 26). The 360-day year of the schematic calendar is at odds with the solar year of almost 365 ¼ days and the lunar year of 354 days. The discrepancy in number of days would cause certain phenomena, such as the cardinal points of the year, to annually fall on different dates of the schematic calendar and rarely on the prescribed dates. This also includes observable phenomena such as heliacal risings and settings—a major theme in MUL.APIN—as well as the correlations drawn in the rising time scheme texts, most commonly between culminations on one hand and either the end of a microzodiacal sign or the 15th day of each month on the other hand. By definition, calendars are an artifice of organizing time—and most often period relations—in a usable manner. In particular, the schematic calendar would not have been able to accurately reflect empirical reality due to the issues outlined above. Yet it is important to note that it was used extensively in scholarly, astronomical contexts. This is a testament to its value within a scholarly community, where it served as a basis on which scholars could access, frame, and discuss certain phenomena that were important to that community, in this case, the particular phenomena that took place at specific moments.

[155] A full discussion of the schematic calendar vis-à-vis modeling lies beyond the scope of this dissertation. For recent literature with bibliography on the calendar, see Steele (2011) and Robson (2004).

[156] In Enūma Anu Enlil and texts of the Three Stars Each tradition, the equinoxes and solstices are placed one month earlier, i.e., beginning with the vernal equinox, the dates are XII 15, III 15, VI 15, and IX 15. Research into the reason for this difference remains a desideratum.

One may speculate that this had a divinatory application. Brown (2000a, 113) has argued that the aim of the periods embedded in the schematic calendar, such as the dates of heliacal rising and setting, was to judge whether celestial phenomena behaved in an ideal way, i.e., at its prescribed time. According to Brown, if a phenomenon did take place at its appointed time, it was considered propitious, while one that does not was considered an ill omen. But it is important to note that, as described above, the schematic calendar would rarely align with empirical observations, hence Brown's argument would lead to the conclusion that the vast majority of celestial phenomena occurrences were taken as evil portents. At most, there is a general pattern, e.g., in omens related to heliacal risings, where stars that heliacally rise either at their "(appropriate) time" (UD.DUG$_4$.GA-*šu*$_2$ KUR-*ha*) or become visible early (NIM IGI) correlate to seemingly positive apodoses. Conversely, omens in which a star rises "not at its (appropriate) time" (*la* UD.DUG$_4$-GA-*šu*$_2$ KUR-*ha*) or becomes visible late (ZAL IGI) have apodoses with negative implications.[157] This pattern is reminiscent of the intercalation scheme found in MUL.APIN, in which a star rising on its prescribed month indicates a normal year, while the same star rising a month later indicates an intercalary year (MUL.APIN II Gap A 8 - ii 6). This is not to say that an intercalary year carried a negative connotation, but that both the heliacal rising omens in Enūma Anu Enlil and the intercalation scheme in MUL.APIN reflect an understanding of the disparity between the schematic calendar and empirical reality and the (very likely) possibility of a given phenomenon taking place at different dates. Brown (2000a, 125–26) concludes that since the periods found in the schematic calendar were unable to model celestial behavior with precision—as celestial phenomena rarely fell on prescribed dates—these periods must have had divinatory relevance. As will be demonstrated in this chapter, an accurate reflection of empirical reality was not a primary concern of Assyro-Babylonian astronomers. This is particularly apparent in the case of the *ziqpu*-stars, where observation did not play any significant role, if any at all.[158]

Time-degrees and Intervals

Related to the reliance of *ziqpu*-star sources on the schematic calendar is the

[157] The exception to this pattern is found in Text X of EAE Tablet 51 (K 2920+), line 21, which is unfortunately fragmentary: ¶ *ina* $^{\text{iti}}$AB ⸢$^{\text{mul}}$A$_2$$^{?}$⸣[$^{\text{mušen}}$ …] BE-*ma ina* UD.DUG$_4$.GA-*šu*$_2$ KUR-[*ha*] MUNUS.KUR$_2$ *ina* KUR *ina-pu-*[*uš* …] *ina* KUR GAR, "In Month X, the Eagle [...], if it rises at its appropriate time: enmity will flare up in the land, [...] will be in the land" (after Reiner and Pingree 1981, 60–61).

[158] See the discussion on observation below.

use of the unit UŠ.[159] Employed in various astronomical contexts, 30 UŠ make up 1 *bēru*, and there are 12 *bēru* in a 24-hour period. Thus, there are 360 UŠ in a single nychthemeron. Consequently, an UŠ can be equated with the passage of four equinoctial minutes and can be translated as "time-degree." The similarity between these ratios and those found in the schematic calendar, with its 360 days divided into 12 months of 30 days each, led Babylonian astronomers to model the changing positions of the stars—or conversely the sun's position in relation to the fixed stars—as 1 UŠ per day, as is already stated in MUL.APIN:

> u$_4$-mu 1 UŠ$^{ta.am_3}$ MUL^{meš} ina šer$_3$-ti ana GE$_6$ KU$_4$^{meš}-ni
> u$_4$-mu 1 UŠ$^{ta.am_3}$ MUL^{meš} ina li-la-a-ti ana u$_4$-me E$_3$^{meš}-ni

> The stars enter into the night in the morning, 1 UŠ each day.
> The stars come out into the day in the evening, 1 UŠ each day.
> (MUL.APIN I iii 49-50; after Hunger and Steele 2019)

In regards to the *ziqpu*-stars, UŠ are most commonly found in the rising time scheme texts and the star lists. As mentioned above, rising time scheme texts that are based on the calendar correlate culminations at sunrise and sunset with a date while those based on the zodiac correlate culmination with a position on the zodiac, most often the end of a microzodiacal sign. In some cases, the correlation is to the culmination of a *ziqpu*-star, but in most cases, it is to the culmination of an abstract point that was some interval away from a *ziqpu*-star, measured in UŠ. Since the intervals from one *ziqpu*-star to the next are generally consistent, Babylonian astronomers were confronted with the problem that these intervals would not match the desired values, either in dates (for the calendar-based schemes) or intervals in UŠ (for the zodiac-based scheme). Moreover, the number of *ziqpu*-stars—no more than twenty-five—was insufficient. For example, the microzodiacal scheme would need to mark 144 culminations, twelve for each zodiacal sign. An even bigger disparity would be the calendar-based scheme that provides correlations for every day of the schematic year, thus requiring 360 culminations. Thus, Babylonian astronomers used these abstract points that are measured in UŠ away from the *ziqpu*-stars.[160] For example, the aforementioned daily calendar-based scheme text uses such abstract points extensively:

> 24 ina muh-hi 12 ar$_2$ ⸢ŠU$_2$⸣[-ma ina muh-hi 6 ar$_2$ KUR]
> 25 ina muh-hi 13,20 ar$_2$ ⸢ŠU$_2$⸣[-ma ina muh-hi 6,40 ar$_2$ KUR]

---

[159] This unit is always written with the logogram UŠ (though it is sometimes omitted altogether), and so the Akkadian reading of this sign is unknown.

[160] BM 78161, the so-called GU-text, which may be the earliest case of using an abstract point away from a *ziqpu*-star is further discussed in Chapter 4.

26 ina muh-hi 14,40 ar_2 [$ŠU_2$-ma ina muh-hi 7,20 ar_2 KUR]

24(th day), at the culmination of 12 (UŠ) after (ditto, the sun) sets [and at the culmination of 6 (UŠ) after (ditto, the sun) rises.]
25(th day), at the culmination of 13,20 (UŠ) after (ditto, the sun) sets [and at the culmination of 6,40 (UŠ) after (ditto, the sun) rises.]
26(th day), at the culmination of 14,40 (UŠ) after (ditto, the sun) sets [and at the culmination of 7,20 (UŠ) after (ditto, the sun) rises.]
(A 3414+, rev. i 10-12, after Steele 2017)

As seen in the example above, the culminating point of every consecutive day increases by a constant. For half of the year between the winter solstice and the summer solstice, this constant is 1;20 UŠ for sunset and 0;40 for sunrise. Conversely, for the other half of the year, i.e., between summer solstice and winter solstice, the constant is 0;40 for sunset and 1;20 for sunrise. Therefore, the total difference in UŠ between culminating points over the course of a single month is either 40 UŠ or 20 UŠ, depending on the time of year and whether it relates to sunrise or sunset. The total difference in UŠ between culminating points in regards to sunrise is 40 UŠ for the months between summer solstice and winter solstice and 20 UŠ for the months between winter solstice and summer solstice. The total monthly differences in UŠ are flipped for the months between winter solstice and summer solstice (Steele 2017, 45). These values form a step function, with the monthly difference in the culminating point for either sunrise or sunset dependant on which half of the year is involved, tabulated as follows:

	Sunrise	Sunset
Summer to winter solstice	40 UŠ	20 UŠ
Winter to summer solstice	20 UŠ	40 UŠ

A similar case can be observed in the zodiac-based scheme, because the schematic calendar was mapped onto the zodiac (Steele 2017, 88–89). Here the total difference between consecutive signs for Leo through Sagittarius is 40 UŠ per sign and 20 UŠ for Pisces through Gemini. Cancer, however, located between Gemini (with its 20 UŠ value) and Leo (with its 40 UŠ value), has an intermediary value of 30 UŠ (Steele 2017, 78–79). This value is due to the fact that the winter solstice falls on a date in the schematic calendar that correlates to the midpoint of Cancer. Thus, half of Cancer would fall into the 40 UŠ zone and the other into the 20 UŠ zone.[161] Sections on Aquarius and Capricorn are unfortunately not preserved across all sources, but

[161] Contra Rochberg (2004a), which reconstructs the value for Cancer as 40 UŠ and for Aquarius as 20 UŠ, placing the point of transition at the beginning of these signs rather than their midpoint.

following the pattern for the other signs, Aquarius would have a total difference of 20 UŠ and Capricorn—laying between Sagittarius's difference of 40 UŠ and Aquarius's assumed 20 UŠ, as well as paralleling Cancer, six signs apart—would have a difference of 30 UŠ, for the same reason Cancer has a difference of 30 UŠ. Like with the calendar-based scheme, this would result in a step function whose two extrema are 40 UŠ and 20 UŠ, with a transition step of 30 UŠ between the two:

Leo to Sagittarius	40 UŠ
Capricorn	30 UŠ
Aquarius to Gemini	20 UŠ
Cancer	30 UŠ

As noted by Rochberg (2004a, 90), these values are identical to those found in the scheme for the length of daylight in MUL.APIN, whose extrema have a ratio of 2:1. While it is possible to extrapolate the length of daylight from the rising time schemes, the sources themselves do not explicitly mention the length of daylight and therefore one should not assume that this was their purpose (Steele 2017, 107).[162] Regardless, the ratio of 2:1 does not reflect actual variation in length of daylight for latitudes in Mesopotamia, which the scribes were no doubt aware of. Likewise, the two-zone format (with or without the transitory zones of Cancer and Capricorn) is not empirically accurate. It is clear, then, that empirical data was not used for the creation of these schemes, but instead were constructed based on mathematical principles (Steele 2017, 108).

Most importantly, the target phenomena modeled in these schemes took place at punctual moments in time, described in terms of culmination, or short-time indicators (Steele 2020a, 96). While it was possible to derive duration between two such moments, it was not the focus of the model. Even the rising time scheme texts that give the difference between zodiacal signs—as opposed to microzodiacal signs—can be viewed in a similar fashion, i.e, as giving the moments of culmination correlated to the end of signs, rather than durations.

Unlike almost all other sources for *ziqpu*-stars, the *ziqpu*-star lists do not mention culmination at all.[163] Instead, the most common type of list provides the interval in UŠ between two consecutive stars. Culmination still underpins the lists, however, as the intervals would only align at culmination, where the different

[162] Schaumberger (1955) does assume that the rising time schemes were a means to determine the length of daylight. While Rochberg (2004a) states that it was possible to calculate the length of daylight using these schemes, she does not claim this was their purpose.
[163] The only exception to this would be the natal omens AO 6483 and U 197, surveyed in Chapter 1, but discussed in greater detail in Chapter 4.

declination of the *ziqpu*-stars would have no impact on the intervals listed.[164] The fact that the interval between two non-consecutive stars is never referred to in any source suggests yet again that these are short-time indicators rather than a way of measuring a span of time between *ziqpu*-stars. The single exception may be BM 38369+, the only list to have a subset of the twenty-five known *ziqpu*-stars, though even here it is possible that the author of 38369+ was only familiar with this subset, and thus from their perspective, the listed stars were all consecutive. Moreover, the intervals that appear in the lists are consistently multiples of 5, suggesting that mathematical integrity was valued more in constructing the lists than empirical data.[165] Additionally, the fact that different lists start with different *ziqpu*-stars along the standard sequence is further evidence of their abstraction and the fact that culmination itself was not relevant in these texts.

Intervals between *ziqpu*-stars could be correlated to weight, most likely of water in a water clock (Steele 2020a, 95–96; 2014, 130), as is evident in the lists AO 6478 and K 9794. Each entry in the Seleucid era list AO 6478 contains the intervals in units of weight, of UŠ (*ina qaqqari*), and of *bēru ina šamê*.[166] This list duplicates the Neo-Assyrian list K 9794, but as suggested in Chapter 1, this earlier list only contains intervals in units of weight and in units of *bēru ina šamê*. The only other extant Neo-Assyrian list, 1881-2-4, 413, does not preserve intervals, so it is unknown if the Neo-Assyrian lists already contained intervals in UŠ. It is possible, then, that intervals between *ziqpu*-stars were first framed in terms of weight (and *bēru ina šamê*) and only later on in terms of UŠ, thus requiring no direct empirical data. Later on, the intervals between *ziqpu*-stars were framed in terms of UŠ, almost certainly related to the interval of dates in the schematic calendar found in MUL.APIN's second section on the *ziqpu*-stars. Therefore, the intervals between the *ziqpu*-stars—and consequently the intervals between culminations—were correlated to and modeled after weight in a water clock.[167] This would explain the ability of Babylonian astronomers to use the aforementioned abstract points some interval away from *ziqpu*-stars found in, e.g., the rising time schemes or the Astronomical Diaries. While these abstract points cannot be empirically observed, it is possible to determine the moment of their culmination

[164] From a modern perspective, this would happen when crossing the upper meridian (the meridian passing through the zenith) and the lower meridian (the meridian passing through the nadir). Due to the angle of the horizon in relation to the celestial equator, in the northern hemisphere, stars that have higher declination would rise earlier than stars with lower declination, even if they have the same right ascension.
[165] For the explanation and amendment proposed by Steele (2017, 15–16) of the unusual values of 8, 9, and 12 found in AO 6478, see Chapter 1.
[166] For a discussion of UŠ *ina qaqqari* and *bēru ina šamê* as well as their relationship, see Chapter 1.
[167] This implies that the later Seleucid period water clocks would have worked in a way similar enough to the earlier Neo-Assyrian water clock as to produce the same results. Whether water clocks did in fact change over the course of 1st millennium BCE Mesopotamia, and if so, in what way, remains unknown.

based on the weight measured in a water clock.[168]

Ziqpu-stars and Observation

Thus far, none of the sources discussed reflect observational practices. In addition to the caveats outlined above for the rising time schemes, these texts also encounter the problem that culmination would not have been observable while the sun was up. This would have always been the case for the calendar-based scheme, which focused on moments of sunrise and sunset. For the zodiac-based scheme, while in some cases the sun would be up, that would not be consequential, since the zodiacal and microzodiacal signs themselves cannot be directly observed, necessitating a different method of tracking positions along them, most likely by means of weight in a water clock.

Similarly, MUL.APIN should not be taken as containing observational instructions for the *ziqpu*-stars. The verb used in both sections on the *ziqpu*-stars is *amāru*, whose base meaning is "to see." But the verb can also mean "to look up, to find a result," namely from a different source. The second person language would fit both meanings well. In the case of the latter meaning, it refers to instructing the reader not to directly observe the skies, but rather to determine in some other way the culmination of a *ziqpu*-star, almost certainly by means of weight as discussed above. Lastly, the first entry of the second section on *ziqpu*-stars contains a description of how the reader should orient themselves—with east to their left, west to their right, and their face to the south—so that the Shoulder of the Panther would stand opposite their chest.[169] It is important to note that MUL.APIN is the earliest source making use of the notion of *ziqpu*-stars, and therefore, the description of the reader's orientation

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[168] It is worth noting that the unit of UŠ is also used in the ephemerides, which are not observational, to provide the position along the zodiac (what would be equated to celestial longitude). The Astronomical Diaries, which heavily rely on observation (though not exclusively), use the unit of $KUŠ_3$, "cubit," to describe celestial position, e.g., between a planet and a star. Therefore, it has been proposed that UŠ was used for abstract, calculated purposes while $KUŠ_3$ was used for observational practices (Rochberg-Halton 1991a; Swerdlow 1998, 34–37). While this is true in many cases, it is not a strict distinction. For example, the ephemerides—clearly computed and non-observational—can use $KUŠ_3$ to provide the equivalent of celestial latitude. For the few, mostly early observational texts that use UŠ in place of the expected $KUŠ_3$, see Jones (2004, 530–34). Note, however, that UŠ and $KUŠ_3$ are not a part of the same coordinate system, but rather two independent systems of measurement (Steele 2007).

[169] See fn. 15 for the replacement of these orientational instructions by a DIŠ sign, from the second entry onward.

could have served to familiarize them with where conceptually in the skies the *ziqpu* relates to, namely, the middle of the sky.[170]

The Astronomical Diaries, considered exemplars of observational astronomy, also make use of the *ziqpu*-stars. While the Diaries do record observations, it is clear that some of the information in them was not observed. In some cases, this would be information that is normally observed but for some reason—usually adverse weather conditions—was not, such as the following example, in which the scribe recorded the heliacal settings of Mercury and Saturn despite being unable to see these phenomena:

> GU$_4$.UD ina NIM ár ^{mul_x}KUN^{me} ŠU(!) ù SAG.UŠ ár ^{mul_x}KUN^{me} ŠÚ UD^{me} ŠÚ^{me} NU PAP
>
> Mercury’s last appearance in the east behind the Tails, and Saturn’s last appearance behind the Tails; I did not watch because the days were overcast. (ADART 1, -651, col. i ln. 7-8; after Sachs and Hunger 1988)

Some phenomena would be calculated despite the possibility of observing them, such as the heliacal phenomena of Sirius starting roughly from the year 350 BCE onwards (Britton 2002, 43). Even still, some of the information in the Diaries could not be observed at all, such as the dates of the equinoxes and solstices. It is unknown whether the unobserved data recorded were calculated specifically for each instance or were copied from another source.

As mentioned in Chapter 1, the Diaries correlate culmination with two kinds of phenomena: occultations and lunar eclipses. Only six texts mention occultation, three of which are Diaries recording the same event, namely the occultation of the King (LUGAL), Regulus, by the moon in 133 BCE. Two of those indicate the culmination of the Crab when the occultation began and the culmination of the Four Stars of Its (=the Lion’s) Breast when the occultation concluded. The other cases of occultation only mention the culmination at the beginning of the occultation. In those cases where the Diaries use culmination in relation to lunar eclipses, the texts indicate which *ziqpu*-star (or less often, an abstract point some interval away from a *ziqpu*-star) culminated at the beginning of the eclipse and which one culminated at the end of the eclipse.[171] Steele (2000, 67) has calculated the times in which the eclipse started vis-à-vis the time indicated in the Diaries and concluded that it is unlikely these culminations were observed. Ossendrijver (2020, 44–45) also points out their proximity to sunrise or sunset would almost certainly rule out observation. It is more likely, then, that references to culmination in the Diaries were either calculated,

[170] For a discussion on the term “middle of the sky” vis-à-vis the *ziqpu*-stars, see Chapter 1.

[171] Additionally, the intervals before or after sunrise or sunset are always recorded. This latter time indication was far more common than referencing culmination.

perhaps based on weight in a water clock, or somehow extrapolated from the rising time schemes, though this in itself probably relied on the water clock. It is important to note that the Diaries occasionally include the duration, in UŠ, of the eclipse. This, however, occurs both in eclipse records that include the *ziqpu*-stars and those that do not. Measuring the duration of the eclipse, then, is unrelated to the application of the *ziqpu*-stars as time indicators. Thus, insofar as using the *ziqpu*-stars, the goal was to indicate specific moments that an event took place—much like in other sources that refer to the *ziqpu*-stars— such as the beginning and end of an eclipse, and not its duration.

This is further accentuated in the Neo-Assyrian texts that, like the Diaries, mention culmination as punctual time indicators irrespective of duration, namely three letters SAA 5, 249, SAA 10, 134, and SAA 10, 149, as well as the ritual text BM 121206. SAA 5, 249 is dated to the reign of Sargon[172]—and is thus the earliest dated source to mention the *ziqpu*-stars—and indicates the points in time in which a devastating storm began and subsided:

> ina GE$_6$ ša UD 4 KAM ša-a-⌜ru⌝ dan-nu ša a-dan-niš i-⌜zi⌝-[qa] ^{tug_2}maš-kan^{meš} gab-bu mi-[hu-u] i-ba-aš$_2$-ši u$_2$-ta-⌜si⌝-[hi] UN^{meš} ip-tal-hu a-dan-⌜niš⌝ ANŠE.KUR^{meš} ina ŠA$_3$-bi a-ha-[iš] it-ta-ad-bu-ku ina ⌜UGU⌝ ^{mul}kip-pi-te u$_2$-⌜sar⌝-[ri] ina UGU ^{mul}taš-ka-[a-ti] ⌜it⌝-tu-u$_2$-ah
>
> On the night of the 4th day, an extremely strong wind was blowing. The storm was so (strong) it tore off all the tents; people got panicked, horses piled together making a heap. It started at the culmination of the Circlet and subsided at the culmination of the Star from the Triplet.
> (SAA 5 249, obv. 6’-15’; after Lanfranchi and Parpola 1990)

It seems unlikely that a storm so severe that it warranted a report to the Neo-Assyrian king—the only such instance in the entire Neo-Assyrian state correspondence corpus consisting of several thousand texts—would have allowed the scribe to observe the culmination of stars.[173]

The two Neo-Assyrian letters that reference *ziqpu*-stars in relation to a lunar eclipse merely give a single mention of culmination, without specifying whether this culmination took place at the beginning, the middle, or the end of the eclipse. SAA 10, 134 is quite fragmentary. The only relevant part of the letter that is preserved simply mentions the term *ziqpu* (obv. 8), and the missing part would have insufficient space to

[172] See Chapter 1 for the reasoning of this date.
[173] The reason for this unusual report is unclear to me. One may only speculate that it was a way for the scribe to justify a state of disarray in the Assyrian camp. Why the scribe considered it important to report the time of the beginning and end of the storm by means of culmination is similarly unclear to me.

include another reference to culmination. SAA 10, 149 provides numerous details in its description of the eclipse, but again only one culmination:

> ina ^{iti}SIG$_4$ [UD] ⸢14 KAM⸣ 30 AN.MI [ina] EN.NUN.UD.ZAL i-sa-kan ina ^{im}U$_{18}$.LU i-sa-kan ina ^{im}U$_{18}$.LU u$_2$-zak-ki ina ZAG-šu$_2$ a-dir ina KI ^{mul}GIR$_2$.TAB a-dir ^{mul}qu$_2$-ma-ru ša ^{mul}UD.KA.DUH.A ziq-pu 2 ŠU.SI AN.MI [...] i-sa-kan
>
> On the 14th day of Month III, a lunar eclipse took place [during] the morning watch. It started in the south (of the lunar disk) and cleared up in the south. Its right side was eclipsed. It was eclipsed in the area of the constellation of Scorpius. The Shoulder of the Panther was culminating. An eclipse of two fingers (in magnitude) [...] took place.
> (SAA 10 149, obv. 3’ - rev. 6; after Parpola 1993)

Observation cannot fully be ruled out for these letters, but given that there is evidence for the correlation of weight and culmination of *ziqpu*-stars in the Neo-Assyrian period, as in K 9794, it is quite possible that these reports relied on the scribe using a water clock to determine culmination. This, of course, necessitates that these scribes had access to the water clock. Unfortunately, the context in which these letters were produced is not well understood.

