GREEK 'CULTURAL TRANSLATION' OF CHALDEAN LEARNING

by

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Abstract

The investigation into the relationship between Greek and Babylonian systems of learning has overwhelmingly focused on determining the elements that the former borrowed from the latter, while the fundamental questions relating to the process of transmission of these elements are still largely ignored. This thesis, therefore, offers a preliminary theoretical framework within which the movement of ideas should be analysed. The framework is based on the understanding that all ideas from one culture, when they are to enter another thought and belief system, must be 'translated' into the concepts and terminology prevalent in their new context. An approach is developed which exploits the concept of 'cultural translation' as put forward within various modern disciplines. The thesis examines how the 'translatability' of the material from the perspective of the receiving culture influences its inclusion into the new 'home repertoire' and determines the changes it undergoes as part of this process. A number of case studies in astronomy, astrology and mathematics are presented to help explain what parts of 'Chaldean knowledge' were utilised by Greek and Hellenistic scholars, how these were interpreted according to the existing Greek intellectual network into which the new material was inserted and how it was influenced by the 'cultural grid', a construct reflecting patterns of expectation about a foreign culture.

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Abbreviations

A	Tablets in collection of the Oriental Institute, University of Chicago
ABC	Grayson 1975, *Assyrian and Babylonian Chronicles*
ABL	Harper 1892-1914, *Assyrian and Babylonian Letters*
ACT	Neugebauer 1955, *Astronomical Cuneiform Texts*
ADD	Johns 1898-1923, *Assyrian Deeds and Documents*
AHES	*Achive for History of Exact Sciences*
AMT	Thompson 1923 , *Assyrian Medical Texts*
ANET	Pritchard 1969, *Ancient Near Eastern Texts Relating to the Old Testament*
AO	Tablets from the Antiquités Orientales collection, Musée du Louvre
BaMB	Bagdader Mitteilungen Beiheft
BH	Rochberg 1998, *Babylonian Horoscopes*
BM	British Museum
BMisc	Weissbach 1903, *Babylonische Miscellen*
BNJ	*Brill's New Jacoby*
BNP	*Brill's New Pauly*
BOR	*Babylonian and Oriental Record*
BRM	Clay 1923, *Babylonian Records in the Library of J. Pierpont Morgan*
BT	Brockman Tablets
CAD	*The Assyrian Dictionary of the Oriental Institute of the University of Chicago*
CAH	*The Cambridge Ancient History*
CCAG	Cumont et al. 1898-1953, *Catalogus Codicum Astrologorum Graecorum*
CCDS	Van Berg 1972, *Corpus Cultus Deae Syria*
CT	*Cuneiform Texts from Babylonian Tablets in the British Museum*

CTMMA	Spar & Lambert 2005, *Cuneiform Texts in the Metropolitan Museum of Art*
CTN	Cuneiform Texts from Nimrud (series)
DCCMT	Digital Corpus of Cuneiform Mathematical Texts, http://oracc.museum.upenn.edu/dccmt
DK	Diels & Kranz 1951-2, *Die Fragmente der Vorsokratiker*
DSB	*The Dictionary of Scientific Biography*
EA	Tablets from El-Amarna
EANS	Keyser & Irby-Massie 2008, *Encylopedia of Ancient Natural Scientists*
Ee	*Enuma eliš*
ETCSL	Electronic Text Corpus of Sumerian Literature, http://etcsl.orinst.ox.ac.uk/
FGrH	Jacoby 1923-58, *Die Fragmente der griechischen Historiker*
GEP	Gerber 1999a, *Greek Elegiac Poetry*
GIP	Gerber 1999b, *Greek Iambic Poetry*
GP	Gow & Page 1968, *Greek Anthology*
HS	Tablets from the Hilprecht Collection, Friedrich Schiller University Jena
HSM	Tablets in the collection of the Harvard Semitic Museum
IG	Inscriptiones Graeca (series)
IM	Tablets in the collection of Iraq Museum, Baghdad
JE	Journal d'Entrée of Cairo Museum
JHA	*Journal for the History of Astronomy*
K	Tablets in the Kuyunjik collection, British Museum
KAR	Ebeling 1919, *Keilschrifttexte aus Assur religiösen Inhalts*
KAV	Schroeder 1970, *Keilschrifttexte aus Assur: Verschiedenen Inhalts*
Ki.	Tablets excavated at Kish, in the collection of the Ashmolean Museum, Oxford
LBAT	Pinches et al. 1955, *Late Babylonian Astronomical and Related Texts*
LKA	Ebeling 1953, *Literarische Keilschrifttexte aus Assur*

L-R	Llewellyn-Jones & Robson 2010, *Ctesias*
LSJ	Liddell & Scott 1925, *A Greek-English Lexicon*
MAH	Tablets in the collections of Musée d'Art et d'Historie, Geneva
MCT	Neugebauer & Sachs 1945, *Mathematical Cuneiform Texts*
MLC	Tablets in the Morgan Library Collection, Yale University
MM	Tablets in the collections of the Abbey of Montserrat, Barcelona
MMA	Tablets in the collections of Metropolitan Museum of Art, New York
MPD	Melammu Project Database, http://www.aakkl.helsinki.fi/melammu/home/homeres.php
M-W	Merkelbach & West 1990, *Fragmenta Hesiodea*
NBC	Tablets in the Nies Babylonian Collection, Yale University
NCBT	Tablets in the Newell Collection of Babylonian Tablets, Yale University
ND	Tablets excavated at Nimrud, now in the Iraq Museum, Baghdad
NL	Saggs 1952, *The Nimrud Letters*
OMM	Ostraca of Medinet Madi
PDM	Betz 1986, *The Greek Magical Papyri in Translation*
PNAE	*Prosopography of the Neo-Assyrian Empire*
RA	*Revue d'assyriologie et d'archéologie orientale*
RE	Pauly & Wissowa 1893-1980, *Realencyclopädie der classischen Altertumswissenschaft*
RINAP	The Royal Inscriptions of the Neo-Assyrian Period (series)
RLA	*Reallexikon der Assyriologie und Vorderasiatischen Archäologie*
Rm	Rassam tablets, British Museum
SAA	State Archives of Assyria (series)
SEG	*Supplementum Epigraphicum Graecum*
SH	Lloyd-Jones & Parsons 1983, *Supplementum Hellenisticum*

Sm	Smith tablets, British Museum
SpTU	*Spätbabylonische Texte aus Uruk*
StAT	Studien zu den Assur-Texten (series)
SVF	Von Arnim 1903-5, *Stoicorum Veterum Fragmenta*
TCL	Textes cunéiformes, Musée du Louvre
TCS	Texts from Cuneiform Sources (series)
TMS	Bruins & Rutten 1961, *Textes Mathématiques de Suse*
TrGF	Snell 1971, *Tragicorum Graecorum Fragmenta*
U	Tablets excavated from Ur
UCBC	University of California Babylonian Collection
UM	Tablets in University Museum, University of Pennsylvania
VAB	*Vorerasiatische Bibliothek*
VAT	Tablets in the collections of Vorderasiatisches Museum, Berlin
W	Tablets excavated from Warka
WB	Tablets in the Weld-Blundell Collection, Ashmolean Museum, Oxford
YBC	Tablets in the Yale Babylonian Collection, Yale University
YOS	Yale Oriental Series, Babylonian Texts (series)
ZA	*Zeitschrift für Assyriologie und Vorderasiatische Archäologie*

Abbreviations not in the list are derived either from the L'Année Philologique Abbreviations Key (periodicals) or LSJ List of Abbreviations (classical authors and works).

Introduction

The relationship between Greece and Babylon, and the cultural transfer between them, especially insofar as it concerns their respective traditions of learning, have always received a significant amount of attention from the academic community.[1] This attention, however, has centred on rather specific aspects[2] and on establishing the extent of the Greek debt to older Mesopotamian traditions. As Lloyd notes,

> The issue of the debts of Greek science to Egypt and Babylonia has been, since antiquity an emotive topic; all too often it has been argued, by ancient and modern writers alike, either that the Greeks owed everything, or that they owed nothing, to Eastern wisdom, while fundamental questions relating to the processes of transmission, and to the interpretation of what was transmitted, have been ignored.[3]

That Lloyd's observation did not lead to general reconfiguration of the relevant fields of study is evident from Raaflaub's similar statement, made over two decades later, that:

> we should now focus on the question of how the Greeks integrated and adapted outside impulses and in what ways and why the result of this process of adaption and transformation differed from initial impulses.[4]

A study of these processes is, therefore, long overdue. This thesis does not purport to offer a full-scale treatment of this complex and many-faceted problem, but it proposes a theoretical framework within which to analyse the processes that all goods, material and intangible alike, undergo when

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[1] See e.g. Lloyd 1991: 281-2 for a short summary of the history of the 'long drawn-out' Greek originality/derivation debate, which in his view has amounted to 'often arid, prejudiced and scholarly posturing'.

[2] E.g. Burkert 1992 (crafts, magic, medicine, literature); West 1971 (philosophy); Walcot 1966, Mondi 1990, Penglase 1994, S.P. Morris 1997b, West 1997, Abusch 2001 (poetry and myth); S.P. Morris 1992 and 1997a (art), Raaflaub 2000a & b (political thought), Noegel 2002 (oneiromancy), Scurlock 2004 & 2008 (medicine), Friberg 2007 (mathematics); and most recently Haubolt 2013 (literature).

[3] Lloyd 1979: 226.

[4] Raaflaub 2000a: 61. Although there is an increasing recognition among modern scholars that intellectual history cannot be written without also writing about the culture in which this material is/was embedded and although some serious attempts to consider scientific traditions in their cultural contexts have been published in recent years (e.g. Robson 2008), treatments of the transmission of more intellectually demanding ideas have neglected this aspect. E.g. Friberg 2007, on the overlap of Greek and Mesopotamian mathematics, fails to give any kind of cultural background for either tradition.

they are transferred from one culture to another,[5] and introduces a number of case studies to uncover the subtleties of this practice. As exact sciences are well suited to establish cultural borrowings[6] they will serve here as examples for other systems of knowledge when transmitted from 'Chaldea'[7] to Greece. Underlying this choice is the belief that the way we approach science and its history is implicated in, and formed by, the intellectual culture of our society.[8] Support for this basic tenet is provided by the so-called Edinburgh 'strong programme'[9] of the *sociology of scientific knowledge* (part of *Wissenssoziologie*[10]), which suggests that a sociological approach can explain the

[5] Culture is defined here, following d'Ambrosio (2000: 83), as 'a pool of common knowledge which keeps a group of individuals together and operational.' Knowledge, in turn, is defined from the sociologist perspective: it is whatever people take to be knowledge, it is made up of all those beliefs that they hold to and live by, especially those taken for granted, institutionalised or invested with authority. But whereas beliefs occur at the individual level, knowledge is something endorsed collectively (Bloor 1991: 5).

[6] Ross 2008: 245.

[7] In short, 'Chaldea', which is interchangeable with Babylonia in Greek, comes from the collective name of the tribes inhabiting the areas of southern Mesopotamia near the Persian Gulf (see n. 455 below for the tribes, and n. 1111 for Chaldeans taking over the Babylonian identity). From Herodotus onwards the term is applied with special vigour to Babylonian scholar-priests and is also often used to denote 'astrologers' (see ch. 3.1). In the context of the present study it refers to the cuneiform tradition, which was not limited to Babylon and the surrounding areas. Hence, frequent mention and use is also made of words Babylonia, Mesopotamia and Assyria.

[8] To quote Bloor (1991: 16): '... the knowledge of our culture, as it is represented in our science, is not knowledge of reality that any individual can experience or learn about for himself. It is what our best attested theories, and our most informed thoughts tell us is the case, despite what the appearances may say. It is a story woven out of the hints and glimpses that we believe our experiments offer us. Knowledge then, is better equated with Culture than Experience.' Philosophically this is a complex topic that has generated vigorous debate over the past decades: for a good overview of the key issues see Bunge's (1991 & 1992) criticism of the modern sociology of knowledge, and Slezak's (1994) support for Bunge; earlier criticisms include Meynell 1977 and Freudenthal 1979. The opposing, now outdated, stance stems from the realist belief that there is a body of self-subsistent truth that can somehow be apprehended ever better, that some scientific beliefs do not require causal explanation (i.e. that they just are correct), that successful and conventional intellectual activity is self-explanatory and self-propelling. Hence, it is only lapses in judgement – errors, limitations, and deviations from what we consider right, true or rational (as opposed to wrong, false, irrational) – that evoke sociological or philosophical causes worth exploring (Bloor 1991: 8-9 & 86). However, in Beaulieu's (2010: 1) words, 'intellectual history is not a linear evolution of discoveries and 'firsts' in the great march of humankind towards enlightenment.' A good refutation of the view of science as a process of accretion which stands apart from the wider cultural setting and an 'arbitrary element' (i.e. personal and historical accident) can be found in Kuhn 1962: 1-4, 7, 66, 94-6, 137-41. For a short and accessible discussion on the relativity of 'scientific rationality' see Hesse 1973: 133-5 & 142-3.

[9] E.g. Barnes 1974 & 1977, Bloor 1991, Barnes, Bloor & Henry 1996; for good overviews of the development of the field and the explanatory accounts deployable within it see Woolgar 1981 or Shapin 1995.

[10] A term coined by Mannheim (1936). The paradigm that science is a social institution was laid down by Merton (1973 for a collection of his essays, including the seminal 1938 article 'Science and the Social Order') and Evans-Prichard. Sociology of science as a discipline gained more mainstream popularity from the 1960s onwards, led to the establishment of journals like *Social Studies of Science* (1970) and *Sociology of the Sciences Yearbook* (1977). See Bunge 1991 & 1992, who although offering harsh criticism and characterising the field as

content and nature of scientific knowledge, that 'all knowledge, whether it be in the empirical sciences or even in mathematics, should be treated, through and through, as material for investigation' and that variations in styles, meanings, associations and standards of cogency can and should be explained by social causes.[11] Scientific traditions do not differ significantly in this respect from other sets of beliefs, resulting as they do from experiences of scientists, their psychological thought processes (including conscious and unconscious motivations), habits, patterns of behaviour and institutional standards.[12] As all these things have an effect on the construction of knowledge, they also affect the transmission of ideas between different traditions.

The creation of a suitable theoretical approach is, therefore, underpinned by an assumption that social realities heavily influence not just cultural but also scientific discourse. This is especially relevant to the importation of knowledge from other cultures, a process which involves a large set of complex relationships and networks of commitment. The realisation that such commitments exist is well appreciated by historians, and quite often forms a significant part of the study of intercultural relationships; these studies, nevertheless, are rarely programmatic enough.

However, building on work in modern cultural theory, social anthropology and linguistics (especially Translation Studies), comparative literature, sociology and semiotics, a new method can be created, one that will be applicable to historiographical research and will help to reveal the relationships between the conditions of knowledge production in one culture and the way this knowledge is relocated and reinterpreted in a different cultural setting. This is one which, in the context of this thesis, allows us to determine which cultural and intellectual conditions favoured the adoption of 'Chaldean knowledge' into Greek thought and belief systems during different periods, as well as the possible means for knowledge transfer and the dynamics of cultural acquisition (i.e. the diffusion of information in a new environment). The resulting framework uses linguistic translation as a tool or

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'a grotesque cartoon of scientific research' (525), gives a good overview of its seven core tenets.

[11] Bloor 1991: 3 & 84-130, specifically on mathematics. The relations between a scientific discourse and nondiscursive (e.g. political, economic) factors are also recognised within Foucault's archaeological approach but he was reluctant to see science as straighforwardly determined by social causes (see Gutting 1989: 256-60 for what little Foucault has to say about these things). Bloor's approach has also been picked up by Barton (1994b) in her study of ancient astrology, medicine and physiognomics.

[12] Bloor 1991: 155. This is not to say that no objective scientific truth exists at all. Relevant here is Hesse's (1973: 130) observation that the relationship between so-called 'external' and 'internal' factors is not clear-cut. But as d'Ambrosio (2000: 83) notes: 'The mere fact that to pursue historical analyses one talks about the sciences as distinct from religion, art, and politics, impedes our understanding of the processes of the evolution of ideas and methods which underlie our stuggle to find explanations…'.

metaphor to analyse the processes and transformations that occur. This is based on an understanding that translation does not simply work at the level of languages and linguistics but also in a broader sense incorporates the communication of ideas and knowledge between different traditions, which are rendered comprehensible to recipients by situating them amidst their own familiar intellectual and cultural concepts.

The first chapter, therefore, presents the outlines of this methodological framework, analysing the key terms of 'source text', 'target text', and 'home repertoire'. Its most important objective, however, is to introduce the concept of the 'cultural grid'[13] – a construct that reflects patterns of expectations that have been interiorised by the members of a given culture. In other words, it is all those things that constitute a specific 'culture' in the imagination of another. The particular elements of this grid, its creation, and the effect it had on the Greek discourse on 'Chaldean' society and science will form the focus of the second chapter, which is designed to uncover the sources of Greek knowledge about the Near East, to determine how each contributed to the Greek understanding of Mesopotamian history and culture, and to establish what kinds of issues were projected onto the 'Chaldeans', and what were the most prominent elements of the 'Chaldean mirage', i.e. the themes and questions about Mesopotamian culture that were important to the contemporary man and so most often arise in the surviving literature.

This allows us to reconstruct the intellectual network into which any information about Mesopotamia would have been inserted and to identify the extra-textual constraints that would have conditioned the assimilation of new material. It takes as its starting point the belief that many of the stories we find in the earliest extant accounts must stem - some more, some less – from oral traditions of the archaic and early classical periods, and that these traditions inevitably influenced the choice and presentation of the Mesopotamian history and culture in individual authors like Herodotus and Ctesias. The underlying assumption that new knowledge is heavily dependent on the existing one and, when it comes to cross-cultural exchange of ideas, is influenced by the prevalent assumptions and feelings towards the donor culture, also helps to explain the unusually wide timeframe of the thesis – as it is necessary to go back quite some time to establish the discourse on Mesopotamia in the Greco-Roman world, material is included from all periods of Greek history

[13] Modelled on the idea of 'textual grid' (see e.g. Bassnett & Lefevere 1998: 5, Bassnett 2007: 19).

between Hesiod and Ptolemy.[14] Moreover, the theory-centred nature of the work facilitates the inclusion of a variety of case-studies from different eras.

In order to illustrate the role of the 'cultural grid' in the interpretation of a foreign culture and its specific expressions, four of its most prevalent individual *topoi* or *Erzählmotive* are analysed in greater detail. The *topoi,* some of which persist in the popular imagination to this day, include the Babylonian bride-market and temple prostitution, its legendary rulers, the Hanging Gardens of Babylon, and, most important for the rest of the thesis, the antiquity of knowledge and the emergence of science in Babylonia. In the explanation of the first three, particular emphasis is placed on the question of 'expectations' in order to elucidate the amalgamation of Near Eastern tales and elements into figures like Ninus or Semiramis, or the image of the Hanging Gardens. This will serve as a comparison point to see if the 'expectations' we observe also apply to less literary material. The last section introduces the question of whether 'Oriental wisdom' was just a standard claim routinely applied to Mesopotamia in order to enhance the credibility of what are often viewed as characteristically Hellenistic subjects like personal astrology and geocentric astronomy. The problem emerges from the fact that although the Greeks themselves fully acknowledged, in Burkert's words 'almost too eagerly, that Greek astronomy was based on the accomplishments of the East',[15] there are discernible differences between the alleged 'source text' and its supposed 'target'. These differences, however, can be easily explained as a natural product of the 'cultural translation' process.

The last three chapters, therefore, present case studies of practical translation of Chaldean learning in the fields of astronomy, astrology[16] and mathematics. First of all, they question what characterised

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[14] Due to the nature of the surviving evidence the Mesopotamian material covers just over 2000 years. See Appendix 1 for the periods of Mesopotamian history and the abbreviations used to note them in the text.

[15] Burkert 1972: 299. See e.g. p. 248 for concrete examples.

[16] The inclusion of astrology under sciences is based on its role as such within both Mesopotamian and Greek traditions and uninfluenced by its relegation to a 'pseudo-science' in modern discourse. Western science is no longer the standard against which all other sciences are judged, which had resulted in a series of negative assessments and dictated what does or does not merit attention. For a general introduction to the historiography of science see Kragh 1989, although she does not discuss specific historiographical theories. For these see e.g. Gutting's overview (1989: 12-54) of Bachelard and Canguilhem and their influence on Foucault; Agassi (1981: 55-70) or Bunge (1991: 537-44) for the internalist/externalist debate on causal influences in the history of science; and Agassi (1981: 28-32) for a short survey of inductivist and conventionalist schools. More important for the topic of this thesis, Barton (1994b: 8-17) examines the place of astrology in the historiography of science and Rochberg (1999: 559-61) considers the latter's effects on the reception of Babylonian scholarly lore. For the question of evaluation in the modern historiography of science see Hesse 1973 (esp. 144). According to her, problems with the evaluation of scientific knowledge (its 'truth' and

Greek science and philosophy and thus (a) what changed when certain foreign ideas and methods were incorporated into the body of Hellenistic learning and (b) how these ideas and methods were changed to fit the existing Greek mentality and repertoire. The three subjects are all approached, following from the views just expounded, as 'bodies of knowledge that have been created in a particular context, with specific motivations, and that have been and are subject to insufficiencies and criticism as well as changes resulting from exposure to other cultures.'[17] The analysis tries to take into account as much as possible the great plurality of ideas and traditions in these contemporary societies. However, the large (though seldom sufficient) amount of source material and a very wide time-scale inevitably mean that the treatment of more scientific aspects will remain necessarily superficial at times. It is simply beyond the scope of this thesis to go into considerable detail; more often than not I have had to limit myself to a series of small-scale case studies.

Moreover, each chapter has a slightly different focus. The chapter on astronomy is used to examine long-term processes in the interaction between two intellectual traditions; the chapter on astrology offers the best example for the influence of the 'cultural grid' on this kind of material; and the chapter on mathematics, on the contrary, provides an opportunity to see what happens if the knowledge from a certain field has no place in this 'grid'. The chapters on astrology and mathematics also investigate 'secondary translations', that is the further reconfigurations applied to the borrowed material that are necessary to make it an integral part of the 'home repertoire'. In addition, Chapter 5 provides an overview of issues surrounding the translation of ancient practices into modern mathematical language. This serves many aims: as well as providing an excellent example of how 'cultural translation' works, how the use of 'home repertoire' is essential as an interpretative medium, and how the 'cultural grid' conditions the interpretation of Greek and Mesopotamian scientific texts, it also points out the drawbacks of using modern scholarly jargon to explain this material. Whereas this understanding now permeates work on ancient mathematics, the same cannot be said for astronomy. The complexity of representation has rendered both fields so narrow and inaccessible that specialists (e.g. on mathematical astronomy) can be counted in single digits and

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'rationality') only became recognised around the 1970s. Nevertheless, the 'science' v. 'pseudo-science' debate is still largely ongoing within Assyriology, perhaps helped on by the wish to improve the reputation of Babylonia and Assyria, which to this day still suffer somewhat from a millennia-long vilification as the realms of magic and superstition (see Swerdlow 1998 for an example of a work preoccupied with arguing for the 'scientificity' of Babylonian astronomy). The terms of 'science' and 'scientific' are used here only in their usual descriptive sense, referring to the processes which exemplify a certain set of principles or procedural rules and develop in accord with their established teachings (a definition derived from Bloor 1991: 9 & 159).

[17] D'Ambrosio 2000: 79.

anyone trying to make sense of astronomical or mathematical material is left with a daunting task, to say the least. Consequently, I have tried to place focus on the cultural and social factors in the dynamics of the generation and transfer of such knowledge from Mesopotamia to Greece, rather than on the details and peculiarities of the mathematical and astronomical doctrines and methods, although the study of the latter still forms a considerable part in some arguments. Nor have I managed to avoid the use of modern algebraic notation altogether. A conscious effort has been made, however, to keep the problems and solutions as simple, and as close to the originals, as possible.[18]

The division of the material into three distinct chapters also requires explanation. It is done with full recognition of the fact that the borders between disciplines and genres differ from our own and that modern conceptual or analytical categories do not necessarily apply to other societies.[19] Although it must be noted that a variety of textual forms existed within Mesopotamian and Greco-Roman traditions that can be described as 'astronomical' or 'astrological' in the modern sense, the distinctions do not mean that any such classification existed in the minds of the creators of these texts, nor do they carry any dichotomous implication of different modes of thinking.[20] Especially in the Mesopotamian context they were both an integral part of an integrated system of thought that formed an extension to the local religion.[21] So, the separation of this inherently unitary material into different chapters is arbitrary, made with the aim of breaking a vast amount of source material down into more manageable parts, thus making the analysis more convenient and potentially more productive.[22] Moreover, it will be shown that the boundaries between the respective Mesopotamian and Greek traditions were similarly fluid, so applying modern notions to these fields does not privilege one over the other. Due consideration is paid throughout this study to the ways in which

[18] The thesis includes a glossary that explains the technical terms and symbols used in the text; in addition, one particularly on astrological terms can be found in Neugebauer & van Hoesen 1959: 2-13.

[19] E.g. the interaction between science and religion, or magic and philosophy, function in most past and present societies quite differently from the dichotomic relationship they have in the modern Western world. Even the understanding of 'nature' is culture dependent; consider for example what consititutes a 'natural' v. 'unnatural' cause (a god? magic? bacteria? etc.); or the related question of what counts under 'physical factors' in medicine (see Lloyd 1979: 49-57).

[20] Rochberg 1988c: 328 and 2004: x, xiii & 12. I.e. mathematical astronomy v. more divinatory genres does not equal astronomy/science/sophisticated/true v. divination/religion/naive/false. Note that Ptolemy too, although not believing in the scientific/unscientific divide, still wrote the material into two separate books.

[21] Parpola 1993b: 47-56.

[22] It is also partly conditioned by the fact that modern research has taken, although from this perspective mistakenly, separate ways in its study of these areas.

disciplinary and institutional boundaries may have been conceived and how they matter within the process of cultural exchange.

There is a decision to be made in every study between concentrating on minute structures and looking at the general outlines. I have adopted a stance that detailed studies of very specific questions and narrow fields, though extremely necessary, can only take us so far.[23] Occasionally a more general or more theoretical synthesis is needed to provide additional perspectives and to summarise new discoveries and approaches. And although our limited knowledge of the topics to be covered leaves considerable scope for error, I hope that the adopted approach can provide more insight into our intellectual history than has been hitherto achieved within the traditional research frameworks. It does not profess to uncover historical laws (if those exist) but could hopefully contribute towards unearthing certain trends or tendencies, especially what regards the preconditions that make cultural transmission possible, the limits and the exact modalities of 'cultural translation'.

[23] See Volk 2009: 9 for the 'certain pitfalls and aporias that come with the detailed tracing of literary lineage' and reasons for concentrating on the larger development of ideas and thinking about the world.

Chapter 1: The Theory of Cultural Translation

1.1 Introduction

Anyone who has ever attempted a translation between any two languages knows that it is never a straightforward matter of linguistic equivalence.[24] Although the so-called *verbum de verbo*, word-for-word, translation was utilised in the past by some Roman authors,[25] the low value of the resulting text was soon evident[26] and the Romans, with a little help from Livius Andronicus (3rd cent. BC; a Greek by birth and education) quickly turned to a *sensus de sensu* approach.[27] Whereas modern translation theory gives precedence to content and literal fidelity over style, syntax and rhetoric, in the newly founded Latin translational poetry this was not the case.**[28]** Roman authors, rendering into Latin the famous Greek poems, aimed at providing the reader with an *experience* comparable to reading the original texts.[29] Hence priority was given to aesthetic qualities - fluency and elegance of expression – only achievable by taking into account the linguistic and stylistic resources of the receiving language, and the literary values embodied in the dominant poetics, tastes and expectations of the new audience.[30] With an emphasis on rhetoric, poetic 'translation' quickly

[24] See Kelly 1979: 42 for different types of interlingual translation.

[25] *Verbum de verbo* translation was exactly what it says: 'the replacement of each individual word of the source text with its closest grammatical equivalent in Latin' (Munday 2001: 19). In Brock's (1979: 70) opinion, it had its origin in biblical translation practice, most notably in the translation of the Septuagint, although the Roman approach differs from the way it is used there.

[26] For a critique of literal translation see Persius, *Satire* 1.4 (on Labeo's translation of the *Iliad*), or Terence, *Eun.* prologue 7-8, whose main grievance is the betrayal of the aesthetic quality of the source text. The first comprehensive comments on translation processes come from Cicero's (106-43 BC) *praefatio* to his translation of Aeschines and Demosthenes, and from the *De Finibus*. Although Cicero is sometimes considered the founder of Western translation theory (e.g. in Beall 1997: 215), Possanza (2004: 62) finds that his discussion of translation, as well as those of Quintilian and Pliny the Younger, was lagging far behind actual practice and so the term 'translation theory' is an overstatement.