Lastly, the ritual text BM 121206 employs the *ziqpu*-stars to indicate specific moments in which certain activities should take place. In one place, however, the text frames a window of time during which a prescribed activity should be undertaken. Even here, the *ziqpu*-stars are used as time indicators, irrespective of duration. The important part is to perform that aspect of the ritual after the culmination of the Frond and before the culmination of the Harness:

> bir-ti ^{mul}e$_4$-ru$_6$ bir-ti ^{d}na-dul-lu
> mah-ru-u 6-su qa-bu-tu$_2$ GAR-at
> LUGAL ina E$_2$ aš-šur i-ta-rab
>
> Between (the culmination of) the Frond and (the culmination of) the (Front) Harness, the sixth cup was placed; the king entered the temple of Aššur.
> (SAA 20 52, rev. ii 23’-25’; Parpola 2017)

Given the importance in performing rituals properly, it seems unlikely that the Neo-Assyrian scholars would have relied on observation to dictate these moments, since this would have made them dependent on clear skies.

A Brief Historiography of Textual Classification

Before concluding and discussing the implication of viewing textual references to *ziqpu*-stars as indicative of model-making, it is important to briefly review the historiography of textual classification of Babylonian astronomical texts, as different terms have been used to accentuate differences between texts. Analyzing sources of *ziqpu*-stars from the perspective of models underscores the fact that this textual classification can be misleading.

The first systematic classification of the astronomical corpus was done by Sachs (1948). In this now-seminal paper, Sachs primarily divided the astronomical texts of the Seleucid period into two main categories based on their format, i.e., the arrangement of the text on the tablet. He referred to the first as the Astronomical Tables, consisting of the ephemerides as well as the procedural texts that supplied the arithmetic methods needed to generate values found in the ephemerides (Sachs 1948, 272–75). These would later be thoroughly investigated and published by Neugebauer (1955) with additional material by Ossendrijver (2012). Sachs' second category were the non-tabular texts, where he coined many of the terms still used today, such as the Astronomical Diaries, the Almanacs, and the Goal-Year texts (Sachs 1948, 275–86).

Later scholarship would use different terms for the former category, i.e., Sachs' Astronomical Tables, such as theoretical, mathematical, or computational (e.g., Neugebauer 1955; 1975; Aaboe 1958; 1980; Swerdlow 1998), often interchangeably, as pointed out by Rochberg (2004b, 278). These definitions, however, were never explicated in any meaningful way. For example, Neugebauer simply labels sections of his discussion on the ephemerides as "The Lunar Theory in General" (Neugebauer 1955, 41–43) or "The Planetary Theory in General" (Neugebauer 1955, 279–315). Rochberg (2004b, 278) observed that Neugebauer used the term "theory" to distinguish the texts that use System A and B, the underlying computational methods Neugebauer identified for generating the numerical values in the ephemerides, from astronomical texts that did not. Shortly after, the term "mathematical" was used as an alternative label to "theoretical" (Aaboe 1958), which led to referring to Sachs' second, non-tabular classification as "non-mathematical astronomical texts", or NMAT for short (Aaboe 1980).

It is possible Neugebauer's choice of using the term theory stemmed from early 20th century discussions in the philosophy of science, particularly the views of logical positivism, which aimed to separate theory and observation into two distinct endeavors, in what is referred to as the syntactic or received view.[174] Indeed, it seemed

[174] For the historical background of logical positivism and the received view, see Suppe (1977, 6–16).

at the time that texts that belonged to Sachs' non-tabular classification—and therefore did not belong to Neugebauer's theoretical classification—were by and large observational. The syntactic view would come under attack, particularly for its distinction between observation and theory, and dismantled in the second half of the 20th century, replaced with the semantic view, in which the main tenant was that theories supply meaning (see, e.g., Putnam 1962; Achinstein 1968; Suppe 1977). However, it was Hanson (1958) who first articulated that observation and theory cannot be separated as clearly as advocated by logical positivism. In his seminal work, Hanson demonstrated that in order to observe a phenomenon, one must first conceptualize the phenomenon, i.e., one must have a theory of what is being perceived. To take an example from Babylonian astronomy, the observation of the heliacal rising of a star requires prior conceptualization of heliacal risings, among other things. Therefore, observation itself is theory-laden. Indeed, the so-called observational texts, namely the Astronomical Diaries, demonstrate that their authors had distinct theories on when certain phenomena would take place, even if they were not observed or unobservable to begin with.[175]

Applying terms such as theoretical, mathematical, or computational solely to the ephemerides (and their accompanying procedural texts) creates the impression that astronomical texts that do not fall into this category contain no theory or mathematics. Furthermore, it disregards the fact that astronomical texts belonging to what Steele (2017, 10–12) refers to as schematic astronomy, such as MUL.APIN, Tablet 14 of Enūma Anu Enlil, and the rising time schemes contain conceptualization of—or theorizing about—celestial phenomena. Additionally, these astronomical texts exhibit mathematical underpinning, such as using linear functions to arrive at numeral values for their target phenomena. It is important to note that these texts were not included in Sachs' (1948) treatment of the Seleucid period material, which served as the template for the later theoretical or mathematical divide, since many of them are dated to the 2nd or early 1st millennium. While the rising time scheme texts are roughly contemporaneous to the ephemerides, they were not sufficiently researched and understood at the time of Sachs' publication and were therefore likewise not included. It is possible that their earlier date as well as the simpler values used in their mathematical operations contributed to an incorrect perception of a linear progression of science that was dominant in the history of science during the first half

[175] While Babylonian astronomers had distinct names for some of the genres of astronomical texts (e.g., the Astronomical Diaries were called *naṣāru ša ginê*, "regular watching"), it is unknown whether they considered these genres as distinctly different in the same way modern scholarship views them, e.g., whether so-called mathematical astronomy was indeed "theoretical" to them. A major concern with this issue is the danger of imposing modern terminology and lines of demarcation on the Babylonians. For example, there is no equivalent to the term "theory" in the cuneiform record, but as discussed in this chapter, they clearly had theories about the behavior of celestial phenomena.

of the 20th century. In this view, theory would come late in the history of Babylonian astronomy, namely, the Seleucid period. To a large extent, the use of these terms, framed as they were in the middle of the 20th century, was ossified in the study of Babylonian astronomy despite developments within philosophy of science since then as well as within the study of Babylonian astronomy itself.

Conclusions

Reading the textual sources that make reference to the *ziqpu*-stars through the lens of model-making sheds light on the conceptualization and utilization of the *ziqpu*-stars. It reveals that accurately reflecting empirical reality derived from observation was not of primary concern. Nor was there an interest in measuring the duration of phenomena. Instead, Assyro-Babylonian astronomers modeled the precise moments that target phenomena took place by using the concept of the *ziqpu*. They created correlation between culmination on one hand and other events on the other, such as heliacal risings, eclipses, simultaneous culminations.[176] The cognitive style at work here focused on determining the precise moment that the next instance of a given phenomenon would occur.

This cognitive style that underlies the modeling practice related to the *ziqpu*-stars is similar to the modeling found in the ephemerides, where the interest was in determining the next occurrence of select phenomena (Rochberg 2018). Thus, by looking at the *ziqpu*-star texts through the concept of models and model-making, it becomes apparent that they have more in common with the ephemerides than was first evident. This conclusion accentuates the need to revisit the labels previously used to designate different astronomical texts and to incorporate developments in philosophy of science into the study of Babylonian astronomy, providing modern scholarship with a better and more nuanced understanding of Babylonian astronomy as a whole. Furthermore, it opens up the inclusion of Babylonian astronomy in discussions on models and model-based reasoning in philosophy of science and the place of Babylonian astronomy in the history of science and reasoning.

[176] BM 78161 and SpTU 3, 103+102. The latter is a new join made by the author. For an edition, see Appendix B.

Chapter 4: Isolated Texts

Introduction

This chapter examines several texts that make reference to the *ziqpu*-stars, yet do not seem to belong to the "mainstream" usage of the *ziqpu*-stars as attested by the vast majority of *ziqpu*-star texts outlined in Chapter 1. Most *ziqpu*-star texts are of specific kinds, namely the star lists, the rising time schemes, and the Astronomical Diaries. To these, one may also add texts that make use of the *ziqpu*-stars in similar ways, such as MUL.APIN and the Neo-Assyrian letters and ritual text discussed in Chapter 1. The texts discussed in this chapter, however, either do not belong to these categories or use the *ziqpu*-stars in different ways—either with wholly new approaches or ways that expand on their traditional use.

Here I borrow the term "isolated texts" used by Sachs (1948) to designate texts that he could not place in any of the other classifications he defined. This is not to say that these texts are completely disconnected from the rest of the *ziqpu*-star texts. In fact, in some cases it is possible to identify these texts as referring to *ziqpu*-stars only because their choice of stars matches the well-established repertoire of *ziqpu*-stars, despite not referring to culmination at all.

SpTU 3, 103+102

First published as two individual texts by von Weiher (1988), SpTU 3, 103+102 were first joined into a single text and studied in the present study.[177] This Late Babylonian text from Uruk contains twelve sections, each written across three lines in a strict format:

1st line:	ki-i SN_1 a-na ziq-pi GUB-zu-ma ^{d}30 AN.MI u_2-šar-ru-u_2
2nd line:	SN_1 SN_2 SN_3
3rd line:	a-di-i ^{d}UTU SN_4 KUR-ad_2 pi-$šer_3$-$ša_2$ AN.MI ul u_2-šar-ra-a
	When SN_1 stands in culmination, a lunar eclipse will begin.
	SN_1 (is as) SN_2 (is as) SN_3

[177] Note that a possible join was suggested by Oelsner (1991, 42) in his review of SpTU 3 but was never explicated.

Until the sun reaches SN_4, its meaning (is that) the (aforementioned lunar) eclipse will not (yet) begin.

For example, the entry for the Lion is as follows:

27' ki-i ^{mul_2}e$_4$-ru$_6$ a-na ziq-pi GUB-zu-ma ^{d}30 AN.MI [u$_2$]-⸢šar⸣-ru-⸢u$_2$⸣
28' ^{mul_2}e$_4$-ru$_6$ ^{mul_2}ABSIN ^{d}šullat$_2$(=PA) ⸢u ^{d}⸣haniš$_2$(=LUGAL)
29' a-di-i ^{d}UTU ^{mul_2}ABSIN KUR-ad$_2$ pi-šer$_3$-ša$_2$ AN.MI ul u$_2$-šar-ra-a
(SpTU 3, 103+ ln. 27'-29')

SN_1, which appears as the star in the first line and the first name in the second line, is always the name of a *ziqpu*-star. Following the definition of the *ziqpu*-stars as found in MUL.APIN, SN_1 is also a Star in the Path of Enlil. Indeed, the three stars enumerated in the second line are stars belonging to the three paths of Enlil, Anu, and Ea. The last name, SN_4 in the third line, is one of the stars that appear in the second line, but also one of the Stars in the Path of the Moon from MUL.APIN.[178]

The meaning of this text and the astronomical reality it reflects, if any, remain unclear. The relationship between the stars of each section is not of simultaneous culmination. Only two sections (9 and 10) are fully preserved, and the differences in right ascension between their constituent stars vary between 20° to 40°. A difference of that magnitude would mean a difference of up to 160 minutes in culmination. Thus, while stars of a given section would not culminate simultaneously, they do seem to roughly fall into the same band of right ascension, with each star in the section having decreasing declination. Given that there are twelve sections, one would expect the width of these bands to average at around 30° for a total of 360°.

It is unclear what astronomical reality, if any, SpTU 3, 103+ reflects. In this regard, SpTU 3, 103+ is another example of a model-based approach in using the *ziqpu*-stars. The text most likely had an astrological application in relation to lunar eclipses. The term *pišerša* found in the third line is a common expression found in divinatory literature. More telling is the fact that the sections that immediately follow the main body of the text (section 13 and 14) contain references to the celestial omen series Enūma Anu Enlil, including the incipit of Tablet 17.[179]

[178] While it is tempting to assume that the twelve entries correlate to the twelve months of the year or the twelve signs of the zodiac, based on the proposed reconstruction of the text, that is not the case.

[179] Note that section 13 also contains the signs *ziq-pi a-mur*, "note the *ziqpu*" (rev. 10), but due to the passage being broken, it is unclear what this refers to.

BM 78161

Somewhat similar to SpTU 3, 103+ is BM 78161, a complete tablet published by Pingree and Walker (1988), who suggested dating the tablet to the 7th to 5th century BCE, likely originating from the area of Babylon or Sippar. This suggestion is based purely on the appearance of the tablet and script as well as the date of acquisition, and so cannot be determined with certainty. This is particularly important to note, due to the chronological gap in dateable sources between the Neo-Assyrian sources of the 7th century BCE and the Astronomical Diaries that use the *ziqpu*-stars, dated to the 4th to 1st century BCE.

The text, written on both the obverse and the reverse, consists of twenty sections that follow a standard format. With the exception of the first and last section, each section begins with the name of a *ziqpu*-star (or a point some interval away from one), followed by the logogram KI.MIN, "ditto" (only from the third section onwards), [180] the names of two or three stars, and rarely a reference to the *bīt niṣirti* of a specific planet.[181] The section then concludes with the logogram GU, "string," causing BM 78161 to be referred to as the GU text (see, e.g., Hunger and Pingree 1999, 90). For example:

> ^{mul}e$_4$-⸢ru$_6$⸣ KI.MIN ^{mul}AB.SIN$_2$ ^{d}PA u LUGAL $^{mul.udu.idim}$GU$_4$.UD ša$_2$ ŠE$_3$ ^{mu}[^{l}]AB.SIN$_2$ ina IGI ^{mul}UGA GUB-zu GU
>
> The Frond; ditto, the Furrow, Šullat and Haniš; Mercury which stands towards the Furrow in front of the Raven—a string.
> (BM 78161, ln. 17-18; translation mine)

The tablet seems to begin in media res, with the first section missing its leading *ziqpu*-star and KI.MIN logogram. Similarly, the text abruptly ends mid-string, with the last section missing the name of at least one additional star and its closing GU. This suggests that BM 78161 actually contains only part of the original text. The most widely accepted interpretation of the text is that each string contains stars that would

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[180] For translating KI.MIN as "ditto," contrary to the interpretation by Pingree and Walker (1988) as "or," see the edition of SpTU 3, 103+ in the appendix. For the reason KI.MIN does not appear in the first section, see below. The reason why the second section (lines 2-3) does not include KI.MIN is unclear. One would expect it immediately after IGI-*u$_2$* in line 2. While this section is not preserved well, there is little room for KI.MIN to appear there and may have been accidentally omitted by the scribe.

[181] This has been noted also by Hunger and Steele (2019, 178). In an astrological context, a planet's *bīt niṣirti*, "house of secrets," is the celestial position in which a planet exerts the most influence. See also fn. 113 in Chapter 2.

culminate roughly at the same time (Pingree and Walker 1988).[182] Each string begins with the northmost star, the *ziqpu*-star, with each consecutive star along the same string laying further south. From a modern astronomical perspective, each string contains stars that share roughly the same right ascension, but with decreasing declinations. Three of the strings are headed not by a ziqpu-star, but by an abstract point some interval away from one. These are 5 UŠ behind the Crab, ½ *bēru* behind the Four Stars of Its (=Lion's) Chest, and ½ *bēru* behind the Frond. Steele (2017, 95–96) has pointed out that these three are also the culminating points at sunrise in the middle of Months VII, VIII, and IX in the rising time schemes, which in turn correspond to the culminating points of the middle of the respective zodiacal signs Libra, Scorpio, and Sagittarius. Steele saw this as evidence that the author of BM 78161 chose these three abstract points because they would culminate in the middle of these months. Since BM 78161 does not contain the original text in its entirety, only partial overlap can be made with the rising time schemes. However, insofar as is attested, there is full agreement between the rising time scheme and the culminating points in BM 78161:

BM 78161	Rising time scheme
5 UŠ behind the Crab	VII 15 / Libra 15
2 Stars of the Head of the Lion	-
4 Stars of the Chest of the Lion	-
½ bēru behind the 4 Stars of Its Chest	VIII 15 / Scorpio 15
2 Stars of Its Thigh	-
Single Star of the Tail of the Lion	-
The Frond	-
½ behind the Frond	IX 15 / Sagittarius 15
The Harness	-
ŠU.PA	-
The Second Harness	-
The Circlet	X 15 / Capricorn 15
The Star from the Doublets	-
Star from the Triplets	XI 15 / Aquarius 15
The Crook of the She-Goat (= Lady of Life)	XII 15 / Pisces 15

Steele (2017, 95–96) took this as further evidence that the microzodiacal rising time scheme originated from the calendar-based one.

It is worth noting that both BM 78161 and SpTU 3, 103+ offer correlations between *ziqpu*-stars and other stars that lie south of them. Unlike SpTU 3, 103+,

182 See Pingree and Walker (1988) for the major error made by the scribe half-way through the text that this interpretation suggests. Koch (1992) offered a different interpretation, in which each string represents an altitudinal circle, but see the critique leveled at Koch by Hunger and Pingree (1999, 90–100).

however, BM 78161 follows the well-attested sequence of *ziqpu*-stars found elsewhere. It is clear, then, that the compilation of BM 78161 was informed by the *ziqpu*-star lists. It is therefore apparent that the text is using these stars because they are *ziqpu*-stars, despite the term *ziqpu* or the concept of culmination not appearing in the text at all. It is also worth noting the inclusion of some of the planetary *bīt niṣirti*, which may hint at a possible astrological application for BM 78161.

AO 6483 and U 197

As presented in Chapter 1, AO 6483 and U 197 are two Late Babylonian texts from Uruk, published by Sachs (1952b), that contain natal omens mentioning the *ziqpu*-stars in their protases. Similar to BM 78161 discussed above, both texts never refer to culmination or use the term *ziqpu*, but since the stars mentioned in protases follow the standard sequence of *ziqpu*-stars it is clear they were chosen because of their association with this set. Interestingly, AO 6483 is the only text that explicitly makes use of the *ziqpu*-stars not in their moment of culmination, but instead, refers to them as they "come out," i.e., rise. For example:

> ^{mul_2}qu$_2$-mar ša$_2$ ^{mul_2}UD.KA.DUH.A E$_3$-a uk-ku-uk : su-ku-uk
>
> (When) the Shoulder of the Panther comes forth, he (=the newborn) will have the itch; variant: he will be deaf.
> (AO 6483, rev. 32; after Sachs 1952)

In addition to the stellar omens described above, AO 6483 contains additional sections of an astronomical and/or astrological nature, such as lunar, solar, and planetary natal omens, predictions of a personal character based on zodiacal associations, and a scheme dealing with lunar visibility. It seems, then, that AO 6483 is a compilation tablet that contained information that was important for its owner, likely for casting predictions. The text demonstrates that knowledge of the *ziqpu*-stars—or at least their constituent members and their sequence—was employed in a way that is markedly different than the vast majority of sources of *ziqpu*-stars, namely, in creating astrological omens. Interestingly, the preserved apodoses of all *ziqpu*-star natal omens are negative, from physical disabilities to poverty to death in a variety of different ways.[183]

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[183] It is worth mentioning that the term *ziqpu*—though not the *ziqpu*-stars—appears once as part of a natal omen in LBAT 1593, published by Reiner (2000): *aš$_2$-šu$_2$* MUL$_2$.BABBAR *ana ziq-pi* GUB-*zu* UŠ *u* MUNUS *ša$_2$* U$_3$.TU SIG$_5$, "Because of Jupiter stands in culmination: the male and female born

BM 36628+

This Late Babylonian text from Babylon is a compendium text published by Steele (2015a). It contains numerous sections dealing with a variety of astronomical and astrological matter, such as the *ziqpu*-stars, astrological correlations, predictions related to water level and businesses, astrological medicine, *dodecatemoria* and *Kalendartext*-based schemes, and the earliest attestation of the astrological concept of "Terms," widely used later in Greek astrology. As discussed in Chapter 1, one section (obv. i A1-A10) includes the names of *ziqpu*-stars along with several numbers, some of which are the standard intervals attested elsewhere. More relevant to the current chapter is the second section (obv. ii B8' - iii C15'), which lists the *ziqpu*-stars in a unique way, subdividing the *ziqpu*-stars into groups. Each group begins with a statement referring to "the stars behind SN," where SN is the name of the last *ziqpu*-star of the previous group.[184] This statement is followed by two or three names of *ziqpu*-stars. To the right of each name of *ziqpu*-star, the text includes some kind of qualifier. Although that part of the text is poorly preserved, it seems that the first ziqpu-star is qualified with the sign EGIR, "before," the second *ziqpu*-star with the sign IGI, "after," and, if there is a third star, it is qualified by a sign, that begins with A. Unfortunately, only one such case is preserved, and it is unknown if A was the qualifier in its entirety, or if the cuneiform wedges that make up the A sign are simply the beginning of a larger sign.

Because all lines in this section are broken in the latter half, it is not possible to determine what the different qualifiers meant and whether this section contained any additional information or correlations. However, it is important to note that BM 36628+ is a compendium text, most—if not all—of which deal with astrological

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will be fine" (LBAT 1593, obv. 11'; translation mine). The phrase *ana ziqpi* GUB-*zu* appears elsewhere in relation to culmination (e.g. SpTU 3, 103+). The GUB sign can also be read DU, "to go," used in the rising time scheme texts. It is clear then, that *ziqpu* here refers to culminating, unlike the use of the term *ziqpu* in a Venus omen in Enūma Anu Enlil (for a discussion, see the Introduction, fn. 4). The line in LBAT 1593 is part of a section that predicts the physical characteristics of a person, as well as other natal omens, based on the zodiac and the planets. This section is followed by instructions on preparing medication and apotropaia against diseases or demons. The reverse contains additional natal omens and is followed by a section on planetary periods. Much like AO 6483, LBAT 1593 seems to be a compilation tablet, whose owner considered it important to have all this information on a single tablet.

[184] This can also be a star that is a constituent star of a larger constellation, e.g., the King in C10' is one of the stars of the preceding Four Stars of Its (=Lion's) Chest. Alternatively, this can also be a more encompassing reference to a star, such as in B19', which refers to the Old Man, while the preceding *ziqpu*-star is specifically the Bright Star of the Old Man.

matter, suggesting that for the scribe, having all of these texts together on a single tablet would have served a useful purpose (Steele 2015a).

TU 11, VAT 7825, and SpTU 4, 162

The following three texts are all Late Babylonian texts from Uruk, which refer to the *ziqpu*-stars in relation to lunar eclipse omina. TU 11 (AO 6455 = TCL 6, 11)[185] was originally copied by Thureau-Dangin (1922), but only received a comprehensive critical edition with commentary in Brack-Bernsen and Hunger (2002). The text contains numerous sections dealing with astronomical procedures as well as astrological matter, many of which are difficult to understand. The *ziqpu*-stars appear, as a set, only once in the last line of section 8:

> ina DU$_6$ UD 14 AN.MI EN.NUN USAN ina $^{\text{mul}_2}$LU 30 GAR MUL$_2$.BABBAR u GENNA ina $^{\text{mul}_2}$LU $^{\text{mul}_2}$UR.A $^{\text{mul}_2}$PA u $^{\text{mul}_2}$RIN$_2$ mi-hir ša$_2$ $^{\text{mul}_2}$LU GU SI.SA$_2$ DUB$_2$-šu$_2$ GUB-ma SIG SIG ŠE BAR RA ŠE GAR RA KI GU$_4$.UD ina KI$^{\text{meš}}$ ŠEŠ-ma GUB-ma SIG-ma $^{\text{mul}_2}$GU$_4$.UD GUB AN SIG ki GU$_4$.UD KUR$_4$-ma AN MAH $^{\text{d}}$dele-bat ina ŠA$_3$ SIG A.KAL GIN A.KAL dele-bat ina ŠA$_3$ KUR$_4$ ZI KUR$_2$ SIG-ma nu-hu-uš ina EN.NUN USAN EN.NUN MURUB$_4$.BA EN.NUN UD.ZAL.LA ša$_2$ lu-maš gab-bi 1-ma UD $^{\text{d}}$30 AN.MI GAR ziq-pi a-mur UD ša$_2$ 20 ana ŠA$_3$ KUR pi-šer E
>
> (If) the moon makes an eclipse in the evening watch in Month VII the 14th day in Aries, Jupiter and Saturn are in Aries, Leo, Sagittarius; and Libra (which is) opposite of Aries, a straight string you(?) tighten, and …, and ……… you observe the place of Mercury in the "places," and …… and Mercury stands(?), weak rain; when Mercury is bright, much rain; (if) Venus is faint in it, the flood will come, the flood(?); (if) Venus is bright in it, an attack of the enemy will become weak(?); abundance. In the evening watch, middle watch, morning watch of all the (zodiacal) constellations, it is the same. When the moon makes an eclipse, note the *ziqpu*; when it is of the sun(?), give an interpretation for the land(?). (TU 11, obv. 17-21; after Brack-Bernsen and Hunger 2002)

This section refers to an eclipse after sunset near the autumnal equinox and employs a triplicity, an astrological association of three signs that form an equilateral triangle (Brack-Bernsen and Hunger 2002, 79–80). Such triplicities can be associated with

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[185] TU 11 has become the identifier most often used in modern scholarship for this tablet. Therefore, I have chosen to follow this convention in regards to this text, and not its museum number (AO 6455), the standard for all other sources mentioned in this dissertation.

cardinal directions, which use the names of lands (Rochberg 2004a, 109), which may be related to the "land" mentioned in the last phrase of this section.

VAT 7825 and SpTU 4, 162 are duplicates of a commentary to Enūma Anu Enlil tablet 20.[186] Here, the *ziqpu*-stars are mentioned as a set in relation to a lunar eclipse omen. These texts quote phrases from Enūma Anu Enlil, then either explain them or offer alternative interpretations:

> DIŠ AN.MI : ina UD 7 KAM UD 14 KAM UD 21 KAM : ana UGU IGI-šu$_2$ u TIL-tu$_2$: DIŠ MUL^{me} EN.NUN^{meš} AN.MI u$_2$-kal-lu-mu-ka MUL : ša$_2$ ina ITI EN.NUN a-na ^{d}30 TE-u$_2$ u DAB-u$_2$ MUL^{meš} ziq-pi ša$_2$ ina UGU AN.MI ^{d}30 GAR-an pi-šer$_3$ ana ŠA$_3$ ta-qab-bi
>
> ¶ "An eclipse on the 7th, 14th, (or) 21st" (it is said) with regards to its (first) sighting and termination. "Stars, watches, eclipse(s), he (= the moon) will show(!) you." ¶ "Star" (refers to) that which in the month under watch approached the moon and passed by. "The *ziqpu*-stars" (are) those at culmination (during) an eclipse of the moon. Therefrom you can pronounce an interpretation.
> (CCP 3.1.20.B, rev. 14'-17'; after Jiménez 2015b, 2015a with my corrections)[187]

It is interesting to note that these three texts associate the *ziqpu*-stars with the interpretation of a lunar eclipse, despite the fact that *ziqpu*-stars never appear as part of any lunar eclipse omen preserved in the cuneiform form record. In fact, the only places where *ziqpu*-stars appear in any omen are the natal omens, AO 6483 and U 197, discussed above. There is no doubt, however, that this is related to the association between lunar eclipses and *ziqpu*-star culmination, like those found in the Astronomical Diaries and the two Neo-Assyrian letters, as well as SpTU 3, 103+. Since this association was not consistent or prevalent, it is perhaps unsurprising to also find only sparse evidence for this in divinatory texts such as the ones described in this section.

[186] For the most recent edition with literature, see CCP 3.1.20.B in Yale University's Cuneiform Commentary Project (Jiménez 2015a; 2015b). See Frahm (2011) for a study of the commentaries.
[187] I translated the phrase *ina* UGU to refer here to culmination, as it is commonly attested in the rising time scheme texts (Steele 2017, 17), contrary to other translations of this passage, e.g., Al-Rawi and George (2006).

SpTU 5, 269

Yet another Late Babylonian text from Uruk, SpTU 5, 269 was published by von Weiher (1998). The obverse of the tablet is badly preserved, but the reverse contains at least three sections. The first section (rev. 1-5) is the one that refers to the *ziqpu*-stars. The second (rev. 6-8) contains details on Mars' maximal and minimal latitude in relation to its synodic phenomena. The third section (rev. 9-14), which breaks off, provides the interval between the synodic phenomena of Sirius and the cardinal points of the year, given in months and/or days. It is worth noting that there is a single ruling between the first and second sections and a double ruling between the second and third sections. The first section reads as follows:

> u$_4$-um ŠU$_2$-e ziq-pi IGI-ma ina KI mi-ni-i lu-maš ki-i GUB-zu tam-mar UDU.IDIM ša$_2$ i-na <<ina>> ^{d}UTU.ŠU$_2$.A IGI-ru lu-u$_2$ ŠU$_2$-u$_2$ TA UGU ŠU$_2$-bi ša$_2$ ^{d}UTU a-di UGU a-mar ša$_2$ ^{d}UDU.IDIM u$_3$ EN UGU ri-bi-šu$_2$ ŠID-ma u$_4$-um x [x (x)] ŠU$_2$-e ina UGU ri-bi-šu$_2$ ziq-pi IGI-ma <ina> KI mi-ni-i ki-i GUB-zu tam-mar
>
> "(On) the day of the (planet's) setting, you note the *ziqpu* and you note the region of which constellation it (=the planet that is setting) stands. You reckon the planet, in the west, (its) appearance or setting, from the setting of the sun until the appearance of the planet or until its (=the planet's) setting, and (on) the day [...] of the setting, at its setting, you note the *ziqpu* and you note the region in which it (=the planet) stands."
> (SpTU 5, 269; rev. 1-5; translation mine)

It seems that the text instructs the reader on the process of determining in which constellation a setting planet is located on (or around) the day of the planet's last visibility. In order to do so, the reader is referred to doing so by ascertaining which *ziqpu*-star is culminating at that time. This is reminiscent of MUL.APIN I iv 10-30, where the text correlates between the *ziqpu*-stars and a heliacally rising star. The reason for determining this information is unstated, but it may have some astrological implications.

Note that the first and last phrases in this section are almost identical, though it seems that the latter contains additional signs that are either broken or erased. It is possible that the first phrase is meant to serve as a quick reference to summarize or identify for the reader what this section is about without necessitating that they read the entire passage, though none of the other sections contain such a feature. However, it seems that this text is a compilation text, like some of the other isolated texts, and so the original text may have contained similar summary phrases.

STT 2, 340

STT 2, 340 is a largely intact Neo-Assyrian text from Sultantepe, ancient Huzirina, first published by Gurney and Hulin (1964), with a brief description and transliteration by Reiner and Civil (1967, 194–95). The text is a collection of thirty blessing formulae, one for each day of the schematic month, aimed most likely at the king. Each line begins with its line number followed by KI.MIN, "ditto," though what this refers to is unclear. The blessing formula itself comes immediately after and in many cases features the same number that appeared at the beginning of the line (and hence, the line number itself).[188] For example, line 5 reads:

> 5 KI.MIN 5 ⸢ŠEŠ^{meš}⸣-ka!(E) li-kil-lu <reš>-ka li-nar-ru a-a-⸢bi⸣-ka li-šam-qit-tu$_{2}$ ⸢ge⸣-re-e-ka
>
> 5, ditto. Five (are) your brothers; may they look after you, kill your enemies (and) cause the downfall of your opponents.
> (STT 2, 340, obv. 5; after edition in GKAB)[189]

Line 12 is the line that garnered the attention of modern scholarship in relation to the *ziqpu*-stars:

> 12 KI.MIN 12 DANNA MUL^{meš} ⸢ziq⸣-pi ša$_{2}$ KASKAL šu-ut ^{d}EN.LIL u$_{4}$-me-šam MUNUS.SIG$_{5}$^{meš}-⸢ka i⸣-[na IGI] ⸢EN⸣ EN^{meš} liq-bu-u DU^{meš} A$_{2}$.MIN-ka
>
> 12, ditto. Twelve (are) the *bēru* of the *ziqpu*-stars of the Path of Enlil; may they daily decree your good fortune before the lord of lords (and) may they go at your side.
> (STT 2, 340, obv. 12; after edition in GKAB)[190]

It is important to note that the tablet is somewhat damaged around the signs *ziq-pi*, and in their transliteration, Reiner and Civil (1967) read these signs as *mu*!-*ši*, "stars of the night." Gurney (1981, 94) later collated the tablet and reconfirmed his reading of *mu*!-*ši*, a reading that was followed later by Watanabe (1991) in his

[188] In this regard, this is reminiscent of CUNES 48-10-138, an Old Babylonian text with Sumerian proverbs that lists associations based on numbers. For example, the number twelve is associated with the months of the year: 12-am$_{3}$ ITI MU, "twelve (are) the months of the year (obv. i 12). See edition in http://oracc.org/epsd2/P409762.
[189] http://oracc.org/cams/gkab/P338655.
[190] http://oracc.org/cams/gkab/P338655.

treatment of second person blessings aimed at the Assyrian king. However, if the signs on the handcopy are to be trusted, the reading *ziq-pi* is more likely, which is how scholars who have studied the *ziqpu*-stars interpreted these signs (e.g., Horowitz 1998, 186; Steele 2014, 128).[191] This is further supported by the fact that STT 2, 340 states that these stars are "of the Path of Enlil," one of the ways in which they are described in MUL.APIN. Moreover, 12 *bēru* is the total sum of intervals attested for the *ziqpu*-stars.[192] The references to the Path of Enlil and the 12 *bēru* are difficult to explain if this phrase is to be translated as "stars of night."

Yet the inclusion of the *ziqpu*-stars in STT 2, 340 is likely not due to their role as *ziqpu*-stars. As mentioned above, many of the blessings use the line number in the blessing formula itself. It is plausible that the text included the *ziqpu*-stars here because the author desired an item associated with the number twelve, and what came to mind was the 12 *bēru* of the *ziqpu*-stars. This means that the author of STT 2, 340 was familiar, at least to some extent, with the concept of *ziqpu*-stars, and suggests that they were not necessarily confined to a strict astronomical context during this period.

General Remarks

Seven out of the ten isolated texts discussed above hail from Late Babylonian Uruk. The exceptions are the Neo-Assyrian STT 2, 340, BM 78161, whose date is not well established, and BM 36628+, a Late Babylonian text from Babylon. All seven Late Babylonian Uruk texts make reference to the *ziqpu*-stars in an astrological context, though this remains speculative for SpTU 5, 269. It may seem that the astronomers-astrologers of Uruk were experimenting with new, mostly astrological applications for the *ziqpu*-stars, while their counterparts in Babylon were focused on using the *ziqpu*-stars in producing the Astronomical Diaries, as all known Diaries which mention the *ziqpu*-stars come from Babylon. Yet it is important to note that there remains a large amount of astrological material from Babylon that has yet to be identified and studied, and it cannot be ruled out that these seemingly innovating Urukian texts are copies of texts from Babylon, as was the case for other astronomical texts (Steele 2016). Whether this is the case, it is worth noting that while the *ziqpu*-stars were a tool developed by astronomers to indicate specific moments in time, they were also integrated into astrological practices, particularly during the Late Babylonian period, a time of many innovations in astrological practices.

[191] Horowitz takes this to "allude to a geometrical circle of *ziqpu*-stars," even though STT 2, 340 does not mention any such a circle.
[192] See Chapter 1 for a discussion of the total sum of 359, 364, and 360 UŠ.

Conclusions

This dissertation provided a comprehensive study of the set of stars called *ziqpu*-stars in Babylonian astronomy. Chapter 1 discussed how the *ziqpu*-stars were a tool devised by Babylonian astronomers to indicate specific moments in time. They were a well-defined and stable set, consisting of twenty-five stars. While they are attested only in sources dated to the first millennium BCE, their earliest attestation is in MUL.APIN, which may have been composed in the late second millennium BCE. The primary use of the *ziqpu*-star was to correlate their culmination with horizon-based phenomena, such as heliacal risings or the rising of microzodiacal arcs, and other phenomena, such as eclipses. The correlations with horizon-based phenomena are attested throughout the first millennium, starting with MUL.APIN. While correlations with phenomena that are not horizon-based appear as early as Neo-Assyrian times, they only gained substantial use in the last few centuries of the first millennium BCE. Additionally, MUL.APIN—particularly its first section on *ziqpu*-stars—and some of the Neo-Assyrian sources seem to have a qualitative approach to this set of stars. Later sources employed the *ziqpu*-stars in a more quantitative manner, such as correlating their culmination with weight in a water clock or using numerical constants to create abstract points some distance away from the *ziqpu*-stars and correlating their culmination with the rising arcs of the zodiac.

Chapter 2 provided an overview of the other sets of stars encountered in Babylonian astronomy, namely, the Stars in the Paths of Enlil, Anu, and Ea, the Stars of Elam, Akkad, Amurru, and Subartu, the Stars in the Path of the Moon, the so-called zodiacal constellations, and the Normal Stars. By examining other sets of stars it was possible to contextualize the *ziqpu*-stars as one such set, and to identify similarities between the different sets. Much like the *ziqpu*-stars, the Normal Stars were a tool developed and employed by astronomers. Both sets were named after their function or role, and used in a quantitative way. The *ziqpu*-stars were used to indicate time but only when they were culminating, i.e., in relation to the *ziqpu*, and the Normal Stars, called MUL_2.ŠID$^{\text{meš}}$ or "reckoning stars," were employed to indicate or reckon the positions of the sun, moon, and planets. The *ziqpu*-stars also had similarities with the Stars in the Path of the moon, described qualitatively in MUL.APIN, much like the *ziqpu*-stars. The Stars in the Path of the Moon were a precursor to the Normal Stars and were used earlier to describe celestial position.

The underlying practices involving the production and utilization of the knowledge of *ziqpu*-stars is addressed in Chapter 3. Here, it is shown that this knowledge was used to construct a model of the behavior of certain phenomena that were of interest to Babylonian astronomers. The models constructed by Babylonian astronomers highlight the questions and issues that were important to these astronomers, as the process of model-making is a cognitive process of selection and exclusion of different features of the world. Although modeling and observation are interrelated and implicated with one another, the chapter demonstrated that empirical observation of the *ziqpu*-stars played little to no role in the preserved sources of the *ziqpu*-stars. The models reflect an interest in the specific moments in which certain phenomena occur, with no specific concern for their duration or for their ability to reflect empirical reality. In that regard, the approach of using the *ziqpu*-stars is similar to the approach taken in the ephemerides of the so-called mathematical astronomy. Therefore, these two seemingly different kinds of texts had more in common than previously recognized, which in turn underscores the fallacy of the labels used by scholarship during the 20th century to distinguish different astronomical texts.

While the majority of *ziqpu*-star sources were discussed in Chapter 1, the last chapter of this dissertation examined several texts that either expanded on the primary use of the *ziqpu*-stars or employed them in other ways. In particular, it was observed that the majority of these texts have an astrological context or association, are dated to the Late Babylonian period, and come particularly from Uruk. Yet it is important to remember that the absence of evidence should not be taken as evidence of absence, as there remain astrological texts from Late Babylonian Babylon that have yet to be identified and studied. Continued work on the astronomical texts and their identification could shed further light on the application of the *ziqpu*-stars, particularly in contexts outside their main application, such as astrology.

Many aspects of Babylonian astronomy, such as numerical values and arithmetical methods, had profound influence on and were incorporated into Greek astronomy (see most recently Rochberg 2020). Yet neither the set of *ziqpu*-stars nor the ways these stars were used in Babylonian astronomy found their way into Greek astronomy. One possible reason was due to the central role of the *ziqpu*-stars in the rising time schemes, as the Babylonian arithmetical approach was replaced by a geometric solution in Greek astronomy. Similarly, the Greek preference for a kinematic model with an emphasis on motion was at odds with the Babylonian models that used the *ziqpu*-stars to indicate specific, punctual moments in time. Future research should examine this, particularly in combination with the transmission of knowledge based on the ephemerides.

In this regard, it would be worth delving deeper into the attestation of the *ziqpu*-stars in the Astronomical Diaries, particularly in relation to eclipses. As described in Chapter 1, all Diaries that indicate the time of an eclipse by means of a *ziqpu*-star also do so by means of an interval from sunrise or sunset (insofar as the texts are preserved). Future research should investigate if the appearance of the *ziqpu*-stars is primarily linked with the occurrence of eclipses, i.e., the *ziqpu*-stars were specifically included in order to indicate the time of an eclipse, or if they appear there primarily because of their relationship to sunrise and sunset (also mentioned in each eclipse occurrence in the Diaries) as attested in the rising time scheme texts, and only secondarily with the eclipse. This, in turn, may elucidate a connection between the Astronomical Diaries and the rising time scheme texts.

This dissertation has shown that the underlying practices involving the *ziqpu*-stars were those of producing and employing models as a means to investigate and describe phenomena in the world. This realization warrants the incorporation of this kind of knowledge into current discussions about scientific models and further cements the place of Babylonian astronomy as a whole in the history of science.

Bibliography

Aaboe, A. 1958. "On Babylonian Planetary Theories." *Centaurus* 5: 209–77.

———. 1965. "On Period Relations in Babylonian Astronomy." *Centaurus* 10: 213–31.

———. 1980. "Observation and Theory in Babylonian Astronomy." *Centaurus* 24: 14–35.

Achinstein, P. 1968. *Concepts of Science: A Philosophical Analysis*. Baltimore, MD: Johns Hopkins University Press.

Al-Rawi, F. N. H., and A. R. George. 2006. "Tablets from the Sippar Library XIII: 'Enūma Anu Ellil' XX." *Iraq* 68: 23–57.

Bailer-Jones, D. M. 2003. "When Scientific Models Represent." *International Studies in the Philosophy of Science* 17: 59–74.

Beaulieu, P.-A., E. Frahm, W. Horowitz, and J. Steele. 2018. *The Cuneiform Uranology Texts: Drawing the Constellations*. Transactions of the American Philosophical Society, volume 107, part 2. Philadelphia: the American Philosophical Society.

Bezold, C., A. Kopff, and F. Boll. 1913. *Zenit- Und Äquatorialgestirne Am Babylonischen Fixsternhimmel*. Heidelberg: Carl Winters Universitätsbuchhandlung.

Brack-Bernsen, L., and H. Hunger. 1999. "The Babylonian Zodiac: Speculation on Its Invention and Significance." *Centaurus* 41: 280–92.

———. 2002. "TU 11: A Collection of Rules for the Prediction of Lunar Phases and of Month Lengths." *Sources and Commentaries in the Exact Science* 3: 3–90.

Brack-Bernsen, L., and J. Steele. 2004. "Babylonian Mathemagics: Two Mathematical Astronomical-Astrological Texts." In *Studies in the History of the Exact Sciences in Honour of David Pingree*, edited by C. Burnett, J. P. Hogendijk, K. Plofker, and M. Yano, 95–125. Islamic Philosophy, Theology, and Science, v. 54. Leiden ; Boston: Brill.

Britton, J. P. 2002. "Treatments of Annual Phenomena in Cuneiform Sources." In *Under One Sky: Astronomy and Mathematics in the Ancient Near East*, edited by J. Steele and A. Imhausen, 21–78. Alter Orient Und Altes Testament, Bd. 297. Münster: Ugarit-Verlag.

———. 2010. "Studies in Babylonian Lunar Theory: Part III. The Introduction of the Uniform Zodiac." *Archive for History of Exact Sciences* 64: 617–63.

Brown, D. 2000a. *Mesopotamian Planetary Astronomy-Astrology*. Cuneiform Monographs 18. Groningen: Styx.

———. 2000b. "The Cuneiform Conception of Celestial Space and Time." *Cambridge Archaeological Journal* 10: 103–22.

Brown, D., J. Fermor, and C. Walker. 1999. "The Water Clock in Mesopotamia." *Archiv Für Orientforschung* 46/47: 130–48.