[27] Possanza 2004: 46-56. Also see Leo 1913: 47-75 for Livius Andronicus and Van der Louw 2007: 28 for the philosophical justification for the literal approach. This does not mean, however, that only the two opposed approaches were used. Laws and decrees, for instance, were translated as literally as possible to exclude the chance of any misinterpretation. As a general rule, the more literary the genre the looser the translation. Van der Louw 2007: 37 provides a good discussion on different modes of Latin translation.

[28] For an overview of poetic translation practice see e.g. Possanza 2004: 29-45.

[29] Possanza 2004: 54.

[30] Possanza 2004: 32, 63. This was not least due to Greek and Roman love for oratory and rhetoric. Cicero definitely saw such translation method as a tool to improve students' stylistic abilities, emphasising that he did not translate *ut interpres* but *ut orator*, and in so doing 'I did not hold it necessary to render word for word, but I preserved the general style and force of the language. For I did not think I ought to count them out to the reader like coins, but to pay them by weight, as it were' (*Opt. Gen.* 14; a point repeated in *Fin.* 3.15 and in *Acad.* 1.10).

developed into a competition between the Greek original and the student's rendering of it, resulting in a concept of linguistic translation that was much broader than it is today.[31]

Thus a conscious choice was made between subjective and original v. objective and reproductive translation. Innovative assimilation to the native discourse was preferred over conservative preservation of foreign elements; the texts were treated not as isolated linguistic artefacts but instead as 'living organisms', dynamic entities capable of interacting both with their past[32] and with their new environments.[33] What emerged was a rewriting based on a core equivalence in form, structure and content but something that moved significantly beyond the source text 'in ways which develop latent potential for elaboration in its new linguistic and cultural setting.'[34] All this resulted in the creation of a so-called 'second original', a text with a distinctively Latin character. [35]

The process through which this happened is complicated: despite being a controlled programme of alteration we can observe no set of rules governing the adaptation. Even within the same poetic tradition the exact mode of 'translation' varies, ranging from relatively literal rendition to clever substitutions to serious rewording, including more or less substantial additions, deletions and structural reorganisation. Translators of Aratus' *Phaenomena,* for instance, produced very different Latin versions of the same source text.[36] All these authors were engaged in constant interpretation and decision-making to create meaning in a new language and within a new cultural context.

These observations on the Roman poetic tradition can serve as a template for a more general inquiry into 'translation' as a wider phenomenon. As we have finally moved on from the centuries-old assumption that translation merely takes place between languages,[37] the term itself is no longer used only in its narrow traditional meaning (i.e. a communication from one language to another without

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[31] Van der Louw 2007: 35.

[32] The translation process is incorporative, in Possanza's (2004: 58-9) words: 'texts other than the source text, i.e. both literary texts and critical and exegetical commentary, may be used as sources for material to be included in the translation. In this way various strands of the literary tradition are woven into the fabric of the translation.' In other words, the reception is written into the translation.

[33] Possanza 2004: 2, 47 & 54.

[34] Possanza 2004: 38-9.

[35] Possanza 2004: 6, 37, 57-8 & 105-168 (on the example of Aratus' *Phaenomena*).

[36] Four translations are known, including those of Cicero and Germanicus. For a discussion on the extent to which these can be seen as 'translation', whether between languages, cultures or genre, rather than updates, see Taub 2010.

[37] Snell-Hornby 1988: 39.

changing the meaning of the communicated text) but also constantly appears in a more incorporative sense to denote the interaction of cultures, the transfer of cultural practice, the concern with cultural boundaries, the articulation of liminal experience, and intercultural understanding.[38] The etymological meaning of 'translation' (from Latin *translatio*) - 'transfer to another', 'carrying across' – fully comprehends this broader idea of translation as an inherent part of cultural transfer. As Tymoczko and Gentzler have pointed out, a form of translation is implicit in processes of cultural transformation and change.[39] Contemporary cultural theory, therefore, inquires how information from or about a different cultural setting is relocated and reinterpreted according to the conditions by which knowledge is produced in the receiving culture.[40] Linguistic translation is used merely as a tool or metaphor in analysing the transformation that takes place as a result.

1.2 The Concept of Cultural Translation and Historical Studies

From a historiographical perspective, the idea of translation as a wider cultural phenomenon has been recognised before: Lloyd, for instance, mentions in the introduction to his study of the origins and development of Greek science that

> to translate the concepts of any given society into those of any other is to interpret them, and – so it has been argued – in so doing inevitably to distort them.[41]

But his observation is only applied to the translation into the modern language and thought system and is made in reference to the possibility of objective understanding within the unavoidably distorting enterprise of historical research. Moreover, it remains just a passing allusion. For studies that employ the concept of culture as a translatable entity and the question of translatability of its specific features, though still not in great detail, we must turn to Assmann (1996)[42] and Smith (2008), in the context of Semitic religion. One of Assmann's main concerns is the Babylonian tradition of

[38] Rüdiger & Gross 2009: ix.

[39] Tymoczko & Gentzler 2002: xxviii.

[40] Carbonell 1996: 80.

[41] Lloyd 1979: 1.

[42] Assmann (1996: 34-6) distinguishes between three types of cultural translation in the ancient world: (1) syncretistic translation (which presupposes the fundamental unity beyond all cultural diversities); (2) assimilatory or competitive translation (e.g. the interpretatio Graeca in Herodotus); and (3) mutual translation (the earliest type of cultural translation, which seems to apply to Babylonian material (above) and develops within networks of international law and commerce).

'theological onomasiology'[43] and he argues that when involving gods from fundamentally different religious traditions (e.g. Akkadian and Hurrian) the *interpretatio* often needed a theological solution, becoming transcultural - as opposed to only translingual, when it concerned gods from similar cultures (e.g. Sumerian and Akkadian).[44] Assmann's theory was elaborated by Smith,[45] who in addition to examining in much more detail the deities in the cross-cultural discourse in the 'biblical world' by reviewing how the language and categories for translation of divinity in one culture were borrowed and used by another, also approached his study as a translation of ancient culture into the western world, a mediation between antiquity and the present. However, Smith used a purely descriptive approach, choosing not to adopt any 'modern theory (or meta-theory) for analysing expression of cross-cultural translatability in the texts,' with the view that these might 'run the risk of displacing and obscuring the theoretical operations underlying the ancient texts.'[46] So, the idea of 'cultural translation' is not yet a theory that can be applied, only a descriptive term to label an aspect of cross-cultural transfer.

However, the advances made in various fields that study the phenomena of 'cultural translation' allow us to combine a theoretical approach with one that offers analytical tools that might not hinder but aid the research. The greatest contribution to the 'theory' in its own right comes perhaps from Translation Studies, which appeared as a distinct discipline in the late 1970s and developed through the 1980s, employing methodologies that drew upon research in linguistics and comparative

[43] I.e. compilation of god-lists that equated local gods with foreign deities: in the private archives of Ugarit are found quadrilingual vocabularies containing Sumerian, Akkadian, Hurrian and Ugaritic names of fundamentally the same gods. This demonstrates the Babylonian belief that foreign peoples worshipped the same gods, only under different names. Assmann (1996: 26-8) argues that this practice arose in the context of foreign policy during the general emergence of a common world in the 3rd and 2nd millennium BC, which extended from Egypt to the Near and Middle East, and westward to the shores of the Atlantic, integrating networks of commercial, political and cultural communication.

[44] Assmann 1996: 25-6. However, he has also argued (1991: 29-31) that the second degree of counter distinctive pseudo-speciation - a term coined by Erik H. Erikson to describe the formation of artificial subgroups within the same biological species that in the human world denotes the effect of cultural differentiation that occurs in minority situations (e.g. Jews or Egypt after the Macedonian conquest) - usually defies translatability and in the Egyptian case, even took the form of belief in the untranslatability of the language itself. This idea is expressed e.g. in Iamblichus *De mysteriis* 2.4-5. The notion of untranslatability seems to apply mainly to divine names and was based on the *sympatheia* between the name and the deity. E.g. the opening chapter of *Corpus Hermeticum* 16 contrasts the Egyptian sounds, full of energy, with the empty speech of the Greeks and warns the reader to 'preserve the discourse untranslated'. Nevertheless, quite a few Hellenistic texts present themselves as translations from Egyptian.

[45] Although Smith (2008: 7, 10) argues against Assmann's theory of untranslatability of monarchic Israel.

[46] Smith 2008: 11.

literature.[47] The study of translation as a cross-cultural event was first advanced in this field by Hönig and Kussmaul (1982), Reiss and Vermeer (1984) and Holz-Mänttäri (1984)[48] and the discipline took an overall cultural turn in the 1990s.[49] However, Carbonell Cortes has pointed out that even as much as twenty years later we really

> …do not have as yet a comprehensive theory that explains how cultural translation works. One reason for this lack may be that it is so difficult to assess how translation makes sense of different categories. Translation is a privileged space, a vantage point where linguistic and social systems meet, mingle or clash, which is why it has recently received so much attention from cultural theory. But because it is extremely hard to conflate linguistic and social approaches, attempts to do so have, more often than not, remained frustratingly superficial. Without a discursive 'micrological' dimension, cultural translation theory can go only so far; yet without the broad 'macrological' dimension of cultural contact, institutionalization, hybridization and other such concepts, textual approaches remain limited and are regarded with suspicion or simply ignored by most cultural theorists.[50]

It is beyond the scope and aim of this thesis to fill this vacuum entirely. However, observations made by those who have studied the theory and practice of cross-cultural translation and intercultural understanding will be organised into a framework that will not only serve as a heuristic tool to ask specific socio-cultural questions but also allow us to analyse the modes of incorporating Babylonian learning and religious knowledge into the Greek system. The methods of translation history, when closely allied with literary history, can be used not only to describe changes in literary trends and account for the regeneration of a culture, but, more important in the view of this thesis, to trace changes in politics and ideology, and to explain the expansion and transfer of thought and knowledge in one particular area.[51] Notions of alienation and domestication will be useful to highlight the adoptions that these 'texts' underwent and to reveal the extent to which the process of total alienation in terms of language and vocabulary has corresponded to a gradual domestication of

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[47] Bassnett 2007: 13.

[48] Snell-Hornby 1988: 43.

[49] Bassnett (2007: 15-6) has noted that this turn was paralleled in other disciplines across humanities in general, e.g. literary studies, history and classics (e.g. emergence of reception studies), that took place in the late 1980s and early 1990s.

[50] Carbonell Cortes 2006: 47.

[51] Long 2007: 63.

Babylonian learning and religious concepts. This will then aim to answer questions of the 'cultural interference' Chaldean learning underwent as it was absorbed and domesticated by the Greeks and of the aspects of religious and scientific teaching that have been lost or modified as a result of this process of 'translation'.

1.3 Research Framework of Cultural Translation

1.3.1 Dynamics of Knowledge Acquisition and Diffusion

Any investigation into translation-led cultural change must start with a look at the process of transfer, both in terms of access to, and dissemination of, new knowledge. As we still lack a history-based comprehensive study on how cultural transfer works, Cavalli-Sforza and Feldman's quantitative theory will be used here to evaluate basic probabilities for the success of transmission through various agents in certain socio-political conditions.[52] The success rate is based on a number of factors. First of all, a different degree of interaction between the agents is required for the transmission of varying ideas/skills.[53] The beginning of writing in Egypt around 3200 BC was, for example, the result of the importation *only of the idea* of writing, not of the language or the script itself. Similarly, the adoption of foreign artistic motifs requires no direct communication between the parties.[54] But the same cannot be said about the transfer of complex technical skills, literary, religious and scientific borrowings; all require either oral or written communication in a shared language. It is these complex intellectual ideas that form the focal point of this study. For a successful transfer of such material one would expect to see what has been termed a teacher-student style of communication, either in oral or written form. The latter does not assume a face to face interaction but does presuppose an access to at least partially comprehensible texts: take for example the Pahlavi and Arabic translations of Greek astrological treatises.[55] Alternatively, in some cases access to raw data (e.g. observation data), might not be accompanied by an extended explanation, resulting in an interesting new use in the

[52] Cavalli-Sforza & Feldman 1981.

[53] Lloyd 1979: 226 n.1.

[54] Familiarity with an artefact displaying the motif in question is sufficient. But the most basic cultural migration model is that of 'osmosis', i.e. basically the movement of information from neighbour to neighbour. However, this sets limits to the speed, and often also the accuracy, of transfer.

[55] Dorotheus of Sidon's *Pentateuch* was translated into Pahlavi in the 3rd cent. AD and the revision of this translation served as a basis for al-Tabari's Arabic version; Vettius Valens' *Anthologia* was also translated into Pahlavi (Pingree 1997: 46-8).

receiving culture.

Moreover, 'the degree of communication between all pairs of individuals chosen at random from a population is hardly the same.'[56] The level of interaction is not only determined by the participants' language skills (or the presence of an interpreter); factors like education play a similarly important role.[57] Their significance becomes even greater when it comes to the diffusion of the new knowledge into what Even-Zohar has termed the 'home repertoire' (below). The efficiency with which imported material or intangible goods are integrated into a local culture is heavily dependent on how and by whom they are introduced. In the absence of mass communication hierarchies play an important part in the dissemination of information. The speed and success of knowledge transfer is often determined by the social standing of the agent. The teacher/leader type of transmission has the chance of being the quickest and the most effective, whereas information filtering to a society through non-élite classes is usually much slower.[58] Moreover, the boundaries between social classes can set limits to information movement.[59] Raaflaub, for instance, has speculated that in Archaic Greek society the fairly low social status of traders might have limited their cultural influence.[60]

As to 'how' the transfer happens, cultural transmission is a two-stage process, consisting of awareness (through a signal – teaching or observation) and of acceptance (learning). Hence, cultural selection, both by the agent itself and the receiving audience, is inherently inscribed in the transmission process. This selection is based on the factors like the desirability of the innovations and the authority and prestige of the source culture.[61] Even-Zohar suggests that the historical situation would determine the quantity and type of translations that are undertaken and that the status of those translations would be greater or lesser according to the perceived prestige of the donor culture.[62] In his opinion a transfer can be considered a success when 'it is not only the goods themselves which become domesticated, but rather the *need* for those goods.'[63] However, let us first

[56] Cavalli-Sforza & Feldman 1981: 177.

[57] See Cavalli-Sforza & Feldman 1981: 177 for levels of interaction.

[58] Cavalli-Sforza & Feldman 1981: 204, 356-7.

[59] Cavalli-Sforza & Feldman 1981: 57-8.

[60] Raaflaub 2004a: 198. It will be argued below in ch. 2.2.1 that élite mercenaries make more likely agents.

[61] Cavalli-Sforza & Feldman 1981: 62, 163.

[62] Bassnett 2007: 17. See the 'antiquity of civilisation and written records' argument used for Egyptian and Babylonian cultures below in ch. 2.3.4.

[63] Even-Zohar 1997: 359, 362. In many cases the import occurs to fill certain functions absent in the target

look at the processes through which awareness itself occurs.

1.3.2 Creation of Meaning

D'Ambrosio offers a concise introduction to the general theory of knowledge production:

> We see knowledge as emanating from the people, essentially a product of their drive to explain, understand and cope with their immediate environment and with reality in general. This drive is subjected to a process of exposure to other members of society, and, thanks to communication, both immediate and remote in time and space, goes through the process of codification, intertwined with an associated underlying logic, inherent to the people as a form of knowledge that some call wisdom. The modes of communication and the underlying logic are recognized as the result of the prevailing cognitive processes. Cognitive evolution, related to environmental specificity, gives rise to different modes of thought and different underlying logic, communication and codification. Hence knowledge is structured and formalized according to culture.'[64]

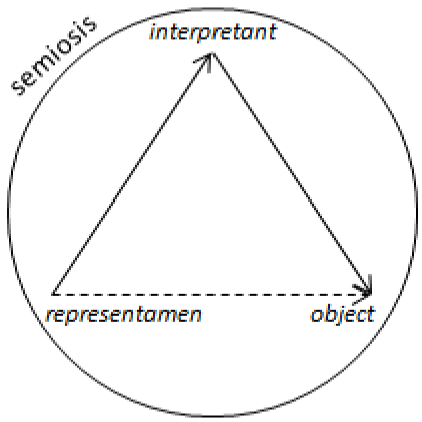

Figure 1: Semiotic process

How meaning is created by the cognitive processes can be explained by the theory of semiotics. Peirce, one of its founding fathers, argued that a sign consists of three interrelated elements, which stand in a triangular relationship: (1) the sign in the narrow sense (*representamen* or sign vehicle) which represents something else; (2) that which the sign stands for or is represented by it (object or referent): and (3) the (possible or potential) meaning that the sign allows for, in reference to a sort of idea which Peirce called the ground of the *representamen* (*interpretant*).

The *interpretant* can also be viewed as the mediator between the sign vehicle and the object it stands for. For example, if the *representamen* is the word 'tree', it takes a person who understands

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culture.

[64] D'Ambrosio 2000: 84.

English, i.e. is aware what the word 'tree' means, to establish the image of a tall plant with a wooden stem and many branches in his/her mind. Although Saussure claims that there is an arbitrary relationship between the word 'tree' and the natural object it signifies, in the process of semiosis this relationship alone cannot function as a sign (in its broader meaning) without an interpreter. Hence the line between the *representamen* and the *object* is dotted on the diagram.

However, as a sign is functionally and positionally characterised only by the fact that it represents something for someone, there are no limits to what may serve as a sign.[65] In Peirce's own words:

> Sign in general [is] a class which includes pictures, symptoms, words, sentences, books, libraries, signals, orders of command, microscopes, legislative representatives, musical concertos, performances of these.[66]

Hence we can expand the notion of a sign to almost anything and use the same analytical tools on a macro level. This approach has been recently used by Manuela Foiera in her study of the adoption of Soka Gakkai religion from Japan into Italy. Her thesis is underpinned by an assumption that the whole religion with all its doctrines can be approached as 'a text' whose vocabulary, symbols and ritual practices need to be deciphered and translated when transferred to another country. The Soka Gakkai in the Japanese context is approached as a 'Source Text', the same religion in the Italian context as a 'Target Text'.[67] The same can be applied with certain reservations to our material. Thus, Babylonian astronomical/astrological/mathematical knowledge is 'translated' into its target in Greek culture and through this act a new significance is created. Yet, in the case studies to follow it is not the entire (modern) fields themselves that will be approached as 'Source' and 'Target' texts but rather the individual or sets of motifs within these areas. The key argument here is, however, that the concepts like these are applicable to our material in a way that allows for the tools of semiotics and translation theory to be used for its analysis.

1.3.3 Primary Cultural Translation Against an Existing Scientific Grid

As the semiotic principle states, the words and expressions in any language and culture have meaning

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[65] For a more comprehensive explanation see Johansen & Larsen 2002: 114.

[66] Peirce, manuscript no. 634, 1909: 18.

[67] Foiera 2007: 11.

only in terms of the ideas, values, and circumstances of concrete human lives.[68] Hence, all agents are inevitably bound to their own culture and this, despite some long-standing beliefs of the contrary, applies equally to those active in the scientific disciplines like astronomy or mathematics. As the translation between cultures consists of human interaction, it is necessary to identify the textual and extra-textual constraints, or manipulatory processes, active upon the translator or mediator. A distinction can be made between purely 'field' based beliefs and other networks of commitment.

On a more general level, Bachmann-Medick has pointed out that 'one of the major problems for translation in cultural anthropology is the way the languages and, even more importantly, the ways of thinking of other cultures – especially those outside Europe – have to be 'translated' into the languages, the categories and the conceptual world of the Western audience… the problem is that the translation of other cultures may be further distorted by describing indigenous conceptualizations within a Western conceptual system.'[69] It is worth remembering here that no 'aims and preoccupations of any one field in one culture will be identical with those in any other' and although broad comparisons can be made, the wider intellectual and social space that these fill in any given culture must be written into the analysis.[70] Each field comes with its own problems[71] – what would and would not be transmitted varies within them, especially as the extent to which the transmission must be mediated *through language* differs.

The extended set of semiotic triangles (fig. 2) schematises the relationships and dependencies between the agents and factors of cultural translation. It underlines how the relationship between the 'source text' and the 'target text' is not dyadic but is in fact conditioned by the translator. So it is illusory to suppose that any change in Babylonian ideas, including what we describe as its 'science', in Greece was due to some form of 'distortion' with no explanation other than failure to understand or interpret correctly. Rather, the target version results from an act of acculturation by the interpreter, who is conditioned by his prior knowledge of the topic and the conceptual boxes supplied by his own professional education. In terms of 'science' it is generally the ruling paradigm that defines research

[68] Nida & Reyburn 1981: 1.

[69] Bachmann-Medick 2006: 35. Lefevere (1999) takes it a step forward, arguing that the process, by which Western cultures have constructed non-Western ones by translating them into Western categories, naturally distorts and falsifies. Also see Bassnett 2007: 20; and n. 41 above.

[70] Lloyd 1991: 278.

[71] See Lloyd 1991 for a short consideration of technology, religion and mythology, mathematics and astronomy, and medicine.

problems and methods as well as rules and standards against which any imported knowledge will be measured and which determines what can and cannot be incorporated into the scientific field in question.[72]

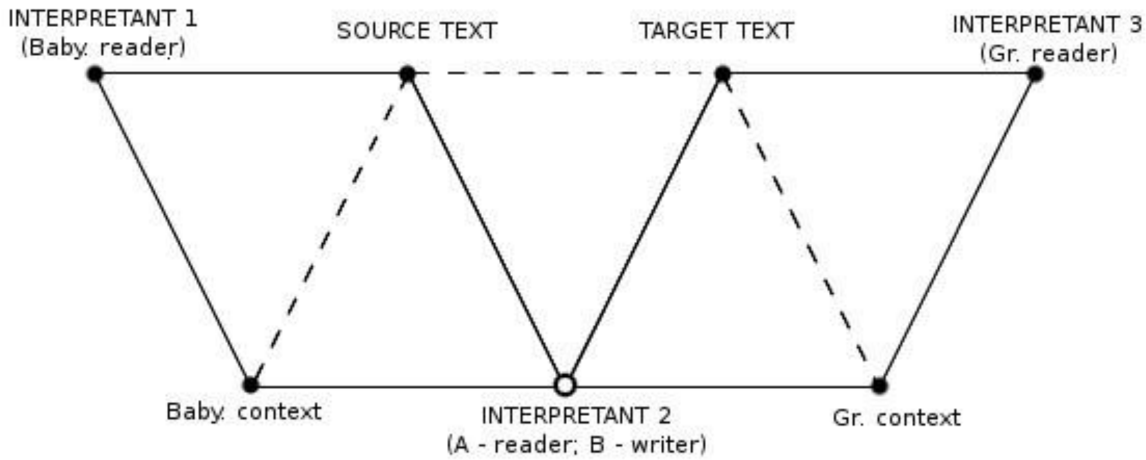

Figure 2: Extended diagram of semiotic process as applied to the translation of Babylonian knowledge to a Greek context

Texts relating pieces of astrological and other knowledge are received in a context that Even-Zohar calls a 'Culture (or Home) Repertoire', defined as the aggregate of options utilised by a group of people, the size of which can vary from 'society' to 'family' and which by definition are all cultural entities, and by the individual members of the group, for the organisation of life.[73] The major procedures in making of the repertoire are invention and import. However, Even-Zohar argues that these two are not opposed procedures: inventing can be carried out via import.[74] The term 'transfer' denotes in this context the state of integrated importation of foreign goods into a 'Home Repertoire', the process by which this happens and the consequences generated by the integration.[75]

[72] See Kuhn 1962.

[73] Even-Zohar 1997: 355-6.

[74] Even-Zohar 1997: 358. 'Even in cases of seemingly conspicuous 'originality', i.e. inventivness which cannot be traced back to a simple source, import may be present. In short, import has always played a much more crucial role in the making of repertoire, and hence in the organisation of the groups, and the interaction between them, than is normally admitted. There is a permanent, quiet, as it were, flow of import at any moment in the history of groups.'

[75] Even-Zohar 1997: 358-9.

The initial translator clearly imports, although perhaps supplementing the material in a way that may look like an invention. Subsequent writers, or indeed anyone working on the material (Interpretant 3+ on fig. 2), make a new sense of the system, each time reproducing for their own context the received data, although the gap between the new 'Target texts' will be substantially narrower than that between the 'Source text' and its first 'Translation'. The secondary 'translations' are driven more to supplementation and restructuring of the original material. Yet, as the next section will demonstrate, the continuing cultural translation is governed by the same set of 'rules' as the initial translation; it is not a random act of 'distortion'.

1.3.4 Onward Development Conditioned by the Cultural and Intellectual *Koinē*

The otherwise quite simple semiotic model is further complicated by the extraneous forces the *interpretants* are subjected to. It is not just the field-based problems like paradigms and terminology that have their effect on a 'text' and the history of an imported motif or an idea does not stop after its first introduction. The body of Chaldean knowledge and its place within Greek culture, which itself does not stay constant, continues to move. And this movement is conditioned as much by the changes of scientific paradigms as it is by the more general approach to Chaldea and its learning as a topos in the Greek 'cultural grid'. 'Cultural grids' are constructs that reflect patterns of expectations (e.g. about 'Chaldea') that have been interiorised by the members of a given culture, essentially a framework of assumptions, standards, purposes and meanings which are shared with other members of the society.[76]

An important work, making use of and showing parallels with some notions developed within this line of thought, is Edward Said's celebrated *Orientalism* (1978), which states that 'every writer on the Orient (and this is true even of Homer) assumes some Oriental precedent, some previous knowledge about the Orient, to which he refers and on which he relies.'[77] This forms the basis of Said's underlying principle that the 'Orient', whether that of the Greeks or the post-Enlightenment central Europe's, is essentially a cultural construct, and even more importantly, that 'no one writing, thinking,

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[76] They exist in all cultures in ways that pre-exist the language (Bassnett 2007: 19). Compare Bloor's (1991: 31) observation that 'experience always impinges on a state of prior belief. It is a cause which brings about an alteration of that state of belief. The resulting state will always arise by compounding the fresh influence with the old state of affairs. That means that experience may bring about change but does not uniquely determine the state of belief,' which is especially relevant for the discussion in ch. 2.

[77] Said 2003: 20.

or acting on the Orient could do so without taking account of the limitations on thought and action imposed by Orientalism… This is not to say that Orientalism unilaterally determines what can be said about the Orient, but that it is the whole network of interests inevitably brought to bear on (and therefore always involved in) any occasion when that peculiar entity 'the Orient' is in question.'[78] This 'Orient' is thus an archive of information, held together by a set of structures (ideas and values) that govern the community life. In Said's words, 'these ideas explained the behaviour of Orientals; they supplied Orientals with a mentality, a genealogy, an atmosphere; most important, they allowed Europeans to deal with and even to see Orientals as a phenomenon possessing regular characteristics.'[79] This natural mental operation of domestication, which includes constricted vocabulary, silences and elisions and disfigurements, and helps to control and decode the (potentially hostile) subject matter, results in a reduced model of the 'Other', one that is suitable for the culture that created it and allows for systematic approach. However, the limited vocabulary, imagery and rhetoric that this reduced model entails is best characterised by the metaphor of an imaginary museum without walls or that of a stage.[80] What emerges is a set repertoire – typical encapsulations, representative figures (*tropes* or *topoi*), a set of references, and congeries of characteristics – some of which become almost obligatory for any author participating in the discourse in question.[81] Although some minor aspects change we will observe that the 'Orient' has always been a place of romance and exotic beings, made and re-made by 'our' need for self-affirmation and self-determination, our most recurring image of the 'Other', but as such also the place on which the repressed desires are projected at large.[82]

The translation practice can therefore be viewed as one of the strategies a culture devises for dealing with 'the Other'.[83] This relationship has been examined, among others, by Carbonell-Cortes who finds that 'the history of exoticising and anti-exoticising translations is inscribed in a long dialectic of power and domination. A complex picture of cultural representation and misrepresentation comes to the

[78] Said 2003: 3.

[79] Said 2003: 41-2.

[80] Said 2003: 63, 166 & 177.

[81] Analysed in ch. 2, also see Grosrichard 1998 for the inventory of the 'Oriental' repertoire during the Enlightenment period.

[82] Said 2003: xiv & 1-5.