Driel, G. van. 1969. *The Cult of Aššur*. Studia Semitica Neerlandica, 13. Assen: Van Gorcum.
Epping, J. 1889. *Astronomisches Aus Babylon*. Freiburg im Breisgau: Herder'sche Verlagshandlung.
Fermor, J., and J. Steele. 2000. "The Design of Babylonian Waterclocks: Astronomical and Experimental Evidence." *Centaurus* 42: 210–22.
Fincke, J. C., and W. Horowitz. 2017. "Another Neo-Assyrian Ziqpu-Star List from Nineveh (81-2-4, 413)." *NABU*, no. 104: 183–85.
———. 2018. "New Information about the Ziqpu-Stars, the Sun, and Cubits Based on One New Tablet (BM 37373) and Some Previously Known Texts." *Journal of Near Eastern Studies* 77: 249–61.
Frahm, E. 2011. *Babylonian and Assyrian Text Commentaries: Origins of Interpretation*. Guides to the Mesopotamian Textual Record, v. 5. Münster: Ugarit.
Goodman, N. 1968. *Languages of Art: An Approach to a Theory of Symbols*. Indianapolis and Cambridge: Hackett Publishing Company, Inc.
Gössmann, F. 1950. *Planetarium Babylonicum Oder Die Sumerisch-Akkadischen Stern-Namen*. Rome: Pontificio Istituto Biblico.
Graßhoff, G. 1999. "Normal Star Observations in Late Astronomical Babylonian Diaries." In *Ancient Astronomy and Celestial Divination*, edited by N. M. Swerdlow, 97–147. Cambridge, Ma: MIT Press.
Gray, J. M. K., and J. Steele. 2008. "Studies on Babylonian Goal-Year Astronomy I: A Comparison between Planetary Data in Goal-Year Texts, Almanacs and Normal Star Almanacs." *Archive for History of Exact Sciences* 62: 553–600.
———. 2009. "Studies on Babylonian Goal-Year Astronomy II: The Babylonian Calendar and Goal-Year Methods of Prediction." *Archive for History of Exact Sciences* 63: 611–33.
Gurney, O. R. 1981. "The Sultantepe Tablets: Addenda and Further Corrigenda." *Archiv Für Orientforschung* 28: 92–112.
Gurney, O. R., and P. Hulin. 1964. *The Sultantepe Tablets II*. Occasional Publications of the British Institute of Archaeology at Ankara 7. London: British Institute of Archaeology at Ankara.
Hanson, N. R. 1958. *Patterns of Discovery: An Inquiry into the Conceptual Foundations of Science.* Cambridge: Cambridge University Press.
Horowitz, W. 1994. "Two New Ziqpu-Star Texts and Stellar Circles." *Journal of Cuneiform Studies* 46: 89–98.
———. 1998. *Mesopotamian Cosmic Geography*. Mesopotamian Civilizations 8. Winona Lake, Ind: Eisenbrauns.
———. 2014. *The Three Stars Each: The Astrolabes and Related Texts*. Archiv Für Orientforschung Beiheft 33. Wien: Inst. für Orientalistik der Univ. Wien.
Horowitz, W., and F. N. H. Al-Rawi. 2001. "Tablets from the Sippar Library IX. A Ziqpu-Star Planisphere." *Iraq* 63: 171–81.

Huber, P. 1958. "Ueber Den Nullpunkt Der Babylonischen Ekliptik." *Centaurus* 5: 192–208.
Huber, P. J., and S. de Meis. 2004. *Babylonian Eclipse Observations from 750 BC to 1 BC*. Milano: Mimesis.
Hunger, H., ed. 1976. *Spätbabylonische Texte Aus Uruk. Teil I*. Ausgrabungen Der Deutschen Forschungsgemeinschaft in Uruk-Warka, Bd. 9. Berlin: Mann.
———. 1992. *Astrological Reports to Assyrian Kings*. State Archives of Assyria 8. Helsinki: Helsinki University Press.
———. 1999. "Non-Mathematical Astronomical Texts and Their Relationships." In *Ancient Astronomy and Celestial Divination*, edited by N. M. Swerdlow. Cambridge, MA: MIT Press.
———. 2001. *Astronomical Diaries and Related Texts from Babylonia. Volume V. Lunar and Planetary Texts*. Philosophisch-Historische Klasse, Denkschriften 299. Wien: Österreichischen Akademie der Wissenschaften.
———. 2006. *Astronomical Diaries and Related Texts from Babylonia. Volume VI. Goal Year Texts*. Philosophisch-Historische Klasse, Denkschriften 346. Wien: Österreichischen Akademie der Wissenschaften.
———. 2014. *Astronomical Diaries and Related Texts from Babylonia. Volume VII: Almanacs and Normal Star Almanacs*. Denkschriften / Österreichische Akademie Der Wissenschaften, Philosophisch-Historische Klasse, Bd. 466. Wien: Österreichische Akademie der Wissenschaften.
Hunger, H., and D. Pingree. 1989. *MUL.APIN. An Astronomical Compendium in Cuneiform*. Archiv Für Orientforschung Beiheft 24. Horn, Austria: Berger & Söhne.
———. 1999. *Astral Sciences in Mesopotamia*. Handbuch Der Orientalistik. Erste Abteilung, Der Nahe Und Mittlere Osten, Handbook of Oriental Studies. The Near and Middle East, 44. Bd. Leiden ; Boston: Brill.
Hunger, H., and J. Steele. 2019. *The Babylonian Astronomical Compendium MUL.APIN*. Scientific Writings from the Ancient and Medieval World. Abingdon, Oxon ; New York, NY: Routledge.
Jiménez, E. 2015a. "Commentary on Enūma Anu Enlil 20 (CCP 3.1.20.B.a)." *Cuneiform Commentaries Project*. https://ccp.yale.edu/P348755.
———. 2015b. "Commentary on Enūma Anu Enlil 20 (CCP 3.1.20.B.b)." *Cuneiform Commentaries Project*. https://ccp.yale.edu/P392620.
Jones, A. 2004. "A Study of Babylonian Observations of Planets Near Normal Stars." *Archive for History of Exact Sciences* 58.
Jong, T. de. 2019a. "A Study of Babylonian Planetary Theory I. The Outer Planets." *Archive for History of Exact Sciences* 73: 1–37.
———. 2019b. "A Study of Babylonian Planetary Theory II. The Planet Venus." *Archive for History of Exact Sciences* 73: 309–33.
———. 2021. "A Study of Babylonian Planetary Theory III. The Planet Mercury."

Archive for History of Exact Sciences 75: 491–522.
Koch, J. 1992. “Der Sternenkatalog BM 78161.” *Die Welt Des Orients* 23: 39–67.
———. 1995. “Der Dalbanna-Sternenkatalog.” *Die Welt Des Orients* 26: 43–85.
———. 1997. “Kannte Man in Mesopotamien Das 364 Tage-Jahr Wirklich Seit Dem 7. Jahrhundert v.Chr.?” *NABU*, no. 119: 109–12.
Koch-Westenholz, U. 1995. *Mesopotamian Astrology: An Introduction to Babylonian and Assyrian Celestial Divination*. CNI Publications 19. Copenhagen: Carsten Niebuhr Institute of Near Eastern Studies : Museum Tusculanum Press, University of Copenhagen.
Kugler, F. X. 1907. *Sternkunde Und Sterndienst in Babel. Assyriologische, Astronomische Und Astralmythologische Untersuchungen. I.* Münster in Westfalen: Aschendorffsche Verlagsbuchhandlung.
———. 1913. *Sternkunde Und Sterndienst in Babel. I. Teil, I.-VIII. Abhandlung: Astronomie Und Chronologie Der Älteren Zeit.* Münster in Westfalen: Aschendorffsche Verlagsbuchhandlung.
———. 1914a. “Distances entre Étoiles Fixes d’après une tablette de l’époque des Séleucides: Deuxième Partie. Commentaire Astronomique.” *Revue d’Assyriologie et d’archéologie orientale* 11: 1–21.
———. 1914b. *Sternkunde Und Sterndienst in Babel. II. Teil, IX.-XIV. Abhandlung: Sternkunde Und Chronologie Der Älteren Zeit.* Münster in Westfalen: Aschendorffsche Verlagsbuchhandlung.
Kurtik, G. E. 2021. “On the Origin of the 12 Zodiac Constellation System in Ancient Mesopotamia.” *Journal for the History of Astronomy* 52: 53–66.
Lambert, W. G., ed. 2013. *Babylonian Creation Myths*. Mesopotamian Civilizations 16. Winona Lake, Indiana: Eisenbrauns.
Lanfranchi, G. B., and S. Parpola. 1990. *The Correspondence of Sargon II, Part II. Letters from the Northern and Northeastern Provinces*. State Archives of Assyria, V. Helsinki, Finland: Helsinki University Press.
Minsky, M. 1965. “Matter, Mind and Models.” In *Information Processing 1965: Proceedings of the IFIP [International Federation for Information Processing]. Congress 1965.*, edited by W. A. Kalenich, 1–5. London: MacMillan and Co.
Monroe, M. W. 2016. *Advice from the Stars: The Micro-Zodiac in Seleucid Babylonia. PhD Dissertation, Brown University*.
Nersessian, N. J. 2008. *Creating Scientific Concepts*. Cambridge, Mass: MIT Press.
Neugebauer, O. 1955. *Astronomical Cuneiform Texts*. London: Lund Humphries.
———. 1975. *A History of Ancient Mathematical Astronomy*. 3 vols. Berlin, Heidelberg, New York: Springer-Verlag.
Neugebauer, O., and A. Sachs. 1967. “Some Atypical Astronomical Cuneiform Texts. I.” *Journal of Cuneiform Studies* 21: 183–218.
Oelsner, J. 1991. “Weiher, E. von: Spätbabylonische Texte Aus Uruk. Teil III (Book Review).” *Orientalistische Literaturzeitung* 86: 41.

Oelsner, J., and W. Horowitz. 1997. "The 30-Star-Catalogue HS 1897 and the Late Parallel BM 55502." *Archiv Für Orientforschung* 44/45: 176–85.
Ossendrijver, M. 2012. *Babylonian Mathematical Astronomy: Procedure Texts*. Sources and Studies in the History of Mathematics and Physical Sciences. New York: Springer.
———. 2020. "Techniques of Measurement and Computation." In *Hellenistic Astronomy: The Science in Its Contexts*, edited by A. C. Bowen and F. Rochberg, 41–53. Brill's Companions in Classical Studies. Leiden ; Boston: Brill.
Parpola, S. 1993. *Letters from Assyrian and Babylonian Scholars*. State Archives of Assyria 10. Helsinki, Finland: Helsinki University Press.
———. 1970/1983. *Letters from Assyrian Scholars to the Kings Esarhaddon and Ashurbanipal*. Winona Lake, Ind: Eisenbrauns.
———. 2017. *Assyrian Royal Rituals and Cultic Texts*. State Archives of Assyria 20. Helsinki: Neo-Assyrian Text Corpus Project.
Pingree, D., and C. Walker. 1988. "A Babylonian Star-Catalogue: BM 78161." In *A Scientific Humanist: Studies in Memory of Abraham Sachs*, edited by E. Leichty, M. de J. Ellis, and P. Gerardi, 313–22. Occasional Publications of the Samuel Noah Kramer Fund 9. Philadelphia: University Museum.
Putnam, H. 1962. "What Theories Are Not?" In *Logic, Methodology, and Philosophy of Science: Proceedings of the 1960 International Congress*, edited by E. Nagel, P. Suppes, and A. Tarski, 240–51. Stanford, CA: Stanford University Press.
Reiner, E. 1995. *Astral Magic in Babylonia*. Transactions of the American Philosophical Society, v. 85, pt. 4. Philadelphia: American Philosophical Society.
———. 1998. "Celestial Omen Tablets and Fragments in the British Museum." In *Festschrift Für Rykle Borger Zu Seinem 65. Geburtstag Am 24. Mai 1994*, edited by S. M. Maul, 215–302. Cuneiform Monographs 10. Groningen: Styx.
———. 2000. "Early Zodiologia and Related Matters." In *Wisdom, Gods and Literature: Studies in Assyriology in Honour of W.G. Lambert*, edited by A. R. George and I. L. Finkel, 421–27. Winona Lake, Ind: Eisenbrauns.
Reiner, E., and M. Civil. 1967. "Another Volume of Sultantepe Tablets." *Journal of Near Eastern Studies* 26: 177–211.
Reiner, E., and D. Pingree. 1981. *Babylonian Planetary Omens, Part 2*. Bibliotheca Mesopotamica. Malibu: Undena Publications.
———. 1998. *Babylonian Planetary Omens, Part 3*. Cuneiform Monographs 11. Groningen: Styx.
———. 2005. *Babylonian Planetary Omens, Part 4*. Cuneiform Monographs 30. Leiden, Boston: Brill/Styx.
Reynolds, F. 2019. *A Babylon Calendar Treatise: Scholars and Invaders in the Late First Millennium BC*. Oxford ; New York, NY: Oxford University Press.
Robson, E. 2004. "Counting the Days: Scholarly Conceptions and Quantifications of Time in Assyria and Babylonia, c. 750-250 BCE." In *Time and Temporality in the*

Ancient World, edited by R. M. Rosen, 45–90. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.

Rochberg, F. 1998. *Babylonian Horoscopes*. Transactions of the American Philosophical Society, v. 88, pt. 1. Philadelphia: American Philosophical Society.

———. 1999. "Empiricism in Babylonian Omen Texts and the Classification of Mesopotamian Divination as Science." *Journal of American Oriental Society* 119: 559–69.

———. 2004a. "A Babylonian Rising Time Scheme in Non-Tabular Astronomical Texts." In *Studies in the History of the Exact Sciences in Honour of David Pingree*, edited by C. Burnett, J. P. Hogendijk, K. Plofker, and M. Yano, 56–94. Leiden: Brill.

———. 2004b. *The Heavenly Writing: Divination, Horoscopy, and Astronomy in Mesopotamian Culture*. Cambridge: Cambridge Univ. Press.

———. 2010a. "Periodicities and Period Relations in Babylonian Celestial Sciences." In *In the Path of the Moon: Babylonian Celestial Divination and Its Legacy*, edited by F. Rochberg, 355–71. Studies in Ancient Magic and Divination 6. Leiden ; Boston: Brill.

———. 2010b. "Sheep and Cattle, Cows and Calves: The Sumero-Akkadian Astral Gods as Livestock." In *Opening the Tablet Box. Near Eastern Studies in Honor of Benjamin R. Foster*, edited by S. Melville and A. Slotsky, 347–59. Culture and History of the Ancient Near East 42. Leiden ; Boston: Brill.

———. 2016. *Before Nature: Cuneiform Knowledge and the History of Science*. Chicago: The University of Chicago Press.

———. 2018. "Reasoning, Representing, and Modeling in Babylonian Astronomy." *Journal of Ancient Near Eastern History* 5: 131–47.

———. 2020. "The Babylonian Contribution to Greco-Roman Astronomy." In *Hellenistic Astronomy: The Science in Its Contexts*, edited by A. C. Bowen and F. Rochberg, 147–59. Brill's Companions in Classical Studies. Leiden ; Boston: Brill.

Rochberg-Halton, F. 1983. "Stellar Distances in Early Babylonian Astronomy: A New Perspective on the Hilprecht Text (HS 229)." *Journal of Near Eastern Studies* 42: 209–17.

———. 1988. *Aspects of Babylonian Celestial Divination: The Lunar Eclipse Tablets of Enūma Anu Enlil*. Archiv Für Orientforschung Beiheft 22. Horn, Austria: Verlag Ferdinand Berger & Söhne Gesellschaft.

———. 1991a. "Between Observation and Theory in Babylonian Astronomical Texts." *Journal of Near Eastern Studies* 50: 107–20.

———. 1991b. "The Babylonian Astronomical Diaries." *Journal of the American Oriental Society* 111: 323–32.

Roughton, N. A., and G. L. Canzoneri. 1992. "Babylonian Normal Stars in Sagittarius." *Journal for the History of Astronomy* 23: 193–200.

Roughton, N. A., J. Steele, and Christopher B. F. Walker. 2004. "A Late Babylonian Normal and Ziqpu Star Text." *Archive for History of Exact Sciences* 58: 537–72.

Sachs, A. 1948. "A Classification of the Babylonian Astronomical Tablets of the Seleucid Period." *Journal of Cuneiform Studies* 2: 271–90.
———. 1952a. "A Late Babylonian Star Catalog." *Journal of Cuneiform Studies* 6: 146–50.
———. 1952b. "Babylonian Horoscopes." *Journal of Cuneiform Studies* 6: 49–75.
———. 1955. *Late Babylonian Astronomical and Related Texts. Copied by T. G. Pinches and J. N. Strassmaier*. Providence, RI: Brown University Press.
Sachs, A., and H. Hunger. 1988. *Astronomical Diaries and Related Texts from Babylonia. Volume I. Diaries from 652 B.C. to 262 B.C.* Philosophisch-Historische Klasse, Denkschriften 195. Vienna: Österreichischen Akademie der Wissenschaften.
———. 1989. *Astronomical Diaries and Related Texts from Babylonia. Volume II. Diaries from 261 B.C. to 165 B.C.* Denkschriften 195, 210, 247. Vienna: Österreichische Akademie der Wissenschaften.
———. 1996. *Astronomical Diaries and Related Texts from Babylonia. Volume III. Diaries from 164 B.C. to 61 B.C.* Denkschriften. Vienna: Österreichische Akademie der Wissenschaften.
Schaumberger, J. 1935. *Sternkunde Und Sterndienst in Babel. 3. Ergänzungsheft Zum Ersten Und Zweiten Buch*. Münster in Westfalen: Aschendorffsche Verlagsbuchhandlung.
———. 1952. "Die Ziqpu-Gestirne Nach Neuen Keilschrifttexten." *Zeitschrift Für Assyriologie Und Vorderasiatische Archäologie* 50.
———. 1955. "Anaphora Und Aufgangskalender in Neuen Ziqpu-Texten." *Zeitschrift Für Assyriologie Und Vorderasiatische Archäologie* 51.
Spar, I., and W. G. Lambert, eds. 2005. *Cuneiform Texts in the Metropolitan Museum of Art. Vol. II: Literary and Scholastic Texts of the First Millennium B.C.* CTMMA 2. New York: Metropolitan Museum of Art.
Steele, J. 2000. *Observations and Predictions of Eclipse Times by Early Astronomers*. Archimedes 4. Dordrecht ; Boston: Kluwer Academic Publishers.
———. 2003. "Planetary Latitudes in Babylonian Mathematical Astronomy." *Journal for the History of Astronomy* 34: 269–89.
———. 2007. "Celestial Measurements in Babylonian Astronomy." *Annals of Science* 64: 293–325.
———. 2011. "Making Sense of Time: Observational and Theoretical Calendars." In *The Oxford Handbook of Cuneiform Culture*, edited by K. Radner and E. Robson, 470–85. Oxford Handbooks. Oxford ; New York: Oxford University Press.
———. 2014. "Late Babylonian Ziqpu-Star Lists: Written or Remembered Traditions of Knowledge?" In *Traditions of Written Knowledge in Ancient Egypt and Mesopotamia. Proceedings of Two Workshops Held at Goethe-University, Frankfurt/Main in December 2011 and May 2012*, edited by D. Bawanypeck and A. Imhausen, 123–51. Alter Orient Und Altes Testament, Band 403. Münster: Ugarit-Verlag.

———. 2015a. "A Late Babylonian Compendium of Calendrical and Stellar Astrology." *Journal of Cuneiform Studies* 67: 187–215.

———. 2015b. "Mesopotamian Astrological Geography." In *The Star of Bethlehem and the Magi: Interdisciplinary Perspectives from Experts on the Ancient Near East, the Greco-Roman World, and Modern Astronomy*, edited by P. Barthel, 201–16. Themes in Biblical Narrative: Jewish and Christian Traditions, volume 19. Leiden ; Boston: Brill.

———. 2016. "The Circulation of Astronomical Knowledge between Babylon and Uruk." In *The Circulation of Astronomical Knowledge in the Ancient World*, edited by J. Steele, 83–118. Leiden: Brill.

———. 2017. *Rising Time Schemes in Babylonian Astronomy*. SpringerBriefs in History of Science and Technology. New York, NY: Springer.

———. 2018a. "Another Microzodiac Rising Time Text: BM 48166." *NABU*, no. 84: 132.

———. 2018b. "The Development of the Babylonian Zodiac: Some Preliminary Observations." *Mediterranean Archaeology and Archaeometry* 18: 9.

———. 2020a. "Short Time in Mesopotamia." In *Down to the Hour: Short Time in the Ancient Mediterranean and Near East*, edited by K. J. Miller and S. L. Symons, 90–124. Time, Astronomy, and Calendars, Volume 8. Leiden ; Boston: Brill.

———. 2020b. "The Continued Relevance of MUL.APIN in Late Babylonian Astronomy." *Journal of Ancient Near Eastern History* 8: 259–77.

Steele, J., and C. Proust. In preparation. *Astronomical and Related Cuneiform Texts from Uruk in the Ancient Orient Museum of Istanbul*.

Stephenson, F. R., and C. B. F. Walker, eds. 1985. *Halley's Comet in History*. London: British Museum Publications.

Suppe, F., ed. 1977. *The Structure of Scientific Theories*. 2nd edition. Urbana, Ill.: University of Illinois Press.

Swerdlow, N. M. 1998. *The Babylonian Theory of the Planets*. Princeton, NJ: Princeton University Press.

Thureau-Dangin, F. 1913. "Distances Entre Étoiles Fixes d'après Une Tablette de l'époque Des Séleucides: Première Partie: Texte et Traduction." *Revue d'Assyriologie et d'Archéologie Orientale* 10: 215–25.

———. 1922. *Tablettes d'Uruk*. TCL 6. Paris: Musées du Louvre.

Verderame, L. 2002. *Le Tavole I-VI Della Serie Astrologica Enūma Anu Enlil*. Nisaba 2. Messina: Dipartimento di science dell'antichità, Università di Messina.

Virolleaud, C. 1905. *L'astrologie Chaldéenne : Le Livre Intitulé "Enuma (Anu) Ilu Bêl."* Paris: Librairie P. Geuthner.

Waerden, B. L. van der. 1949. "Babylonian Astronomy. II. The Thirty-Six Stars." *Journal of Near Eastern Studies* 8: 6–26.

———. 1974. *Science Awakening II: The Birth of Astronomy*. Dordrecht: Springer Netherlands.

Walker, C. B. F. 1995. "The Dalbanna Text: A Mesopotamian Star-List." *Die Welt Des*

Orients 26: 27–42.
Watanabe, K. 1991. “Segenswünsche Für de Assyrischen König in Der 2. Person Sg.” *Acta Sumerologica* 13: 347–87.
Watson, R., and W. Horowitz. 2011. *Writing Science Before the Greeks: A Naturalistic Analysis of the Babylonian Astronomical Treatise MUL.APIN*. Culture and History of the Ancient Near East 48. Leiden ; Boston: Brill.
Weidner, E. F. 1915. *Handbuch Der Babylonischen Astronomie*. Vol. 1. Leipzig: J. C. Hinrichs’sche Buchhandlung.
———. 1941. “Die Astrologische Serie Enūma Anu Enlil.” *Archiv Für Orientforschung* 14: 172–95.
———. 1959. “Ein Astrologischer Sammeltext Aus Der Sargonidenzeit.” *Archiv Für Orientforschung* 19: 105–13.
———. 1963. “Astrologische Geographie Im Alten Orient.” *Archiv Für Orientforschung* 20: 117–21.
———. 1967. *Gestirn-Darstellungen Auf Babylonischen Tontafeln*. Österreichische Akademie Der Wissenschaften, Philosophisch-Historische Klasse 254. Vienna: Österreichische Akademie der Wissenschaften.
Weiher, E. von. 1988. *Spätbabylonische Texte Aus Uruk. Teil III*. Ausgrabungen Der Deutschen Forschungsgemeinschaft in Uruk-Warka 12. Berlin: Gebrüder Mann Verlag.
———, ed. 1993. *Uruk. Spätbabylonische Texte aus dem Planquadrat U 18. Teil IV*. Ausgrabungen in Uruk-Warka / Dt. Archäolog. Inst., Abt. Baghdad. Hrsg. von Rainer Michael Boehmer 12. Mainz am Rhein: von Zabern.
———. 1998. *Spätbabylonische Texte Aus Uruk. Teil V*. Ausgrabungen in Uruk-Warka Endberichte 13. Mainz am Rhein: Verlag Philipp von Zabern.