[83] Lefevere 1999.

surface in every case, challenging traditional ideas about translation.'[84] Venuti adds to this the acknowledgement that 'since all translation is fundamentally domestication and is really initiated in the domestic culture, there is, therefore, a fundamental ethnocentric impulse in all translation'.[85] As shown, in order to deal with the exotic, translations have to fit into the target culture's image of the source culture. However, in doing that they further strengthen the target culture's already distorted and manipulated perception of the source culture.[86] Kramsch has further noted that every culture has self-created or self-perpetuating myths about themselves that override any evidence to the contrary; as the 'Other' is always perceived through the perception of oneself, the distortion of the self-image results in the even more distorted image of the antithesis of oneself.[87] The intercultural dialogue thus doubles the myth-creating potential.[88] The strength and longevity of the myths one culture invents of another is demonstrated for example by Parker's observation about mistakes in the Roman perception of India not allowing themselves to be corrected despite the availability of accurate information, and similar comments by Said regarding the 'European Orient'.[89]

Hence, translation of cultures is deeply inscribed within the politics, the strategies of power and the mythology of stereotyping and representation of other cultures.[90] Niranjana, for example, sees translation as 'a collusive activity that participates in the fixing of colonised cultures into a mould fashioned by the superior power.'[91] It is thus closely intermeshed with power relations, and hence in most cases with relationships of cultural inequality.[92] When taken to extremes, the activity of translation as such can be seen as an aggressive act.[93] Indeed, Said has proved with considerable force that the relationship between the Orient and the Occident that constructed it is very much one

[84] Carbonell Cortes 2006: 47.

[85] Venuti 1995: 47.

[86] Katan 1999: 223.

[87] Kramsch 1993: 208. E.g. Said's (2003: 1-2) view that the Orient has helped to define Europe (or the West) 'as its contrasting image, idea, personality, experience.'

[88] Katan 1999: 223.

[89] Parker 2008, Said 2003.

[90] Carbonell 1996: 80.

[91] Niranjana 1992, Bassnett 2007: 19.

[92] Bachmann-Medick 2006: 35.

[93] E.g. Niranjana 1992, Cheyfitz 1991 (these works have been written in the 1990s with an opposing colonialist agenda), Bassnett 2007: 19.

of power and dominion.[94] But it must be noted here that when Greek discourse was formed the situation was very different from the one in the colonial Europe. Nevertheless, there was still a wholly developed picture of what it was like (to a Greek) for things to be Babylonian. In short, any new import from the Near East would be conditioned against a form of Orientalism, adding to the orientalising repertoire. The further development of all things termed Chaldean was equally dependent on this emerged picture.

According to Said's theory, the reality of the 'Other' becomes secondary. However, it is far from certain that the origins of all of the elements in the Greek 'Chaldean repertoire' can be ascribed to the practice of self-reflection. I would rather suggest that almost none of the 'Chaldea' that emerges in the following pages is purely fictitious, in the sense of a set of ideas with no corresponding reality. Unlike Said, who is happy to omit any correspondences between Orientalism and the Orient from his study of the post-Enlightenment period,[95] I am more interested in how, and not just why, certain images came to represent specific 'Others', the relationship between the 'reality' of the source culture (as much as such a thing can be reconstructed from the surviving material to any degree of objectivity and truthfulness) and its reflection in the distorting mirror of Greek imagination.

1.4 Conclusion

To quickly summarise, material drawn from Translation Studies, Semiotics and other academic fields allows us to construct a research framework that helps explain the ways in which knowledge of Babylonian history and society, and more particularly of its learning, were transmitted to, and used in, a Greek context. Underlying this framework is the fact that the relationships involved in the creation of meaning, as analysed by semiotics, are valid for anything from a simple singular sign to entire scientific and cultural fields. This allows for the application of the same analytical tools irrespective of the quantitative nature of the 'sign' or 'text' in question. The way these are understood, however, is dictated by the conceptual system of the interpreter. Hence, this framework also takes into consideration the transfer agents, their social standing, previous experiences and pre-conceived expectations that influence the transfer success rate and determine the form the transferred 'text' takes. The opposite would, of course, be quite impossible from the point of view of

[94] Said 2003: 5.

[95] This choice is explained in Said 2003: 5.

knowledge acquisition theory, which postulates that all new knowledge must always be based on the learner's individual and cultural history.[96]

Of relevance to the latter is their dependence on the 'cultural grid', i.e. a pre-existing pattern of assumptions of what the 'source culture' and its elements are like and stand for. This has the potential to make any 'translation' a politically motivated act. Although this might be an extreme view, the implications it carries must be borne in mind. The 'cultural grid' determines the *topoi* associated with a nation or locality in question, reducing the entire living, constantly evolving and thus essentially boundless culture to a subjective simplified model. These models, although subject to some change, tend to be persistent and often irresponsive in the face of more accurate information. The extent to which this observation applies to Babylonia will be discussed in the next chapter.

[96] D'Ambrosio 2000: 82. For practical examples see Verran 2000, who has studied how Western mathematics is taught to aboriginal and African children through their own indigenous systems (e.g. by the juxtaposition of the Western decimal number system and the Yoruba vigesimal system).

Chapter 2: Chaldea and the Near East as Greek Cultural Concepts

2.1 Introduction

Like Said's 'Orient', the *Sphaera Barbarica* of the Greeks, of which Chaldea forms an important part, is, generally speaking, an idea, albeit an idea with its own history, imagery and vocabulary. As the way in which early Greek historians chose to depict the foreign lands and the peoples inhabiting them inevitably influenced their audiences' perception of these places and cultures, and came to exert a strong influence on subsequent authors, it is similarly evident that the choice and presentation of their own subject-matter was to a large extent grounded on, and constrained by, their audiences' experiences, demands and expectations, i.e. the 'cultural grid'.[97] Herodotus, the author of the first extant, although incomplete study of Mesopotamia,[98] may have been writing primarily about events long past, but his work was deeply rooted in his 5th cent. BC context - a context in the light of which he almost inevitably misinterpreted earlier customs and ideas[99] and which, therefore, bears considerable importance for how the *Histories* can be analysed and interpreted.[100] Herodotus, and later authors like Ctesias and Berossus, may have been innovative in their own right but they cannot be viewed in isolation from their predecessors, the availability of their source material, and the limits of their or their audiences' historical perspective.

In order to analyse Herodotus' Babylonian *logoi*, or any other relevant text, from the perspective of cultural translation, one must first make an attempt to understand the intellectual matrix in which those works were embedded. As was argued in the previous chapter, any translation of a culture is deeply inscribed within the home culture's politics, the strategies of power and the mythology of stereotyping and representation of other cultures.[101] Thomas has noted that 'the reliability of Herodotus' information is often initially judged by nineteenth- or twentieth-century standards of what he should have seen, and described, if he had visited a certain site.'[102] The problem with 'reliability' becomes even more crucial with Ctesias. So, in order to give a more balanced analysis of the various Babylonian *logoi,* this chapter first aims to determine the textual and extra-textual

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[97] Rood 2006: 292, 296.

[98] Lack of promised Assyrian *logoi:* Hdt. 1.106, 184.

[99] McNeal 1988: 55.

[100] Thomas 2000: 8.

[101] Carbonell 1996: 80.

[102] Thomas 2000: 8.

constraints, or manipulatory processes, that were exercising their influence upon various authors as the translators or mediators between Greek and the 'barbarian' cultures.

Hence, this chapter first seeks to discover the sources of Greeks' knowledge of the Near East (especially Assyria and Babylonia), and ascertain how each contributed to their understanding of its history and culture. It also pays some attention to the emergence of Greek literary tradition and genres. Having established the background against which the first depictions of Babylonia must be analysed, it will examine a selection of elements from this set repertoire of 'Chaldea', utilised from Herodotus down to the Roman era and sometimes to modernity. This will demonstrate the practical functioning of the 'cultural grid', and that not only in Antiquity but also within the present-day scholarly tradition. It also pays attention to the establishment of these grids by examining the relationship between the (Greek) 'myths' and (Babylonian) 'reality'.

2.2 Intellectual Context and Extra-Textual Constraints

2.2.1 Sources of Oral Traditions during the Archaic Period

Drews has convincingly argued that although 'Greeks were interested in the major personalities and events of the contemporary East already during the archaic period, this interest remained, for the time being, confined to oral tradition because the stories and incidental facts remembered about the 'more pedestrian recent past... would not have qualified for literary treatment.'[103] But with the development of Greek literary genres and the dawn of *historie*, things other than myths and legends became incorporated into the textual canon; oral accounts, often enhanced and distorted by generations of storytellers, sometimes to an extent that they had acquired the characteristics of legends - e.g. Gyges' magic ring, Croesus' escape from the pyre - came to be written down. Early evidence suggests that among such oral traditions were stories about Assyria and Babylonia, with whom Greeks had contacts far beyond the common recognition among many modern scholars.[104] Although the earliest Greek literary evidence for Babylon - Alcaeus' poem in honour of his brother's

[103] Drews 1973: 4-19.

[104] E.g. Kuhrt 1982: 541: 'Little more than than a suggestive exotic glow surrounded the names [of Assyrian and Babylonian greatest cities and their founder]; systematic exploration and investigation of such distant places was of little relevance by the middle of the 6th century.' Hall (1989: 93) believes the same to apply to early 5th cent. BC: 'Only three and half lines are however devoted to the whole of the eastern empire (*Pers.* 52-5), which probably indicates that Aeschylus knew little about it except the name of Babylon itself.'

return from the service of the Babylonian king at the end of the 7th cent. BC[105] - reflects, when taken alone, little more than basic knowledge of the kingdom's existence and some contact with it, the (possibly) earliest mention of Nineveh, which Aristotle attributes to Hesiod,[106] allows for slightly more significant conclusions. The passage in question refers to the siege of Nineveh and of an 'eagle that presided over the auguries as in the act of drinking.' One can deduce from this reference that Greeks were not merely aware of the sad end of the magnificent metropolis but did, in fact, know it, or the traditions associated with it, in considerable detail.[107] Hence, Herodotus' unwritten story on the manner in which Nineveh was taken[108] could, quite possibly, have been based on a genuine Greek tradition.

The archaic period was, to use Hall's expression, 'an age of continually widening horizons.'[109] The cosmopolitan and bilingual atmosphere of Asia Minor is especially well represented by Hipponax (6th cent. BC), who used a number of foreign words in his poetry;[110] but numerous mentions of exotic

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[105] Alcaeus F 350 & 48 Campell.

[106] Arist. *Hist. Anim.* 8.18 (601b) = Hesiod F 364 M-W. The reference is pseudo-Hesiodic as Hesiod could not have written about the events of 612 BC. Some scholars have tried to shift the attribution to different authors altogether. Rawlinson's (1885: 35) suggestion that Aristotle accidentally wrote Hesiod instead of Herodotus cannot be correct since Olson (1987: 495-6) has demonstrated that the reference is made specifically to a poet and it does not come from Herodotus as we know it; Kuhrt (1982: 544, 551 n.42) has proposed reading 'Herodorus' (*BNJ* 31). On the other hand, Drews (1973: 6) finds that it indeed refers to some later Hesiodic poem, perhaps *Ornithomanteia* or *Mantica* that Pausanias (9.31.5) claims to have read. The latter is said to have concerned seercraft and the interpretation of portents, something to which the story of a drinking eagle would have been directly relevant.

[107] The use of 'foolish Nineveh' without an accompanying explanation in Phocylides F 4 Gentili & Prato = Dio Chrysostom 36.13 ('καὶ τόδε Φωκυλί δεω· πόλις ἐν σκοπέλῳκατὰ κόσμον / οἰ κέουσα σμικρὴ κρέσσων Νί νου ἀφραινούσης') potentially offers further support to this claim. Phocylides is usually dated to 6th-5th cent. BC but Korenjak & Rollinger (2001) have argued that the fragment in question comes from Pseudo-Phocylides, a Hellenised Alexandrian Jew, instead. However, this idea is largely based on their belief that the contents fit the Jewish literary context much better than that of archaic Greece.

[108] Hdt. 1.106.

[109] Hall 1989: 17.

[110] *GIP* Hipponax F 3, 38 – πάλμυς (Lyd. 'king'), 3a – Κανδαῦλα (Lyd. 'dog-throttler', see Bolling 1927), 4 – καύης (Lyd. 'priest'), 30 – δοῦμος (Phry. 'gathering of women'), 79 - (Egy. 'wine'), 92 - βασκ...κρολεα (*Faskati krolel,* a rendering in the Greek alphabet a Lydian phrase); 125 - βέκος (Phry. 'bread'), 142 - βῖ κος (a term used for various kinds of containers for liquids and food), 160 - μαυλιστήριον (a Lydian coin or 'prostitute's fee'), 164 – νηνί ατος song (a Phrygian song (Pollux *Vocabulary*), 168 – τετρακί νη (Phry. 'lettuce'); perhaps also 30 – Malis, possibly a Lydian goddess identified with Athena, 139 – βασαγικόρος (Lyd. a term used to describe one who is quick to have sexual intercourse), 144a – βύκκων ('used by Lydians and Ionians in Ephesus of one who eats greedily(?) or of an ass' (Tzetzes, *Chiliads*)); see also F 2 & 2a (Scythia), 27 & 118e (Phrygians), 67 & 115 (Thrace), 104 (Croesus), 125 (Cyprus); 127 & 156 (Cybele, Thracian Bendis), and especially 42, which gives a description of a road to Smyrna through Lydia.

lands, cities, gods and products also survive in the fragments of other early poets.[111] Occasional references to Mesopotamian recent history, contemporary circumstances and religion betray casual acquaintance with this region.[112]

However, work on Near Eastern influences on Greek culture,[113] coupled with archaeological material and evidence from the cuneiform sources, indicates that contacts between Greece and the Near East during the archaic period were much more vigorous than is indicated by these few direct and relatively late references. Close trade and cultural relations between Greece and the various regions of the Near East date back to the Late Bronze Age.[114] Although these links declined after the collapse of the palace societies, the exchange of resources, artefacts and ideas did evidently not come to a complete halt. An 'extraordinary' amount of Near Eastern imports unearthed in Lefkandi confirms that relations between Greeks and at least the 'diaspora' communities in Cyprus, Asia Minor and Palestine were retained and even expanded throughout the 10th and 9th centuries BC.[115] Moreover, Greek finds dating to the same period have been uncovered in a restricted number of sites in the Near East.[116] Nevertheless, regular exchange activities and the Near Eastern influences on various spheres of Greek culture only intensified from the late 9th cent. BC onwards. That unsurprisingly coincides with the time that Greek activities overseas display a fundamental change and Greek culture as a whole seems to have undergone a general 'renaissance'.[117] An increased amount of

[111] Another possibly Phrygian or Thracian word, σατί ναι (a women's carriage), is attested in Sappho F 44, *Hymn to Aphrodite* 13, Anac. 288.10, Eur. *Hel.* 1311; *libanos* and *murra* are semitic loanwords, *kasia* is Assyrian (Sappho F 44, line 30; Hall 1989: 46). Other references to Phrygia: Sappho F 115(?), *GEP* Alcaeus F 42 (Phrygians=Trojans); Lydia: Sappho F 16, 39, 96, 98a, 132; Alcaeus F 9b-e, 69; Mysia: Alcaeus F 413; Caria: Alcaeus F 388; Scythia: Hipponax F 2, 2a; Thrace: Callinus F 4.

[112] A glimpse of the international dimensions of the late archaic/early classical Greek world-view is also offered by Menander who claims that Sappho and Alcman often 'summon Artemis from many mountains and cities, from rivers too, and Aphrodite from Cyprus, Cnidos, Syria and many other places' (= Sappho F 47 Campbell). Also see the opening statement of Aeschylus' *Persians*, which depicts Syria as bordering Egypt, and more tricky reference to Syrians and Amazons in Pindar F 173 Maehler = Strabo 12.3.9.

[113] For short overviews of oriental imports see West 1997: 1-60 and Boardman 1982: 446 & 449-52 (list of technological advances).

[114] From more recent publications see e.g. Duhoux 2003, Bietak, Marinatos & Palivou 2007, and Phillips 2008.

[115] Popham 1994: 12.

[116] Dickinson 2006: 214, Fantalkin 2006: 200-1 and Lane Fox 2008: 59-61. Also see Luke 2003: 56-9 for a survey of arguments and opinions; Braun 1982: 8 fig. 1, Popham 1994: 27 fig. 2.12 and Dickinson 2006: 212 fig. 7.4 for distribution maps; Rollinger 2001: 249-250 for a concise overview on geometric pottery in Near Eastern sites and Luke 2003 for an exhaustive analyses.

[117] Feldman 1996: 14-15.

borrowings can now be more or less securely dated to the 8th and early 7th centuries BC.[118]

Dickinson has seen this intensification of contacts as the result of political changes in the Near East.[119] Little Neo-Hittite principalities that thus far had formed the focal point of Greco-Oriental relations and constituted the link between Greek culture and what was left of the Hittite and Canaanite cultural spheres came under repeated attacks from the expanding Assyrian empire from the middle of the 8th cent. BC onwards. Assyrian aggression had, of course, started much earlier during the reign of Aššurnasirpal II in the early-9th cent. BC but it did not at first result in the Neo-Hittite states' loss of political independence. It did, however, give rise to anti-Assyrian alliances between various states, which came to include Urartu and Mita of Mushki - or Midas of Phrygia as he was known to the Greeks[120] - in the 720s-710s or even earlier.[121] It is possible, that these alliances also lie, at least partly, behind the incorporation of Greek city-states into the wider Eastern Mediterranean political and cultural scene, because, if Lanfranchi is right, such alliances also existed between Midas and some Greek principalities.[122] Midas' appearance in Herodotus' *Histories* as the first foreign ruler to have made a dedication at the sanctuary of Apollo at Delphi,[123] traditions associating him with

[118] For more conventional dating of the Greek alphabet see McCarter 1975 and Jeffery 1982. However, these views have been challenged by Naveh (1982: 177-184, Feldman 1996 for supporting arguments), who argues that although we know of no Greek inscription from earlier than the 8th cent. BC, a comparative analysis of the characteristic traits of the West Semitic scripts and those of archaic Greek writing point towards the adoption of the latter from Proto-Canaanite script around 1050 BC. The final phase of the Homeric epics has been dated to the orientalising period (Raaflaub 1998: 187, n. 71; according to Burkert 1992: 114 the canonical version of the *Iliad* may date to as late as the 1st half of the 7th cent. BC).

[119] Dickinson 2006: 216.

[120] See Mellink 1991: 623-5 for positive identification.

[121] There is reason to believe that the coalition between Phrygia and at least Urartu goes back to earlier than 720 BC, perhaps to as early as the 1st half of the 8th cent. BC (Mellink 1991: 622-3, Hawkins, s.v. 'Mita' in *RLA,* Lanfranchi 2000: 17 (n. 40 for a list of sources)).

[122] Lanfranchi 2000, cf. Fantalkin 2006: 201-203, who uses the same basic model to explain Greeks being drawn into international warfare and mercenary service by the Lydian involvement in Egyptian affairs and the subsequent large-scale employment of Greek mercenaries by Egyptian pharaohs, but denies the possibility of it applying to a slightly earlier period and Phrygia.

[123] Hdt. 1.14. Gifts from a number of kings have been recorded: Gyges - Hdt. 1.14, Strabo 9.3.9 records gifts inscribed *Γύγου* (instead of the usual genitive *Γύγης*, which Kaplan (2006: 131) interprets as reflecting that someone else had inscribed this name; however, Assyrian sources refer to Gyges as Gugu, perhaps indicating that the Lydian form of the name was closer to the latter and used in the inscription instead of the Greek variant); Croesus - Bacchylides *Ode* 3; Hdt. 1.92, 5.36, 8.35 & 122; Strabo 9.3.9, Parian Marble 41 (sacred ambassadors in Delphi) and column drums from Ephesus (sculpture B16 and possibly B136 in the British Museum); Necho II - Hdt. 1.81, 2.159; Amasis - Hdt. 2.182. Dedicating to gods was probably part of the transformation of aristocratic gift exchange (Greaves 2010: 92, Kaplan 2006: 151-2, S.P. Morris 1997a: 65-6), a diplomatic medium and a language through which to interact, but could, in some cases, reflect counter-favours for possible military assistance (e.g. Croesus and Necho dedicating to Branchidai-Didyma (Greaves 2010: 92,

Cyme,[124] archaeological evidence for a sudden increase in trade contacts between Greek and Phrygia,[125] depictions of horsemen with Greek-style weapons, shields, and helmets on the decorated furniture fragments from Gordion (8th cent. context),[126] the scattered nature of Greek material found in the Phrygian capital,[127] and the evidence for Greek attacks on Phoenicia and Que in Assyrian records[128] all point towards the credibility of this claim and let one assume that Midas could have hired Greek soldiers as mercenaries or acquired them via more diplomatic means. All this creates a perception that Greek city-states were around this time redrawn to a cultural continuum that existed around the Eastern Mediterranean.

Although the initial contact between Greece and the Near East must be seen in the context of commercial and piratical activities (with 'ill-defined boundaries' between them)[129], I believe that it was the participation in the Near Eastern military affairs that became one of the major, though by no means the only, vehicle for transmission of Oriental ideas, traditions and knowledge into Greece.[130] Many Greek families and city-states maintained relations or ritualised friendships with non-Greek dynasties,[131] and as Trundle has observed, mercenary service must have played an important part in

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155)). Thus the suggestion that the 'Midas chair' might have been a dedication by one of the Greek soldiers employed by Midas or perhaps by an allied state, possibly Cyme (Lanfranchi 2000: 19, Kaplan 2006: 150; compare Pedon's dedication in Bowie 2007: 32-4), seems reasonable.

[124] Pollux 9.83; Aristotle F 611.37.

[125] Lanfranchi 2000: 19-20.

[126] Kaplan 2006: 141.

[127] Kaplan 2006: 150, cf. Mellink 1991: 646-7. The *argumentum ex silentio* could perhaps apply here. If in Phrygia's case warfare and diplomacy preceded widespread trade contacts, one should not expect to find much archaeological proof. Oriental exports and orientalising objects, especially things paralleled in Greek material, have been found there in multitude.

[128] First mention of Greeks in Assyrian records dates to the 730s BC and comes from a letter (NL 69) informing the Assyrian king about Ionian raids on some smaller cities on the Levantine coast. It is hard to prove conclusively that these were anything else than regular attacks by pirates (Parker 2000: 74). However, a more politically motivated reasons could be argued for similar attacks on Phoenicia and Que some 20 years later (Annals of Sargon, l. 117-9; Sargon cylinder, l. 21; inscription on a colossal man-headed bull, l. 25; Little Annals, l. 15; Threshold inscription, type 4, l. 34). Lanfranchi (2000: 15-22) has questioned Greek motivation to partake in military manoeuvres directed against the Assyrian Empire and come to the conclusion that it must have been at least partly stimulated by Phrygian interests.

[129] Rollinger 2001: 250.

[130] I have outlined my arguments regarding this idea in the forthcoming article 'Greeks in the Near East and Their Role in Knowledge Transfer – A Model of Cross-Cultural Communication'.

[131] Hall 1989: 12. International guest-friendships in the *Odyssey* (Diomedes and Glaucus 6.226-31; Menelaus and Egypt 4.124-30; Menelaus and the king of Sidon 4.617-9; Odysseus and Egpyt 14.278-86.

this scene of international politics, being ‘an extension to the family’s relationship both inside and outside the *polis*’ – mercenaries played and essential role in diplomacy and ‘in creation and retention of inter-polis and international relationships between great men of the period.’[132] These men, the well-educated and well-connected members of the élite, were more apt to penetrate the cultures they found themselves emerged in and more likely to have had access to Near Eastern high culture and science than merchants and pirates. Their high social status would have also allowed them to exercise wide cultural influence on their home cities, fulfilling the conditions for successful cultural transmission as outlined in the previous chapter.

The existence of mercenaries during the late 8th/early 7th cent. BC is still largely regarded as an ‘open question’[133] but if the identification of North Syrian frontlets, blinkers and mace-heads found in a number of Greek sanctuaries as part of war booty from Damascus (732 BC), dedicated as thanks-offerings to gods, is correct, then Greeks could have been present in the Assyrian army as early as the 730s,[134] making a similar situation in the Phrygian army soon after even more likely. This becomes important in relation to alleged battles between Greek and Assyrian forces. Sargon II claims that he battled with the ‘Ionians’ who live ‘in the midst of the sea’ in 715 BC and there is evidence that his successor Sennacherib too faced them in Cilicia.[135] Battles between Ionian and Assyrian forces, especially the victory of the latter, would have had important ramifications for Greeks in terms of increased access to Mesopotamia and its culture. Namely, due to its small population and ever-growing need for manpower to protect and expand the empire, Assyrians had adopted a custom of enrolling peoples, whether by violent or diplomatic measures, from conquered armies into their own forces.[136] There is, indeed, evidence that some Greeks were either transported or found their way into the Mesopotamian heartland. Much of the relevant evidence has, however, been contested, mainly on linguistic grounds. First of all, Braun and Brown’s claim that Greeks were employed as ship-

[132] Trundle 2004: 3, also see Kaplan 2002: 230.

[133] Rollinger 2001: 251.

[134] Bronze bridle plaque from the sanctuary of Hera at Samos and two cheekpieces of a similar bridle at the sanctuary of Apollo at Eretria on Euboea (S.P. Morris 1997a: 66). Luraghi (2006: 40) points out further objects from Samos and Miletos that belong to the same group of offerings in terms of chronology and style.

[135] For Sargon II see n. 128 above. Battle(s) of Sennacherib: for the octagonal prism describing the campaign in Cilicia in 696 BC see King 1910 and Luckenbill 1924: 61-3; for supposed Greek involvement in the confrontation *BNJ* 680 F 7c (Berossus via Eusebius) & *BNJ* 685 F 5 (Abydenus, probably also stemming from Berossus).

[136] Dalley 1985: 31-48, Oded 1979: 50-4, Kaplan 2008: 135-6,145-7 & 151-2.

builders in Nineveh[137] has been challenged on the basis of Luckenbill's allegedly false reading of ^{kur}*Ia-[am!?]-n[a]-a-a* instead of ^{kur}*ia-ad-na-na-a* (i.e. Cypriots) in Sennacherib's Bull Inscription T 29.[138] However, Frahm has suggested that since Iadnaja would have needed six signs instead of the five used in the inscriptions, Iamnaja remains a possible reading and although opened to further debate can at least be used as a 'working hypothesis.'[139] These people, whether they were Cypriots or Greeks, not only built the ships in Nineveh but also manned them in Assyrian campaign against the Chaldean tribes,[140] thus coming into contact with interior Mesopotamia.

Secondly, three Neo-Assyrian texts from Nineveh mention individuals called *Iamani*.[141] Although the use of ethnic designations as proper names is relatively common in the Assyrian documents,[142] whether *Iamani* is one of those occasions is highly questionable.[143]

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[137] Braun 1982: 19, Brown 1984: 302.

[138] Kuhrt 2002: 19.

[139] Frahm 1997: 117, supported by Lanfranchi 2000: 28-9 and Rollinger 2001: 242.

[140] On the Chaldean tribes see n. 455 below.

[141] SAA 14 024 = K 281 (from 659 BC) records the buying of women by the cohort commander of the crown prince. One Yamannu is listed as the first witness and another as the forth witness. The latter is said to have been the commander-of-fifty; SAA 14 011 = ADD 0076 (from 654 BC) mentions Yamani as a third witness to a contract which obliges Belet-isse'a, maid of the harem manageress, to serve Sinqi-Issar for life; SAA 14 017 = K 408 = ADD 0214 (from 633 or 631 BC) says that Ninuaya, eunuch of the king, bought a slave-woman from Yamani. Because of the same name form, another Yamani who figures in Assyrian annals as a man who overthrew Sargon's puppet king of Ashdod must be considered together with this group of evidence (Rollinger 2001: 245-47, q.v. also for a collection of fragments).

[142] E.g. the theophoric element *Ia-ú* in proper names is probably an indication of a person of Israélite-Judean origin (on the assumption that *Ia-ú* = YHWH (Jahu) (Oded 1979: 13-14); ND 216 mentions a man by the name of *Ṣi-li* ^{kur}*Ar-ma-a-a*, i.e. Sili the Aramaean; ABL 633 records Halbishu the Samarian; Tablet no. 283 in King (1914: 227) refers to *Ab-di-sa-am-si* ^{kur}*Ṣur-ra-a-a*; SAA 14 094, r3 = ADD 0025 gives a witness called Indû from Commagene (URU.*ku-muḫ*). But gentilitics are also used alone to mark individuals: ABL 512 mentions someone called *Mu-ṣur-a-a*, i.e. Egyptian; in a text from Tell Halaf we find a man called *Ku-sa-a-a*, i.e. a man of Kush or Nubian origin (Oded 1979: 14). *Tabālāyu,* a gentilitic of Tabal (*Tabālu*) and anthroponyms *Ta-ba-li* and *Tab-al-lu-u-a* (Zadok 2010: 423-4 list 25 possible instances, e.g. in SAA 06 170, r4 = ADD 1190; SAA 14 091, 3' = ADD 0197; SAA 18 170, 3' = ABL 0967) became relatively common from Sargonid period onwards when Tabaleans (Cappadocians) were deported to Assyria (Zadok 2010: 422); ^{m}*KUR.gar-ga-meš*-a-a* (a man from Carchemish) is listed as one of the men selling slaves in SAA 06 145, 2; gentilitic *Hattāyu* ('man of Hatti') is recorded on 3 occasions (SAA 06 244, 4 = ADD 0178; StAT 2, 195, 3 and 2, 184, rev.13; StAT 2, 82, rev.1); and *Kaskāyu* ('Kaškean') in 2 cases (SAA 06,133, 1; CTN 3, 34, rev.15); a Phrygian (^{m}*mu-su-ka-a-a*) is sold as a slave in SAA 14 146, 1.