Appendix A: Catalogue of Sources

Below are all the sources that form the textual corpus of the present study. The sources are listed by their museum numbers. When available, each source contains (1) a one-sentence description of the source; (2) period and provenance; (3) CDLI no.; (4) reference to a photo of the source; (5) reference to a handcopy of the source; (6) reference to editions of the source; (7) a brief description of the source.

A 3414 (+) U 181a (+) U 181b (+) U 181c (+) U 181d

Rising time scheme, calendar-based (daily)
Late Babylonian Uruk (Bīt Rēš)
P497323
Photo: Oriental Institute Museum Collection (for A 3414)
Edition: Steele (2017); Schaumberger (1955)
A rising time scheme that gives the *ziqpu*-star or the point after that culminates on any given day of every month of the schematic calendar. While significant parts of the text are missing, because of its repetitive nature, it is possible to restore the entire scheme. The scheme begins with the 15th day of month IV, which is the summer solstice in the schematic calendar.

A 3427

Rising time scheme, microzodiacal (detailed)
Late Babylonian Uruk
Photo: Steele (2017)
Edition: Steele (2017); Rochberg (2004a); Schaumberger (1955)
Large fragment containing sections on the rising time scheme for Scorpio and the beginning of Sagittarius. Originally, the tablet likely contained the scheme for the signs of Scorpio, Sagittarius, Capricorn, and Aquarius (Steele 2017, 61–62).

AO 6455 (= TU 11)

Collection of rules for the prediction of lunar phases and of month length
Late Babylonian Uruk (end of the 3rd century BCE)
P363684
Copy: TCL 6, 11
Photo: CDLI
Edition: Brack-Bernsen and Hunger (2002)

A large and fully preserved tablet that contains numerous sections detailing astronomical and astrological (from a modern perspective) rules. Section 8 pertains to lunar eclipse omina and includes a single, unclear reference to ziqpu-stars in the entire tablet. For a discussion of this text, see Chapter 4.

AO 6483

Natal omens
Late Babylonian Uruk
P363687
Copy: TCL 6, 14
Photo: Louvre Collections Online
Edition: Sachs (1952b)
The top of this fairly large tablet is missing. Double ruling divides this tablet into three sections. Only the last few lines of the first section, on lunar visibility throughout the month, are preserved. The beginning of the second section deals with the zodiac, before transitioning to natal omens based on planetary phenomena. Only the right side of the last section is preserved, with only ten lines before the tablet breaks off. This section presents natal omens, two per line, with protases involving the *ziqpu*-stars coming out (E_3-*a*), the only text to refer to the *ziqpu*-star in such a way.

AO 6478

List w/multiple intervals
Late Babylonian Uruk
P363694
Copy: TCL 6, 21
Photo: CDLI
Edition: GKAB; Schaumberger (1952); Thureau-Dangin (1913)
The most well preserved *ziqpu*-stars lists, enumerating the standard sequence of twenty-five stars, with an additional entry for the distance between the Front and Rear Twins.[193] The preserved text begins with an introduction that repeats the one in MUL.APIN I iv 1-3 almost verbatim, before splitting into three columns.[194] Col. i lists weights in mina, col. ii listing intervals in UŠ *ina qaqqari*, and col. iii lists intervals in *bēru ina šamê*. Columns i and iii are duplicates of K 9794. Note the following corrections to the edition in GKAB: rev. 15, col. i should read 3 MA.NA ⅓ MA MIN, and

[193] See also the studies by Kugler (1913, 77–87; 1914a; 1914b, 182–92) and Schaumberger (1935, 353–54).
[194] The remains of a line above the introduction section in AO 6478 are visible, but due to its state of preservation, the preceding text remains unidentified.

col. iii should read 36 LIM DANNA *ina* KI.MIN; rev. 21, col. ii should read ⅔ DANNA 5 UŠ *i-na* KI.MIN.

BM 32276 + Rm 829

Rising time scheme, microzodiacal (detailed): obv.; Correlations between watches and *ziqpu*-stars: rev.
Late Babylonian Babylon (likely)
Photo: Steele (2017)
Edition: Steele (2017): BM 32276; Appendix: Rm 829
Steele has recently identified a join between BM 32276 and Rm 829 (personal communication). Obv. i duplicates the rising time scheme for Aries found on BM 34713. Obv. ii and rev. i are too broken to identify. Rev. ii begins with a section that delineated the watches of the night by culminating ziqpu-stars. The sections that follow mention the culmination of *ziqpu*-stars in relation to the 1st and 30th day of Months VIII-X, though what phenomenon this refers to is unclear.

BM 34639

List w/intervals: obv. i; Rising time scheme, calender-based (monthly): obv. ii
Late Babylonian Babylon(?)
P364250
Copy: LBAT 1501
Photo: Steele (2017)
Edition: Steele (2014): obv. i; Steele (2017): obv. ii
Tablet contains multiple texts. Obverse preserves first two columns and reverse preserves last two columns, with another column probably missing on both sides. Obv. i is a *ziqpu*-star list. Although all the intervals are broken, lines 5’-11’ and 14’-15’ preserve *ana* before the star name, which were preceded by an interval. Obv. ii partially preserves a rising time scheme describing which *ziqpu*-star culminates on the 15th day of a month at sunset and sunrise. Only months IV-I and the first part of month II are preserved. Stars that culminate at sunset on a given month appear as culminating at sunrise six months later. Rev. ii’ describes the limits of the path of the moon relative to the Normal Stars. Rev. iii’ begins with a duplicate of Atypical Text E and continues into an unidentified section.

BM 34664

Rising time scheme, microzodiacal (detailed)
Late Babylonian Babylon (almost certainly)
P364252
Copy: LBAT 1503

Photo: Steele (2017)
Edition: Steele (2017); Rochberg (2004a)
Fragment with microzodiacal rising time scheme on both obverse and reverse. Steele switches the obverse and reverse as published in LBAT. Preserved sections cover the second half of Libra and the end of Pisces. Originally, the tablet likely contained the scheme for the entire second half of the zodiac, from Libra to Pisces.

BM 34713 rev. 10-34

Rising time scheme, microzodiacal (detailed)
Late Babylonian Babylon (almost certainly)
P364248
Copy: LBAT 1499
Photo: Steele (2017)
Edition: Steele (2017); Rochberg (2004a); Schaumberger (1955)
Likely a two-column tablet, but only obv. ii and rev. i are preserved. Obverse and beginning of reverse contain a Three Stars Each text (see Horowitz 2014, 124–39), followed by a horizontal ruling, a blank space of several lines, and another horizontal ruling, after which the rising time scheme begins. The scheme correlates the culmination of a *ziqpu*-star or a point in relation to a *ziqpu*-star with the rising of the end of a microzodiacal sign. Duplicate of the obverse of BM 32276 from Babylon and U 196 from Uruk.

BM 34790 obv. ii

List w/unclear intervals
Late Babylonian
P364251
Copy: LBAT 1502
Edition: Steele (2014)
A compilation tablet with a section (obv. ii) listing ziqpu-stars. Roughly half of the intervals are preserved, but do not match the known intervals found in other ziqpu-star lists. The text does not preserve the units of interval as well. Therefore, the meaning of these intervals remains unknown. The other sections of the tablet contain what may be pairs of stars on the eastern and western horizon at sunrise and sunset, distances related to Normal Stars, and a section on lunar latitude similar to Atypical Text E (see Steele 2007, 304–5 for bibliography).

BM 35161

Unidentified
Late Babylonian Babylon

P364257
Copy: LBAT 1508
Edition: Appendix
A small fragment written on both sides, with the names of *ziqpu*-stars on the reverse. Every two lines on the reverse seem to begin with the name of a month and list the names of *ziqpu*-stars, but the relationship between the months and the stars is unclear to me.

BM 35456

Rising time scheme, microzodiacal (simplified)
Late Babylonian Babylon
P364254
Copy: LBAT 1505
Photo: Steele (2017): obv.
Edition: Steele (2017)
Small fragment from bottom right corner of tablet. Steele switched the obverse and reverse as designated in LBAT. Preserved part contains parts of a rising time scheme for Virgo (obv. and lower edge) and Libra (rev.). The completed tablet may have held the rising time scheme for the entire zodiac (Steele 2017, 72).

BM 35973

Unidentified
Late Babylonian Babylon
P364255
Copy: LBAT 1506
Edition: Appendix
Small fragment, divided into two sections by a double ruling. Both sections preserve the term *ziq-pi*. Interpretation of this text is not possible given its broken state. A preliminary transliteration is found in the Appendix.

BM 36175

List w/intervals: obv.; lunar latitude: rev.
Late Babylonian
Edition: Appendix
Small fragment, obverse and reverse assigned by curvature but uncertain. The obverse contains a *ziqpu*-star list with intervals. None of the intervals or star names are preserved, but because of the sequence of units used (DANNA and UŠ) restoration of the names of stars is possible. The reverse contains a duplicate of the section on lunar latitude found in Atypical Text E.

BM 36609+36664+37030+37076+37342+37356+37379

Sections on ziqpu-star as well as rising time scheme: obv.; sections on Normal Stars, incl. catalogue: rev.
Late Babylonian Babylon
Copy: Roughton, Steele, and Walker (2004)
Photo: Roughton, Steele, and Walker (2004)
Edition: Steele (2017): obv. iii 14-29; Roughton, Steele, and Walker (2004)
Roughton, Steele, and Walker (2004) identify seven preserved sections on the obverse, with sections 4-7 referring to the ziqpu-stars and are further discussed in Steele (2017). The six preserved sections on the reverse relate to the Normal Stars. See Chapter 1 for an explanation on the use of intervals, normally associated with *ziqpu*-stars, with Normal Stars in section 9.

BM 36628+36786+36817+37178+37197 (+) 36303+36326 (+) 36988

Calendrical and stellar compendium
Late Babylonian (likely 4th century) Babylon
P482079
Photo: Steele (2015a)
Edition: Steele (2015a)
A compendium text, with three columns on each side. Sections include astrological geography, prediction of market prices, river levels, *ziqpu*-stars, illnesses, *Dodecatemoria*- and *Kalendertext*-based schemes, and correlations of parts of a month to planets (a forerunner to the Greek "Term"). *Ziqpu*-stars appear in two sections. The first (obv. i A1-A10) lists them with numbers (at least some of which correspond to the known intervals) as well as the term AN.NE, "midday," possibly meaning to culminate, as the sun culminates at midday (Steele 2015a). The second section (obv. ii B8' - iii C15') groups two or three *ziqpu*-stars and lists them as "behind"(EGIR) another star. See the discussion of this text in Chapter 4.

BM 36927

Unidentified
Late Babylonian Babylon
Edition: Appendix B
Too few signs remain on the obverse to identify the text. Obv. 3' contains the only reference to a ziqpu-star, namely to what seems to be the culmination of the Shoulder of the Panther. The reverse parallels LBAT 1593 obv. 12'-13'. These lines belong to a section of LBAT 1593 that contains predictions regarding the physical characteristics

of a person as well as natal omens, one of which refers to the culmination of Jupiter (see Chapter 4).

BM 37159

Rising time scheme
Late Babylonian Babylon
Photo: Steele (2017)
Edition: Steele (2017)
The obverse of this small fragment contains a list of numbers after a blank space, whose meaning is unknown. The reverse of the tablet preserves two lines that give ranges of positions at or behind *ziqpu*-stars. The second position in each entry correlates with the 15th day of Months III and IV at sunrise (Steele 2017, 104). The colophon identifies the owner as the well-known Marduk-šāpik-zēri of the Mušezib family, written by his son Iddin-Bēl (Steele 2017, 101).

BM 37373

List w/number of constituent stars per *ziqpu*-star: obv.; Rising time scheme, calender-based (monthly): rev.
Late Babylonian Babylon (likely) or Borsippa
Copy: Fincke and Horowitz (2018)
Photo: Fincke and Horowitz (2018)
Edition: Fincke and Horowitz (2018)
Obverse of this fragment has a *ziqpu*-star list with the number of constituent stars that make up each ziqpu-star. The number listed per entry only partially matches similar information found in VAT 16436 and the obverse of the Sippar Planisphere. The barely preserved reverse has what seems to be a simple calendric rising time scheme, potentially with a number of scribal errors (Fincke and Horowitz 2018).

BM 38369+38694

List w/intervals
Neo-Assyrian/Neo-Babylonian Babylon
Copy: Horowitz (1994)
Photo: Horowitz (1994)
Edition: Horowitz (1994)
Two-column fragment. Left-hand column is barely preserved. Right-hand column contains a *ziqpu*-star list, likely in media res, with two names per entry along with an interval. This is the only *ziqpu*-star list to contain a subset of the known repertoire of twenty five *ziqpu*-stars. Ends with sections that resemble MUL.APIN in addition to referring to the 12 *bēru* of the circle of *ziqpu*-stars. All entries but one begin with a DIŠ

sign, which are omitted from Horowitz's edition (see the discussion of this text in Chapter 1). This tablet has been referred to as Neo-Babylonian (Horowitz 1994) and Neo-Assyrian (Horowitz 1998; Britton 2002). The text was written in Neo-Babylonian script and found in Babylon (Hunger and Pingree 1999, 84).

BM 38704

List w/intervals: obv.; Rising time scheme, calender-based (monthly): rev.
Late Babylonian Babylon (almost certainly)
Photo: Steele (2017)
Edition: Steele (2014): obv. and rev.; Steele (2017): rev.
Fragmentary tablet with obverse containing a list of *ziqpu*-stars with intervals in UŠ and DANNA, and reverse containing a month-based rising time scheme identical to the one found in BM 34639 (with minor orthographic differences).

BM 40126

List of settings of *ziqpu*-stars
Late Babylonian Babylonia
Edition: Appendix
This small, partially-preserved tablet contains a list of setting *ziqpu*-stars.

BM 41024

Rising time scheme
Late Babylonian Babylon
A poorly preserved 2-column fragment that partially duplicates the rising time scheme found in BM 36609+. I cannot make out any names of *ziqpu*-star or the term *ziqpu*, though it is likely they originally appeared in the text.

BM 41570

List
Late Babylonian
P364256
Copy: LBAT 1507
Edition: Steele (2014): obv.
Small fragment. Obverse lists *ziqpu*-stars, which are divided into groups. Each group is headed by the signs MUL^{meš}, "stars." These groups correlate with rising arcs of zodiacal signs. It is unclear what the text on the reverse is, but it is worth noting that it is written at a 90° angle to the text on the obverse.

BM 41679

Rising time scheme
Late Babylonian Babylonia
P364258
Copy: LBAT 1509
Edition: Appendix B
Fragment of a rising time scheme text.

BM 42784

Unidentified
Late Babylonian Babylon
Edition: Appendix B
A badly preserved fragment with seven lines, separated by two rulings. Mentions the term *ziqpu*, but not enough remains to identify the text.

BM 46167

Rising time scheme, microzodiacal (simplified)
Late Babylonian Babylon
Photo: Steele (2017)
Edition: Steele (2017)
Small fragment of rising time scheme for Aquarius and Pisces.

BM 46272

Unidentified
Late Babylonian Babylonia
Edition: Appendix
A small fragment with only a few preserved signs. Line 4' mentions [MUL]^{meš} *ša$_2$ ziq-pi*. Unfortunately, it is not possible to determine what was the original text.

BM 48166

Rising time scheme, microzodiacal (detailed)
Late Babylonian Babylon
Edition: Steele (2018a)
Small fragment of rising time scheme for the second to fourth portions of Aries.

BM 61677

List w/intervals
Late Babylonian Sippar
Copy: Horowitz and Al-Rawi (2001)
Photo: Horowitz and Al-Rawi (2001)
Edition: Horowitz and Al-Rawi (2001)
Small fragment from a multi-column text, though only part of one column is preserved, containing a *ziqpu*-star list with intervals. The scribe mistakenly followed the Bright Star of the Panther with naṣrapu, skipping over the Knee, the Heel, the Four Stars of the Stag, the Dusky Stars, and the Bright Star of the Old Man. This is clearly a case of homoioarcton, because of the similarity between the names of the Bright Star of the Panther and the Bright Star of the Old Man.

BM 65756 ln. 8'-13'

Rising time scheme(?)
Late Babylonian Sippar(?)
Edition: Appendix B
This fragment appears to preserve two sections. The first one (ln. 1'-7') contains a procedure text with arithmetical operations using a constant coefficient, similar to the unpublished texts BM 36665+ and BM 36854.[195] The second section (ln. 8'-13') looks somewhat like a rising time scheme. However, it seems to repeat the same phrase multiple times. According to the British Museum catalogue this fragment is from "Sippar(?)."

BM 77242

Rising time scheme, microzodiacal (simplified)
Late Babylonian Babylon(?)
Copy: Horowitz (1994)
Photo: Steele (2017); Horowitz (1994)
Edition: Steele (2017); Horowitz (1994)
Small fragment with culminating points corresponding to the microzodiacal signs of Cancer. According to the British Museum catalogue this fragment is from "Sippar(?)," though Steele (2017, 74) states it is almost certainly from Babylon .

[195] These texts are currently being studied by John Steele. I would like to thank him for generously providing me with his preliminary editions.

BM 78161 (GU text)

List-informed simultaneous culminating stars
7th-5th century BCE(?) Babylon or Sippar (uncertain)
Copy: Pingree and Walker (1988)
Photo: British Museum Collection Online
Edition: Pingree and Walker (1988)
The text enumerates sets of stars, all of which begin with a *ziqpu*-star (or a point some interval away from one) and ends with the logogram GU, "string." The text has a few oddities and one major mistake, leading Pingree and Walker to suggest in their publication that the text was compiled from two separate lists. See the description in Chapter 1 and the discussion in Chapter 4.

BM 121206

Ritual text
Neo-Assyrian (7th century BCE) Aššur
P336140
Copy: Van Driel (1969)
Photo: British Museum Collection Online; Van Driel (1969)
Edition: SAA 20 52; Van Driel (1969)
A text describing ritual and cultic activities surrounding the god Aššur in the city of Aššur. The relationship between some of the many sections of the text is difficult to determine, it is likely that this is in fact a compilation text. A few of the sections mention the name of Sennacherib or describe his construction projects, thus giving a terminus post quem to these sections as well as the tablet in its entirety. The *ziqpu*-stars are used to indicate the time that certain cultic activities are to take place.

K 1216 (= SAA 10 149 = LAS 105)

Letter
Neo-Assyrian Nineveh (621 BCE)
P334911
Copy: ABL 1444
Photo: CDLI
Edition: SAA 10 149
A letter reporting on a lunar eclipse, during which the Shoulder of the Panther culminated.

K 1876 (= SAA 5 249)

Letter
Neo-Assyrian (late 8th or 7th century BCE) Nineveh
P313612
Copy: CT 53, 197
Photo: CDLI
Edition: SAA 5 249
A letter describing a storm that wreaked havoc on the Assyrian camp. Name of author missing. Likely attributed to the reign of Sargon based on the mention of the city of Šarru-iqbi.

K 9794

List w/multiple intervals
Neo-Assyrian Nineveh
P398319
Copy: CT 26, 50
Photo: CDLI
Edition: Appendix; Kugler (1914b, 116): col. ii'
2-column fragment (with no preserved edges) duplicating parts of col. iii and probably col. i of AO 6478. Beyond minor orthographic differences, the major difference between the two texts is that K 9794 does not seem to have col. ii of AO 6478, i.e., the one with distances.

KM 89551

List w/intervals
Late Babylonian(?)
P235270
Copy: YOS 15, 7
Photo: CDLI
Edition: Appendix B; Steele (2014)
Fragment of *ziqpu*-star list with intervals. None of the intervals are preserved, but the text does preserve several UŠ and *ana* signs, indicating that there were intervals in the missing part of the text. Listed erroneously in YOS 15 as museum number 894-551 and in Steele (2014, 135) as U. Mich. 895-551. Note that CDLI erroneously lists this fragment as Old Babylonian, likely because it appears in the Old Babylonian section of YOS 15.

MMA 86.11.337

List w/intervals
P412249
Copy: CTMMA 2, 78
Photo: The Met Collection Online
Edition: Spar and Lambert (2005)
Small fragment of a *ziqpu*-star list. No intervals are preserved, but several lines have *ana* (or parts of *ana*) before the star names, indicating that the original text likely included such intervals.

SAA 10 134 (= LAS 80)

Letter
Neo-Assyrian Nineveh
P334605
Copy: ABL 882
Photo: CDLI
Edition: SAA 10 134
A fragmentary letter by Babu-šumu-iddina reporting on a lunar eclipse. The letter mentions the culmination of a star, but does not preserve the name of the star or whether it culminated at the beginning or end of the eclipse

Sippar Planisphere

Star diagram w/stars: obv.; list w/intervals: rev.
Neo-Babylonian Sippar
Copy: Horowitz and Al-Rawi (2001)
Photo: Horowitz and Al-Rawi (2001)
Edition: Horowitz and Al-Rawi (2001)
Circular tablet. The partially preserved obverse is divided by twelve equidistant radials. Star names are written on the outer part of the tablet, with circular marks symbolizing the named stars located between the radii.

SpTU 3, 103+102

Correlation of *ziqpu*-star and other stars in relation to eclipses
Late Babylonian Uruk
P348707+P348706
Copy: von Weiher (1988)
Edition: Appendix B; GKAB; von Weiher (1988)

A new join made by the present author. The text correlates ziqpu-stars with Stars in the Path of Anu, and Ea, as well as singling out one of them for being a Star in the Path of the Moon. For a critical edition with commentary, see Appendix B. For an overview, see Chapter 4.

SpTU 4, 162

Commentary on Enūma Anu Enlil 20
Late Babylonian Uruk (20 September 321 BCE)
P348755
Copy: von Weiher (1993)
Edition: CCP; GKAB; von Weiher (1993)
This tablet originally belonged to the library of Iqīšāya and was copied on 20 September 321 BCE and is duplicated by VAT 7825 (Jiménez 2015a). The text is a commentary on Enūma Anu Enlil tablet 20 and contains a single mention of the *ziqpu*-stars (rev. 16'), where they are related to a lunar eclipse. See Chapter 4 for a discussion of this text.

SpTU 5, 269 rev. 1-5

Instructions for planetary position at last visibility
Late Babylonian Uruk
P348856
Copy: von Weiher (1998)
Edition: Appendix B; GKAB; von Weiher (1998)
The text seems to instruct the reader on how to determine the constellation in which a planet heliacally sets. For a discussion of this text, see Chapter 4.

SpTU 5, 271

Eclipse report(?)
Late Babylonian Uruk
P348858
Copy: von Weiher (1998)
Edition: GKAB; von Weiher (1998)
A badly preserved small tablet. Only preserves the first few signs in each line of the obverse and the bottom edge. Obv. 4 begins with the signs *ziq*-⸢*pi*⸣. GKAB identifies it as a horoscope, but the preserved signs are more in line with the information one would expect to find in an eclipse report.

STT 2, 340

List of blessings
Neo-Assyrian Sultantepe/Huzirina
P338655
Copy: Gurney and Hulin (1964)
Edition: GKAB; Reiner and Civil (1967)
A collection of thirty blessing formulae, one for each day of the schematic month. The text does not mention any specific ziqpu-star, but probably refers to 12 *bēru* of the ziqpu-stars. See the discussion of this text in Chapter 4.

U 196

Rising time scheme, microzodiacal (simplified)
Late Babylonian Uruk (Bīt Rēš)
P497348
Edition: Steele and Proust (In preparation); Schaumberger (1955): rev. (likely)
The reverse of this small fragment preserves the microzodiacal scheme for Sagittarius. The obverse contains the end of the scheme for Taurus and the beginning of the one for Gemini.

U 197

Natal omens
Late Babylonian Uruk
P497349
Edition: Sachs (1952b, 74–75)
Only the beginning of a few lines on the obverse are legible, most beginning with the name of a *ziqpu*-star. Obv 4’ begins with ^{lu_2}TUR *a-lid-ma* suggesting that the text contained natal omens. Based on the sequence of *ziqpu*-star names, each line contained the names of two consecutive *ziqpu*-stars.

UET 6, 924

list w/intervals
Late Babylonian Ur
P346961
Copy: UET 6/3, 924
Photo: CDLI
Edition: Steele (2014)

The only astronomical text from Ur (Steele 2014, 129). While none of the intervals are preserved, the following *a-na* suggests that the text originally contained them.

VAT 7825

Commentary on Enūma Anu Enlil 20
Late Babylonian Uruk (Bīt Rēš, 30 April 232 BCE)
P392620
Copy: Weidner (1941 pl. 6)
Photo: CDLI
Edition: CCP; GKAB; Rochberg-Halton (1988)
This tablet was found during uncontrolled excavation at Uruk, but likely in the area of the Bīt Rēš temple. The colophon identified the scribe as Tanittu-Anu, who copied the text on 30 April 232 BCE (Jiménez 2015b). The text is a commentary on Enūma Anu Enlil 20 and is a duplicate of SpTU 4, 162. For further information, see SpTU 4, 162 in this catalogue and the discussion on both texts in Chapter 4.

VAT 16436

List w/unclear intervals and number of constituent stars per *ziqpu*-star
Late Babylonian Uruk
Copy: Schaumberger (1952)
Photo: Fincke and Horowitz (2018)
Edition: Fincke and Horowitz (2018), Schaumberger (1952)
A complete tablet listing the standard repertoire of twenty-five *ziqpu*-stars, though it switches the positions along the sequence of the Harness and Rear Harness. The intervals listed in this text are different from those found in all other *ziqpu*-stars lists and their meaning is unknown. For a discussion of this text, see Chapter 1.

VAT 16437

List w/intervals
Late Babylonian Babylon
Copy: Schaumberger (1952)
Edition: Schaumberger (1952)
The lower part of a tablet, measuring intervals in UŠ and DANNA. The end of the list is likely on rev. 8, as the following line appears empty. The scribe added 1 DANNA on the left edge in obv. 3’, 5’, 7’, 9’, and rev. 5. On the obverse, these seem to mark a summation of the current line with the previous line, adding up to 1 DANNA (= 1 *bēru*). Therefore, these may have been inscribed to aid the scribe to sum up the total interval, albeit these are lacking in other expected lines. If there was a grand total, it would have been written in the now broken part of the tablet.

W 22281a

Rising time scheme, calendric (monthly)
5th-3rd century BCE Uruk
P348516
Copy: SpTU 1, 95
Edition: Steele (2017, 29–30); GKAB; Hunger (1976)
Partially preserved tablet excavated from the so-called "house of the *āšipu*s," which was occupied (not concurrently) by two families of scholars during the fifth to third centuries BCE (Steele 2017, 28). The text is divided into several paragraphs, each enumerating several stars that are said to be in balance (*šit-qu-lu*) on the 15th of month *n* as the sun rises, as well as in the evening with sunset (*ina li-la-a-ti* KI $ŠU_2$ $ša_2$ ^{d}UTU) on the 15th of month *n*+6. Each enumeration of stars begins with either a *ziqpu*-star or a distance behind a *ziqpu*-star.

1881-2-4, 413

List w/intervals
Neo-Assyrian Nineveh
P452337
Copy: Fincke and Horowitz (2017)
Photo: CDLI
Edition: Fincke and Horowitz (2017)
Fragmentary list of ziqpu-stars. Each line lists the name of two stars, similar in style to the star lists K 9794 and AO 6478, presumably with the interval between the two, though no intervals or *ana* signs are preserved. The majority of stars use DINGIR as a determiner, with a few using MUL.

MUL.APIN

The most recent critical edition of the astronomical compendium MUL.APIN is by Hunger and Steele (2019), and all citations of the text in the present study are taken from this edition, unless otherwise noted. A previous critical edition was published by Hunger and Pingree (1989). The following are the sources of MUL.APIN that preserve sections on the *ziqpu*-stars. See Hunger and Steele (2019, 20–29) for information on these sources and their sigla.

Source	Museum Number
a	K 12376

A	BM 86378
AA	VAT 9429
BB	VAT 9435 (+) 19306
E	AO 7540+
f	BM 59313
F	K 3852
g	BM 46871
h	BM 73815
H	BM 76505
J	Rm 319
JJ	VAT 9527
k	BM 32427
K	BM 32311
L	BM 45922
O	K 3020
Q	Rm 322
R	BM 35207
SS	VAT 9415 (+) 10836+11532+11665+11784
T	BM 41218
X	BM 32626

Astronomical Diaries and Related Texts

Unless otherwise noted, all references to *ziqpu*-stars in the following sources are related to lunar eclipses. The dates listed are those of the phenomenon correlated with the *ziqpu*-stars, and are based on ADART (Sachs and Hunger 1988; 1989; 1996; Hunger 2001; 2006) as well as Huber and de Meis (2004). The provenance of all these sources is Babylon.

Astronomical Diaries

ADART 1, -328 = Rm. 845+BM 32332(=LBAT 197)+32611
ADART 1, -289 = BM 32320+32370+32387+32568: Occultation of Saturn
ADART 2, -225 (1 Aug -225) = BM 33655
ADART 2, -214 (25 Dec -214) = P364487 = BM 36402(=LBAT 294)+36865
ADART 2, -193B (5 Nov -193) = P364512 = BM 35331 = LBAT 324
ADART 2, -190B = BM 45617(=LBAT 326)+45682: Occultation of Mars
ADART 2, -184B (24 Nov -184) = P364524 = BM 35330 = LBAT 336
ADART 2, -182A (4 Oct -182) = P364528+P364529 = BM 45613(=LBAT 340)+Rm 0693(=LBAT 341)+Rm 0734

ADART 3, -163B (30 Mar -162) = P364566 = BM 41462+41941 = LBAT 380+920
ADART 3, -160 (6 Jan -159) = P364571 = BM 46003 = LBAT 385
ADART 3, -149 (3 Jul -149) = P364584 = BM 34632 = LBAT 400
ADART 3, -134B_1 (10 Mar -133) = P364607 = BM 34669+35740 = LBAT 432+433
ADART 3, -132B (28 Oct -132) = P364612 = BM 35070+45699 = LBAT 438+439: Occultation of the King
ADART 3, -132C (28 Oct -132) = BM 47748+47885: Occultation of the King
ADART 3, -132D_1 (28 Oct -132) = P364613 = BM 34157+34341 = LBAT 440+556: Occultation of the King
ADART 3, -124B (9 Jan -123) = P364622 = BM 45693+45853 = LBAT 450+451: Occultation of Saturn
ADART 3, -122D (2 Aug -122) = BM 33044+33047
ADART 3, -95F (3 Aug -95) = P364585 = BM 34754 = LBAT 401
ADART 3, -93A (13 Jul -93) = P364658 = BM 32884 = LBAT 494
ADART 3, -90 (5 Nov -90) = P364659 = BM 41529(=LBAT 41529)+41546(=LBAT 496)+132278+Böhl 1332(=LBAT 497)
ADART 3, -87C (28 Feb -86) = P364664 = Rm 695+Sp 172(+)BM 41921 = LBAT 504+505+506
ADART 3, -85B = BM 38117: Potentially an occultation of the Jaw of the Bull
ADART 3, -85C_1 = P364666 = BM 41691+42100 = LBAT 507+970

Excerpts

ADART 5, No. 16 (5 Nov -193) = P364197 = BM 34236 = LBAT 1436
ADART 5, No. 17 (1 Aug -187) = P364200 = BM 42053 = LBAT 1439
ADART 5, No. 18 (28 Feb -189) = P364198 = BM 33643 = LBAT 1437
ADART 5, No. 21 (5 Nov -128) = P364202 = BM 33982 = LBAT 1441
ADART 5, No. 22 (1 Jun -119) = P364203 = BM 45845 = LBAT 1442
ADART 5, No. 23 (28 Feb -86) = P364118 = BM 34963+35198+35238 = LBAT 1334+1435+1443
ADART 5, No. 24 (21 Apr -80) = P364204 = BM 42145 = LBAT 1444
ADART 5, No. 25 (11 Apr -79) = P364205 = BM 33562A = LBAT 1445
ADART 5, No. 78 (26 June -190) = P364174 = BM 45687 = LBAT 1408: Occultation of Jupiter

Goal-Year Texts

ADART 6, No. 47 (30 Mar -162) = P364054 = BM 34037 = LBAT 1264
ADART 6, No. 62 (17 Feb -142) = P364066 = BM 34658(=LBAT 1277)+35787(=LBAT 1278)+35341
ADART 6, No. 69 (1 Apr -135 and 21 Mar -134) = P364072 = BM 34034 = LBAT 1285

Unrelated/Unclear

The following texts have appeared as ziqpu-star texts in previous literature, but have been excluded from the present study. While they may contain the names of stars that are attested as *ziqpu*-stars elsewhere, their appearance in the following texts have nothing to do with their role as *ziqpu*-stars. Texts whose association with the concept of *ziqpu* remains unclear are also included below.

BM 32405

Stellar omens (possibly Enūma Anu Enlil 50)
Late Babylonian Babylon
The fragment contains what appears to be omens related to stars. Unfortunately, the tablet is badly preserved and only a few signs remain readable. Reiner (1998, 292) remarked that it relates to *ziqpu*, but I could not identify any such connection in the text.

BM 34403

Unclear
Late Babylonian Babylon
P364263
Copy: LBAT 1514
A small fragment which preserves only a few signs, with no identifiable name of *ziqpu*-star. Labeled as *ziqpu*-star text in LBAT, though marked as "doubtful" (Sachs 1955, XXXV).

BM 34666

Iconography/uranology(?)
Late Babylonian Babylon
P364259
Copy: LBAT 1510
The text seems to describe the iconography of constellations, though it is not included in the recent study of the uranology texts (Beaulieu et al. 2018). The authors of that study point out that the Frond (e_4-ru_6) is described in BM 34666 obv. 8-11 as holding a *sissinnu*, "date frond." However, it does not seem that this star is mentioned in its capacity as *ziqpu*-star. Although obv. 4 may contain the term *ziq-pi*, it is written directly on a break, making this reading uncertain. An edition of this text will be published in the future.

BM 35260

Unidentified
Late Babylonian Babylon
P364260
Copy: LBAT 1511
Edition: Appendix B
This small flake partially preserves the name of one of the constituent stars of the Panther, which are well attested as *ziqpu*-stars. Due to the broken context of this text, it is not possible to identify it and determine whether it is indeed a *ziqpu*-star text. Designated as a *ziqpu*-star text in LBAT, with the reservation that it is “doubtful” (Sachs 1955, XXXV).

BM 35511

Unidentified
Late Babylonian Babylon
P364262
Copy: LBAT 1513
The poorly preserved text appears to mention the term *ziq-pi* in several places, but its poor state of preservation prevents any meaningful reading. Designated as a *ziqpu*-star text in LBAT, with the reservation that it is “doubtful” (Sachs 1955, XXXV).

BM 36748

Enūma Anu Enlil 22 lunar eclipse omens
Late Babylonian Babylon
This large fragment contains sections of Enūma Anu Enlil tablet 22. The only connection to *ziqpu*-stars is found in rev. ii’ 12’, which preserves part of the name [UD.K]A.DUH.A, the Shoulder of the Panther, though nothing indicates it is due to its role as a *ziqpu*-star.

BM 41666

Astrological microzodiacal text
Late Babylonian Babylon
P364253
Copy: LBAT 1504
Edition: Monroe (2016)

This small fragment correlates days of possible eclipses found in omen literature to microzodiacal portions of Aries. Although listed in LBAT as a *ziqpu*-star text, it does mention *ziqpu*-stars and is listed here only as a correction to LBAT.

BM 45653

Unclear
Late Babylonian Babylon
P364261
Copy: LBAT 1512
Edition: Appendix
This fragment contains the names of several stars, though I was unable to identify the text. While it contains the names of several *ziqpu*-stars (lines 3', 5'-7'), it also refers to other stars (lines 2', 3', 5', 10'-13'). It is unclear whether the *ziqpu*-stars appear in this text in their capacity of *ziqpu*-stars.

BM 45810

Unidentified
Late Babylonian
Only one side of this tablet is preserved. According to the catalogue of the British Museum, this text contains a procedure text with *ziqpu*-stars. The term *ziqpu* does appear in lines 9' and 14'. Two names of *ziqpu*-stars, the Two Stars of Its (=Lion's) Thigh and the Single Star of Its (=Lion's) Tail, also appear in lines 13' and 16' respectively, alongside names of other stars, namely, the Scales (ln. 9'), the True Shepherd of Anu (ln. 17'), and Pabilsag (ln. 20'). I was unable to identify the text or determine its nature. An edition will appear in a future publication.

K 16772

Unidentified
Neo-Assyrian Nineveh
P402217
Copy: CT 34, 14
Photo: CDLI
Edition: Appendix B
Horowitz (1994, 89 fn. 5) suggested this small flake may belong to a *ziqpu*-star text. The flake preserves the signs for ⅔ DANNA, attested in other *ziqpu*-star lists, but that is insufficient to determine any association with the *ziqpu*-stars.

Appendix B: Text Editions

The following appendix offers preliminary editions to unpublished material as well as several amendations to previously published texts. Some of these texts will be published in the future in greater detail.

BM 35161 (=LBAT 1508)

Transliteration

Obv.

1’ ina ⸢MUL$_2$$^?$⸣ [...]
2’ ^{mul_2}LU 5 UŠ x [...]
3’ ina SAG MAŠ$_2$ LU x [...]
4’ ina 80 MU x x [...]
5’ ^{mul_2}LU 5 UŠ [...]
6’ 15 UŠ SI[G$^?$ ...]
7’ ITI 1 TA$^?$ [...]
8’ 6 KUŠ$_3$ [...]
9’ ZA$^?$ x [...]
(remainder broken)

Rev.

1’ [...] ⸢x⸣ KAM$_2$$^?$ [...]
2’ [...] ^{mul_2}LU [...]
3’ [...] MUL$_2$.MU[L$_2$$^?$ ...]
4’ [^{iti}SI]G$^?$ ^{mul_2}U[R.A$^?$ …]
5’ [...] x A T[U$^?$ ...]
6’ [^{iti}Š]U ^{mul_2}ŠU.G[I …]
7’ [... ^{m}]^{ul_2} ŠU.PA$^?$ ^{mu}[^{l_2} …]
8’ ⸢^{iti}⸣IZI ^{mul_2}G[AM$_3$ ...]
9’ ^{mul_2}UR.KU ⸢x⸣ [...]
10’ ^{iti}KIN MUL$_2$ [...]
11’ [...] ⸢x x⸣ [...]
(remainder broken)

BM 35260 (=LBAT 1511)

Transliteration

1’ [...] ⸢x DU$^?$ x⸣ [...]
2’ [...] ⸢x⸣ u$_3$ ana 20$^?$ [...]
3’ [...] ⸢x⸣ AMAR E GIR$^?$ ⸢x⸣

4’ [... š]a$_2$$^?$ ^{mul}UD.KA.DU[H.A]
5’ [...] ŠU$_2$ [(x)]
==============================
6’ [...] KUR$^?$ [(x)]
(remainder broken)

BM 35973 (=LBAT 1506)

Transliteration

1’ [...] ⸢x⸣ TA ša$_2$ NI$^?$ ⸢x⸣
2’ [...] ⸢šu$_2$$^?$⸣ GUB-zu
3’ [...] ⸢x⸣ KUŠ$_3$ e-ma-ra
4’ [...] ⸢x⸣ KUŠ$_3$ SIG$^?$ ziq-pi
5’ [...] ⸢TIL$^?$⸣-šu$_2$-nu$^?$
=================================
6’ [...] TA 2$^?$ ALLA EN 23 A
7’ [...] 1 UŠ AL$^?$ ziq-pi ⸢x⸣
8’ [... ina U]GU ana ALLA IGI-šu$_2$ ana ⸢x⸣
9’ [... z]iq-pi SAG-šu$_2$ ša$_2$ ⸢x⸣
10’ [...] ⸢x⸣ ša$_2$-ru-u$_2$ [(x)]
11’ [...] ⸢x⸣ IŠ$^?$ RIN$^?$ [...]
12’ [...] ⸢x⸣ [...]
(remainder broken)

BM 36175

Transliteration

Obv.

1’	[...] ⸢UŠ⸣	[...]
2’	[...] ⸢DANNA⸣	⸢x⸣ [...]
3’	[...] ⸢DANNA⸣	⸢a⸣-na [...]
4’	[...] ⸢UŠ⸣	a-n[a …]
5’	[... DAN]NA	a-na M[UL$_2^?$ …]
6’	[... DA]NNA	a-na ⸢MUL$_2^?$⸣ [...]
7’	[...] 10 UŠ	a-na ⸢MUL$_2^?$⸣ [...]
8’	[...] ⸢x DANNA⸣	a-na ⸢MUL$_2^?$⸣ [...]
9’	[... U]Š	a-na ⸢MUL$_2^?$⸣ [...]

(remainder broken)

Translation

Obv.

1’ [... 10] UŠ [to the Bright Star of its Chest …]
2’ [... ⅔] bēru [to the Knee …]
3’ [... ⅔] bēru t[o the Heel …]
4’ [... 10] UŠ t[o the Four Stars of the Stag …]
5’ [... ½] bēru to the [Dusky Stars …]
6’ [... ½] bēru to the [Bright Star of the Old Man …]
7’ [...] 10 UŠ to [Naṣrapu …]
8’ [... ½] bēru to the [Crook …]
9’ [... 10 U]Š to the [Hand of the Crook …]

Commentary

The obverse contains a list of distances between *ziqpu*-stars. Although none of the distances or star names are preserved, the sequence of UŠ and *bēru* signs used appears in other *ziqpu*-star lists in only one part of the list, and the reconstruction is based on this sequence. The reverse duplicates Atypical Text E published by Neugebauer and Sachs (1967).

BM 36927

Transliteration

Obv.

1’ [...] ŠU$_2$ ⸢x⸣ [...]
2’ [...] ⸢x x x x x⸣ ziq-pi ⸢x x⸣ [...]
3’ [... UD].KA.DUH.A ziq-pi ^{mul_2}UD.KA.⸢DUH⸣.[A …]
4’ [...] u ^{mul_2}AL[LA$^?$ …] ⸢x x⸣ MES$^?$ [...]

5’ [...] ⸢x KI$^{?}$ x⸣ [...] ⸢x⸣ GUB-za ina 4 30$^{?}$ 7 [...]
6’ [...] ⸢x x⸣ KI MES$^{?}$-ma KI 4$^{?}$ UŠ i-s[i$^{?}$-...]
7’ [...] ⸢x x⸣ BE$^{?}$-ma ⸢x⸣ 30 ina KI ⸢x x x⸣ [...]
(remainder broken)

Rev.
1’ [...] ⸢x x x x⸣ [...]
2’ [...] ina KI SAL^{meš} GUB-z[u …]
3’ [...] ⸢x⸣ BU šu-u UD^{meš}-šu ⸢x⸣ [...]
4’ [...] (blank) LU BI KI ŠU ŠU$_2$ ⸢x⸣ [...]
5’ [...] ⸢x⸣ a$^{?}$-lid ^{d}UDU.IDIM ša$_2$ ina IGI <ša$_2$> ^{d}UDU.IDIM [...]
6’ [...] I BI KUR-šu u$_2$ šim-tu$_2$
7’ [... ^{d}]UDU.IDIM^{meš} (blank) ⸢x⸣ [...]
----

u.e.
1 [...] ⸢x⸣ u BAR u$^{?}$ x AM ana MU ⸢x⸣ [...]
2 [...] ⸢x⸣ MU x KIŠIB$^{?}$ KI DINGIR-šu$_2$ [...]
3 [...] ⸢x x⸣ [...]
4 [...] ⸢x⸣ [...]

Commentary

Assignment of obverse and reverse uncertain and based on curvature and what appears to be the clear edge on the reverse. Rev. 5’ duplicates LBAT 1593 obv. 12’-13’ and rev. 6’ partially resembles LBAT 1593 obv. 13’.

BM 40126

Transliteration

Obv.
1 [...] ⸢x⸣ ina UGU IGI ŠU$_2$
2 [...] ⸢10$^{?}$⸣+20 MIN MIN KUN A ŠU$_2$
3 [...] ⸢x⸣ MIN MIN e$_4$-ru$_6$ ŠU$_2$
4 [...] ⸢TA$^{?}$⸣ MIN MIN GABA A ŠU$_2$
5 [...] ⸢x⸣ 5 MIN 5 ar$_2$ ALLA ŠU$_2$
6 [...] ⸢x⸣ 5 MIN 5 ar$_2$ <ALLA$^{?}$> ŠU$_2$
7 [...] ina UGU ŠU$_2$
8 [...] MIN ŠU$_2$

9 [...] MIN x x A ŠU$_2$
10 [...] ⸢x⸣ MIN ⸢x⸣ [...]
(remainder broken)

Rev.
1’ [...] ⸢ŠU$_2$⸣
2’ [...] ⸢LU.LIM⸣ ŠU$_2$
3’ [...] ⸢LU⸣.LIM ŠU$_2$
4’ [...] KIŠIB GAM$_3$ ŠU$_2$
5’ [...] ŠU.GI ŠU$_2$
6’ [...] ⸢x⸣ UR$^?$.KU$^?$ ŠU$_2$
7’ [...] ⸢x⸣ KIŠIB GAM$_3$ ŠU$_2$
8’ [...] 7 ⸢UŠ$^?$⸣ ⸢x⸣ ša$_2$ ar$_2$ ŠU.GI ŠU$_2$
9’ [...] ⸢x⸣ GABA UR.A ŠU$_2$
10’ [...] ⸢x⸣ BAR$^?$ $^{d?}$ŠU.GI ŠU$_2$

u.e.
1 [...] ⸢x⸣ MU$^?$ x x x 30 KAM$^?$ ⸢x⸣
2 [...] ⸢x⸣

Commentary

Both obverse and reverse seem to refer to the setting of *ziqpu*-stars. Note that this differs from the setting of stars found in MUL.APIN I iii 13-33. Several stars seem to be mentioned multiple times: 5 UŠ behind the Crab in obv. 5-6, the Stag in rev. 2’-3’, the Hand of the Crook in rev. 4’ and 7’. Note also that the Old Man appears in both rev. 5’, 8’, and 10’, though at least in rev. 8’, it is 7 UŠ behind it. The upper edge may contain a colophon, but is too poorly preserved to be read clearly.