[143] Another Yamani appears in a census-list from Harran as a brother of Dui and Ilu, who are clearly Syrian (Braun 1982: 17, cf. Brown 1984: 300 who argues that considering the nature of the document, Yamani must be an accurate self-designation, perhaps reflecting a mixed marriage). Tadmor (1958: 80 n. 217) has also drawn attention to Palestinian names that bear a close similarity to Yamani - Iamîn in Simeon (II Chr. 4:24) and Jerachmiel (I Chr. 2:21); Imnâ/Imnaʿ at Gen. 46:17 and II Chr. 7:35. Brinkman (1989: 56 n.14), Rollinger (2001:

Two more texts testify to Greeks' presence in Assyria. A letter from the Governor of Dēr to Nabû-ra'im-niše-šu in the time of Esarhaddon mentions among the 15 fugitives it lists a certain Addiqritušu[144] (*I.ad-di-ik-ri-tú-šú*) whom Rollinger and Korenjak have identified as Greek Antikritos.[145] Another document, which lists the silver payments in connection with the Queen mother, mentions one or more 'Ionians'.[146] If nothing else, these texts show that some Greeks had direct contact with Mesopotamia and its culture.

Later evidence from Egypt and Persia shows Greeks in high positions in their respective courts. A papyrus from Hermopolis, dated to 575 BC, names as a district official one Ariston – 'obviously a Greek.'[147] Persian Fortification tablets mention, among other multi-ethnic aides of the chief economic official and Darius' uncle Parnaka ('Pharnaces'), one called Yaūna.[148] But more interestingly, excavations in Persepolis have yielded a ration tablet written in Greek.[149] Hence, as Lewis deduces, 'somewhere out in the [Persian] administrative circuit there was someone to whom it came most naturally to write in Greek and who, moreover, knew that there was someone at the administrative centre who would know what it meant.'[150]

245-48) and Kuhrt (2002: 20) have more recently argued that the name is philologically incompatible with the adjectival *Yamnaja* or *Yawnaja* and the surface similarity is misleading.

[144] ABL 140; rev. 2. See s.v. 'Addiqritušu' in *PNAE*.

[145] Rollinger & Korenjak 2001, Rollinger 2001: 252.

[146] SAA 07 048 = ADD 1075 = K1493. The poor state of preservation makes it impossible to say for certain if the word is singular or plural; although Haider 1996: 80 and Melville 1999: 101 say the exact dating is uncertain, Rollinger 2001: 243, 252 believes it to refer to Naqiʾa. Cf. Fantalkin 2006: 201.

[147] Kaplan 2002: 240. Consider also the story of Phanes of Halicarnassus and the Egyptian pharaoh Amasis (Hdt. 3.4); Pigres, a Carian as the personal advisor of Psammetichus I (Polyaen. *Strat.* 7.3; Niemeier 2001: 17 for discussion); Hdt. 2.163 records that Greek and Carian mercenaries in Psammetichus' army numbered around 30,000. An archival document from c. 597 BC refers to a small contingent of 75 Greek mercenaries in the Arad fortress (Luraghi 2006: 23).

[148] Plus others under the same name: one appearing a few years earlier as a grain-handler in an outstation (possibly the same man) but another some 16 years later in the same position as Yaūna but in the service of Artatakma (Lewis 1977: 12).

[149] Lewis 1977: 12.

[150] Lewis 1977: 13. As for specific individuals, consider the long tradition of Greek doctors in the Persian court: Democedes of Croton (Hdt. 3.125 & 129-137), Apollonides of Cos (Ctesias F 14 L-R = Phot. §34 & 44), Ctesias of Cnidus (Ctesias T 1b, 3, 6aβ, 7a) and Polykritos of Mende (Plut. *Art.* 21.3); or explorers like Scylax of Caryanda (Hdt. 4.44) and later Eudoxus of Cyzicus (Strabo 2.3.4); plus a long list of Greek exiles and refugees who found favour with eastern rulers, including for example Syloson, Histiaeus of Miletus, Coës of Mytilene, Scythes the king of Zancleans, Demaratus, Metiochus, the Pisistratidea, Dicaeus son of Theocydes (Hdt. 3.139-44, 5.11, 6.24, 6.41, 6.70, 7.6 & 8.65). Altogether, Hofstetter (1978: 192-3) has counted records for at least 40 Greeks in Persia under Darius I, with a few more during his predecessors and successors. At the lower end of the social

Drews has argued that much of Herodotus' account on Lydia and Saite Egypt seems to have been based on stories already current in the Greek tradition.[151] Perhaps it is then, in the light of the evidence just presented, not unreasonable to expect a similar situation in regard to Assyria and Babylonia. Greeks obviously knew more about Assyria and Babylonia than can be gathered from the surviving evidence. As will shortly be shown, Herodotus' patchy account of Mesopotamian history betrays knowledge in considerable detail even without the promised Assyrian *logoi*.[152] Lewy has proposed that Sennacherib can be recognised in some features of Ninos, the eponymous founder of the Assyrian empire[153] and the story of Sardanapallos, especially the fact that Hellanicus talked of two Sardanapali, implies that Aššurbanipal too was alive in the popular memory of the 5th cent. BC Greeks.[154] So all in all, there is a strong possibility that at least part of the Classical Greek image of Mesopotamia was rooted in direct contacts with the Neo-Assyrian and Neo-Babylonian empires during the archaic period. Nevertheless, much information must have reached Greeks through other means and agents, perhaps most notably through Phoenician merchants, Phrygian and Lydian allies, and through multi-lingual communities in Cyprus and Cilicia, further adding to the distortion of the Babylonian stereotype in Greek imagination.

2.2.2 From Oral to Literary History

With the first recording of these stories and their arrangement into a coherent narrative began the emergence of a literary matrix that would set the rules for most subsequent authors. The style- and subject-choices of early poets and logographers would, if not wholly determine, at least have an impact on those made by their successors.

The inclusion of events of both Greek and non-Greek recent history can be observed already in some

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scale, Greek craftsmen at Persepolis and Susa are known from direct reference as well as by their work and graffiti, and there were Greeks engaged in the transport of the building materials. Some texts seem to go lower still, down to a group of 23 female irrigation-workers (Lewis 1977: 14).

[151] Drews 1973: 6.

[152] Hdt. 1.102-6: birth of Median Empire, Phraortes killed by Assyrian forces in 653 BC, Assyrian empire suffering under revolts around the same period, Cyaxares' attempts to avenge his father and war with Lydians when the solar eclipse occurred. Further details of Assyrian history are promised but not delivered, see n. 98above.

[153] Lewy 1952: 266-70.

[154] *FGrH* 4 F 63. Braun 1982: 21. Lewy 1952: 266-70 has proposed that Sennacherib too can be recognised in some features of Ninos, the eponymous founder of the Assyrian empire.

elegiac and iambic poets.[155] In the middle of the 7th cent. BC Callinus put into verses the Cimmerian sack of Sardis in 652 BC[156] and according to Pausanias, Mimnermus (fl. c. 630-600 BC) recorded the traditions about the battle of the Smyrnaeans against the Lydians, which took place a few generations earlier, during the time of Gyges (716-678 BC). Later, the 5th cent. BC lyric poet Bacchylides wrote an ode to commemorate the fall of Croesus (560-547 BC).[157] Moreover, it has been suggested that a fragment from a late Hellenistic papyrus describing the story of Gyges and the establishment of the Mermnad dynasty, as found in Herodotus (1.8ff), could belong to an early tragedian, possibly Phrynichus.[158] These and other similar works probably served as a source for Herodotus. It was not uncommon of him to use poets for historical facts, including Phrynichus himself, whom he refers to in 6.29.[159]

Consequently, it is clear that many of the stories recounted by Herodotus, his predecessors and contemporaries must have been based on oral traditions, which 'would inevitably become smoother and more schematic in the telling, not to mention 'deformed' by the later reasons of retelling them.'[160] One must therefore agree with Thomas that:

> It seems likely that many tales and traditions were still in circulation at the time he [Herodotus] wrote them down (that does not, of course, mean that they were necessarily accurate memories of the past). Provided one does not take the view that Herodotus made up most of his narrative, it is then possible to say that he may have changed the emphasis, inserted tales into larger, more meaningful narratives and historical patterning, but to a large extent the repeated story-motifs may be the product of the traditions he picked up rather

[155] See Bowie 2001: 45-66.

[156] Strabo 13.4.8 ('Callisthenes says that Sardeis was captured first by the Cimmerians and then by the Treres and the Lycians, as is set forth by Callinus the elegiac poet, and lastely in the time of Cyrus and Croesus. But when Callinus says that the incursion of the Cimmerians was against the Esioneis, at the time of which Sardeis was captured, the Scepsian and his followers surmise that the Asioneis were by Callinus called the Esioneis, in the Ionic dialect'); 14.1.40; ('Now Callinus mentions the Magnetans as still being a prosperous people and as being successful in their war against the Ephesians...and Callinus recalls another, and earlier, invasion of the Cimmerians when he says: 'And now the army of the Cimmerians, mighty in deeds, advanceth,' in which he clearly indicates the capture of Sardis'); a possible fragment of the poem is Callinus F 5a-b & 3 West 1992.

[157] Bacchylides 3.

[158] *P. Oxy.* 2382, from 2nd or 3rd cent. AD. For translation see Raubitschek 1955: 48 and for discussion 49-50 (he suggests Ion of Chios as the author). Also Lloyd-Jones 1966: 24-32, esp. for Gyges' possible association with Ionia; and Travis 2000 for a more recent treatment of the topic.

[159] Lloyd-Jones 1966: 29.

[160] Thomas 2000: 6 & 2006: 62.

> than his own creation. … The nature of these sources should presumably tell us something about the period (mid-fifth century and later) in which such traditions were still remembered, and sometimes they may tell us more about the reasons for their being remembered than about the period they purport to record.[161]

Generally Herodotus conforms to the usual Greek practice of not naming his sources, especially previous prose authors, barring of course Hecataeus.[162] Those unnamed prose predecessors of his are, however, a key to the study of sources and approaches. Dionysius of Halicarnassus (1st cent. BC) describes the traits that characterised these *archaioi syngrapheis* as follows:

> Some wrote Greek histories, others barbarian. They did not make these histories cohere with each other, but divided them up by nations (*ethnos*) and cities, rolling them out separately from each other, keeping to one and the same objective: all the memories that were preserved by inhabitants in nations and cities, or writings that were stored in sacred and profane areas – these they aimed to bring out (i.e. publish) to the shared knowledge of all, just as they got them, neither adding anything nor subtracting. In them there were also some myths, given credence as they were so long-standing and some sensational reversals of situation which modern taste judges to be pretty stupid.[163]

Despite Jacoby's objections, there is no reason to doubt Dionysius' reliability, either in regard to the dating or to the characteristics he describes, although the latter must naturally involve some generalisations.[164] The given passage confirms our assumption that the first accounts of Near Eastern history were primarily based on oral traditions, current in Greece and, in some cases, the relevant areas abroad. Toye explains that these early histories followed the example set by the Hesiodic *Catalogue*, grounding their narrations in the realm of myth and the eponymous heroes, basically composing genealogical narratives and ignoring more recent historical events.[165]

Among those early historians we find Xanthus, a Lydian by birth[166] (*floruit* probably around 450s-440s

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[161] Thomas 2000: 6.

[162] Lateiner 1989: 93. E.g. Aristeas; see Dowden's commentary in *BNJ* 35 F 2.

[163] Dionysius of Halicarnassus, *On Thucydides*, 5.3. Trans. by Dowden from http://www.iaalocal.bham.ac.uk/infonet/staff/dowden/historians/dh.htm.

[164] Toye 1995: 282-5, esp. n. 7 about Dionysius' access to relevant works.

[165] Toye 1995: 286-8, 299.

[166] Strabo 13.4.9 ('Xanthus, the ancient historian, is indeed called a Lydian, but whether he was from Sardis I do

BC),[167] who, as far as we know, was the first person to write in Greek about Zoroaster and aspects of Iranian religion, as well as a book on Lydia, thus playing 'an exemplary role' in presenting details of an eastern history, and in translating cultural and religious practices to Greek discourse.[168] The *Lydiaka* (and possible other books by Xanthus)[169] conformed to Greek ideas and ideals, with the covered *topoi* reflecting the interests of the local audience. The narrative was essentially genealogical, starting with the descent of Lydians and probably concentrating on recording events of the Heroic Age rather than the more recent history.[170] It mentioned exotic and, for Greeks deviant, sexual customs like the Lydian female eunuchs[171] or the Persian incest and wife-swapping practices[172] (discussed in more detail later). The material on Lydia was allegedly based on temple records and word of mouth.[173]

As for a comparative work on Mesopotamia, Hellanicus of Lesbos is purported to have been the earliest author to compile a history, however brief, of Assyria. Little is known of his *Persica* - mere 16 fragments survive - but it could possibly, although not necessarily, pre-date Herodotus.[174] The tendency to record heroic myths and genealogies, highlighted above, applies equally to him and the Near Eastern nations he describes, with one surviving fragment recording his identification of the

not know').

[167] Kingsley 1995: 174-6.

[168] Momigliano 1975: 7, Kingsley 1995: 173. Ephorus claims that even Herodotus was greatly indebted to Xanthus as a source and a literary model but the phrase 'ὡς παλαιοτέρου ὄντος καὶ Ἡροδότῳ τὰς ἀφορμὰς δεδωκότος' in *FGrH* 70 F 180 = 765 T 5 (= Athenaeus 515e), has raised some concerns. The accuracy of this claim has been challenged (Drews 1973: 102-3, West 1971: 32-33 too thinks it might be a guess) but Kingsley (1995: 175-6) argues that Ephorus has been unfairly treated by the modern scholarship in favour of Herodotus and 'no genuine reason has ever been produced for doubting the accuracy of Ephorus' statement.'

[169] Clement claims that the information on Persian customs came from a work he refers to as *Magica.* However, several scholars have attributed it to the *Lydiaca,* of which they believe the former was a part (Clemen 1920: 23; Nock 1972: 689, Kingsley 1995: 183-5) but this is in distinct opposition with what Dionysius says about local histories standing as separate books.

[170] *FGrH* 765 F 16, cf. Hdt. 1.7. Drews 1973: 100-103, Toye 1995: 288 n. 42 & 290; more thorough overview of Xanthus in Pearson 1939: 109-37, and a more recent discussion on the extent to which Nicolaus of Damascus can be used to reconstruct Xanthus' account of the reigns of Gyges and Croesus in Toher 1989: 160 & 192-72.

[171] F*GrH* 70 F 180 = 765 T 5 (Athenaeus 515e). Although challenged, authenticity argued by Kingsley 1995: 176-9.

[172] *FGrH* 765 F 31 = Clem. *Strom.* 1.21.131.

[173] Kingsley 1995: 173, esp. n. 4.

[174] Drews (1973: 23-4 & 30) argues that although there is no doubt that some of Hellanicus' works were published after Herodotus' *Histories*, the *Persica,* the work that contained the Assyrian *logoi*, predated it.

Chaldeans as a people once called Cephenes, after Cepheus, father of Andromeda.[175]

Hence, it is not surprising that later authors, especially those who prided themselves for a more factual approach, described the stories of early historians as 'composed with the view rather of pleasing the ear than of telling the truth, since their stories cannot be tested and most of them have from lapse of time won their way into the region of the fabulous so as to be incredible.'[176] This might be, on the one hand, largely due to the fact that, like Herodotus, early logographers were similar to modern anthropologist or observers as they represented and recorded each tradition as they found it.[177] Still, on the other, we can observe clear attempts of rationalisation; consider for example Hellanicus' assertion that there were two kings named Sardanapallos.[178]

Hence, the researches of early logographers, as well as those of Herodotus himself, set the basic parameters of the Greek cultural and literary grid of Mesopotamia, and the way foreigners were subsequently perceived and depicted: tragedians, for instance, often used their observations to add 'picturesque detail to the presentation of the non-Greeks of heroic tradition.' However, such influence is naturally not linear: influences and motifs also moved from other literary areas to historiography, and all currently popular topics and controversies propounded by the contemporary writers had some input into the emerging discourse.[179]

Directly related to the description of peoples and their customs, for example, is the belief that climate and geography had a profound effect on human character.[180] Such theory is best exemplified by the

[175] *FGrH* 4 F 59. Also Persia as the land which Perses, son of Perseus and Andromeda, colonised (F 60). Toye (1995: 292) argues that the fragments of Hellanicus, variously assigned to *Ktiseis* (Foundings), *Ktiseis Ethnōn kai Poleōn* (Foundings of Nations and Cities), *Ethnōn Onomasiai* (Names of Nations), *Peri Ethnōn* (On Nations), and *Barbarika Nomina* (Foreign Customs), all probably stem from a single work (F 66-70, 72-73 ; see Kingsley 1995: 183-4 for problems with naming) that described the customs of various Scythian, Thracian, and Lydian tribes.

[176] Thucydides 1.21 if Toye is right about equating the *logographoi* with Dionysius' *archaioi syngrapheis;* Dionysius 5.13 as above; Strabo 1.2.8 and 8.3.9; also see Diodorus 4.1.

[177] Murray 2001: 26-7.

[178] *FGrH* 4 F 63. This legendarily hedonistic Assyrian king is a very popular topic in later literature, especially following Ctesias, but he will be discussed in more detail in subsequent chapters. Cf. Herodotus' two Labynetoses (1.188) or two Nitocrises (1.185f, 2.100).

[179] Hall 1989: 133. E.g. Anaxagoras' theory of melting snows as the source of Nile's flood in Aesch. F 300, Eur. *Hel.* 1-3, and *Archelaus* F 1; Hecataeus' cartography inspired passages in Aeschylus and Sophocles, and his notes on the Egyptian diet in the *Supp.* 761 & 953. Although Hall (1989: 76) doubts that Hecataeus could have influenced the way barbarians came to be depicted in Greek tragedy, believing that his information of the foreign customs amounted to no more than 'brief aetiological or ethnographic tags'.

[180] Thomas 2006: 65. Hippocratic theory on the links between geography and ethnography, attested also in

Hippocratic *On Airs, Waters, and Places,*[181] which, although having a primarily medical perspective, still occasionally generalises on the qualities of peoples exposed to different climatic conditions.[182] The stereotypes that emerge from this text are clear: Asia altogether is more magnificent and beautiful than Europe; its peoples are gentle, affectionate and feeble but as such prone to cowardice and lack of 'manly courage, endurance of suffering, laborious enterprise, and high spirit.'[183] All this reflects general Greek views on eastern peoples. Chaldea, as part of the 'Other' that emerged as a result, was inevitably influence by the general approach to everything non-Greek.

2.2.3 The Barbarian Stereotype and Literary *Topoi*

Edith Hall, in her preface to *Inventing the Barbarian*, states the prevailing opinion of late 20th cent. scholars by saying that her book:

> has been written in the conviction that ethnic stereotypes, ancient and modern, though revealing almost nothing about the groups that they are intended to define, say a great deal about the community which produces them.[184]

However, such a view is too extreme. Although it gains some support from the above discussion on the politicisation of 'cultural grids' and the way these constructs are allegedly built as mirror images of any society, assuming that they only reflect Greek exercises of self-definition, where the barbarian is 'often portrayed as the opposite of the ideal Greek', [185] is a cross oversimplification. It is not in the scope of this thesis, nor is it my intention, to provide another detailed reconsideration of the famous Greek/non-Greek polarity and the introduction of the derogatory term and concept of the

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Hdt. 1.71, 9.82 & 9.122.

181 Dating to late 5th cent. BC, direct borrowings from or to the *Histories* cannot be established with any certainty (Thomas 2000: 24-5 & 2006: 65).

182 E.g. people living in the cities exposed to cold winds during the summer are 'in disposition… rather ferocious than gentle', whereas 'inhabitants of the cities which are exposed to winds between the summer and the winter rising of the sun' are 'in temper and intellect, superior to those which are exposed to the north' (*On Airs, Waters and Places* 4-5).

183 Ibid 12 and esp. 16 for contributing cultural reasons (i.e. despotism).

184 Hall 1989: ix. Hall chooses to see Greek discourse on barbarians in terms of 'invention', 'innovation' and 'creativity' – 'because it is important to stress that the conceptual boundaries which estrange different peoples, as they divided Greeks from non-Greeks, are socially produced rather than inherent in nature.'

185 Hall 1989: 1-55.

'barbarian';[186] the work done so far simply serves to show the shape of the 'cultural grid' surrounding the idea by the 5th cent. BC. Despite there being no reason to believe that a largely artificially constructed xenophobia, allegedly based on an ethnocentric belief that barbarians were generically inferior, even slavish by nature,[187] was an all-pervasive phenomenon, embracing all levels of Greek society and all *poleis* in equal degree, such politically sanctioned polarisation nevertheless had an effect on how Greeks came to view foreigners during the classical period. Certain generalisations and stereotypes, enforced by rhetoric, exercised strong influence even centuries later, some reaching down to modern times, and introduced many topics that came to prevail the later discussion about oriental cultures. Following the assumptions outlined in the theoretical chapter, these generalisations, stereotypes and *topoi* must be scrutinised to a sufficient degree.

The earliest extant poetic expressions of the Greek views of foreigners[188] come mainly from the verses of Archilochus and take the form of ethnographic observation, exotic detail, and abuse along ethnic lines.[189] However, the best insight into the shape that the 'cultural grid' or discourse on the eastern 'barbarians' has taken by the 5th cent. BC comes from Aeschylus' *Persians*. Hall summarises the ethnographically detailed depiction of the Persians by Aescylus as follows:

> Cultural differentiation is expressed primarily in terms not of religion but of political psychology, formulated in opposition to Athenian political ideals, and backed up by extensive references to the protocol of the court and the administrative apparatus of the empire. The passages illustrating the use of differentiation are so numerous and the effect so pervasive that it is totally inadequate to describe them as 'eastern touches', the opinion of those who

[186] For studies see Hall 1989: 3-17.

[187] E.g. Arist. *Pol.* 1327b-23-36.

[188] The Greeks' view of the non-Greek world in the archaic period is controversial. Homeric poems (*Od.* 4.124-30; 3.302, *Hymn to Aphrodite,* 113-6) seem to portray an open society, one not yet plagued by ethnocentrism, but nevertheless in more or less constant contact with foreign lands. The language is never a problem: consider for example Menelaus' and Helen's stay in Egypt. The *Odyssey's* terms for speakers of other tongues - *allothroos* (1.183), *barbarophonos and agriophonos* - do not put 'all Greek-speakers and all *allothrooi* on different sides of a conceptual or cultural fence' (Hall 1989: 12), although some negative connotations could be read into them Compare for example the Trojan *epikouroi* in *Il.* 2.803-4: 'ἄλλη δ᾽ ἄλλων γλῶσσα πολυσπερέων ἀνθρώπων' with the with the depiction of Typhoeus, who had 'voices in all his dreadful heads which uttered every kind of sound unspeakable,' in Hes. *Th.* 820-35. *Epikouros* is altogether mentioned 33 times, e.g. 10.435, 12.31ff (Lavelle 1997: 229-32, Kaplan 2002: 231). The chaotic and savage nature of the foreign allies appears to be implicit in the imagery used. For language, ethnographic and behavioural differences, or lack of them, see Hall 1989: 19-47.

[189] Hall 1989: 19, 37.

> see the play's ethical interest as paramount. The tragedy is not ornamented by oriental colouring but suffused in it; indeed it represents the first unmistakable file in the archive of Orientalism, the discourse by which the European imagination has dominated Asia ever since by conceptualizing its inhabitants as defeated, luxurious, emotional, cruel, and always dangerous.[190]

So, the play, explaining the Persian conduct in reference to Greek ethical norms but covering them with a thick 'oriental' veneer, is a careful negotiation between domestication and alienation of another society. There are certain aspects of the Persians' demeanour and attitudes that are clearly intended to be related to their ethnicity, which, as the genre developed, were to be canonised as features of barbarian psychology. Three of the most emphasised ones are hierarchy, immoderate luxury, and unrestrained emotion. Hall argues them all to be based more on Greek ideals and the Greek view of themselves rather than on the realities of Persian temperament and lifestyle:[191] the historical Persians appear to have been 'extremely tough and highly trained in the manly arts' and 'their luxuriousness was undoubtedly exaggerated by the Greeks.'[192] However, it is more likely that many of these features can be identified as continuities in the cultural grid of all things 'Orient'. Reconstruction of earlier stereotypes will show that the belief in Near Eastern monarchs' great wealth and luxury was indeed based on a historical reality, although not what modern scholars would believe to have been the reality of the Achaemenid Empire but what the Greeks knew as the reality of earlier eastern regimes. West has suggested that the story of Nineveh's fall, alluded to above, probably served as an excellent moral paradigm[193] and thus one could speculate that by the 6th cent. BC, even before Greek victory over the Persians, their view of the Eastern empires was already along the lines of: rich, mighty and luxurious, but as such inevitably prone to destruction. Phocylides' assertion that a small but well-ordered city on a distant crag is better than foolish Nineveh,[194] is closely paralleled by Pindar's (522-443 BC) saying that he would not trade 'Karthaia a narrow ridge of

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[190] Hall 1989: 99. Aeschylus uses a number of devices to add an Oriental flavour to his Persians: their speeches are interspersed with items of Persian vocabulary, elaborate expressions, 'meaningless' cries, passionate repetition of words and anaphora, plus a high proportion of Ionicisms and special epic words to create a foreign effect (Hall 1989: 78-9, 99), e.g. Βαλλήν (658) – a possibly Phrygian word for king, also used by Sophocles (F 515, from *Shepherds*) to refer to Priam in Troy.

[191] Hall 1989: 79-84, 95-8 & 121-2 (Greek ideals). See concrete references to their luxury in n. 197 & 198 below.

[192] Hall 1989: 81 n.113; and 85-6 for oversimplification of Greek spear v. barbarian bow antithesis.

[193] West 1978b: 166.

[194] See n. 107 above.

land... for the Babylon of plains'[195] - Babylon obviously serving here as the synonym for wealth and pomp. In the *Persians,* the reference to Babylon as 'rich in gold'- πολύχρυσοι[196] - does not apply to Babylon singularly; the same word and other equivalent expressions are used to describe the Persians, Lydians, as well as other Asiatic nations.[197] The overwhelming wealth of such peoples is mentioned well before the 5th cent. BC although not necessarily in a pejorative tone. Drews, indeed, argues that the 'scarcely masked envy' of the early poets[198] would indicate that the Greeks were profoundly impressed by the splendour and sophistication and 'held their Eastern neighbours in high esteem, while viewing with contempt the barbarous Thracians and Scythians to the north.'[199]

Hence, the image of eastern nations and empires as incredibly wealthy was prevalent among Greek communities long before its alleged 'invention' in Athenian tragedy, and accords well with the image of luxuriousness that Aeschylus tried to impose upon his barbarians. But whether it was seen as negatively during the archaic era as it was by classical playwrights, when it was closely associated with the display of monarchic power, remains questionable. One must also bear in mind that attitudes towards personal wealth and display of affluence differed strongly within the Greek communities even during the classical period and our view tends to carry a strong Athenian bias, which put Eastern corrupting and destructive wealth and luxury into strong contrast with a Greek rustic and simple lifestyle.[200] But even this tendency is not unattested earlier: Athenaeus writes that 'the Magnesians of Magnesia on the Maeander were destroyed, as we read in the elegiac poems of Callinus and in Archilochus, by excessive luxury, their city being captured by the Ephesians.'[201] So a

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[195] Pi. *Pae.* 4, 15-6 (F 52d).

[196] Aesch. *Pers.* 52.

[197] E.g. line 3 (Xerxes' palace 'rich in gold'), 42-3 ('Lydians of luxurious lifestyle'), 45 ('Sardis, rich in gold'), 135 ('Persian women, grieving amid their luxury'), 159 (the queen's 'gold-bedecked palace'). 168 (Persian queen: 'our wealth is ample (lit. 'irreproachable')'), 251 ('O land of Persia, repository of great wealth!').

[198] Archilochus of Paros (7th cent. BC) mentions the 'wealth of a gold-rich Gyges' (F 22 Diehl; Hdt. 1.12). Alcman, who according to some traditions was born in Sardis (*P.Oxy.* 2389 F 9; Antipater of Thessalonica on Alcman in *Palatine Anthology* 7.18), also made many references to Asian and especially Lydian culture (e.g. Athenaeus 9, 389f; Alexander of Aetolia in *Palatine Anthology* 7.709; Steph. Byz. s.v. 'Annichorum') and Sappho too mentioned Lydia or its commodities a couple of times (e.g. 2.19, 3.82 Cox).

[199] Drews 1973: 4-5.

[200] E.g. Xenophanes of Colophon (Ath. 12.31a-b) says that the Colophonians 'learnt all sorts of useless foolishness from the effeminate Lydians, while they were held in bondage of sharp tyranny. They went into the forum richly clad in purple garments, in numerous companies, whose strenght was not less than a thousand men, boasting of hair luxuriously dressed, dripping with costly and sweet-smelling oils.'

[201] Ath. 12.525c.

discourse about the corruptive qualities of luxury clearly existed in pre-classical Greece. The same discourse was applied to Assyrian history, especially Ninyas and Sardanapallos.[202] Hence it is safe to say that the stereotypes - although perhaps not true *per se*, rather severely twisted and exaggerated for the purposes of dramatic effect and political agenda - were grounded in the existing 'cultural grid', one reliant on a long-lasting first-hand experience, and were not a mere 'innovation' by the Athenian imagination.

All in all, one can conclude that although Hall is probably right in arguing that the themes, symbols and actions thought to characterise the Persians became applied to mythical barbarians,[203] the previously present stereotypes were applied to the Persians themselves. It was the Assyrians, Babylonians, Phrygians and Lydians who exercised a certain amount of influence over the way that Persians became to be depicted in Classical Greece, not vice versa. There are, furthermore, other *topoi* connected to foreigners that appear from quite early on. Lateiner has observed that any man visiting an overseas country 'will find himself exploring those aspects of a foreign culture that correspond to his curiosity about his own.'[204] Hence, the use of eunuchs, matriarchal rule[205] or powerful queens were strong orientalising features, which reflect Greeks' general fascination with sexual and social practices that deviated from the norms of their own male-centred society. One of the earliest plays on a historical theme, Phrynichus' (born c. 530 BC) *Phoenissae,* started with a eunuch setting out chairs for the members of the Persian royal council and announcing the news of defeat.[206] The Greek norm of the ascendancy of males over the females doubtless fuelled countless stories of powerful barbarian women but Hall's argument that

> the powerful barbarian women of the ethnographers and mythographers therefore have more bearing on the Greek male's own definition of himself by comparison with the outside world than on the actual social structures prevailing in Egypt or Asia or the Pontus at the time[207]

[202] Discussed below in ch. 2.3.2.

[203] Hall 1989: 101-113, 121-133.

[204] Lateiner 1989: 146.

[205] E.g. Lycian matrilineal system of inheritance in Hdt. 1.173.

[206] *TrGF* 3 F 8.

[207] Hall 1989: 201-2. Characters like the Persian queen in Aeschylus' *Persians.*

ignores the evidence for a long-standing acquaintance with and tradition of the influential positions of Oriental queens and princesses.

Similar trends can be found in the Greeks' alleged evidence for polygamy and incest, as well as for promiscuity, in other cultures. Clement of Alexandria attributes to Xanthus of Lydia the following passage:

> the magi make love to their own mother, and to their daughters and their sisters (so goes their custom); and the women belong to everyone in common, so that when a man wants to take another man's wife as his own he does so without using force or secrecy but with mutual consent and approval.[208]

The first part is apparently right - magi, or perhaps Persians more generally, did indeed practice incest as a religious duty.[209] There is, however, no evidence in the Persian sources for any type of communal wife-swapping practices. Kingsley has therefore argued the passage to be a result of 'collective projection', a common practice of early historians to 'ascribe these somewhat alluring activities [wife-swapping and free sex] to as many foreign peoples as possible'.[210] Compare for example what Herodotus says about the Machlyans and the Auseans, as well as the inhabitant of the Caucasus mountains and India, who all have sexual intercourse out in the public 'like cattle'[211] or about the

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[208] *FGrH* 765 F 31.

[209] Kingsley 1995: 179 n. 46, Stolkin 1947: 612-7.

[210] Kingsley 1995: 179-81. Beyond the point here is Kingsley's belief that the reference to Persian 'wife-sharing' does not stem from Xanthus but from Clement himself, who used it to facilitate his attack on the 'free love' practised by some of the Gnostics, although it is probably correct, considering that a number of possibly earlier authors refer to the incestous relationship allegedly so common among the magi, but *in corpore* fail to mention the 'wife-swapping' practices. E.g. Eur. *Andr.* 173ff ('Suchlike is the whole barbaric race: father with daughter, son with mother weds, sister with brother: kin the nearest wade through blood: their laws forbid no whit thereof. Bring no such thing midst us!); Ath. 4.220d ('Alcibiades... had sex with his mother, sister, and daughter, as the Persians do'); Ctesias F 44a and 44b L-R; Diog.Laert. 1.7 ('they see no impiety in marriage with a mother or daughter, as Sotion relates in his twenty-third book'); Catullus 90 ('for a wizard must be the offspring of mother and son, if the unnatural religion of the Persians is true'); Strabo 15.3.20 ('and these Magi, by ancestral custom, consort even with their mothers'); Philo of Alexandria *On Special Laws* 3.13 ('Moses, detesting and loathing the customs of the Persians, repudiates them as the greatest possible impiety, for the magistrates of the Persians marry even their own mothers, and consider the offspring of such marriages the most noble of all men'); Curtius Rufus *History of Alexander* 8.2.19 ('The satrap was Sisimithres, who had two sons born of his own mother; for among those people it is lawful for parents to cohabit with their children'); Plut. *Alex.* 1.5 (328c) ('But if you examine the results of Alexander's instructions, you will see that he educated the Hycarnians to respect the marriage bond... and the Persians to revere their mothers and not to take them in wedlock') and *Art.* 23.4 (on Artaxerxes marring his daughters). For similar claims in later authors see Slotkin 1947: 614-5.

[211] Hdt. 1.203, 3.101 & 4.180.

Massagetai and the Auschisai, among whom 'whatever woman a man... may desire he hangs up his quiver in front of the waggon and has commerce with her freely.'[212] Similar wife-sharing habits allegedly apply to the Agathyrsians,[213] some Scythians[214] and the Etruscans, whose promiscuous lifestyle was vividly described by Theopompus in the forty-third book of his *Histories*.[215]

Another, and from the point of view of this thesis the most important *topos,* is the concept of barbarian knowledge. It is baffling how 'the schizophrenic vision of inferiority and of utopia gives rise to an inherently contradictory portrayal of the barbarian world... the home on the one hand of tyrants and savages, and on the other of idealized peoples and harmonious relations with heaven.'[216] Hence the tendency to consider barbarian societies as the abodes of 'ancient wisdom'; one that, as shall be shown, remained operational throughout the Greco-Roman history.

Ambiguous attitudes towards foreign cultures become especially obvious as the relativist theory starts to exert its influence on Greek writers. Views of the more radical sophists of the 2nd half of the 5th cent. BC were reflected both in Herodotus[217] and in tragic playwrights as the previously inherent antithesis between Hellenes and non-Hellenes came to be questioned.[218] Hippias claimed that incest was not outlawed by divine ordinance on the ground that some peoples allowed it, a sentiment echoed by Macareus' words in Euripides' *Aeolus:* 'What is shameful, if it does not seem so to those practicing it?'[219]

It is then against this politically and culturally conditioned 'grid' that all subsequent attempts by Greek logographers to provide more or less genuine descriptions of foreign peoples and cultures must be analysed and assessed. The following subchapters will discuss a sample of more specific elements of the 'Chaldean repertoire' drawn primarily from the writings of Greek and Roman historians. Some topics, such as the conquest of Babylon by Cyrus and its architecture have been excluded as they have been thoroughly studied in other works and the limited time and space of this

[212] Hdt. 1.216 & 4.172.

[213] Hdt. 4.104.

[214] Ephorus *FGrH* 70 F 42.

[215] Theopompus *FGrH* 115 F 204.

[216] Hall 1989: 149-50.

[217] E.g. Hdt. 3.38.2-4 with its famous assertion '*nomos* is the king of all.'

[218] Hall 1989: 215.

[219] Eur. *Ael.* F 19; Hall 1989: 189.

thesis simply cannot accommodate a range wider than the one chosen here.[220]

2.3 Individual Erzählmotive of the Babylonian *Logoi*

2.3.1 Babylonian Bride-Market and Temple Prostitution

In recent years the topic of sacred prostitution, and with it the Babylonian bride-market episode in Herodotus' *Histories*, have become the subject of vigorous scholarly attention. The two are paired in Herodotus' narrative as 'the most honourable' and 'the most shameful'[221] of all Babylonian practices and, therefore, often discussed in secondary literature as ideologically paired. Although modern explanations vary in the degree of severity, both are now generally viewed as intrinsically false, devoid of any local historical reality, mere images of hostile Greek imagination. And as they are, like so many other elements, often said to reflect more on Herodotus and the Greeks than on the Babylonians,[222] the way these motifs have over time been approached by scholars also betrays something about modern researchers and their practices.

The custom that Herodotus finds the most laudable among the Babylonians is conveniently nicknamed the 'Babylonian bride-market'. According to his description villagers gather together in one place once a year to arrange marriages in the following fashion: the money got from the sale of the most attractive girls is used to pay for the future husbands of those 'unshapely or crippled'. The custom is also mentioned with slight variations in Strabo but his account clearly stems from Herodotus, although possibly through, or together with, an intermediary source.[223] It is also noteworthy that Herodotus goes on the say that this practice has since gone out of use and now poorer people have to prostitute their daughters instead.

On the other end of Herodotus' moral compass stands the temple prostitution, 'the most shameful'

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[220] See Ravn 1942, Baumgartner 1950, MacGinnis 1986 and especially Rollinger 1993; for a more recent discussion of Babylonian topography and its relation to the city depicted by Greco-Roman authors see Boiy 2004: 55-98 (esp. 67-72 & 77-8, concluding that Babylon served as a prototype of an architecturally ideal city).

[221] Hdt. 1.196 f.

[222] E.g. McNeal 1988: 54.

[223] Strabo 16.1.20: 'Now in general their customs are like those of the Persians, but it is a custom peculiar to them to appoint three wise men as rulers of each tribe, who present in public the marriageable girls, and sell them by auction to the bridegrooms, always selling first those who are the more highly prized. Thus marriages are contracted.' See Beard & Henderson 1997: 491-2 and also MacLachlan 1992: 149-50 for the possibility that Herodotus himself could have drawn his information on Babylon from this mysterious source.

of all Babylonian customs. The type of prostitution that Herodotus describes is a once-in-a-lifetime sale of one's body in honour of a divinity - in this case Mylitta/Ištar[224] - and must be differentiated from other subdivisions of sacred prostitution (e.g. sale of temple slaves, professional prostitutes or priests/priestesses) and sacred sex in general.

Modern approaches to these, and other motifs of the discourse, take one of the three general directions. The 'Hellenocentrists' seek to interpret everything in the light of Greek preconceptions, with the danger that the oriental core of their material is completely ignored. The 'empiricists' and the 'distortionists' accept the eastern origin of certain Greek ideas, but the first concern themselves only with determining the data that lies behind those ideas, whereas the latter explain the differences by a random failure in the linear transmission model. Discussions of the episodes in question, then, exhibit these largely ideological approaches, especially the Hellenocentric view. As said, both episodes have been generally rejected as faithfully drawn reports of Babylonian life, first because no Sumerian, Babylonian or Assyrian source has ever confirmed or even indicated the existence of such marriage rites, and secondly, no less important, due to the allegedly overwhelming Greek orientation of the passages.[225] It has been long recognised that the bride-market shows close similarities to the idea proposed by the 5th cent. Greek writer Phaleas of Chalcedon who 'affirmed that the citizens of a state ought to have equal possessions... and that the shortest way to encompass the desired end would be for the rich to give and not receive marriage portions, and for the poor not to give but to receive them,'[226] and could thus be grounded in current Greek political theory, simply imposed on a foreign context.[227] McNeal has further argued that the bride-market would not have even been possible in Babylonia in the terms that Herodotus proposes. The auction system would only have worked if there was a third party, a state, mediating between the husbands (e.g. organising the exchange of coined money, sureties etc.) – something that in the Near Eastern context would have been virtually impossible, but was fully comprehensible in Greece; in Babylonia marriage was a private affair and never subject to public policy as it was in the Greek *poleis.*[228] There are significant parallels with Athenian marriage customs: e.g. state control; insistence on *engye,* whether in the

[224] Hdt. 1.199: 'every woman of the country must sit down in the precinct of Aphrodite once in her life and have commerce with a man who is a stranger.'

[225] Ravn 1942: 89; McNeal 1988: 55 & 63.

[226] Arist. *Pol.* 1266a-7a.

[227] Griffiths 2001: 167.

[228] McNeal 1988: 55-7.

meaning of betrothal agreement or surety; and not least the public provision of dowries to the daughters of public benefactors or poor citizens.[229] This has led McNeal to the conclusion that 'whoever the inventor was, and whatever basis in actual fact the story had, it has gone through the reflecting medium of a Greek mind and emerged in the *Histories* in a peculiar Greek shape.'[230] Hence, the 'bride-auction' acquired the symbolic meaning of a Greek ideal.

Furthermore, the existence of sacred or temple prostitution, although generally accepted as a historical fact until relatively recently,[231] has now come under serious questioning and thus forms one of the most intriguing chapters in the study of Babylonian discourse. It is one of the best examples of how a *topos* or an *Erzählmotiv* can take on a completely independent life of its own. Like the bride-market, sacred prostitution in the form that Herodotus describes it is unlikely to have functioned in Babylonian or indeed in any society.[232] So, the view currently advocated leans towards postulating that sacred prostitution is a myth, an historical and ethnographic fallacy, produced by the lack of communication between different disciplines and the use of circular arguments: the love-child of ambiguous Greek and biblical references and Victorian anthropology.[233] It is indeed evident that the treatment and investigation of this *topos* in Classical and Orientalist scholarship was largely a product of a scholarly 'witches circle': classical authors led orientalists to believe that such a thing existed and thus all Near Eastern material that depicted sexual intercourse was almost forcefully interpreted as a proof of this preconceived expectation.[234] Not least important in this circle was the willingness of 19th cent. scholars to propagate the image of the contemporary Western woman – modest, almost sexless, pious, and faithfully married – as the polar opposite of the beautiful, powerful, seductive and

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[229] McNeal 1988: 55-71.

[230] McNeal 1988: 69. See fig. 2 again.

[231] See Oden 1987: 135 for an instructive summary on sacred prostitution in modern study, also Assante 2003: 19-27; longer discussion in Budin 2008: 287-336.

[232] Griffiths (2001: 166) holds that the problems inherent in it would have included unwanted pregnancies, doubt about paternity and crowd control. His argument, although sensible and almost definitely applicable to Babylonia, of course only stands if we accept that these would indeed pose problems to every single society.

[233] Oden 1987: 131-153, Beard & Henderson 1997: 480-503, Assante 2003: 14 ('Scholars so consistently read Mesopotamian art and texts through the thick lens of nineteenth century social theory that their original meaning is nearly imperceptible in the secondary literature. Art historians colluded in creating this standard discourse. Without critical evaluation, they distorted the meaning of Mesopotamia's erotic art to fit already existing labels.'), Budin 2008 is an especially vocal advocate of the idea that no form of sacred prostitution existed anywhere at all.

[234] Budin 2008: 4 & 15-6.

dangerous Eastern female.[235] And it is through sheer repetition and the authority of its proponents that this, in the Near Eastern context allegedly non-existent, notion of sacred prostitution became accepted as reality in orientalist discourse.[236]

Indeed, as far as evidence from Mesopotamia goes, there is virtually none. Literary terminology and artistic representations once taken to prove the existence of the practice have now been rebutted. Assante has convincingly argued that kar.kid/*harimtu,* and Budin added the other words previously translated as 'cult prostitute' (*entu/ugbabtum*, *ištaritu, kezertu, kulmašitu, naditu, qadištu, or šamhatu*), cannot be demonstrated to carry this meaning in the cuneiform corpus beyond any reasonable doubt.[237] The same applies to supposed iconographical evidence. Middle Assyrian lead erotica, interpreted before as representing orgiastic cults, are more likely to depict foreign captives engaged in bizarre sexual acts, probably in line with the tendency to equate sexual exploitation with territorial conquest,[238] a symbol that, if we are correct in the following interpretation, recurs in Herodotus 1.199.

The lack of proof from Mesopotamia has led scholars to look for alternative explanations for the passages in question. The usual self-identification motive has been (not surprisingly) applied to the topic by modern scholars. Oden hypothesised that the numerous denunciatory mentions of the practice in the Bible as well as those found in classical and patristic literature could be seen as 'an *accusation* rather than a *reality*', a tendency that carried on into early modern scholarship.[239] Such 'accusation-type' explanation postulates that historically unsubstantiated claims were made towards foreign, especially eastern nations, to depict them in a negative light as decadent and immoral.[240] Herodotus 1.196 and 1.199 can indeed be grouped together with other similar stories that reflect the Greek obsession with barbarian sexual mores.[241] Brosius, who has investigated passage 9.14.16 in Strabo, which connects temple prostitution with the cult of Anahita in Persia, follows the same line of reasoning. She concludes that there is no historical basis for such a claim, at least not in the

[235] Assante 2003: 13-4.

[236] Assante 2003: 14. For a more thorough and theoretical discussion on the principle see Said 2003.

[237] Assante 1998, Budin 2008: 20-31.

[238] Assante 2003: 15.

[239] Oden 1987: 132, author's italics.

[240] Brosius 2009: 126-7.

[241] Discussed earlier in ch. 2.2.2 & 2.2.3.

Achaemenid Empire (though leaving room for the changes that cult might have undergone during the Hellenistic and Roman-Parthian periods), but that the accusation was made by Herodotus' Babylonian prototype, showing once more that the 'cultural *topoi*' can indeed transcend what we see as national borders.[242] She has also drawn attention to another element connected to (sacred) prostitution in classical writers that seems to add weight to the accusation-type argument, namely its close association with tyranny, or rather the misuse of tyrannical power. A fragment of Clearchus of Soli (in Athenaeus) depicts Omphale prostituting élite girls to male slaves and Justin records a comparable story about Dionysius of Syracuse and the daughters of the Lokrians.[243]

Budin, on the other hand, has found that rather than an outright accusation, the entire *topos* of sacred prostitution is 'a methodological mistake, a huge misunderstanding'.[244] There is now an emerging consensus that the relevant passages should not be read literally but, on the contrary, allegorically and/or didactically. However, what exactly they symbolise is still a matter of debate. Kurke believes that it comes down to the reading of Babylon as 'a figure for vast urbanization devoid of civic coherence',[245] a socio-economical Other, everything that the ideal *polis* is not. In the light of the interpretation of the contrasting bride-market motif as a, however twisted, symbol of this *polis,* her idea carries some promise at first sight. She offers a highly allegorical interpretation, discrediting Pembroke's (1967) idea that these passages of the Babylonian *logos* form 'a part of a larger system through which Herodotus represents the 'Oriental subjection of women', insisting instead that these narratives of traffic in women should be read as emblematic 'of all that circulates or can be allotted within the city: money, property, honours, and offices;' in other words, they are allegories of competing economic systems.[246] According to this theory, the temple prostitution that Herodotus so vividly describes envisages 'a long-term transactional order utterly antithetical to the Greek civic ideal', whereas the bride-auction represents a competing alternative, one closer to the Greek mind, one that puts the interests of the community first and, hence, is deemed the most honourable.[247]

Another line of reasoning suggests that these *Erzählmotive* can indeed be read allegorically, but it is

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[242] Brosius 2009: 126-149.

[243] Clearchus F 43a Wehrli = Athen. 12.516; Justin 21.3.

[244] Budin 2008: 12.

[245] Kurke 1999: 233.

[246] Kurke 1999: 230-1 & 245.

[247] Kurke 1999: 238-9.

the status of a fallen empire that they refer to.[248] Accordingly, the auction symbolises the 'lost virtue of the Babylonian *past*,'[249] whereas the prostitution of the female children and the Mylitta-cult are the present of a conquered society. In Beard and Henderson's view Babylon occupied a distinctive niche in Herodotus' 'cabinet of ways to be un-Greek which explains how Cyrus' Persia conquered and supplanted it; and in so doing [Herodotus] put his finger on the strengths and weaknesses, socio-political, customary-religious, solidary-hierarchical, of their culture as a system – in heyday, and in eclipse.'[250] There is, in addition, a strong rape motif in the story, with a sheer lack of volition and choice on the women's part. As Budin has noted, 'these concepts – defeat, effemination, and rape – are long-enduring and long-entwined in Greek ideology... to be defeated implies effemination and rape, and *vice versa*.'[251] But if we believe Assante, these were, in certain forms, already part of Mesopotamian ideology and iconography.[252] In this sense, it is probably right to conclude that 1.199 reflects this ubiquitous creed, with sacred prostitution becoming the symbolical 'rape' of Babylonia by Persians. It is unlikely to be used as an accusation, hence Budin's reluctance to view the origins of the *topos* as such. Rather, one can observe some sympathetic undertones and view it as part of Herodotus' wider deliberation on the mutability of fortune and the fate of the defeated.[253] But why would such a victimising custom be connected to a local deity? And why would it be made sacred? It could be explained by the Near Eastern belief that it was gods who decided the outcomes of war. In this context it is perceivable that if the Babylonian women were indeed in reality ever subjected to such a ritual punishment, they would have viewed it as a divine will and would have dedicated the proceedings to Ištar, the goddess of love and war.

So, is Herodotus knowingly projecting Greek concerns with conquest onto Babylonia, choosing these specific stories as meaningful allegories for their past freedom and contemporary slavery,[254] in order

[248] Beard & Henderson 1997: 488, Lateiner 1989: 137, Budin 2008: 79-89.

[249] Beard & Henderson 1997: 488, authors' italics.

[250] Beard & Henderson 1997: 488.

[251] Budin 2008: 82-3.

[252] Above, p. 49.

[253] Cf. the parallel of the softening and subsequent decadence of the Lydians. The association of some parts of Cyprus with a similar practice could also be meaningful. What connects the two territories is the fact that both participated in a rebellion after the initial Persian conquest (plus, in Budin's view, their shared ethnic heterogeneity). No less important is Herodotus' insistence that the 'client' must be a stranger, probably in a sense of a foreigner.

[254] The severity of the situation, at least in the city of Babylon itself, might not have been as great as this would lead one to imagine. Boiy's (2004: 194-204) careful consideration of the surviving documents shows that

to emphasise the importance of political independence and the fate that Greeks themselves once so narrowly escaped but could share in the future? If so, where do these stories originate from? Did Herodotus make them up? One significant hint comes from his view that the rationale behind it was religious, on the one hand, for he describes the act as a 'duty to the goddess', but moralistic, on the other, for one will not 'be able thenceforth to give any gift so great as to win her.'[255] Why would Herodotus provide this seemingly contrived rationalisation if his main reason for relating the custom was something completely different?

I therefore agree with Griffiths in thinking that although the Babylonian material is probably fiction, 'the fantasy of an outsider projecting Greek Utopian theory onto a realm where it can be imagined as reality', it is more likely to be the result of an anonymous popular tradition which Herodotus picked up and transmitted, as he often did, 'without much personal input'.[256] If the tradition had been around for some time, it must have picked up new elements and narrative decorations over time, perhaps even changed its location (as happened to some historical narratives that will be discussed later). It cannot be argued with any certainty that Herodotus did not check his sources. When his contemporary sources failed to confirm the existence of the bride-market custom, he could simply have concluded that it was no longer in use. That could have given him the idea to use it as a symbol of bygone days. Nor can one argue with full certainty that the story of sacred prostitution had no factual basis, no matter how ill-interpreted and 'mistranslated': at its most basic, all it would take is one temple, one cult, to get the ball rolling. It need not be a mainstream or an official state religion but a simple (mis-)observation that grew and changed over time, acquiring all elements that we find in Herodotus' account, reinforced by further misinterpretation of local Babylonian customs - in effect of preconceived ideas similar to the ones made by classicists and orientalists. After all, 43 sanctuaries are listed in a cuneiform document known as Tintir tablet IV[257] but with the majority of these temples remaining unexcavated, we know virtually nothing of the cults they served.

Bottéro attempted to give a more defensive explanation for 1.199 along these lines, reasoning that

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Babylon was *de iure* a temple state, and although under foreign overlordship, its daily affairs were most probably run by the local *šatammu* (high priest and administrator) and *kiništu* (temple council). For the situation during the Seleucid period see Sherwin-White & Kuhrt 1993: 59-61.

[255] Hdt. 1.199.

[256] Griffiths 2001: 167; cf. Kurke 1999 who thinks that both the prostitution and the wife-auction episodes are Herodotus' own fantasy.

[257] For text and translation see George 1992: 58-32, and for commentary 294-332.

Herodotus, or more likely his source, could have seen a great number of prostitutes in the precinct of Ištar and mistaken them for the entire female population of Babylon.[258] The small discrepancies between the accounts of Herodotus and Strabo leave room for a slight possibility that there could have been an earlier written source on which they both drew.[259] The story could have been included in the *Histories* for its allegorical resonances, but it is unlikely to have been deliberately fictitious. Neverthless, the belief that Babylonians practised some form of sacred prostitution was underlain by an *imaginaire* that had emerged from the more general cultural grid of the 'Orient', more particularly the speculations on the sexual and ethical mores of the barbarians, and by the time of Herodotus the resulting stories were very close to fiction. We can expect that this pair of Herodotean narratives was in one way or another influenced by prevalent beliefs surrounding this topic and as such we can perhaps talk of a 'misreading' of whatever Herodotus or his source(s) witnessed in Babylon rather than of outright invention as the 'Hellenocentrists' would have it.

2.3.2 Legendary Rulers from Ninus to Sardanapallos

Greco-Roman authors give shorter or longer, but all equally perplexing, descriptions of a number of Assyrian and Babylonian rulers. Undoubtedly the most famous and most influential on Greek and subsequent Western thought are the figures of the all-powerful Oriental queen Semiramis and the affluent and feminine king Sardanapallos. This subchapter serves to illustrate the development of a motif within the 'cultural grid' and is of special relevance as these characters, or the stereotypes that they provide, still persist in modern culture.[260] The key elements of discourse on Mesopotamian history and rulers - e.g. once powerful empires undermined by excessive luxury, reversal of gender stereotypes - all occupy an important part in the Greek mind-set as discussed before in the context of a general 'Oriental discourse'. Nevertheless, it will be argued that this matrix only provides what it says – a framework – which is to be filled with what can be described as a selection of perceived facts. For the convenience in discussion of parallel episodes in the cuneiform material, the following

[258] Bottéro 1992: 189.

[259] MacLachlan 1992: 149-50.

[260] From the 1st cent. AD *Ninus Romance* (or the *Novel of Ninus and Semiramis*) through the Middle Ages and Renaissance (see Samuel 1944, Eilers 1971, Alexander 2004; e.g. Semiramis appears in Dante's *Divine Comedy* (early 14th cent.)), up to the modern era (e.g. 5 operas called *Semiramide*, by Cimarosa, Portugal, Mysliveček, Meyerbeer and Rossini; Byron's play *Sardanapallos* (1821); Delacroix's pointing *The Death of Sardanapallos*; Berlioz's cantata on the same subject, Semiramis as a character or prototype of a character in numerous books and films, often representing lustfulness or beauty).

paragraphs give a short overview of stories told about Assyrian and Babylonian kings and queens by Greek authors.

The earliest references to Mesopotamian rulers date to the 5th cent. BC. The earliest extant account can be found in Herodotus, who mentions Ninus, his son Sardanapallos, and talks of the exploits of queens Semiramis and Nitocris, in addition to preserving a few haphazard references to a couple of historical rulers.[261] Yet these mentions are all rather short; only the queens are provided with a more extensive history. Herodotus depicts Nitocris as living five generations after Semiramis and as being more accomplished, especially in regard to her building projects. Another early mention of Sardanapallos, or more specifically the two of them, comes from Hellanicus of Lesbos.[262]

Around these key figures a colourful mythology and history is built up, especially by Ctesias of Cnidus, in whose hands these characters changed rather significantly. Ctesias' narrative makes use of earlier Greek notions of what life in the eastern courts must have been like (e.g. eunuchs, court intrigue), as well as stories that must have had wider international circulation. Hence, the second half of this subchapter will concentrate on the question of sources and origins. The resulting gallery of kings and queens became the standard for centuries to come. Strabo, for instance, depended on him indirectly[263] and a very boiled down version of Ctesias' narrative, with an addition that Semiramis disguised herself as her son Ninyas, is given in Justin's epitome of the *Philippic History* of Pompeius Trogus;[264] moreover, Syncellus also notes that Diodorus, Kephalion, Kastor and Thallos all took the Assyrian history to run from Belus to Sardanapallos.[265] The account given here relies on the longest fragment of the relevant passages from Ctesias in Diodorus Siculus. As it includes extrapolations from other, later accounts, it provides a sort of amalgamation of what was current in the 1st cent. BC discourse on Ninus, Semiramis, and their successors. Other accounts will be mentioned when and where appropriate.