BM 41679 (=LBAT 1509)

Transliteration

Obv.
1’ [...] ⸢x x⸣ [...]
2’ [... K]AM$_2$ ki-i ⸢ALLA$^?$⸣ [...]
3’ [... EN UD 30] ⸢KAM$_2$⸣ ša$_2$ ^{iti}GAN$^?$ RI$^?$ [...]⸢x⸣ aṣ$_2$-ṣa ⸢x x⸣ [...]
4’ [...] UD 1 KAM$_2$ EN UD 30 KAM$_2$ ša$_2$ ^{iti}⸢x⸣ [...]
5’ [... ^{it}]^{i}BARA$_2$ ina EN.NUN USAN 1 DANNA ⸢x⸣ [...] ⸢NIM⸣ [...]
6’ [...] 1 KUŠ$_3$ ^{mul_2}MAŠ.MAŠ IGI-i ⸢ana⸣ ziq-pi 7$^?$ [...]

7’ [...] ⸢x x⸣ ^{iti}GU$_4$ UD x x BI UD ⸢30$^?$⸣ [...]
8’ [... im-šu]h$^?$ ZI 1 UŠ ⸢40$^?$⸣ NINDA ⸢ar$_2$⸣ ^{mul_2}MAŠ.⸢MAŠ⸣ [...]
9’ [...] ⸢x⸣-tu$_2$ HA.LA ša$_2$ ABSIN $^{⸢mul_2⸣}$ALLA [...]
10’ [...] ⸢x x⸣ 8 UŠ 20/3[0 …] KAM$_2^?$ [...]
11’ [...] x x ša$_2^?$ [...]
12’ [...] ⸢x x x x⸣ [...]
13’ [...] ⸢x x⸣ [...]
(remainder broken)

Rev.
1’ [...] ⸢x x⸣ [...]
2’ [...] ⸢x⸣ EN EN$^?$ ⸢x⸣ [...]
3’ [...] ⸢x⸣ x ^{iti}⸢SIG$^?$⸣ ⸢x x⸣ 4$^?$ ⸢x⸣ [...]
4’ [...] ⸢x 3$^?$⸣ [...] 20 ⸢ZI$^?$⸣ 10+4$^?$/5$^?$ ⸢UŠ$^?$⸣ [...]
5’ [...] ⸢13 AN NI$^?$ x⸣ [...] ⸢x 12 UŠ$^?$ x x⸣ [...]
6’ [...] ⸢GABA$^?$⸣-šu$_2$ EN$^?$ [...] ⸢x⸣ [(x)] ⸢x x x⸣ [...]
7’ [...] SA$_4$ ša$_2$ GABA-šu$_2$ x x x [...] x [...]

8’ [... SIPA$^?$].⸢ZI$^?$.AN$^?$.NA$^?$⸣ ina UGU ^{mul_2}⸢x⸣ [...]
9’ [...] ⸢x⸣ ^{mul_2}dele-bat ⸢x⸣ [...]
(remainder broken)

BM 42784

Transliteration

1’ [...] TUM$^?$ SI$^?$ [...]
2’ [...] ⸢x⸣ ziq-pi ⸢x⸣ [...]

3’ [...] ŠA$_3^?$ PA GAL$_2$ 8-šu$_2^?$ ⸢x⸣ [...]
4’ [...] la ziq-pi ša$_2$ QA$^?$ [...]
5’ [...] ALLA$^?$ TUM$^?$ [...] ⸢x⸣ [...]
6’ [...] ⸢x⸣ ŠU$_2$ x [...]

7’ [...] ⸢x ŠA$_3^?$⸣ [...]
(reminder broken)

BM 45653 (=LBAT 1512)

Transliteration

1’ [...] ⸢x⸣ [...]
2’ [...] ⸢x⸣ ^{mul_2}KAK$^?$.SI.SA$_2$ 1 KUŠ ⸢20 x x x x x⸣ [...]
3’ [...] ⸢x⸣ KUŠ$_3$ 1 KUŠ$_3$ NIM-a ina ša$_2$ ina IGI ^{mul_2}ŠU.GI u ^{mul_2}NUMUN$^?$ LAGAB$^?$ AD$_6$ x [...]
4’ [...] KUŠ$_3$ NIM NU MUL$_2$ ša$_2$ NU U$_2$ ša$_2$ ina IGI nap-⸢x x⸣ 2$^?$ KUŠ$_3$ ŠU$_2$ ŠU$_2$ [...]
5’ [... GI]Š.KUN UR.A u NIM KI.TA ^{mul_2}LUGAL GABA$^?$ ⸢x x x x x⸣ [...]
6’ [...] ⸢x⸣ ša$_2$ 2 GIŠ.KUN-šu$_2$ 1 KUŠ KUR MUL ša$_2$ SAG.<DU> MUL$_2$ ⸢x⸣ [...]
7’ [...] ⸢x⸣ NI qu$_2$-mar ša$_2$ ^{mul}UD.KA.DUH.A [x] 2$^?$ NIM [...]
8’ [...] ⸢x⸣ KUR ša$_2$ ⸢x⸣ UZ$^?$ 1 KUŠ$_3$ ⸢x x x x⸣ [...]

9’ [...] ZA$^?$ MU U$_2$ [(x)] ša$_2$ ⸢GUB$^?$⸣ [...]
10’ [...] ⸢x⸣ ša$_2$ ina IGI ^{mul_2}UGA^{mušen} 1 KUŠ$_3$ [...]
11’ [...] ⸢x⸣ 3-šu$_2$ ša$_2$ AŠ.GAN$_2$ 1 KUŠ$_3$ 13 ⸢x⸣ [...]
12’ [... ^{mul_2}U]GA^{mušen} 1 KUŠ$_3$ KUR NU ⸢x⸣ [...]
13’ [... ^{mul_2}UG]A^{mušen} 1 KUŠ KUR NU [x] ⸢x⸣ [...]
14’ [...] ⸢x⸣ u KUN$^{?me}$ ša$_2$ [...]
15’ [...] ⸢x⸣ MUL$_2$ ⸢x x x⸣ [...]
16’ [...] MUL$_2$ ⸢x x x⸣ [...]
17’ [...] ⸢x⸣ ŠU$_2$ ana$^?$ [(x)] ⸢x⸣ [...]
18’ [...] ⸢x⸣ ŠU$_2$ ana$^?$ [...]
19’ [...] ⸢x⸣ [...]
20’ [...] ⸢ša$_2$$^?$ GIŠ$^?$⸣ [...]
21’ [...] ⸢x⸣ [...]
22’ [...] ⸢x⸣ [...]
(remainder broken)

BM 46272

Transliteration

1’ [...] ⸢x MAŠ$_2$$^?$ x⸣ [...]
2’ [...] IGI [...] x ⸢KUR$^?$ AN x⸣ [...]
3’ [...] ⸢x⸣ ME ⸢x⸣ PA A U ⸢x⸣ [...]
4’ [... MUL]^{meš} ša$_2$ ziq-pi U[GU$^?$ …]
5’ [...] ⸢x⸣ a-na$^?$ x ia$^?$ [...]

7’ [...] (blank) [...]
8’ [...] ⸢x x x⸣ [...]
(reminder broken)

BM 65756

Transliteration

1’ [...] ⸢x UŠ x⸣ [...]

2’ [... A.R]A$_2$ 30 2$^?$/3$^?$ 3 U[Š ...]
3’ [...] x ⸢KAM$_2$⸣ 40 8 A.RA$_2$ 1⸢2⸣ [...]

4’ [...] x ŠU$^?$ 2 A.RA$_2$ 30 2 UŠ$^?$ A$^!$(ŠA$_2$).⸢RA$^?$⸣ [...]
5’ [...] 4 A.RA$_2$ 12 10 4 20 4 4 A$^!$(ŠA$_2$).RA x [...]
6’ [...] x A.RA$_2$ 30 40 he-pi$_2$ ša$_2$ x$^?$ ša$_2$$^?$ 40 A$^!$(ŠA$_2$).RA x [...]
7’ [... KA]M$_2$$^?$ ina GAD$^?$ 9-šu$_2$ qaq-qar-šu$_2$ u$_2$-qa-at-ta ina ŠA$_3$-bi [...]

8’ [...] x UŠ TA UGU GIŠ.KUN ša$_2$ ^{mul_2}LU UD.15.KAM$_2$ ša$_2$ ^{d}UTU.ŠU$_2$ x [...]

9’ [...] ⸢^{d}⸣UTU.ŠU$_2$.A 9 UŠ TA UGU GIŠ.KUN ša$_2$ ^{mul_2}LU UD.15.KAM$_2$ ša$_2$ ^{d}⸢UTU⸣ [...]
10’ [... T]A UGU GIŠ.KUN ^{mul_2}LU UD.15.KAM$_2$ ša$_2$ ^{d}UTU x LU$^?$ [...]

11’ [...] x TA UGU GIŠ.KUN ša$_2$ ^{mul_2}[...]
12’ [... UG]U GIŠ.KUN ^{mul_2}LU$^?$ UD.15.⸢KAM$_2$ ša$_2$⸣ [...]
13’ [...] ⸢x x x x x⸣ [...]
(remainder broken)

K 9794

Transliteration

col. i’
1’-2’ (broken)
3’ [...] (blank)
4’ [...] KIMIN
5’ [...] (blank)
6’ [...] i-na KIMIN

7’ [...] (blank)
8’ [...] ⸢x⸣ na i-na KIMIN
9’ [...] (blank)
10’ [... n]a$^{?}$ i-na KIMIN
11’ [... ^{mul}UD.KA.D]UH.A (blank)
12’ [... m]a-na ina KIMIN
13’ [...] (blank)
14’ [... n]a$^{?}$ i-na KIMIN
15’ [...] (blank)
16’ [...] i-na KIMIN
17’ [...] (blank)
(remainder broken)

col. ii’
1’ EN MU[L …]
2’ 9 LIM DANNA ina [...]
3’ EN MUL tak-ša-⸢a⸣-[ti …]
4’ 18 LIM DANNA ina K[IMIN …]
5’ EN MUL [...]
6’ ⸢18⸣ LIM DANNA ina [...]
7’ EN ^{mul}G[AM$_3$$^{?}$ UZ$_3$ …]
8’ 30 LIM 6 LIM DANN[A …]
9’ EN qu$_2$-ma-ru ša$_2$ ^{mul}UD.[KA.DUH.A …]
10’ 18 LIM DANNA ina K[IMIN …]
11’ EN MUL ni-bi-i ša$_2$ ⸢x⸣ [...]
12’ 30 LIM 6 LIM DANNA [...]
13’ EN ^{mul}ki[n-ṣi]
14’ 30 LIM 6 LIM DAN[NA …]
15’ EN ^{mul}a-s[i-di …]
16’ 18 LIM DANN[A …]
17’ ⸢EN⸣ [...]
(remainder broken)

K 16772

Transliteration

1’ DIŠ ^{d}SI[PA$^{?}$.ZI.AN.NA …]
2’ ⅔ KASKAL.B[U(=DANNA) …]

3’ DIŠ MUL^{meš} ^{d}[...]
4’ DIŠ ⌜MUL⌝ [...] ⌜x⌝ [...]
(remainder broken)

KM 89551

Transliteration

1’ [... U]Š a-na [... ni-ri]-⌜i⌝ [...]
2’ [... U]Š ana ^{mul}na-ad-[dul-lum …]
3’ [... U]Š ana ^{mul}kip-⌜pat⌝ [...]
4’ [... DAN]NA ana MUL ša$_2$ maš-ša$_2$-a-[ti]
5’ [... U]Š ana MUL tak-ša$_2$-a-[ti]
6’ [...] ana MUL e-d[u]
7’ [...] ana ^{mul}be-lit T[IN]
8’ [...] ana qu$_2$-ma-ri ša$_2$ ^{mul}UD.KA.DUH.⌜A⌝
9’ [...] ana ⌜MUL⌝ ni-bu-u$_2$ ša$_2$ GABA-šu$_2$
10’ [...] ^{mul}⌜kin⌝-ṣi
11’ [...] ana ^{mul}a-si-du
12’ [...] 4 ša$_2$ ^{mul}LU.LIM
13’ [...] ana ^{mul}um-mu-lu-pu
14’ [...] ⌜MUL⌝ ni-bu-u$_2$ ša$_2$ ^{mul}ŠU.GI
15’ [... ^{mu}]^{l}na-aṣ-ra!(ṣa)-pu
16’ [... ^{mu}]^{l}gam-lum
17’ [...] rit-na$_2$ gam-lum
18’ [...] ⌜x x x⌝
(remainder broken)

Rm 829 rev.

Transliteration

1 ⌜x⌝ TA UD 15 KAM EN UD ⌜x TA$^{?}$⌝ [...]
2 ⌜x⌝ EN$^{?}$ 5 UŠ ar$_2$$^{?}$ $^{mul_2?}$⌜x x⌝ [...]
3 ša$_2$ ^{mul_2}UD.KA.DUH.A EN$^{?}$ [...]
4 a-dir TA 4 MUL$_2$ ša$_2$$^{?}$ [...]
5 EN.NUN MURUB.BA ⌜x⌝ [...]
6 EN 5 UŠ$^{?}$ ar$_2$ [...]

7 ⌜x⌝ [...]
(remainder broken)

Commentary

This fragment joins BM 32276 published by Steele (2017) and first suggested by him (personal communication). RM 829 confirms his restoration of rev. ii of BM 32276, but offers additions to the first two lines. As noted in Steele's edition of BM 32276, the later part of this section uses the culmination of *ziqpu*-stars to delineate the three watches of the night. The beginning of the section does indeed note the time from the culmination of the Shoulder of the Panther on the 15th day of Month VIII (though the month is not explicitly stated until the next section) to the culmination of another star, whose name is broken. The culmination of the Shoulder of the Panther most likely refers to the moment of sunset, as is the case in the rising time scheme texts (Steele 2017, 100–101).

As for the broken name in line 2, it is possible to suggest that the text used Single Star of Its (=Lion's) Tail, based on four elements in the text. First, the following sections refer to measurements from the 1st to the 30th day. Second, the measurement here is from sunset on the 15th day of Month VIII. Third, the section then goes on to divide the three watches of the night, i.e. from sunset to sunrise. Lastly, the culminating point is actually 5 UŠ behind the star. According to the rising time scheme, the point that is 5 UŠ behind the Single Star of Its Tail would culminate at sunrise on the 30th day of Month VIII. What little remains of the signs is reminiscent of KUN, "tail." However, all extant ziqpu-star sources always qualify it as "the Single Star," by writing either DELE or *e-du* at the beginning of the name. Furthermore, the purpose of measuring from sunset on the 15th day to sunrise on the 30th day is unclear to me. Therefore, this suggestion remains purely speculative.

SpTU 3, 103+102

SpTU 3, 102 is the lower part of a tablet, preserving lines on both sides, while SpTU 3, 103 is a fragment preserving several lines, whose beginning and end are missing. Although at first glance the two do not seem to physically join, based on the contents of the preserved lines as well as where the breaks are, it is evident that these two pieces originally belonged to a single tablet.[196]

[196] It is worth noting that Oelsner (1991, 42) has suggested a possible join in his review of SpTU 3, though it was never explicated.

The preserved lines can be divided into 15 sections, although given the extent of the tablet that is missing, the reverse would have contained much more. Examination of the curvature of the tablet may help in determining how much of the obverse is missing, but this was not possible at the time of publication. The text begins with section 0, which is barely preserved, but may have contained an introduction to sections 1-12. It refers to lunar eclipses and preserves the sign KUR, which appears in sections 1-12 with the meaning of "to reach." Section 13 (rev. 6-11) may contain some concluding remarks or instructions. Given that there is a ruling running through this section, it is possible that this section actually contains two separate subsections. Parts of this section seem to parallel VAT 7825, a commentary to Enūma Anu Enlil tablet 20. SpTU 3, 103+ rev. 6-7 parallel VAT 7825 rev. 15' and SpTU 3, 103+ rev. 9-11 is somewhat similar to VAT 7825 rev. 16'-17'. Lastly, section 14 contains the incipit of Enūma Anu Enlil tablet 17 (see Part I, lines 1-2 in Rochberg-Halton 1988, p. 117).

Discussion of Sections 1-12 (obv. 3' - rev. 5)

The main part of the preserved text can be divided into twelve sections, each containing three lines arranged in the following format:

1st line: ki-i SN_1 a-na ziq-pi GUB-zu-ma ^{d}30 AN.MI u_2-šar-ru-u_2
2nd line: SN_1 SN_2 SN_3
3rd line: a-di-i ^{d}UTU SN_4 KUR-ad_2 pi-$šer_3$-$ša_2$ AN.MI ul u_2-šar-ra-a

The translation of each entry would then be:

"When SN_1 stands in culmination, a lunar eclipse will begin.
SN_1 (is as) SN_2 (is as) SN_3
Until the sun reaches SN_4, its meaning (is that) the (aforementioned lunar) eclipse will not (yet) begin."

The star name in the first line, SN_1, is always a ziqpu-star. The second line lists three star names, one from each path of Enlil, Anu, and Ea: SN_1 is the same (*ziqpu*-)star in the 1st line and is an Enlil-star. SN_2 is an Anu-star and SN_3 is an Ea-star (this may include a pair of stars that consistently appear together, such as Šullat and Haniš as in obv. 28'). The star name in the third line, SN_4 is one of the stars in the path of the moon. Since the path of the moon passes through all three paths of Enlil, Anu, and Ea, insofar as preserved, SN_4 is one of the stars that appears in the second line:[197]

Sect.	SN_1 = ziqpu-star	SN_2 = Enlil-star	SN_3 = Anu-star	SN_3 = Ea-star	SN_4 = Star in the Path of the moon

[197] For the sake of space, the MUL_2 determiner has been omitted from the names of stars.

1	[... UD.KA.DU]H.A	[... UD.KA.DU]H.A	SIM.MAH	u ^{mul_2}[...]	[...]
2	[...]	[...]	[...]	[UDU].IDIM ša$_2$ KUN^{meš} ^{d}[...]	[...]
3	[...]	[...]	[a-nu]-ni-tu$_4$	[...]	[...]
4	[...]	[...]	MUL$_2$.MUL$_2$	[...]	[...]
5	[GAM$_3$]	⌜GAM$_3$⌝	is le-e	[...]	[is l]e-e
6	MAŠ.MAŠ	MAŠ.TAB.BA.GAL.GAL	SIPA.ZI.AN.NA	[...]	SIPA.ZI.AN.NA
7	ALLA	ALLA	KAK.SI.SA$_2$	[...]	ALLA
8	UR.GU.LA	UR.A	MUŠ	[...]	UR.A
9	e$_4$-ru$_6$	e$_4$-ru$_6$	ABSIN	šullat$_2$ u haniš$_2$	ABSIN
10	ŠU.PA	ŠU.PA	GIŠ.RIN	ŠAR$_2$.UR$_4$ ŠAR$_2$.GAZ	GIŠ.RIN
11	kip-pat	[kip-pat]	[...]	[...]	[...]
12	[...]	[...]	TI^{mušen}	[...]	SUHUR.MAŠ$_2$

Only sections 9 and 10 preserve the names of all the stars. Based on the identification in Hunger and Pingree (1999), it seems that these stars are spread across several successive hour cycles, with each following star having a slightly larger right ascension. For the year -500, the following is the right ascension of these stars:

Star	Identification	Right ascension
Eru	γ Comae Berenices	153.15°
Absin	α Virginis	169.29°
Šullat	μ Centauri	173.68°
Haniš	ε Centauri / ν Centauri	171.02° / 173.70°
ŠU.PA	α Boötes	185.12°
GIŠ.RIN	α Libra / β Libra / γ Libra	189.80° / 196.91° / 200.52°
ŠAR$_2$.UR$_4$	υ Scorpii	222.42°
ŠAR$_2$.GAZ	λ Scorpii	223.11°

To a certain extent, SpTU 3, 103+ is reminiscent of BM 78161, the so-called GU text, which contains "strings" of stars. The most likely interpretation for BM 78161 is that stars belonging to the same string would culminate roughly at the same time

(Hunger and Pingree 1999). This, however, is not the case for SpTU 3, 103+, where a difference of roughly 20° to 40° of right ascension between the stars in each section would result in significant differences in culmination. Some of these stars are actually larger constellations, so in some cases it is difficult to know which one the author has intended. For example, the Snake, MUŠ, in section 8 spans many different hour circles, though its proximity to the Lion is attested elsewhere, even given iconographic representation in VAT 7847, where the Lion is drawn standing atop the Snake. Because of these large constellations, it is difficult to determine similarities between the sets of stars used in SpTU 3, 103+ and the strings in BM 78161. The only exception is section 9 which mirrors the stars of String K precisely: $^{\text{mul}}$e$_4$-⌜ru$_6$⌝ KI.MIN $^{\text{mul}}$AB.SIN$_2$ $^{\text{d}}$šullat$_2$ u haniš$_2$ $^{\text{mul udu.idim}}$GU$_4$.UD *ša$_2$ ana* $^{\text{mu[l}}$]AB.SIN$_2$ *ina* IGI $^{\text{mul}}$UGA GUB-*zu* GU (BM 78161, ln. 17-18; after Pingree and Walker 1988).[198]

A different text that might parallel the stars listed in SpTU 3, 103+ is CT 33, 9, a Neo-Assyrian tablet from the library of Ashurbanipal. As published in Horowitz (2014: 209-211), the reverse of CT 33, 9 provides a list of stars in the paths of Enlil, Anu, and Ea. The stars for each path are arranged in six lines, with two stars per line. For the sake of convenience, the following table shows the listed stars in order:

	Enlil-star	Anu-star	Ea-star
1	[...]	[SIM].MAH	GU.LA
2	$^{\text{m}}$[$^{\text{ul}}$ ...]	IKU	UDU.IDIM ša$_2$ ina KUN$^{\text{meš}}$
3	[...]	[a-nu]-ni-tu$_4$	NU.MUŠ.DA
4	[...]	MUL.MUL	KU$_6$
5	[...]	[G]U$_4$.AN.NA	$^{\text{d}}$u$_2$-ge-e
6	MAŠ.TAB.B[A ...]	SIPA.ZI.AN.NA	⌜DAR⌝.LUGAL$^{\text{mušen}}$
7	[...]	[K]AK.SI.SA$_2$	Eridu
8	UR.GU.[LA]	UGA$^{\text{mušen}}$	nin-mah
9	[...]	AB.SIN$_2$	šullat$_2$$^{\text{⌜al!⌝}}$ u $^{\text{d}}$haniš$_2$

[198] SpTU 3, 103+ may shed light on the meaning of KI.MIN found in BM 78161. Pingree and Walker have interpreted this sign as "or," i.e., offering an alternative to the star name that appears before the KI.MIN sign. But given that in SpTU 3, 103+ the first two stars to appear in the same section are identical, it could be that KI.MIN in BM 78161 was likewise meant to refer to the star that preceded it.