In brief, Diodorus relates how Ninus, the first Assyrian king recalled in history, made an alliance with

[261] Hdt. 1.7 (Ninus & Belos), 1.74, 1.77 & 1.188 (two kings called Labynetos, possibly Nabonidus, although their exact identity is somewhat obscure), 1.184-188 (Semiramis & Nitocris), 2.141 (Sennacherib), 2.150 (Sardanapallos, son of Ninus).

[262] See n. 154 above.

[263] Bichler 2004: 502.

[264] Justin, *Epit.* 1.1-3.

[265] Sync. *Ec.* 172.17 = *BNJ* 254 F 1 = 93 F 2 = 250 F 1b = 256 F 5.

King Ariaeus of Arabia and subdued Babylonia, invaded Armenia, defeated Media and killed its king Pharnus. Inspired by his success he undertook to subdue the whole of Asia and during his 17-year campaign came to rule everyone except the Indians and the Bactrians.[266] The great king then went on to build the city of Ninus (Nineveh), the biggest that the world had ever seen.[267] After this Ninus undertook a campaign against Bactria, during which he married Semiramis, 'the most remarkable of all women of whom we have a record', a demi-god born from a union of Ascalon's goddess Derceto and a Syrian youth. But the goddess, growing ashamed of the affair, killed the man, discarded the baby-girl, who was subsequently nourished by doves, and threw herself into the lake where her body changed into that of a fish.[268] Semiramis, however, whose name is alleged to come from the word for dove in the Syrian language, was found and given to Simmas, an attendant of the King's cattle.[269] She grew up to become an exceptional beauty and married Onnes, a lieutenant of the King's court and governor of Syria, with whom she had two children, Hyapates and Hydaspes.[270] During the Bactrian campaign (*v. supra*), Semiramis made her way to her husband, helped to capture the besieged city

[266] Ctesias F1b L-R (the fragment numbers, if provided, will always refer to this edition; for the sake of convenience, they will be omitted in the case of Diodorus from now on) = Diodorus 2.1.4-2.2.2. Follows (2.2.3) the list of the defeated tribes.

[267] Diodorus 2.3.1-4.

[268] See Ath. *Deipn.* 8.37 for further discussion on the worship of fish, also Ctesias F1eα and F1eβ L-R, and CCDS 23-35, 39 on Derceto and the constellation of the 'big-fish'. Athenaeus records the words of Mnaseus (*History of Asia*) who talks of a queen who loved to eat fish and hence forbade her people from eating it but names her Gatis, saying that common folk mistook it for Atergatis (cf. Goddess Atargatis). 'A custom still prevails, when the Syrians pray to the goddess, to offer her golden or silver fish...' Most important however, he says his information came from Xanthus (*FGrH* 795 F17a) who said this Atergatis 'being taken prisoner by Mopsus, king of Lydia, was drowned with her son in the lake near Ascalon, because of her insolence, and was eaten up by fishes.' The mother and son falling into the element of water is paralleled in the explanation for the constellation of Pisces: e.g. CCDS 39-43, 47, 49, 51-2. According to Hyginus (CCDS 43 = *Astronomica* 2.30) the story comes from Diognetus Erythraeus who says that 'once Venus and her son Cupid came in Syria to the river Euphrates. There Typhon… suddenly appeared. Venus and her son threw themselves into the river and there changed their forms to fishes, and by so doing this escaped danger. So afterwards the Syrians, who are adjacent to these regions, stopped eating fish, fearing to catch them…' Although Jacoby (*FGrH* 120 F2 commentary) thinks it a variant of Ctesias, the inclusion of the son in the story must stem from another source, most probably Xanthus. Ovid obviously knew both legends (*Met.* 4.43-8, trans. Kline 2000): 'She wondered which of many she should tell (since she knew very many), and hesitated whether to tell about you, Babylonian Dercetis, who, as the Syrians of Palestine believe, with altered shape, your lower limbs covered with scales, swam in the waters, or how your daughter, assuming wings, lived her earliest years out among the white dovecotes' (also compare this with *Fasti* 2.457-74).

[269] F 1b = Diodorus 2.4.1-6, F1c = Anonymous, *On Women*, 1; for Derceto also F1d = Strabo 16.4.27, F1eα = Eratosth. *Cat.* 28, F1eβ = Hyg. *Astron.* 2.41, F1m = Athenagoras, *Embassy for the Christians* 30.

[270] Diodorus 2.5.1. Although Ammianus Marcellinus (23.6.22-23) says that Semiramis was 'formerly the queen of Persia'.

and thus attracted the attention of king Ninus whom she married after her first husband's suicide.[271]

Semiramis and Ninus begot Ninyas and after Ninus' death Semiramis took over as ruler of the Assyrian Empire.[272] The new queen, eager in her wish to surpass her late husband, founded the city of Babylon, for the construction of which she assembled 2 million men from all over the kingdom.[273] After finishing her elaborate building projects Semiramis undertook a campaign against Media. On the way through Asia she set up, among other things, a camp and inscriptions at Mount Bagistanus (i.e. Behistun), and built a compound near Chauon and a lavish palace at Ecbatana.[274] She then moved on to Egypt and Ethiopia, conquered most of Libya and got an oracle from Ammon about her impending death through the plotting of her own sons.[275]

Semiramis' next feat was to wage war on India and its king Strabrobates. Preparations for the expedition were extensive – troops were gathered from the entire kingdom; collapsible riverboats were built by Phoenicians, Cypriots and other maritime people under Assyrian rule; and, most fascinatingly, an enormous number of fake elephants were constructed in order to frighten the Indians, using the hides of 300,000 black cows, straw, camels to carry the models around and men to operate them.[276] Ctesias recorded that the army comprised 3,000,000 infantry, 200,000 cavalry, and 100,000 chariots, plus an additional 100,000 camel-riders, 2,000 riverboats and, of course, the fake elephants.[277] Strabrobates, however, outdid Semiramis in the number of ships, men and elephants (real ones) alike,[278] and Semiramis was eventually forced to flee, having lost two thirds of her force.[279]

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[271] Diodorus 2.6.1-10, F1c.

[272] Diodorus 2.7.1, F1c.

[273] Diodorus 2.7.2-9.9.

[274] Diodorus 2.13.1-14.2, F1h.

[275] Diodorus 2.14.3-4. Nicolaus of Damascus (F11δ = *FGrH* 90 F1) gives, in considerable detail, the story of Semiramis' and Onneus' sons' plot against their mother, presenting them as pushing her off the cliff, a story left out from Diodorus' summary. Nicolaus does not say how the episode ended: the narration breaks off when Semiramis, having found out about her children's' treachery, addresses them and asks them to fulfil their wicked plan, but an allusion in Cephalion (F1g, via Eusebius) states that she 'butchered her sons herself.'

[276] Diodorus 2.16.1-10.

[277] Diodorus 2.17.1-2.

[278] Diodorus 2.17.4-8.

[279] Diodorus 2.18.1-19.10. According to Nearchos (*BNJ* 133 Fa = Arr. *An.* 6.24.2-3, F3b = Strabo 15.1.5-6) the number of survivors was mere twenty souls and Megasthenes (*BNJ* 715 F11a = Strabo 15.1.6, also F11b = Arr. *Ind.* 5.4-5) denied the historicity of the Indian campaign altogether. Although Roller (*BNJ* 715 F11 commentary) doubts if the ultimate source is actually Megasthenes. In his opinion, and that of Whitby (commentary to *BNJ*

Finally, having ruled for forty-two years, she abdicated in favour of her son Ninyas, in accordance with the oracle, and disappeared.[280] With the reign of Ninyas starts the discourse of decline: the demise of the Empire and the depiction of Assyrian rulers as overly luxurious weaklings, for

> in the first place he spent all his time in the palace, seen by no one except his concubines and attendant eunuchs, and sought luxury and idleness and the total avoidance of suffering and anxiety, thinking that the goal of a happy reign was to enjoy every kind of pleasure without restraint.[281]

Yet, his excesses were not comparable to those of Sardanapallos,[282] who, ruling 30 generations after Ninyas,[283] saw the Empire which had dominated Asia for 1,360 years come to its end.[284] He

> surpassed all the others that came before him in luxury and idleness. For apart from the fact that he was never seen by anyone outside the palace, he lived the life of a woman, and spent his time with his concubines, spinning purple cloth and working the softest fleeces, and he took to wearing female clothing and made up his face and his whole body with white lead, and other things courtesans customarily use, more delicately than any luxury-loving woman. He purposefully adopted a woman's voice and during his drinking sessions not only did he continually enjoy such drinks and food as were capable of providing the most pleasure, but he also pursued the delights of sex with men as well as women; for he freely enjoyed

133 F3a), this story is imbedded in the tradition that aimed to highlight Alexander the Great's achievements.

[280] Diodorus 2.20.1-2; F1c varies slightly in details: 'After being plotted against by her son, Ninyas, she died at the age of 60, having reigned for 42 years', whereas Diodorus says she lived for 62 years; an even more garbled form appears in F1g = Eus. *Chron.* 29, 3-10 Karst, which says that Cephalion relates 'Semiramis campaign against the Indian land, and her defeat and flight; and how she butchered her sons herself; and how she was herself killed by her own son, Ninus, after she had reigned for 42 years.'

[281] Diodorus 2.21.1-2, also F1n = Ath. 12.38 p. 528ef, F1oα = Eus. *Chron.* 29, 10-26 Karst

[282] Diodorus 2.21.3-7.

[283] Eusebius (*Chron.* 29, 10-26 Karst) says that according to Cephalion's report (a corruption of Ctesias') 'they ruled for a period of a thousand years...and that not one of them held power for less than twenty-years.' He makes an interesting claim that Ctesias listed them all by name. The list has, unfortunately, not survived. A few names come down to us through Agathias (F1oβ = *Histories* 2.25.4-6) who says that it 'has been recorded somewhere by Binon and by Alexander Polyhistor' that at some point power was usurped from the last king of Semiramis' family by a man named Beletras. The father of Sardanapallos (Sarandapallus in Ath. 12.38) is said to have been either Anacynadaraxes or Anabaraxares.

[284] Diodorus 2.21.8.

intercourse with both, not worrying at all about the shame engendered by the deed...[285]

Such lifestyle and character generated enough disdain among his subjects to cause plots and revolts against the king, which finally resulted in his downfall.[286] Ctesias describes how the joint forces of the Medes, Persians, Babylonians and Arabians came to Nineveh and, through difficult struggles and great losses, finally managed to defeat Sardanapallos' forces with the help of the Bactrians.[287] After a three-year siege, a flooded river brought down a section of the city wall – a sign that the king interpreted as a fulfilment of an oracle – and, giving up any hope of salvation, he 'burnt himself and all the others to death and razed the palace to the ground.'[288]

It has long been recognised, that this *logos,* although considered untrustworthy, indeed almost fairytale-like in some aspects, still contains episodes that bear startling resemblance to the historical events recorded in the cuneiform sources. MacGinnis, for one, has pointed out that 'certain elements in Ctesias' description of the fall of Nineveh go back to the details actually derived from an earlier siege and fall of Babylon'.[289] Not only is there a correspondence between the lengthy three year siege of Babylon between 650 and 648 BC that was the culmination of a rebellion instigated by Aššurbanipal's brother Šamaš-šum-ukin but the constitution of the allied forces (Medes, Persians, Babylonians and Arabs), the role of military leaders as instigators, and the king's death in a fire he himself created are all closer to the named revolt than to the one that saw the destruction of Nineveh.[290] If we add the confusion of the rivers, which will be discussed in more detail below, and the mention made of an ominous heavenly sign – Aššurbanipal records an eclipse – the similarities are too strong to be a simple coincidence.[291] An Aramaic text in demotic script about this event has actually been discovered in Egypt, relating the story of Sardanabal (Aššurbanipal) and Sarmuge (Šamaš-šum-ukin), although discrepancies between the account and the evidence of the cuneiform sources are significant.[292]

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[285] Diodorus 2.23.1-4; also F1pα = Ath. 12.38, F1pβ = Arist. *Pol.* 5.10.22, F1pγ = Poll. 2.60, F1pδ = *FGrH* 90 F2.

[286] F1pε = *FGrH* 90 F3.

[287] Diodorus 2.24.1-26.9.

[288] Diodorus 2.27.1-2, F1q = Ath. 12.38. Cf. *BNJ* 680 F7d.

[289] MacGinnis 1988: 37.

[290] MacGinnis 1988: 37-39.

[291] MacGinnis 1988: 39-40.

[292] Ed. and trans. Steiner & Nims 1985: 70-81, synopsis 63-5.

Worth consideration in this context is also Ctesias' claim that Herodotus' account of Darius' siege of Babylon actually refers to the reign of Xerxes.[293] What implication do these two battle-accounts have? MacGinnis himself, I suspect quite rightly, concludes that Ctesias must have relied on oral tradition.[294] Whether Ctesias and/or Herodotus relocated the elements themselves, or they had already been incorporated into general siege-stories is hard to tell. However, this discrepancy between the accounts of Herodotus and Ctesias is not a singular phenomenon; they actually make use of a number of same general stories and motifs but differ in detail and personae associated with them.[295] It appears that what we have here is a 'collection' or 'gallery' of motifs associated with the Near East. Although Bichler's preferred explanation of a literary game between the two Greek authors probably accounts for some of the differences, the fact that it cannot be used to argue away all the material is shown by a substantial number of similar examples that will be outlined presently.

First, however, König reckons that the campaigns of Sargon II on Urartu were the inspiration behind the deeds of Ninus in Armenia, just as those of Sennacherib on southern Babylonia and Esarhaddon and Aššurbanipal on Elam were essentially behind the deeds of Semiramis against the 'Indians.'[296] Furthermore, he has offered a simple but brilliant explanation as to why the wars against the Elamites became one massive campaign against the Indians in Ctesias, arguing that the Elamites depicted in the Assyrian reliefs with their short kilts, bare feet, and thick straight hair tied in a band at the back of the head, look very similar to the Persian depictions of Indians.[297] There might also be ethnic relations between the two with Elamite possibly belonging to the Dravidian family of languages spoken in India.[298] The Indian-Elamite confusion is further confirmed by Herodotus' reference to the 'Indian dogs'[299] which are mirrored in an Assyrian lexical list by an 'Elamite dog'.[300]

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[293] Ctesias F13 = Photius §26; also see West 2003: 431-2.

[294] MacGinnis 1988: 40-1.

[295] Including Cyrus being wounded in battle in the same way as Cambyses in the *Histories,* the change from 'false Smerdis' to 'false Tanyoxarkes', the revolt of Babylon being connected not to Darius and Zopyros but to Xerxes and Megabyzos etc. See Bichler 2004: 505 for a short overview and further references.

[296] König 1972: 35-40. Alternatively, the Indian campaign is held to be modelled on Alexander's expedition and this is used to argue that Diodorus could not have drawn his material from Ctesias, but perhaps from Cleitarchus' reworking of Ctesias (Stronk 2007: 32-3, Gardiner-Garden 1987: 8-9). This is, nevertheless, unlikely, as Ctesias is also mentioned by Nicolaus of Damascus; unless of course, Nicolaus too used Ctesias indirectly (Stronk 2007: 32-3).

[297] König 1972: 38, Dalley 2003: 183-4.

[298] McAlpin 1974 and 1981, McAlpin et al. 1975.

[299] Hdt. 1.192: '...of Indian hounds moreover such a vast number were kept [in Babylon] that four large villages

Moreover, Vlaardingerbroek has looked at the founding myths of Nineveh and Babylon in Greek historiography and has concluded that these too include some genuine Babylonian elements.[301] For instance, parallels can be drawn between the founding story of Babylon by Semiramis and the founding of Babylon by Marduk in *Enuma eliš*.[302] Scholars have argued, based on the attribution of the establishment of Nineveh to Ninos, that he was entirely a Greek invention, corresponding to the Greek idea that every city needed an ἥρως ἐπώνυμος[303] and it has been held that this is no doubt a Greek convention, as is the starting of Babylonian king list with Belus, i.e. the idea that a dynasty should start with a deity, although the god used is a Babylonian one (Marduk).[304] But Dalley has recently pointed out that this might not necessarily be the case. Namely, the 'phenomenon can be described as fulfilling the local need to make a city's foundation prestigious through myth, and to explain the role played by its patron deity.'[305] Assur and Anat, after all, bear the names of gods.

The case of Semiramis too constitutes a particularly interesting and complex example of how genuine Babylonian features are combined and transformed through the application of Greek 'cultural grid'. It is evident that Semiramis is, in essence, a fictitious figure that combines features of several queens, kings and deities, and projects them upon one legendary woman. This is made quite clear when one compares Ctesias' depiction of Semiramis with that of Herodotus who offers descriptions of two Babylonian queens instead of just one.[306] Compared to Ctesias, Herodotus' Semiramis lives later and is clearly outshone by her successor. No mythical elements (e.g. birth-legend, death-legend) are added to the account, either.

The inspiration behind these two queens has not failed to perplex scholars. It would be easy to conclude from the Hellenocentric perspective that the reason for the incorporation of this/these queen(s) into classical Greek works on Mesopotamian history was general Greek fascination with the 'powerful Oriental female', the opposite of a 'Greek wife', a similar line of argument as witnessed

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in the plain, being free from other contributions, had been appointed to provide food for the hounds.'

[300] Dalley 2003: 187.

[301] Vlaardingerbroek 2004: 233-39.

[302] *Ee* 6.44-7. Vlaardingerbroek 2004: 235.

[303] Vlaardingerbroek 2004: 234.

[304] Vlaardingerbroek 2004: 234.

[305] Dalley 2005: 18-9.

[306] Hdt. 1.184-88.

before in the case of sacred prostitution. But the evidence for strong Orientalising elements in the narratives suggests that there is more hidden behind these figures than simple self-searching of a patriarchal society. Despite some attempts to dissociate Nitocris/Semiramis legends from the Syro-Palestinian and Mesopotamian background, the looming similarities show that the figures stem, at least partly, from local traditions and are not mere products of Greek imagination. In the following is set down a selection of elements that have been argued to have parallels in the various Near Eastern traditions.

Weinfeld argues that the names 'Semiramis' and 'Derceto' both derive from the epithets of Syro-Palestine goddesses (Astarte, Anat and Aserah; or Atarata, a combination of those).[307] Ugaritic text RS 24.252 describes Anat as *darkatu* and *šamīm ramīm* ('the mistress of dominion, the mistress of the high heavens'[308]); Astarte is also referred to as the 'lady of heaven' or heavenly in Phoenician and Palestinian tradition (as was Ištar in Babylonia (*šarrat šamê* 'queen of heaven')).[309] The recognition that Semiramis is an epithet is of course much older, with Robertson Smith suggesting in 1887 that it could mean 'the highly famed' (shĕmi, 'name' + rām, 'exalted').[310] The word that Diodorus, or more likely his source, had in mind when he said that Semiramis meant dove was probably Akkadian *summatu*.[311] In general, parallels with Ištar (or eastern goddesses more universally), especially the unfortunate end of her lovers, were recognised from early times.[312]

Semiramis as a historical person has been commonly identified as Sammuramat, the queen of Šamši-Adad V, who ruled as a regent of her son Adad-Ninari III probably between 811-808 or 809-792 BC.[313] A boundary stone from Pazarcik (near Marash in Turkey) confirms that Sammuramat campaigned with her son in Anatolia, refuting the previous belief that the military leader aspect of the Semiramis

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[307] Weinfeld 1991: 99-103.

[308] But see Dalley 2005: 19: masculine *Sammû* (written GIŠA.ZÀ.MI)-*rama* found in an Assyrian text, meaning 'the lyre is beloved'.

[309] Weinfeld 1991: 100. Consider also Aphrodite Ourania – 'heavenly Aphrodite' (see Burkert 1987: 152-53).

[310] Robertson Smith 1887: 305. Cf. Hiram 'brother of Ram', Ram meaning 'the exalted one.'

[311] Sayce 1888b: 106. CAD also gives 'a fish' as one of its possible meanings.

[312] Lenormant 1872; Robertson Smith 1887 and Sayce 1888b agree. Compare Semiramis' lovers buried alive with Ištar rejected by Gilgamesh for sending everyone she has ever loved to damnation (*Gilg.* 6.32-79); and especially the love for a horse in Pliny 8.42 (from Juba) and *Gilg.* 6.53-7.

[313] See s.v. 'Sammuramat' in *PNAE*. For a list of Assyrian sources on Sammuramat see Schramm 1972: 514; note also how Schramm denies that Sammuramat acted as a regent (*ibid*., 521). She must have been born c. 850 and died c. 790 or 785 BC.

figure must have been fictitious.[314] The only other document that relates to the military actions by royal women is SAA 18 85 – a letter addressed to Naqiʾa (below), concerning the Elamite invasion of the Sealand.[315] It is also evident from the royal correspondence that from the beginning of the 7th cent. BC onwards Assyrian queens had direct command over their own army units, whose size and exact duties, however, remain unknown.[316]

Later Armenian sources too, although obviously heavily influenced by the Greco-Roman tradition,[317] could record some genuine local stories that associate Semiramis with the war against Aram and his son Ara.[318] Sammuramat's father-in-law Šalmaneser III fought several campaigns against the Urartian king Arramu in 858, 856 and 844 BC.[319] Although all too early for Sammuramat to have been directly involved - taking account of the fact that she was contemporary with another Urartian king Menua, who build the 'Shamiram canal'[320] - it is reasonably likely that she was a well-known figure in the Armenian region and her memory survived in some confused and mingled form in popular tales, for Moses clearly states that the legends of his country confirm the claims made by the Syrians especially in regard to Semiramis' death in Armenia.[321] On the other hand, as regards the story of Ara, the legend appears to be a variation of the story of Tammuz (hence also related to the Adonis myth) and also bears some resemblance to Plato's myth of Er.[322] Chahin nevertheless allows himself to speculate, almost as freely as Dalley later, that the legend could have been born after Sammuramat's (very tentative) victory over Menua's son Inushpua but for some reason 'Inushua's personality passes

[314] Dalley 2005: 12.

[315] Svärd 2012: 103.

[316] Svärd 2012: 132.

[317] Compare Moses of Chorene, *History of Armenia*, 1.17 with *FGrH* 90 F1 (Ctesias through Nicolaus of Damascus) on Semiramis' childrens' plot against her; mention of her war in India in 1.18; 1.18-9 – Ninyas kills Semiramis and becomes king. Moses names Cephalion and Mar Ibas Katina (1.18) as his sources, the latter allegedly used the Greek translation of the *History of Assyria* that Alexander had made and he had accessed in the royal archives of Parthia (Tisdall 1897: 38-9).

[318] Moses of Chorene, *History of Armenia*, 1.15.

[319] Dalley 2005: 12-3.

[320] A canal flowing from a spring near Mzenkert through Tushpa into Lake Van, some 45 miles long. A cuneiform inscription attributes its construction to king Menua and gives its name as the Menua Canal, but it is also known as 'the queen among canals' (Chahin 1987: 74).

[321] Moses of Chorene, *History of Armenia,* 1.18.

[322] Robertson Smith 1887: 307-8, Chahin 1987: 74-5.

into the world of legend under the guise of Ara the Beautiful.'[323]

Further, the fish-motif of the legend could originate from the time of Sammuramat when a new temple was built in Nimrud adorned with mermaid iconography and dedicated to Nabû, who from Adad-ninari III's time onwards enjoyed the status of an *apkallu,* a 'sage'.[324] The sages, seven in number, were depicted as fish-like men who brought culture and civilisation to early humans (see below).[325] Dalley suggests that the Semiramis-Fish connection could have emerged through Sammuramat's link to the temple.[326] The *apkallu* association is manifest also in the inclusion of Onnes, a corruption of Oannes, the first sage (below) as Semiramis' first husband.[327]

Another potential prototype for the figures is Sennacherib's second wife and Esarhaddon's mother Naqi⍰a (Akkadian Zakūtu).[328] Lewy has aimed to demonstrate that a lot of the elements present in the Nitocris story correspond to what we know of her and her deeds.[329] The association of Semiramis with Ascalon, on the Palestinian coast, is also interesting here as Sammuramat and Naqiᵓa/Zakūtu are said to have been of Palestinian/Philistine and Syrian/Hebrew origins, respectively.[330] On the one hand, there is indeed evidence that Naqi⍰a wielded strong authority during the reign of Esarhaddon – she built him a palace at Nineveh, dedicated cult objects, communicated personally with high officials, was portrayed in reliefs and statues, and, perhaps most important, was referred to 'with accolades normally reserved for kings alone.'[331] On the other hand, Melville has argued, contra Lewy, that none of the evidence proves that she ever ruled any part of the empire, held an administrative position or influenced imperial politics,[332] although she might have played a more important part in

[323] Chahin 1987: 75.

[324] Dalley 2005: 13.

[325] De Breucker 2003: 29.

[326] Dalley 2005: 14.

[327] Robertson Smith 1887: 313-4, Dalley 2005: 18.

[328] Lewy 1952: 264-286, supported by Pettinato 1985 and Dalley 2005: 11.

[329] Lewy 1952: 264-286. See Melville 1999 for the discussion on the role of Naqiᵓa in Sargonid politics.

[330] Weinfeld 1991: 102.

[331] Melville 1999: 32-3. The honourable position that Naqiᵓa held in the court is also evident from the application of the honorific word *bēlu* (masculine for 'lord') to her in no less than eight surviving texts (see Svärd 2012: 72-4, esp. n. 247, for a list of occurrences). Only one other case in which the word is used to address a female is known from SAA 16 56 (a letter to Balti-lešir). She was also, to modern knowledge, the only woman to have had her portrait placed in a temple, which was usually reserved only for kings (Melville 1999: 52).

[332] Melville 1999: 43, 72 & 77. In her view the use of the word *palû* ('reign'), used on the dedication tablets of

the government in times of crises.[333] In her view, behind Naqiʾa's rise to prominence lay most probably Esarhaddon's wish to ensure the smooth accession of Aššurbanipal and Šamaš-šum-ukin, culminating with the 'Zakūtu-treaty',[334] a loyalty oath imposed by Naqiʾa on the nation for the benefit of Aššurbanipal.[335]

Gera, however, has pointed out that one of the inconsistencies between historical Naqiʾa and Herodotus' Nitocris is that she was not the mother of Nabonidus (Herodotus claims that Nitocris was the wife of one Labynetos and mother of another).[336] It has, therefore, been suggested that Nitocris must be Nabonidus' mother Adad-Guppi, who appears in an inscription detailed below.[337] But Ctesias says that Semiramis was Ninus' wife, so Sargon's wife Atalya also enters the picture.[338] Campbell Thompson has noted parallels between a letter he believes to have been written straight after Sargon's accession and mentioning a king taking a wife of his prefect to his royal harem and Ctesias' story of Ninus stealing Semiramis from Onnes.[339] Even if his interpretation that the prefect is none other than Sargon himself (in which case the woman in question could be Atalya) is mistaken,[340] it gives indisputable evidence of the practice being if not common, then at least occurring. However, Frahm has proposed that the woman in question was Tašmetum-šarrat, the 'beloved wife' of Sennacherib.[341] Radner finds this too tentative and proposes a far simpler option, that the governor's

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Naqiʾa and Libbali-šarrat, carries only symbolic meaning. Cf. Svärd 2012: 69-70 & 114-5, who says that Melville's argument could easily be turned around, meaning that both queens had 'institutionalized authority in the realm.'

[333] Melville 1999: 81.

[334] SAA 02 008.

[335] Melville 1999: 59-60. A possible parallel to this situation has also, if very fleetingly, been suggested for Atossa by Sancisi-Weerdenburg (1983: 25-6): if indeed Atossa occupied a powerful position in the Persian royal court, she could have acquired it only after Xerxes was chosen, due to political motivations, as the heir to the throne, not because of Atossa's already influential position as Herodotus suggests.

[336] Gera 1997: 108. Hdt. 1.188. One Labynetos the Babylonian is mentioned in 1.74 as one of the peace envoys between Lydians and the Medes in 584 BC.

[337] Reade 2000: 200.

[338] Dalley 2005: 11-2.

[339] Campbell Thompson 1937: 42. ABL 473 = SAA 16 095: 'The king received the [wife] of the governor and brought her into the Palace. On the day we heard that the king was dead and the people of the Inner City were weeping, the governor brought his wife out of the palace...' (trans. Luukko & van Buylaere 2002).

[340] Ibid. 35-43.

[341] Frahm 1997: 184.

wife could have been held hostage to keep her husband under control.[342] The motif itself, however, is not uncommon in the Near Eastern tradition; a similar plot is used in the biblical story of David and Bathsheba.[343]

As if all this confusion were not enough, MacGinnis has argued that some deeds attributed to Nitocris are feats of Nebuchadnezzar, 'Lake Nitocris' being the most obvious example,[344] and Dalley provides a rather long list of things that various authors attribute to Semiramis or Nitocris but that were actually undertaken by Sennacherib.[345] In addition to these, ABL 1091 shows that the death of Semiramis possibly records the circumstances of the death of Sennacherib:

> In his work, Nicolaus presents a conflict between the sons of Semiramis from her first marriage and their step-brother; accordingly, in reality, there was a conflict between Sennacherib and his older sons, and between the sons of their step-brother Esarhaddon. Consequently, we should identify Ninyas from the work of Nicolaus with Esarhaddon, the youngest son of Sennacherib born in his marriage with Naqia-Zakutu.[346]

How can this mixture of all those various elements in the *Assyrian logoi* be explained? Dalley has put forward a very appealing set of reasons for the confusions we encounter in the *Assyrian logoi* of Herodotus, Ctesias and their followers. These are, first of all, modern ignorance, primarily caused by a 'poor base of evidence', particularly our lack of sufficient data on Mesopotamian oral traditions; secondly, the misinterpretation of Assyrian sculptures and their themes; and finally, 'the naïve acceptance by Ctesias and others of Aramaic stories which had shifted their historical setting.'[347] She proposes two interesting models of information movement. First, she argues that contrary to modern belief Nineveh was not an uninhabited ruin in the time of Herodotus: Aššurbanipal's and Sennacherib's royal palaces have yielded Greek inscriptions and sculptures belonging to much later

[342] Radner 2012: 695.

[343] 2 Samuel 11.

[344] MacGinnis 1986: 68. Compare Hdt. 1.185 with Ctesias F1b (= Diodorus 2.9.1). It is probably the 'Median Wall' of Xenophon, a construction referred to in VAB 4.19.6 – two walls, running from Babylon to Kish and from Sippar to Opis on the Tigris, which, however, could not have served as a flood embankment. This has led some scholars to argue that Nitocris is Nebuchadnezzar, feminised by the Greek tradition for some reason or other (Baumgartner 1950: 96. Bergamini 1977: 136).

[345] Dalley 2005: 16.

[346] Zawadzki 1990: 71-2.

[347] Dalley 2003: 171, 188.

periods, hinting that the palaces were, in fact, in use or at least accessible centuries after their alleged destruction.[348] Dalley goes as far as suggesting that tour-guides were 'readily available for adventurous Greek travellers.'[349] That Ctesias' description of Babylonian palace reliefs fits that of Nineveh instead could indicate that access was indeed possible. These reliefs could, furthermore, bring some clarity to both the 'Assyrian queen' and the 'effeminate king' motifs. It is possible that Diodorus, when talking of the portrayal of Semiramis and Ninus, is alluding to one of the lion hunt scenes well-known from the Assyrian palaces.[350] Figures now believed to be young men or eunuchs could have easily been identified as women by the visiting Greeks, as they often wore earrings and bracelets,[351] especially if the pre-conceived expectation was already present in the spectator's mind. The king is similarly often depicted wearing beautifully embroidered robes and eye make-up.[352]

Dalley believes the confusions about Assyrian artistic representations to have arisen during the Persian period.[353] However, as I have argued earlier, many elements of this 'Oriental discourse' must be a continuation of earlier Greek views. The Greeks who visited or studied Mesopotamia with Persian aid must already have had some preconceived expectations of what they would find. The stories of Sardanapallos could be a case in point. They also show that it is not the case that all knowledge or views of Mesopotamia can and must be attributed to direct contacts; other transmission channels and influences must be considered.

Cuneiform sources from Nineveh about diplomatic relations between Gyges and Aššurbanipal include an interesting historical episode: the Lydians, when they first planned to contact the Assyrian king had no knowledge of how successfully to make that contact. But as they succeeded in their endeavour, they must have taken advice from an insider who was well acquainted with the diplomatic practices and sensitivities of the Assyrian court. Hence Gyges was well prepared for the Assyrian mission, providing interpreters and a story of his 'Assur-dream' that Aššurbanipal was bound

[348] Dalley 1994: 56, Reade 2000.

[349] Dalley 2003: 172.

[350] Diodorus 2.8.6. However, the lion-hunt scenes were not limited to Assyrian palaces; the image remained popular with later Babylonian and Persian kings as well. The motif was used by Nebuchadnezzar (e.g. one carved into a rock-face at Wadi Brisa, Lebanon: Braun-Holzinger & Frahm 1999: 141; Börker-Klähn 1982: 228, relief 259), and a Persian example survives on one of the door jambs in Persepolis' Hall of a Hundred Columns.

[351] Dalley 2003: 183.

[352] See, for example, the wall painting of an Assyrian king and his court from Nimrud, reproduced as fig. 5 in Llewellyn-Jones & Robson 2010: 47.

[353] Dalley 2003: 187-8.

to recognise. But he was nonetheless outmanoeuvred by the latter, who had no interest in sending his troops to help the North-western states in their struggle against the Cimmerians. The subsequent embarrassment on Gyges' side could have been the reason why he was so willing to help Psammetichus expel the Assyrians from Egypt. He achieved his aim: Lydian intervention was well noticed in Nineveh. But once the Cimmerian attacks were resumed and Gyges died as a result, his son and successor Ardys once again turned to Aššurbanipal for help - and was once again denied.[354] This leads to the question whether the disparaging Sardanapallos-legend could possibly have had its origins in failed Lydian-Assyrian relations.

Taking into account the discussion on intensified Greek-Lydian relations during the rule of Gyges, this does not seem an inconceivable option. An idea on these lines had already been expressed by Sayce but seems to have been largely neglected thus far.[355] Sayce suspected some sort of Lydian connection, saying that he saw 'no way of accounting for the Greek form of his name except by supposing that it has been assimilated to the name of Sardes, the Lydian capital'[356] and apart 'from the two names, one of which came certainly, and the other probably, from an Egyptian source, all that Herodotus knows about the rulers of 'Assyria – so far as we can trace it home – points to a Lydian origin.'[357]

Although the last point is an exaggeration, there is reason to believe that the stories of Sardanapallos entered the Greek 'Assyrian discourse' very early. Aristophanes refers to Sardanapallos in a clearly disparaging tone in the *Birds* (415 BC) with a clear expectation that the audience is well aware of the image:

> ΕΠΙΣΚΟΠΟΣ: ποῦ πρόξενοι;
>
> Πε.: τίς ὁ Σαρδανάπαλλος οὑτοσί;[358]

And as noted above, a later scholion on the work remarks that Hellanicus was even compelled to

[354] Fuchs 2010: 410-415; Cogan and Tadmore 1977: 65-85 for the literary development of the story in cuneiform records.

[355] Sayce 1888b: 110-1.

[356] Sayce 1888b: 108.

[357] Sayce 1888b: 109.

[358] *Birds* 1309-10.

believe in the existence of two separate kings with the same name.[359] However, Hellanicus' treatment of Sardanapallos hints that the tradition about this/these Assyrian king(s) had gained considerable popularity in the Greek world, and there must have been a number of irreconcilable stories going around for him to be unable to attribute them to a single king.[360] Furthermore, the allusion to Xanthus' story in which Atergatis 'being taken prisoner by Mopsus, king of Lydia, was drowned with her son in the lake near Ascalon, because of her insolence, and was eaten up by fishes' bears close resemblance to the motifs used in Semiramis legend and shows, on the one hand, that these motifs had wide currency in the contemporary Near East and the Mediterranean basin, and on the other, reflects some genuine Lydian ideology in their reworking.[361]

This and similar stories must have been either confirmed, reworked or rationalised when they came into contact with Near Eastern traditions and evidence (e.g. the reliefs). It is likely that Greeks had increasing access, perhaps in Egypt or Persia, not only to local[362] but also to Aramaic stories, originating from Assyria, but some of which had in the course of constant retelling been transferred to the courts of Babylonian and/or Achaemenid Persian (or indeed even Lydian?) kings.[363] Egyptian narratives preserved in the demotic papyri definitely testify to the confusion between eastern empires and rulers. In the story of 'Naneferkasokar and the Babylonians', for example, the setting is Achaemenid rather than Babylonian and Spiegelberg has compared this phenomenon with the Coptic Cambyses Romance where Cambyses and Nebuchadnezzar are confused.[364] Or take for example the story of Ahiqar,[365] which is essentially the only fragment of Aramaic literature that has survived, but

[359] See n. 154 and Weissbach 1920: 2437 for discussion.

[360] Llewellyn-Jones & Robson 2010: 48-9.

[361] See p. 36-7 & 44 for the importance of Xanthus as a source to Herodotus and other early historians.

[362] Demotic narratives show that the Assyrian invasion was a fairly popular topic in Egyptian literary tradition. For an overview of the largely unpublished material see Ryholt 2004. Greek authors' dependence on such tales is demonstrated, for instance, by the story of Pheros, son of Sesostris (Hdt. 2.111, Diod. Sic. 1.59, Pliny, *NH* 36.74) that has now been identified in the unpublished P. Carlsberg 324, and which forms part of the Petese Stories (Ryholt 2006: 31-58; more on these on p. 190 below).

[363] Dalley 2003: 182.

[364] Ryholt 2004: 204. According to Ryholt it has since been shown that the historical setting of the Cambyses Romance is based on the Septuagint. For more on this see Richter 1997/1998.

[365] W 20030,7 (=ULKS in table 1 below) lists Esarhaddon's counsellor Aba-Enlil-dar as the one 'whom the Arameans call Ahuqar' – showing that the story of Ahiqar was known but seen as part of 'popular' Aramaic, rather than élite cuneiform culture. Oldest preserved version of the Ahiqar story is recorded on a 5th cent. BC Aramaic papyrus (P. Berlin P 13446; see Lindenberger 1983) from Elephantine, Egypt. Two demotic versions are known from 1st cent. AD Egypt (Ryholt 2004: 497-9).

was translated into numerous languages and provided the template or inspiration for a number of other literary works, including the biography of Aesop and various Aesopic fables.[366] The incorporation of Nabonidus into the image of Nebuchadnezzar in Jewish tradition, which in Sack's words is 'perhaps as fine an example as can be found of a melding of history and oral tradition' could, furthermore, also draw some of its elements from the Ahiqar story.[367] Machinist has also argued that late 7th or 6th cent. BC biblical texts concerned with Neo-Babylonia derived at least some of their language and imagery from Nahum's account of the fall of Assyria.[368] Other examples of such background shifts, or 'migratory motifs' as we may call them, include elements in birth-story of Sargon transferred to Semiramis and Cyrus,[369] the biblical book of Esther, the different parts and versions of which set the narrative in the court of two different Persian kings;[370] and a Persian epic known as the *Book and Deeds of Ardashir, son of Papakan* (c. AD 500-600), which borrows from the stories about earlier Achaemenid kings but transfers the motifs to a much later Sassanid monarch.[371] Not surprisingly, Greek authors would have taken such stories, which in Rollinger's words belonged to a 'kind of literary gene pool' in the Near East, at face value or at least recorded them more or less verbatim.[372] And the Aramaic literature, to which many of these must go back to were, as the Ahiqar story demonstrates, 'not a calque of cuneiform models', so we cannot expect to find any equivalent material from the latter.[373]

One story that could have provided inspiration specifically for the Semiramis legend is the tale of the

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[366] West 1969: 115-22. For some parallels in the late Egyptian literature see Dieleman & Moyer 2010: 437-8. Beaulieu 2006b: 190 mentiones echoes of his sayings in Democritus and Theophrastus; and West 2003: 423-8 suggests it formed a model for Herodotus' story of Croesus as an advisor of Persian kings.

[367] Sack 1983: 65-6 ('when the Hebrews returned to Palestine, they carried with them their own hatred for Nebuchadnezzar plus the Persian hostility towards Nabonidus and, as a consequence, transformed them both into a story of a conqueror-king who would forsake his god and require the worship of another by his subjects,' hence also didactic and propagandist reasons. Rather interestingly, Sack finds that 'the subsequent account of the madness of Nebuchadnezzar (Daniel 4:33) reflects the contents of the *Lives of the Prophets* and the *Wisdom of Ahiqar,* and also echoes the Prayer of Nabonidus... where the king is said to have lived apart from men for seven years.' See also Müller 1985: 1-9 and Braun-Holzinger & Frahm 1999: 152.

[368] Machinist 1997: 184-5.

[369] Drews 1974: 388-99.

[370] Dalley 2003: 182.

[371] Llewellyn-Jones & Robson 2010: 65.

[372] Rollinger 2000: 76, Dalley 2003: 182, also Rollinger 2000: 65-77 for examples of Venus' capacity to turn men into women and army passing between a halved corpse, and West 2003: 427 for a comparable example about the 19th cent. Egypt and European travellers.

[373] Beaulieu 2006b: 190.

Egyptians and the 'Amazons'.

> The story narrates how an unnamed Pharaoh travelled to Nineveh to visit the Assyrian queen Sarpot, fell in love with her by enchantment, for she was a great sorceress, and helped her to defeat the Indians. The naming of Nineveh points to a seventh-century BC date, for the city was the main royal residence for less than a century. As factual historical events, one of Assurbanipal's brother-in-law was the ruler of a city in the Nile delta, and Egyptian troops almost certainly played a part in Assyrian battles against the Elamites. This is a very precious indication that Aramaic stories with, originally, an Assyrian background, are a missing link which connects actual history with later, legendary retellings.[374]

But Dalley has also presented another idea in regard to Semiramis. She argues that the conflation of various Assyrian and Babylonian queens into one figure is down to the Mesopotamian concept of archetypes, going as far as suggesting that 'Assyrian historical writing connected with those times show some features normally identified as Hellenistic, allowing us to discard the idea that those legends were constructed by Greeks in the Persian and Seleucid periods' altogether.[375] The idea of archetypes postulates that the 'ideal institutions and offices in heaven had their examples from time to time on earth' and that 'this understanding would imply that Semiramis was the name used for any powerful queen who represented the archetype, with more or less divine status.'[376]

All in all, the mounting evidence strongly suggests that the stories of Assyro-Babylonian rulers are essentially an amalgamation of Near Eastern tales and elements. But this is not to say that the context in which they were told in Greece and its cultural successors did not have an effect on the content. The framework into which the individual stories and elements were inserted is clearly Greek – we must assume that the discourse of destructive luxury would have had little currency in the Near East itself. The stories must have been twisted (using e.g. silences and elisions, disfigurements etc.) to fit the intentions of Greek authors and the expectations of their audiences. Over time, the exploits of Naqiʾa (if stories of Shammuramat had not already reached Greece earlier) became fused with features of other Assyrian rulers, both kings and queens alike, as well as with deities, producing a

[374] Dalley 2003: 188. An Assyrian queen Seshemnefertum with great magic powers also appears in an Egyptian story of the battle between her and Imhotep (see Ryholt 2004: 501-2).

[375] Dalley 2005: 11.

[376] Dalley 2005: 11 & 20.

larger Greek 'Oriental Queen' mythology.[377] Hence, attempts to identify Semiramis and Nitocris, or indeed Ninus or Sardanapallos,[378] with any *one* historical person will remain fruitless. It is apparent that by the late 5th cent. BC, these Oriental royals belonged in a modern sense more to the realm of mythology than history and each occupied a place in the Greek *imaginaire,* embodying very specific features of the 'Oriental *man*'.

2.3.3 The Hanging Gardens

Alongside Semiramis and Sardanapallos, the legendary Hanging Gardens of Babylon is another myth still persisting in the popular imagination as one of the wonders of the ancient world. It therefore comes as an unwelcome news, although not too surprising in the light of discussions above, that no hard evidence has ever been found to confirm their existence.[379] This has, nevertheless, by no means stopped the endless search.[380] Despite Reade's observation that 'we are free to speculate on their locations, since brick-robbing continued at Babylon for thousands of years and removed all but the foundations of many major buildings,'[381] it is perhaps more telling that the extensive cuneiform evidence, recording with meticulous care the building programmes, restorations and innovations of the Babylonian kings, says nothing of the allegedly so magnificent gardens.[382] Of course, it remains a

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[377] Cf. Lewy 1952: 286, who credits the Arameans of Babylonia during the time of Nabonidus with the transmission.

[378] In Hdt. 1.7 Ninus is the son of Belus, grandson of Alcaeus and great-grandson of Heracles. His son Agron was the first king of the Lydian Heraclid dynasty that ruled for 505 years before the accession of Candaules and the Mermnads. Bichler (2004: 501) suggests that Herodotus reveals a concept that 'the origins of almost all imperial power in Asia can be traced back to Heracles.' On the other hand, Ninos is also rather perplexingly later mentioned as the father of Sardanapallos in Hdt. 2.150.

[379] Cf. Reade 2000: 213, who concludes that 'there is no basis for the idea, widely current, that the excavations at Babylon have failed to produce any likely sites for them.'

[380] Stevenson 1992: 43-6 offers a good overview and discussion on some of the suggestions. To mention just a few, Rassam (1897: 352-5) proposed the Gardens were located at Babil, i.e. in the 'Outer Palace' situated near the city wall at the northern end of the city; cf. Reade (2000: 205-6) for problems with this site. Koldewey (1914: 91-100) identified a building in a corner of Nebuchadnezzar's palace, based on hewn stone, unusually thick walls and the unique presence of a well, as the site of the Hanging Gardens, cf. Wiseman (1983: 140), Stevenson (1992: 43-44) and Reade (2000: 208) for summaries of contra-arguments. Wiseman (1983: 140-1; 1985: 56-9) has suggested a location closer to the river, to the north of the great 'Western Outwork' but others have thought that the Outwork itself could have accommodated the Gardens (in addition to Stevenson see Reade 2000: 208-13 for discussion).

[381] Reade 2000: 196.

[382] Finkel 1988: 40-1. Although see Brodersen 1996: 48 for an inscription that describes a terraced *kummu*-building that is shaped like a mountain. What a *kummu*-building is remains unknown.

tentative possibility that the gardens were described in a document not known to us (but perhaps known to Berossus).[383]

Nevertheless, there is an obsession in the modern world with finding the right location for the gardens to such an extent that it or the connected issues are taken as a scholarly exercise.[384] It is rather striking that although the literary context in which the information appears is exactly the same; the study of the Hanging Gardens has merited an approach completely different from that of the issues discussed above: the Gardens are hardly ever approached as a *topos*/composite motif as are Semiramis or sacred prostitution. I propose that the explanations that apply to the latter could apply equally well to them.

The first hint is provided by the fact that the classical Greek sources on the topic are as ambiguous as the evidence from Mesopotamia itself. Herodotus, although describing Babylon in great detail,[385] never mentions the Gardens; and neither does Xenophon. On the whole it is unnecessary to give a detailed description and analysis of all the relevant passages here when this can be conveniently found elsewhere.[386] One standard testimony from Diodorus Siculus shall suffice:

> There was also, beside the acropolis, the Hanging Garden, as it is called, which was built, not by Semiramis, but by a later Syrian king to please one of his concubines; for she, they say, being a Persian by race and longing for the meadows of her mountains, asked the king to imitate, through the artifice of a planted garden, the distinctive landscape of Persia. The park extended four plethora on each side, and since the approach to the garden sloped like a hillside and the several parts of the structure rose from one another tier on tier, the appearance of the whole resembled that of a theatre... And since the galleries, each projecting beyond another, all received the light, they contained many royal lodgings of every description; and there was one gallery which contained openings leading from the topmost surface and machines for supplying the garden with water, the machines raising the water in great abundance from the river, although no one outside could see it being done. Now this

[383] As suggested by Reade 2000: 199.

[384] E.g. Stevenson 1992, who says in the preface that his article was initially a response to ‘a competition sponsored by the Iraqi government to solve the riddle of how the Hanging Gardens of Babylon were irrigated’. Van de Mieroop (2003: 269) has also observed that ‘much ink has flowed (with little progress) in determining their exact whereabouts in Babylon and the technology used to water them.’

[385] Hdt. 1.181.

[386] Stevenson 1992: 38-40, Brodersen 1996: 49-56.

park, as I have said, was a later construction.[387]

The quoted passage is inserted between information taken from Ctesias, meaning that there is a fair chance it too comes from the *Persica.* This is assumed, for example, by Reade.[388] Llewellyn-Jones and Robson, however, exclude it from their fragments of Ctesias, in line with Pearson and Bigwood who believe it to stem from Cleitarchus' history of Alexander instead.[389] Two 1st cent. AD accounts are preserved in Strabo (16.15) – based perhaps on Onesicritus, or some other contemporary of Alexander the Great[390] - and in Curtius Rufus' *History of Alexander* (5.1.35).[391] Pliny the Elder mentions them briefly, indicating that he was aware of various traditions concerning the origin of the Gardens.[392] Another account also exists, previously attributed to Philo of Byzantium but apparently of a much later date.[393]

The reference to the Gardens attributed to Berossus requires a comment for here again we come against the Hellenocentric viewpoint. It will presently (ch. 4.4.3) be shown how the interpretation of Berossus has been conditioned by the now-questioned assumption that Berossus wrote for a Greek audience and aimed to correct Greek misapprehensions about Babylonian history. It is to this aim that his mentions of Semiramis and the Hanging Gardens have often been attributed. Although it is very likely that Berossus was indeed familiar with 'Greek fables' as the stories of Babylon are often called following Curtius, new evidence casts doubt on the extent to which Berossus might have been concerned with refuting specific Greek authors like Herodotus or Ctesias, especially considering the wider circulation of many such stories. Berossus' mention of the Hanging Gardens is connected to his account of the building-projects of Nebuchadnezzar, based on the latter's account on the Basalt Stone Inscription and its copies.[394] It is not inconceivable that he indeed mentioned that these

[387] Diodorus 2.10.1-6.

[388] Reade 2000: 198.

[389] Although Pearson (1960: 230) thinks that 'Ctesias attributed the Hanging Gardens to Semiramis and that Cleitarchus corrected him'; Bigwood 1980: 205; also Wiseman 1983: 139.

[390] Polinger Foster 2004: 207; Pearson (1960: 239-30) has suggested Aristobulus but also lists Polycleitus and Nearchus as options.

[391] See Polinger Foster 2004: 207 for his probable reliance on Cleitarchus and Ctesias.

[392] *NH* 19.19: 'and the Handing Gardens, whether they were the work of Semiramis, or whether of Cyrus, the king of Assyria, a subject of which we shall have to speak in another volume'. This promise is not kept. Reade (2000: 200) has suggested Cyrus (Κῦρος) is a corruption of 'Assyrian', Σῦρος.

[393] Reade 2000: 199.

[394] See van der Spek 2008: 296-300.

structures were erected by Nebuchadnezzar and not by Semiramis as the Greeks suppose.[395] On the other hand, we cannot rule out that the sentence about the 'Hanging Gardens', although purporting to be a direct quote, is an addition by later excerptor, most probably Alexander Polyhistor.[396] The Hanging Garden episode belongs to the same passage in the book, although a parallel on the Basalt Stela – a 'mountain-like' construction - is more ambiguous. Van der Spek has offered two explanations to account for their inclusion in the *Babyloniaca*. First is the option that they were inserted into the text by Alexander Polyhistor who abridged the *Babyloniaca* in the 1st cent. BC.[397] However, this option is discredited if Geller is right about Josephus having made use of the original Aramaic version instead of Polyhistor's summary (below).[398] Secondly, van der Spek proposes that Berossus simply follows the Greek tradition and, in an attempt to attribute the Gardens to a Babylonian king, even makes up the Median princess episode, although he acknowledges that this might have been inspired by Nebuchadnezzar's Palace. Yet he insists that though the story itself might perhaps go back to a Persian fairy-tale, Berossus' version of it is very much derived from a Greek source.[399]

But such an approach is conditioned and makes an assumption that Berossus' choice of topics was somehow determined by Greek interests (again, see ch. 4.4.3). This leaves no room for any local considerations and the option that the Hanging Gardens fable, like the Semiramis-myth, formed part of a repertoire of a much larger geographic and cultural area. Neither can it be ruled out that Nebuchadnezzar's 'mountain-like' palace was indeed adorned with trees and resembled a 'Hanging Garden', just like Abydenus and Josephus say.[400]

As Reade has pointed out, the descriptions given by Greek and Latin authors, although there are

[395] Mentions of Semiramis are drawn out by Josephus and Eusebius (*BNJ* 680 F5a) but Abydenus says the Chaldeans paid no particular attention to her and Ninus (*BNJ* 680 F7). Hence we can, rather than arguing for their deliberate inclusion, conclude that if they were mentioned, then very fleetingly. This again casts doubt to the argument that Berossus explicitly aimed to correct the Greek beliefs.

[396] *BNJ* 680 F 8a (= Josephus, *Ap.* 1.141): 'In this palace he built high stone terraces and made them appear very similar to mountains, planting them with all kinds of trees, thus constructing and arranging the so-called Hanging Garden, because his wife, who had been raised in the regions of Media, longed for a mountainous scenery'.' He must be quoting Alexander Polyhistor not Berossus.

[397] Van der Spek 2008: 310-1.

[398] See p. 202 below.

[399] Van der Spek 2008: 311-3, Bichler 2004: 514.

[400] *BNJ* 685 F 6a & see n. 396.

discrepancies between them, are all feasible and conform to local architectural practices.[401] That elaborate palace and temple gardens existed in Mesopotamia is evident from a number of sites; the practice could evidently date back to as early as the Old Babylonian period.[402] The word *kirimāhu* – 'garden' - was first used by Sargon II in a sense of 'pleasure garden' attached to the palace, as opposed to the *kirû* – a botanical garden outside the capital city.[403] Sargon's inscriptions and palace reliefs testify for elaborate *kirimāhu* that he built in Dur-Šarrukin and modelled on Amanus mountain range.[404] Similarly elaborate gardens were constructed on Sennacherib's orders in Nineveh.[405]

Hence, Dalley has proposed an explanation that would, at first sight successfully, reconcile the textual and archaeological evidence and could, at the same time, shed light on many other discrepancies in Mesopotamian discourse. She argues, namely, that the Greeks mistook Nineveh for Babylon.[406]

[401] Reade 2000: 201.

[402] Wiseman 1983: 137-8.

[403] Wiseman 1983: 137.

[404] Radner 2000: 239.

[405] Dalley 2013: 43-82.

[406] Dalley 1994. Some support is lent to the idea by Poliger Foster 2004 but cf. Reade 2000 and Van de Mieroop 2003: 269, who speculates that such a proposition is perhaps caused by desperation at being unable successfully to locate the gardens in Babylon. That Babylon and Nineveh were indeed occasionally confused is evident from a number of examples. E.g. Athenaeus records Ctesias as saying that Sardanapallos 'sent his three sons and two daughters to Ninus to the King there, giving them 30,000 talents of gold' (F 1q = Ath. 12.38), whereas according to Diod. Sic. 2.26.8 he sent them from Ninus to Paphlagonia. It could of course be the result of poor copying but nevertheless highlights the confusion, or lack of interest, surrounding ancient Mesopotamian geography. The confusion could have started with Sennacherib and the destruction he inflicted on Babylon. An explanation preferred by Dalley is that Babylonians and Chaldeans formed the majority of the slave labour used to build Sennacherib's palace and gardens in Nineveh and thus Nineveh became 'Babylon' during Sennacherib's reign. When the real Babylon was rebuilt, it assumed the name of 'New Babylon' as opposed to the 'Old Babylon' (=Nineveh) mentioned by Azarquil. She draws (1994: 46, 55) some further parallels between Babylonian city and temple hymns and phrases Sennacherib used to announce that Nineveh was to become his royal residence. Her theory, moreover, explains Curtius Rufus' attribution of the building of the great Gardens to 'the king of Assyria, reigning in Babylon.' Van de Mieroop (2004: 1-3), on the other hand, argues that the late cuneiform tradition tied the 'fates of Nineveh and Babylon together. At least with respect to their destructions, these cities were each other's mirror images, each other's doubles.' Arguably, Sennacherib chose to portray the destruction of Babylon as the negative parallel to Nineveh's construction and once the latter was destroyed, Babylonians saw it as an opportunity to do, or at least claim to have done, to it what its king had once done to them. A number of motifs in Nabopolassar's declaration of war correspond to the ones in Sennacherib's Bavian inscription, especially reference to a flood. The said motif enjoyed popularity in general. Consider e.g. Greek and Biblical accounts of the fall of Nineveh in Nahum 1.8 ('But, with an overrunning flood He shall make a full end of its place, and darkness shall pursue His enemies') and 2.7 ('The gates of the rivers have opened, and the palace has dissolved'). It is even speculated that Ctesias' account of the flood in Nineveh could stem from a ritual destruction of part of a city wall by artificial flood, inspired by the former deeds of Sennacherib (Machinist 1997: 190-5, Stronach 1997: 319-22, Van de Mieroop 2004: 3).