10	ŠU.P[A]	zi-ba-ni-tu_2	$ŠAR_2$.UR_4 $^{d}ŠAR_2$.GAZ
11	[...]	DINGIR.TUŠ.$A^{meš}$	PA.[B]IL.SAG
12	UZ_3	$TI_8^{mušen}$	SUHUR.$MAŠ_2^{ku_6}$

As can be seen, there is significant overlap between the stars in SpTU 3, 103+ and CT 33, 9. Although very few Enlil-stars are preserved in CT 33, 9, those that remain match. The best correlation is found in the Anu-stars, where there are nine matches. Two of the remaining entries (section 2 and section 13) are missing in SpTU 3, 103+ but given the stars that appear in the sections before and after them, one would expect to have the stars from CT 33, 9. The only place where the two texts seem to different is with the 8th Anu-star. SpTU 3, 103+ clearly has MUŠ, while CT 33, 9 has $UGA^{mušen}$.[199]

Only a few Ea-stars are found in SpTU 3, 103+, but those match CT 33, 9 (sections 2, 9, and 10). While the Ea-star in section 12 is not preserved, it is almost certain the star that appears as the star in the path of the moon, namely, SUHUR.$MAŠ_2$, those also matching the 12th Ea-star in CT 33, 9. If so, one would expect the Ea-star in SpTU 3, 103+ to be Pabilsag (which would also be the star in the path of the moon for this section), thus also matching CT 33, 9. The correlation between SpTU 3, 103+ is particularly apparent in the Ea-star in section 2, UDU.IDIM *$ša_2$ ina* $KUN^{meš}$, a star that is otherwise unattested elsewhere.

The distances between *ziqpu*-stars, attested in numerous *ziqpu*-star lists, are roughly 30°, though in some cases it is hard to determine, such as with the Lion, which includes several *ziqpu*-stars. By combining this rule of thumb, along with the stars attested in CT 33, 9, and the order of stars in MUL.APIN, it is possible to reconstruct most of the stars as follows:

Sect.	SN_1 = ziqpu-star	SN_2 = Enlil-star	SN_3 = Anu-star	SN_3 = Ea-star	SN_4 = Star in the Path of the Moon
1	[qu_2-ma-ru $ša_2$ UD.KA.DU]H.A	[qu_2-ma-ru $ša_2$ UD.KA.DU]H.A	SIM.MAH	u ^{mul_2}[GU.LA]	[GU.LA]
2	[kin-ṣa]	[kin-ṣa]	[IKU]	[UDU].IDIM $ša_2$ $KUN^{meš}$ ^{d}[...]	[UDU.IDIM $ša_2$ $KUN^{meš}$ ...][200]
3	[LU.LIM]	[LU.LIM]	[a-nu]-ni-tu_4	[NU.MUŠ.DA]	[a-nu-ni-tu_4]
4	[ŠU.GI]	[ŠU.GI]	MUL_2.MUL_2	[KU_6]	[MUL_2.MUL_2]

[199] Although note the iconography in the aforementioned VAT 7847, where the Raven stands atop of the Snake, not far from the Lion.
[200] This is likely an alternative name for the Tails of the Swallow, $KUN^{meš}$ ^{mul}SIM.MAH, found in MUL.APIN (I iv 36-37) between ^{mul}GU.LA and ^{mul}*a-nu-ni-tu_4*.

5	[GAM$_3$]	⌜GAM$_3$⌝	is le-e	[^{d}u$_2$-ge-e]	[is l]e-e
6	MAŠ.MAŠ	MAŠ.TAB.BA.GAL.GAL	SIPA.ZI.AN.NA	[DAR.LUGAL$^{\text{mušen}}$]	SIPA.ZI.AN.NA
7	ALLA	ALLA	KAK.SI.SA$_2$	[eridu]	ALLA
8	UR.GU.LA	UR.A	MUŠ	[nin-mah]	UR.A
9	e$_4$-ru$_6$	e$_4$-ru$_6$	ABSIN	šullat$_2$ u haniš$_2$	ABSIN
10	ŠU.PA	ŠU.PA	GIŠ.RIN	ŠAR$_2$.UR$_4$ ŠAR$_2$.GAZ	GIŠ.RIN
11	kip-pat	[kip-pat]	[DINGIR.TUŠ.A$^{\text{meš}}$]	[PA.BIL.SAG]	[PA.BIL.SAG]
12	[$^{\text{mul}}$UZ$_3$][201]	[$^{\text{mul}}$UZ$_3$]	TI$^{\text{mušen}}$	[SUHUR.MAŠ$_2$]	SUHUR.MAŠ$_2$

If this restoration is accepted, then sections 1-2 and 11-12 use their Ea-star as their star in the path of the moon. Sections 3-6 and 9-10 use their Anu-star, and sections 7-8 their Enlil-star. It is important to note that the sections do not precisely align to the standard division of twelve months of the schematic calendar or twelve signs of the zodiac, as both the Stars and the Jaws of the Bull appear in two consecutive entries. In the schematic calendar and the zodiac both are assigned to Month II or Taurus respectively.

The question remains what is the purpose of SpTU 3, 103+. The term *pišerša*, "its meaning," is commonly associated with divination. But it is unclear if SpTU 3, 103+ should be understood as some kind of astrological text, as was taken by GKAB, where it is labeled as "Enuma Anu Enlil Varia." It should be noted that the tablet breaks off with the incipit of Enūma Anu Enlil 17, and so it is possible that the tablet was a compilation of several texts or that the compiler of the tablet found it useful to include both texts on the same physical object. SpTU 3, 103+ may represent some kind of astronomical theory on the possibility of eclipse occurrence, based on the culmination of certain stars, and offering alternative stars to the *ziqpu*-stars, which were normally used for culmination.

Sources
A = SpTU 3, 103 (obv. 1'-20')
B = SpTU 3, 102 (obv. 16' - rev. 13')

Transliteration
obv.

[201] If the *ziqpu*-stars listed here are meant to be spaced roughly every 30 UŠ, one would expect here the Single Star, DELE, because it is 30 UŠ away from the Circle in the preceding section. The She-goat, preserved in CT 33, 9 is 40 UŠ from the Circlet.

§0
1’ [...] KUR ^{d}30 AN.⸢MI⸣ x x [...]
2' [...]-i ^{d}30 AN.MI [...]

§1
3’ [... ^{mul_2}UD.KA.DU]H.A a-na ziq-pi GUB$^{⸢meš⸣}$-[zu-ma ...]
4' [... ^{mul_2}UD.KA.DU]H.A ^{mul_2}SIM.MAḪ u ^{mul_2}[...]
5' [... KUR]-⸢ad$_2$⸣ pi-šer$_3$-ša$_2$ AN.MI <ul> ⸢u$_2$$^?$⸣-[šar-ra-a]

§2
6' [... GUB]^{meš}-zu-ma ^{d}30 AN.MI ⸢u$_2$⸣-[šar-ru-u$_2$]
7' [... UDU].IDIM ša$_2$ KUN^{meš} ⸢$^{d?}$⸣[...]
8' [... KUR]-⸢ad$_2$⸣ pi-šer$_3$-ša$_2$ AN.MI ul u$_2$-[šar-ra-a]

§3
9' [... a]-na ziq-pi GUB^{meš}-zu-ma ^{d}30 [...]
10' [... ^{mul_2}a-nu]-ni-tu$_4$ [...]
11' [...] ⸢KUR⸣-ad$_2$ pi-šer$_3$-ša$_2$ AN.MI ul ⸢u$_2$⸣-[šar-ra-a]

§4
12' [... a]-⸢na⸣ ziq-pi GUB^{meš}-zu-ma ^{d}⸢30⸣ [...]
13' [...] MUL$_2$.MUL$_2$ ^{mul_2}[...]
14' [... KUR]-⸢ad$_2$⸣ pi-šer$_3$-ša$_2$ AN.MI ul ⸢u$_2$⸣-[šar-ra-a]

§5
15' [... ziq]-⸢pi⸣ GUB^{meš}-zu-ma ^{d}30 AN.⸢MI⸣ [u$_2$-šar-ru-u$_2$]
16' ⸢x GAM$_3$⸣ [(x)] ^{mul_2}is le-e [...]
A [...] ^{mul_2}is le-e [...]
B 1’ ⸢x GAM$_3$⸣ [(x)] ^{mul_2}is le-e [...]

17' a-di-i ^{d}UTU ^{mul_2}[is] ⸢le⸣-e KUR-ad$_2$ pi-šer$_3$-ša$_2$ AN.[MI ul u$_2$-šar-ra-a]
A [... ^{mul_2}is] ⸢le⸣-e KUR-ad$_2$ pi-šer$_3$-ša$_2$ AN.[MI ...]
B 2’ a-di-i ^{d}UTU ^{mul_2}[...]

§6
18' ki-i ^{mul_2}MAŠ.MAŠ a-na ziq-⸢pi GUB⸣-zu-ma AN.MI ^{d}[30 ...]
A [... ziq]-⸢pi GUB⸣-zu-ma AN.MI ^{d}[30 ...]
B 3’ ki-i ^{mul_2}MAŠ.MAŠ a-na ziq-⸢pi⸣ [...]

19' ^{mul_2}MAŠ.TAB.BA.GAL.GAL ^{mul_2}SIPA.⸢ZI⸣.AN.NA [...]
A [... ^{mul_2}SIPA].⸢ZI⸣.AN.NA [...]

B 4’ ^{mul_2}MAŠ.TAB.BA.GAL.GAL ^{mul_2}SIPA.[ZI.AN.NA ...]

20’ a-di-i ^{d}UTU ^{mul_2}SIPA.ZI.AN.⸢NA KUR$^{?}$⸣ [... KUR-ad$_2$ pi-šer$_3$-ša$_2$ AN.MI ul u$_2$-šar-ra-a]

A [...] ⸢NA$^{?}$ KUR$^{?}$⸣ [...]

B 5’ a-di-i ^{d}UTU ^{mul_2}SIPA.ZI.AN.⸢NA⸣ [...]

§7

21’ ki-i ^{mul_2}ALLA a-na ziq-pi GUB-zu-⸢ma⸣ [^{d}30 AN.MI u$_2$-šar-ru-u$_2$]

22’ ^{mul_2}ALLA ^{mul_2}KAK.SI.SA$_2$ [...]

23’ a-di-i ^{d}UTU ^{mul_2}ALLA KUR-ad$_2$ pi-šer$_3$-ša$_2$ AN.[MI ul u$_2$-šar-ra-a]

§8

24' ki-i ^{mul_2}UR.GU.LA a-na ziq-pi GUB-zu-ma [^{d}30 AN.MI u$_2$-šar-ru-u$_2$]

25' ^{mul_2}UR.A ^{mul_2} ^{d}MUŠ [...]

26' a-di-i ^{d}UTU ^{mul_2}UR.A KUR-ad$_2$ pi-šer$_3$-ša$_2$ AN.MI ⸢ul⸣ [u$_2$-šar-ra-a]

§9

27' ki-i ^{mul_2}e$_4$-ru$_6$ a-na ziq-pi GUB-zu-ma ^{d}30 AN.MI [u$_2$]-⸢šar⸣-ru-⸢u$_2$⸣

28' ^{mul_2}e$_4$-ru$_6$ ^{mul_2}ABSIN ^{d}šullat$_2$(=PA) ⸢u ^{d}⸣haniš$_2$(=LUGAL)

29' a-di-i ^{d}UTU ^{mul_2}ABSIN KUR-ad$_2$ pi-šer$_3$-ša$_2$ AN.MI ul u$_2$-šar-ra-a

§10

30’ ki-i ^{mul_2}ŠU.PA a-na ziq-pi GUB-zu-ma ^{d}30 ⸢AN.MI⸣ u$_2$-šar-ru-u$_2$

31' ^{mul_2}ŠU.PA ^{mul_2}GIŠ.RIN$_2$ ^{d}ŠAR$_2$.UR$_4$ ⸢^{d}⸣ŠAR$_2$.GAZ

32' a-di-i ^{d}UTU ^{mul}GIŠ.RIN$_2$ KUR-ad$_2$ pi-⸢šer$_3$⸣-[ša$_2$ AN].MI ul u$_2$-šar-[ra]-a

§11

33' ki-i ^{mul_2}kip-pat ana ziq-pi GUB-zu-ma ^{d}30 AN.MI u$_2$-⸢šar-ru⸣-u$_2$

rev.

1 [^{mul_2}kip-pat …]

2 [a-di-i ^{d}UTU … KUR-ad$_2$ pi-šer$_3$-ša$_2$ AN.MI ul u$_2$-šar-ra-a]

§12

3 [ki-i ...] a-na ziq-pi ⸢GUB-zu-ma⸣ [^{d}30 AN.MI u$_2$-šar-ru-u$_2$]

4 [... ^{mul_2}SUḪUR.MAŠ$_2$] ^{mul_2}TI$_8$^{mušen} [...]

5 [a-di-i] ^{d}UTU ^{mul_2}SUḪUR.MAŠ$_2$ KUR-ad$_2$ pi-šer$_3$-[ša$_2$ AN.MI ul u$_2$-šar-ra-a]

§13

6 [... EN].NUN^{meš} AN.MI ^{d}30 u$_2$-kal-lim-ka [...]

7 [...] a-na UGU ^{d}[...]

----

8 [... ^{mu}]^{l_2} ^{d}SAG$^{!}$(PA).ME.GAR u$_2$-lu ^{d}dele-bat u$_2$-lu$^{!}$(KU) x [...]
9 [...] ⸢u$_2$⸣-lu ^{d}GENNA a-na ^{d}30 TE-u$_2$ u$_2$ DAB-[u$_2$ …]
10 [...] ziq-pi a-mur ki-i pi-i an-ni A ⸢x⸣ [...]
11 pi-šer$_3$-<ša$_2$> ⸢ul⸣ [...]

----

§14
12 DIŠ ina ^{iti}BAR$_2$ UD 14 KAM$_2$ EN.NUN A[N ...]
13 ⸢MAN MAR.TU⸣^{ki} ⸢MU AN.MI BI⸣ [...]
(remainder broken)

Philological Notes
obv. 5’: the author omitted the expected UL sign, which appears in every other preserved entry.
obv. 18’-19’: at the last entry of source A and throughout source B, the author uses GUB-*zu* as the verb for the first line of each entry, as opposed to GUB^{meš}-*zu* used previously. Additionally, while every other entry has ^{d}30 AN.MI, here the author swapped the order and wrote AN.MI ^{d}[30]. Furthermore, note that the name of the *ziqpu*-star is written MAŠ.MAŠ, “the Twins,” while the Star in the Path of Enlil is explicitly called “the Great Twins,” written MAŠ.TAB.BA.GAL.GAL.
obv. 24’-26’: the name of the *ziqpu*-star in the 1st line of this section is written in the older form, namely UR.GU.LA, where elsewhere in this section it appears as UR.A.

SpTU 5, 269

Transliteration
Rev.
1 u$_4$-um ŠU$_2$-e ziq-pi IGI-ma ina KI mi-ni-i lu-maš
2 ki-i GUB-zu tam-mar UDU.IDIM ša$_2$ i-na <<ina>> ^{d}UTU.ŠU$_2$.A IGI-ru
3 lu-u$_2$ ŠU$_2$-u$_2$ TA UGU ŠU$_2$-bi ša$_2$ ^{d}UTU a-di UGU a-mar ša$_2$ ^{d}UDU.IDIM
4 u$_3$ EN UGU ri-bi-u$_2$ ŠID-ma u$_4$-um x [...] ŠU$_2$-e
5 ina UGU ri-bi-šu$_2$ ziq-pi IGI-ma <ina> KI mi-ni-i ki-i GUB-zu tam-mar

----
--

6 ^{d}ṣal-bat-a-nu EGIR UŠ-tu$_2$ IGI-tu$_2$ NIM-šu$_2$ ½$^{?}$ ITI IGI-šu$_2$
7 ina 2 ITI ana <u$_4$>-me E-a UŠ-tu$_4$ 2-tu$_4$ NIM-šu$_2$ 2 ITI SIG-šu$_2$

8 3 ITI ar_2-ki UŠ-tu_2 IGI-tu_2 ZI-ah-$šu_2$ TUR-ir
===
(text continues)

Translation
Rev. 1-5
(On) the day of setting, you note the culmination and you discover the region of which constellation it stands in. You reckon the planet that, in the west, becomes visible or sets, from the setting of the sun to the appearance of the planet or until its setting, and (on) the day of setting, at its setting, note the culmination and you discover the region which it stands in.

Appendix C: Astronomical and Technical Terms

The following is a brief explanation of astronomical and technical terms used throughout the present study. These definitions are by no means exhaustive and are aimed to assist the reader in understanding these terms in the context of this dissertation.

Acronychal rising. The last day in which a star or a planet rises before being blotted out by the light of the sun on subsequent days. This occurs around opposition. This occurs once a solar year for stars. The period between two acronychal risings for planets varies and depends on the planet.
Apodosis. In divinatory literature, an apodosis forms the second clause of an omen, which provides the prediction, based on the condition listed in the protasis.
Celestial equator. An abstract extension of the Earth's equator into space. Due to the rotation of the Earth, celestial objects appear to travel in the sky parallel to the celestial equator. Its point of intersection with the ecliptic defines the vernal and autumnal equinoxes. The celestial equator also serves as the plane of zero-value for declination. Right ascension is measured eastward along the celestial equator from the vernal equinox.
Celestial latitude. The angular distance of a celestial object north or south of the ecliptic. Can be used as an ecliptic-based coordinate system together with the celestial longitude.
Celestial longitude. The angular distance of a celestial object eastward along the ecliptic from the point of the vernal equinox. Can be used as an ecliptic-based coordinate system together with the celestial latitude.
Conjunction. The moment when a planet or a star is located directly behind the sun in relation to Earth. Because the sun would be located between Earth and that celestial object, it would be rendered invisible for an observer on the ground. Note that conjunction also refers to a celestial object being located between the sun and Earth. For example, new moon is the conjunction of the sun and the moon.
Culmination. The moment when a celestial object reaches its highest point in the sky during its daily journey. By definition, this occurs when the object crosses the meridian.
Declination. The angular distance of a celestial object north or south of the celestial equator. Can be used as an equatorial-based coordinate system together with right ascension.
Ecliptic. A great circle that describes the annual path of the sun across the sky. It is at an oblique angle to the celestial equator, due to the angle between the rotation of the

Earth and its orbit around the sun. The equinoxes are the points on the celestial sphere where the ecliptic intersects with the celestial equator. The ecliptic serves as the plane of zero-value for celestial latitude, and celestial longitude is measured eastward along it from the vernal equinox.

Ephemerides. In the context of Babylonian astronomy, the ephemerides are texts that tabulate numerical values related to the sun, moon, and planets, such as the dates of synodic phenomena or zodiacal positions. These are often referred to as mathematical astronomical texts or ACT (named after the publication of the majority of them), among other names.

Equinoctial minute. The length of time measured by a minute on the day of the vernal or autumnal equinox, used in modern time reckoning. This is in opposition to seasonal minutes, in which the length of time units (hours, minutes, second) varies depending on the length of daytime. This is a factor of the sun's position along the ecliptic, correlating to seasons.

Equinox. The two points on the celestial sphere where the celestial equator and the ecliptic intersect. The vernal (or spring) equinox is located where the sun moves from negative to positive celestial latitude. The autumnal equinox is located where the sun moves from positive to negative celestial latitude. The vernal equinox also serves as the zero-point for right ascension (based on the celestial equator) and celestial longitude (based on the ecliptic). Thus, the sun's right ascension and celestial longitude at the vernal equinox is 0° and at the autumnal equinox 180°. This can also refer to the days of the solar year when the sun passes through these points, in which day and night are of equal length.

First visibility. For stars and outer planets, this is similar to heliacal rising. Since the inner planets appear on the eastern and western horizon—with an intervening period of invisibility—their first visibility on both horizons is differentiated.

Greek-letter phenomena. See synodic phenomena.

Heliacal rising. The first time a star becomes visible over the course of a year, owing to the westward motion of the sun against the backdrop of the stars. This phenomenon takes place over the eastern horizon. Note that planets heliacally rise, but due to their motion, behave somewhat differently (particularly the inner planets). Sometimes referred to as first visibility.

Heliacal setting. The last time a star is visible over the course of a year, after which it is located too close to the sun, and is therefore blotted out by the sun's light. This phenomenon takes place over the western horizon. Note that planets heliacally set, but due to their motion, behave somewhat differently (particularly the inner planets). Sometimes referred to as last visibility.

Meridian. Unless otherwise noted, the present study uses the term meridian to refer to the upper meridian, the arc that passes through the zenith (i.e. above the observer) and reaches the northernmost and southernmost points on the horizon plane. The

lower meridian is the arc that passes through the nadir and reaches the northernmost and southernmost points on the horizon plane.
Nadir. The point on the celestial sphere directly below the observer, i.e., directly opposite the zenith.
Nychthemeron. A period of twenty four hours, encompassing both daytime and nighttime.
Opposition. The moment when a planet or a star is located opposite the sun, with the earth standing directly between them. For the outer planets, this occurs in the midpoint between first and second station.
Protasis. In divinatory literature, protasis forms the first clause of an omen that lists the condition to be watched for, conceptually in the form of an "if" statement. The apodosis forms the second clause.
Right ascension. The angular distance of a celestial object measured eastward from the point of the vernal equinox. Can be used as an equatorial-based coordinate system together with declination.
Solstice. The two points on the celestial sphere where the sun would be at its maximal and minimal declination. The point of maximum declination is called the summer solstice and the point of minimum declination is called the winter solstice. The day of the solar year in which the sun is located at the summer solstice would result in the longest daytime and shortest nighttime. The sun's right ascension and celestial longitude at this point is 90°. Conversely, the sun located at the winter solstice produces the shortest daytime and longest nighttime. The sun's right ascension and celestial longitude at this point is 270°. Solstice, then, may also refer to the time of year when the sun is located at these points.
Station. Planets appear to move against the backdrop of the stars in two ways. Direct motion is when a planet appears to travel eastwards. Retrograde is when a planet travels westwards. Between these two motions, a planet appears to stop changing its position against the backdrop of the stars. These are called stations. First station is when a planet stops moving in direct motion and changes to retrograde motion. Conversely, second station is when a planet ceases to move in retrograde and resumes direct motion.
Synodic phenomena. The cyclical behavior of the moon, the planets, or the stars in relation to the sun produces a number of recurring phenomena. For the outer planets (Mars, Jupiter, and Saturn), these are heliacal rising, first station, opposition, second station, and heliacal setting. For the inner planets (Mercury and Venus), these are evening rising, evening/first station, evening setting, morning rising, morning/second station, and morning setting. For the stars, these are heliacal rising, cosmic setting, acronychal rising, and heliacal setting. The synodic phenomena of the moon are not discussed in the present study.
Zenith. The point on the celestial sphere directly above the observer.