A list of her arguments includes a realisation that the account that Ctesias gives for the palace decorations fits those found in Aššurbanipal's palace in Nineveh rather than those excavated from Babylon; a corresponding muddling between the sieges of two cities has already been alluded to above; a note made by Azarquil of Toledo about the observational data stemming from 'Old Babylon', appears to come from Nineveh instead; and the theatre-like setting of the Gardens that Diodorus describes and the measure he gives fit into Russell's contour map of Sennacherib's palace.[407] In addition, no textual or archaeological evidence for any relevant large-scale waterworks has been found in Babylon. Many of Sennacherib's inscriptions, however, refer to their existence in Nineveh.[408] Hence, Dalley has attempted to reconcile the ambiguous description Sennacherib provided for his gardens with what the classical and Hellenistic authors say about the novel water-system used to sustain them, arguing that he used screws enclosed in cylinders, a device known as Archimedes' or the Egyptian screw.[409] This argument, however, only works when we accept that there was only *one* 'Hanging Garden'. But is such a view actually substantiated?[410]

As the watering mechanisms are described by Diodorus, Strabo and Philo of Byzantium in different ways, the conclusion is fairly certain that they did not rely on a single source.[411] Curtius Rufus, moreover, claims that the Gardens were still intact in his day (1st cent. AD) in Babylon. I would argue that what happens in modern scholarship, i.e. trying to locate 'the one', also applies to the ancient writers. Strabo locates the Gardens on the (east) bank of River Euphrates, Diodorus near the acropolis (the South Citadel) and close to the river, Curtius on top of the (South) Citadel and Berossus at or within the palace grounds.[412] An undeniable fact emerges: they simply did not know where the Hanging Gardens were. In essence, they all describe different gardens. Curtius' assertion that it still existed in his day clearly demonstrates that he, or his source, identified one of the Babylonian gardens as 'the' Hanging Garden. Perhaps the idea itself did indeed stem from Sennacherib's garden

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Furthermore, the taking of ashes from Nineveh to Babylon is also paralleled in the taking of earth of Babylon to the Assur temple (Stronach 1997: 322). The gold and silver element of the same story could, within some stretch of the imagination, refer to the looting of the city's temples and treasuries (Van de Mieroop 2004: 4).

407 Dalley 1994: 46-54 & 2003: 178-81.

408 Dalley 1994: 47. See Jacobsen & Lloyd 1935.

409 Dalley 1994: 52-3. For 'Egyptian screw' see *BNJ* 87 F117.

410 See Stevenson 1992: 45-6 for the reasons to believe in their existence. Nagel (1982: 242-41 [sic.]) has suggested that there were two gardens, one build by Sennacherib, and the other by the Persians.

411 Dalley 1994: 46.

412 Stevenson 1992: 42, also for the problems with these locations.

in Nineveh; for as has been argued above, Greeks could have had enough direct or indirect contacts with Nineveh for the knowledge of extraordinarily magnificent palace gardens to spread. Over time it became common knowledge, gaining strength when travellers actually witnessed such gardens for themselves, and subsequently developed into a literary motif. As Curtius says, it was a popular topic with poets above anyone else. By the time Greeks developed the need to write down more detailed descriptions - that is centuries after their alleged initial construction - the story had become to occupy a prominent place in the Greek 'cultural grid'. It had also become inevitably entangled, but it was necessary and partly possible, to make new sense in the bits and pieces incorporated into the oral tradition against the re-examined Babylonian evidence. And considering the previous garden-building tradition, it is unlikely that there were no suitable gardens to be found in Babylon.

2.3.4 Antiquity of Knowledge and the Emergence of Science

We shall see in the final section of this chapter that the observations made above apply, by and large, also to the Greek belief in the Near East as the seat and source of primeval knowledge: the association with magic and elaborate theology constitutes another standard part of the Greek 'Babylonian cultural grid'.[413] So does the Chaldean reputation for astronomy and divination, which dates back to the earliest surviving Greek testimonies.[414] Here too I argue that the Hellenocentric view expressed by some modern scholars on the attribution of origins to certain foreign localities, especially Chaldea and Egypt, seeing them merely as an attempt to gain authority for specific subjects, is not entirely substantiated.[415] As we stand on a somewhat firmer ground in terms of evidence on the topic from Mesopotamia itself, it is possible to demonstrate that much of the Greco-Roman knowledge about cuneiform intellectual traditions is surprisingly accurate. But as with

[413] E.g. Cleitarchus (*FGrH* 137 F6 = Diog. Laert. 1.6), says the Chaldeans apply themselves to astronomy and forecasting the future; Theophrastus (Proc. *On Tim.* 3.151); Cato, *On Agri* 5.4; Cic. *Mur.* 11.25; Diod. Sic. 1.28.1, 2.29-31 & 17.112; Sen. *NQ* 2.32.6, all on Chaldeans as astrologers; Q. Curtius Rufus 5.1.22 says that the role of the Chaldeans is 'to reveal astronomical movements and regular seasonal changes'; Julian, *Or.* 4.156c adds that they are also skilled in theurgy; and Theocritus 2.160-162 mentions them as a source of herbalist knowledge.

[414] See p. 27 for the story of augury and Hdt. 2.109 for the gnomon. However, note that the invention of the gnomon has also been attributed to a number of astronomers, including Berossus (*BNJ* 680 T5c = Vitr. 9.8.1) and Anaximenes (Pliny 2.78); More than 200 Greco-Roman examples of the sundial survive, they have been catalogued by Gibbs 1976; and see Valdés 2000 for an additional 15. Plato (*Ep.* 986e-88a) and Aristotle (*Cael.* 2.12.292ff) gives a, by that time standard, account of Egyptians and Babylonians watching heavens, as part of the tendency to attribute the origins of such knowledge to the Near Eastern civilisation; compare for example Plato, *Phaed.* 274c-d and *Phil.* 18b-d.

[415] See p. 5.

previous topics we can also observe that factual material was inserted and came to form part of a larger, much more fluid, discourse.

In some Greco-Roman circles 'Oriental ideas' were indeed, much like the material discussed above, treated as generalities. Advanced theories were rather carelessly attributed to Chaldeans, Persians and Egyptians without much distinction made between them. Their mystic knowledge, as well as that of the Indian Brahamans and the Gymnosophists, had become part of the general conception of the 'East' as a place where the priestly authorities were the guardians of god-given esoteric lore.[416] There are, for example, rather muddled associations of the Chaldeans with the magi. The application of this term has always been ambiguous in the Greco-Roman sources but it seems that many authors did not distinguish between the two. They appear to be equated with the Chaldeans rather than the Persians in Plutarch, Tacitus, some Patristic authors and also in Philostratus (*Apollonius of Tyana*), who relates the Magi to the native wisdom of Babylon.[417] The Chaldean astrology is also quite often explicitly associated with Zoroaster.[418]

There is no doubt that the oriental provenance of certain 'sciences' formed an important literary *topos,* more often than not used with a very specific agenda. But genuine knowledge about Babylonian intellectual activities can be found in Greco-Roman sources and brushing off all references to 'Oriental origins' as wishful thinking on the part of the Greeks and Romans denies this complex matter of myth-making the attention it deserves; the roles become reversed: it becomes a type of wishful thinking on the part of modern commentators instead.

First of all, the close association of Chaldea with the age-old knowledge is by no means a Greek invention but a commonly held perception in the Near East that has its origins in the Mesopotamian tradition itself.[419] The antediluvian section of the Sumerian King List is characterised by unnaturally long reigns: the eight kings of five cities account for the entire 241,200 year period.[420] The reigns of

[416] Parker 2008: 251-307.

[417] Nock 1972: 308-30 & 516-26 and Kingsley 1995 for a detailed discussion on the use of the word *magus* in Greece, the identification of Magi with the Chaldeans in Athens, and all the relevant references to primary sources. For Apollonius, see Geller 1997: 61.

[418] E.g. Amm. Marc. 23.6.25, 32.

[419] Compare the Greek stories with Isaiah 47.12 and Daniel 5.

[420] A number of copies of the list survive: fragments WB 1923.444 and K 8532+853+8534 contain the antediluvian kings or the few first dynasties. For an extended study of the king lists, see Jacobsen 1939. For the mathematically manipulated dynastic spans of the antediluvian kings, Young 1990 (cf. the Biblical Patriarchs), and for the fluidity of the antediluvian tradition, Finkelstein 1963: 45-51.

the next dynasties, although counted not in tens of thousands but rather in hundreds of years, are equally unnatural.[421] The antediluvian kings are usually seven in number and some cuneiform tablets assign advisors or sages – *abgals* in Sumerian, *apkallus* in Akkadian – to each king.[422] These were wondrous creatures, half-fish or half-birds,[423] created by the wisdom god Ea.[424] The best known description of the *apkallu* comes from Berossus,[425] who also provides us with a list of the sages, as well as of the antediluvian kings and their respective lengths of reign. Much of Berossus' information is authenticated by the cuneiform material (table 1).[426]

It was traditionally held that all knowledge was imparted to human kind by these antediluvian sages, then survived the Flood and was preserved by the priestly classes to the 'present day'. The domain of this secret scribal lore is perhaps best summarised in the professed words of King Aššurbanipal:

> I have learnt the skill of Adapa the sage, secret knowledge of the entire scribal craft; I observe and discuss celestial and terrestrial omens in the meetings of the scholars; with expert diviners I interpret the series 'If the liver is the mirror of heaven'; I solve difficult reciprocals and multiplications lacking clear solution; I have read elaborate texts in obscure Sumerian and Akkadian which is difficult to interpret; I examine stone inscriptions from the time before the Flood.[427]

[421] For the artificially constructed reign-lengths of the first postdiluvian rulers see Young 1988 & 1991.

[422] Compare the Greek tradition of the seven sages, which Annus (2007: 15-6) believes must somehow have been inspired by the Mesopotamian prototype.

[423] Images of these teacher-creatures were set up in the temple of Ninurta in Kahlu c. 875 BC (bas-relief BM 118922) and in the Great Temple of Marduk in Babylon. They were also a popular motif on Hellenistic cylinder seals (Wallenfels 1993: 309-21) and the small *apkallu*-figurines are similarly well attested (e.g. small fish-cloaked BM 90999; bird-headed and winged BM 91839). Berossus' description of them followed this iconographic tradition.

[424] *Erra Epic,* T 1 l. 162: 'Where are the seven sages of the depths, those sacred fish, who, like Ea their lord, are perfect in sublime wisdom'. The so-called Catalog of Texts and Authors (K 2248+Sm 669; K 8981+9717+10802; K 10797) attributes several of the omen and incantation series to 'the mouth of Ea' (K 2248 1-4) and some others to Oannes-Adapa (K 2248 5-6) (Veldhuis 2010: 78-9; for an edition and trans. Lambert 1962).

[425] *BNJ* 680 F 1a & b.

[426] Especially UCBC 9-1819 (from the collection of Phoebe Hearst Museum of Anthropology, University of California; published in Finkelstein 1963), an OB list of antediluvian kings; a bilingual lamentation text K 5044; SpTU 2, 008 (= W 22762/2) - a list of the *apkallū* that is part of the series *Bīt mēseri* and describes them as 'seven brilliant *purādu*-fish, *purādu*-fish from the sea, the seven sages, who were created in the river, who ensure the correct execution of the plans of heaven and earth' (v. I 10-13; paralleled by a bilingual ritual text LKA 76+K 7987+5119+Ki. 1904-10-9,87, edited by Reiner 1961).

[427] L^4, lines I 13-18; trans. Frahm 2004: 45.

Berossus[428]		ULKS[429]		UCBC 9-1819	SpTU 2, 008[430]
Kings	Sages	Kings	Sages	OB King List	Sages
Aloros	Oannes	Ayalu	Adapa	Alulim	U-anna
Alaparos	Annedotos	Alalgar	Uanduga	Alalgar	U-anne-dugga
Amelōn[431]	Euedokos	Ameluana	Enmeduga	Enmeluanna	Enmedugga
Amenōn	Eneugamos	Amegalana	Enmegalama	Ensipazianna	Enmegalamma
(A)megalaros	Eneubolous	Enmeušumgalana	Enmebuluga	Dumuzi	Enmebulugga
Daōnos	Anementos	Dumuzi	Anenlilda	Enmeduranki	An-Enlilda
Euedōrachos	Odakon/Anodaphos	Enmeduranki	Utuabzu	Ubartutu	Utuabzu
Amempsinos		Enmerkar	Nungalpirigal	[Ziuzudra]?	
Otiartes		Gilgamesh	Sin-leqi-unnini		
Xisuthros		...	...		
		Nebuchadnezzar	Esagil-kin-ubba		
		Esarhaddon	Aba-Enlil-dari (Ahiqar)		
		Nikarchos			

Table 1: Antediluvian kings and sages

As the first and last two rows of the quote hint, the distant antiquity was inherent in the local 'mythology of scribal succession',[432] especially in the concept of Mesopotamian *nēmequ* or 'wisdom'.[433] Similar references to Adapa and Enmeduranki – the last of the seven kings - as legitimising predecessors have been found in the inscriptions of Nebuchadnezzar I and some

[428] *BNJ* 680 F 3a & b.

[429] Uruk List of Kings and Sages = W 20030, 7, published in BaMB 2 89. Transliteration of the names from Lenzi 2008: 142.

[430] Transliteration from von Weiher 1983: 50-1.

[431] See Finkelstein 1963: 42 (esp. n. 9) for the exactness of this rendering and that of Amempsinos.

[432] To borrow a term from Lenzi 2008.

[433] For *nēmequ* see Parpola 1993b: 49-52 (see Introduction, p. 7) and Beaulieu 2007b: 3-19. The idea of all-encompassing pre-flood wisdom is already present in the introduction of *Gilgameš* ('He knew the totality of wisdom about all things, he saw the secret and uncovered the hidden, he brought back a message from before the flood' (1.6-8)) and the figure of Utanapištim. For the theory of knowledge in first millennium BC Mesopotamia see Veldhuis 2010, who also draws attention to the fact that the chaotic nature of the scholarly compendia does not necessarily live up to the scribal myth of an organised world.

Neoassyrian rulers.[434] The so-called 'Adapa Myth' is known from a variety of sources;[435] the story of Enmeduranki being granted sacred knowledge by the gods Šamaš and Adad – including the secrets of the *Enuma Anu Enlil* and mathematics mentioned by Aššurbanipal – and his initiation of the priests of Nippur, Sippar and Babylon into the mysteries, is recorded in the text found in the library of Aššurbanipal.[436] And according to Berossus, the wisdom given to mankind by the antediluvian cultural heroes was quite literally set in stone, the tablets surviving the flood after having been dug into the ground in the city of Sippar by Xisouthros (Sum. Ziusudra = Akk. Utnapištim), who is known from the Sumerian poem about the Great Flood:[437] hence Aššurbanipal's reference to the 'stone inscriptions from the time before the Flood'.[438] This rendered the Assyrian and Mesopotamian scholars primarily as the guardians of the Wisdom of Adapa – as 'from that time nothing further has been discovered'[439] - and remained a form of self-validation for the scholars until the very end of the cuneiform culture. However, Lenzi has more recently suggested that although the connection between the sages and scholars was present much earlier, the most explicit and systematic relationship between the *ummânū* and *apkallū* only appears in the Seleucid period and so betrays a strong political element, a deliberately archaising theological tendency in an attempt by scholars to enhance their religious and political authority.[440] As ULKS in the table above shows, the list of kings

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[434] K 4874+Rm 255 o. 7-10: 'am I, distant scion of kingship, seed preserved from before the flood, offspring of [Enmeduranki], king of Sippar… who sat in the presence of Šamaš and Adad, the divine adjudicators…'. For the transliteration and translation, see Lambert 1967: 128-31 for reproduction of these and duplicate cuneiform fragments 134-8 and the transliteration of four additional fragments in Lambert 1974: 434-8. References to Adapa as a legitimiser of Assyrian rulers and comparisons of the latter with him: RINAP 4 077 ('Esarhaddon… to whom the prince, the god Ninšiku [Ea], gave (wisdom(equal to that of the sage Adapa…'), SAA 10 174 ('…the king… is an offspring of a sage and Adapa: you have surpassed the wisdom of the Abyss and all scholarship'); SAA 10 244 ('the mother of the king is as able as (the sage) Adapa!'); SAA 10 380 ('the deeds of the king… are like those of (the sage) Adapa'); and SAA 16 169 ('the king… [is as perfect] as Adap[a]).

[435] For an up-to-date list see Izre'el 2001: 5-8.

[436] K 4364+2486+ (duplicated by K 3357+9941 and K 13307+). For the latest edition of the text see Lambert 1998: 148-58. Compare Enoch in the Jewish tradition, a figure modelled on the Mesopotamian prototype of Enmeduranki (Annus 2007: 16-25).

[437] *BNJ* 680 F 4a & b. Xiosouthros is also attested in the Diyala and Sippar king-lists (*ANET* 42-44) as the last king before the flood. A similar motif of antediluvian knowledge written on stone and clay is attested in the Jewish tradition (Annus 2007: 50-1, also see Annus 2010 for the Babylonian *apkallū*-mythology as the origin of the biblical Watchers).

[438] The same idea is expressed e.g. in K 4023 (= AMT 105, 1) 21-22: '…of Šamaš….. the craft of the *bārū*-priest which…. according to the old sages from before the flood…' (trans. Lambert 1957: 8); and in KAR 177 obv. iv. 25-8: 'Favourable days. According to the seven s[ages(?)]. Duplicate *of a tablet* from Sippar, Nippur, Babylon…'.

[439] *BNJ* 680 F 1b.

[440] Lenzi 2008: 137-40 & 143-165, also see p. 203.

and sages was complimented by a selection of eight pairs of postdiluvian rulers and scribes in a chronological order. This sent a clear message that the contemporary scholars were, through the association with the sages and the continuity of their tradition, the direct professional descendants of these ante-diluvian *apkallū* and thus the inheritors of their sacred knowledge as well as lawful advisors to the king.[441]

The esoteric nature of the Mesopotamian tradition could also have important ramifications for the dissemination of knowledge. As the colophons of some texts indicate, access to their contents was (theoretically) restricted.[442] The question to what extent the warnings and curses contained in those texts reflect the actuality of access resurfaced with the publication of a NB legal document from Uruk by Beaulieu, who interpreted the lines

> You must not make the temple slaves recite the excerpt tablets. If a temple slave goes to his bedroom(?) and he [Bēl-kāṣir] makes him recite the excerpt tablets, he [Bēl-kāṣir] will bear the punishment of the king

as casting doubt to the standard opinion that the warnings were a mere convention, showing that actual restrictions were indeed applied to professional texts and enforced by proper authorities.[443] However, Livingstone has contested this reading of the material and proposed that what we see is an attempt not to hinder the temple slaves' access to learned text but to deny them literacy altogether in order to 'keep them to their station'.[444] The insistence on secrecy perhaps served as a sociological barrier between expert diviners and simple scribes (as a question of convention and social prestige) but it is unlikely to have formed a substantial obstacle for information movement between the local cuneiform scholars and Greeks, especially in the later period when this information obtained the status of cultural and political currency.

[441] Although Lenzi (2008: 162-5) finds that the chances of being advisors in the imperial level must have been unreasonable and this was well understood by the scholars. So, he finds that the political efforts are perhaps directed towards the community leadership (e.g. Nikarchos, see table 1 above and n. 1491 below) rather than the Seleucid rulers themselves.

[442] For discussion and an extensive list of occurences see Borger, s.v. 'Geheimwissen' in *RLA*. To name a few examples here warnings are known from the MB commentaries KAR 4 and UM 10/4 12, later for instance K 170 + Rm 590 r.9; VAT 8917 and an especially lengthy curse in VAT 9555. In case of astronomical tablets secrecy clause is included on e.g. ACT 18 and 135.

[443] NBC 1188 = YOS 19, 110. Beaulieu 1992. Cf. Livingstone's (1986: 1) widely accepted opinion that the secrecy clauses reflect above all scholarly pride in the value of literature and knowledge.

[444] Livingstone 2012: 114.

The extraordinary span of Chaldean observations we find in the Greek sources can easily be explained by reference to the same overall tradition. Although the material is ambiguous, if one adds up the reigns from the antediluvians rulers to the dynasty of Isin, the Sumerian King List covers a period of roughly 270,000 years.[445] This approximate number is paralleled in a passage of Proclus:

> But the Assyrians, says Iamblichus, have not only preserved the memorials of seven and twenty myriads [i.e. 270,000] years, as Hipparchus says they have, but likewise of the apocatastes and the periods of the seven rulers of the world.[446]

The period in question differs quite significantly not just in the cuneiform but also in Greek sources: Pliny informs us that Epigenes, 'a writer of very great authority', gave the span as 720,000, whereas Berossus and Critodemus, 'who make the period the shortest, give it as 490,000'.[447] Syncellus, on the other hand, says that according to Alexander Polyhistor, Berossus described in his second book 'the ten kings of the Chaldeans and the length of their reigns, altogether 120 *saroi,* or about 432,000 years until the Great Flood.'[448] Diodorus, on the other hand, has heard of 473,000 years, Cicero of 470,000, Chairemon of 400,000 and Julius Africanus of 480,000 years.[449] The repeated speculations on this matter reflect Greek fascination with both the idea of ancient civilisations and long-term observations and record keeping.[450] So it is not at all surprising that this aspect of Babylonian scribal

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[445] The number of kings and the length of their reigns vary in different versions of the list. See Finkelstein 1963: 46 table 2 for a sample of different periods.

[446] Procl. *in Ti.* 1.100.

[447] Pliny, *NH* 7.57 (480,000 in some manuscript copies). On the basis of the same number of years Pliny concluded that Critodemus was a pupil of Berossus. The reading of thousands has always been questioned, Huxley (1964: 126-7) reduces it to 480 and finds that it accords well with the period of observations available to Berossus (i.e. from Nabonassar onwards), but some of his assumptions, like the date of Berossus will be questioned in ch. 4.4.3 below. See Bostock & Riley's commentary (1890: 221 n. 54) as to whether the reading of thousands is really justified.

[448] *BNJ* 680 F 1b. Syncellus actually says that the records were preserved in Babylon for more than 150,000 years and that the length of the ten kings was 432,000 years. He draws his material from Eusebius: *BNJ* 680 F 1a too gives two different counts - 215 myriad for the length of record-keeping and 40 myriad for the span of the 10 kings - but these numbers might have been corrupted during the transmission of the text, especially with translation from Greek to Armenian. For the discussion of the given periods see Schwartz 1897: 311-4. The number of the kings and sages is given as seven or ten in the Mesopotamian tradition (see p. 79), so Berossus is not in opposition with the myth described above, he might just be following a competing source.

[449] Diod. Sic. 2.31.9; Cic. *Div.* 1.36 & 2.97; Chairemon *BNJ* 618 F 7; Africanus F 15 Wallraff.

[450] To name just a few well-known examples, consider Hdt. 2.143 (Hecataeus and Egyptian priests and their *piromis*-statues) and Plato *Tim.* 23e (introduction to the Egyptian priest's narrative of Atlantis, Egyptian sacred writing going back 8000 years).

mythology became one of the standard motifs in the Greek 'Babylonian repertoire'.[451]

A summary of Greek knowledge about contemporary Babylonians can be found in the second book of Diodorus Siculus, who, besides preserving for us the fanciful stories of Ctesias about the legendary rulers, also gives an intriguing account of the activities of the Chaldeans, worth quoting here:

> Now the Chaldeans, belonging as they do to the most ancient inhabitants of Babylonia, have about the same position among the divisions of the state as that occupied by the priests of Egypt; for being assigned to the service of the gods they spend their entire life in study, their greatest renown being in the field of astrology. But they occupy themselves largely with soothsaying as well, making predictions about future events, and in some cases by purifications, in others by sacrifices, and in others by some other charms they attempt to effect the averting of evil things and the fulfilment of the good. They are also skilled in soothsaying by the flight of birds, and they give out interpretations of both dreams and portents. They also show marked ability in making divinations from the observations of the entrails of animals, deeming that in this branch they are eminently successful… For among the Chaldeans the scientific study of these subjects is passed down in the family, and son takes it over from father, being relieved of all other services in the state…[452]

This information is supplemented by Strabo:

> In Babylonia a settlement is set apart for the local philosophers, the Chaldeans, as they are called, who are concerned with astronomy; but some of these, who are not approved of by the others, profess to be genethialogists. There is also a tribe of the Chaldeans, and a territory inhabited by them, in the neighbourhood of the Arabians and the Persian Sea, as it is called. There are also several tribes of the Chaldean astronomers.[453] For example, some are called

[451] Note that it is one of the motifs that apply with almost equal force to Egyptians. Diog. Laert. 1 pr. 2 ('Hephaestus was the son of the Nile, and with him philosophy began, priests and prophets being its chief exponents. Hephaestus lived 48,863 years before Alexander of Macedon, and in the interval there occurred 373 solar and 832 lunar eclipses.'); Martianus Capella 8.812 (observations made for 400,000 years); Simplicius, *in Cael.* 1.3 (630,000).

[452] Diod. Sic. 2.29.1-4.

[453] The use of designation 'tribes' goes back to Herodotus but could well be a standard refererence to a social class (compare Hdt. 1.101 & 107 on the Magi being one of the Median tribes) that does not necessarily indicate a separate national identity. Although in the case of the 'Chaldeans', their continued use of Akkadian language as opposed to Aramaic might have led to the belief that they indeed formed a separate 'tribe' in the modern sense.

Orcheni, others Borsippeni, and several others by different names, as though divided into different sects which hold to various different dogmas about the same subjects. And the mathematicians make mention of some of these men; as, for example, Cidenas and Naburianus and Sudinus. Seleucus of Seleuceia is also a Chaldean, as are several other noteworthy men.[454]

The picture pained by these passages accords almost down to the very last detail with what we learn about the 'Chaldeans' from the cuneiform sources. Chaldea proper is located where Strabo says it is,[455] the scribal art was indeed hereditary in ancient Mesopotamia, and though divided into different categories, characterised by polymathy from very early on.[456] The young scholar Marduk-šapik-zeri, when reviewing his learning, declares that he has 'fully mastered my father's profession,[457] the discipline of lamentation', but then goes on to list a number of other rituals and series he is familiar with, including the Enuma Anu Enlil (EAE) series (below) and observation making.[458] Moreover, administrative lists detailing Aššurbanipal's acquisitions of tablets from Babylonian private libraries[459]

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[454] Strabo 16.1.6. Cf. Pliny, *NH,* 6.30: 'Hipparenum, rendered famous, like Babylon, by the learning of the Chaldaei, and situated near the river Narraga… Orchenus also, a third place of learning of the Chaldaei, is situated in the same district, towards the south.' Whereas the Orcenus, like Strabo's Orchenoi, undoubtedly refers to Uruk and its temple, the identification of Hipparenum with Nippur (Oelsner 1971 & 1982) is still slightly inconclusive (see van der Spek 1992: 236-43 for some problems with Oelsner's thesis and an argument (contra Oelsner and Neugebauer 1975: 352) that Sippar cannot be eliminated as a possible candidate. Orchenoi (i.e. people of Uruk) also appear in Ptol. *Tetr.* 2.3 and possibly in P. Oxy. 4139, a treatise on lunar periods.

[455] Chaldaei or Chaldean was a term originally applied to a tribe of western Semitic origin (Brinkman's classification), attested from the early 1st millennium BC in Southern Babylonia. It is disputed whether these Chaldeans were related to, or perhaps formed a group of, the Arameans: the 18 known 'Chaldean' personal names from between 878 and 722 BC leave the answer inconclusive (Brinkman 1968: 265; Edzard, s.v. 'Kaldu' in RLA 5, 291-2 for an overview of theories of their ethnic origin). The area they inhabited came to be called *mât Kaldi* (or *mât Bit Yakin*) by Assyrians and Babylonians but not by the Chaldeans themselves, who differentiated between at least five separate tribes or tribal areas: 1) Bīt (i.e. 'the House of') Amukāni, 2) Bīt Dakkūri, 3) Bīt Jakīn(i), 4) Bīt Ša'alla, -sa'alli and 5) Šilāni, -silāna/i (see Edzard, s.v. 'Kaldu' in RLA 5, 293 for their respective geographical locations). A strict differentiation between Chaldea and Babylonia is only partially supported by the sources. On the one hand, as in Strabo above and Ptol. *Geogr.* 5.20, Chaldea is seen as a region of Babylonia, on the other, as in Amm. Marc. 23.6, it is depicted as separate from it. Still, the *mât Kaldu* in late cuneiform texts, as well as *Kaśdîm* in the Old Testament and Chaldaeans in classical tradition, are used as a synonym for 'Babylonians'.

[456] Parpola 1993b: 49-52, Brown 2000: 33-52. See Neugebauer 1955: 13-16, Doty 1988: 100-1 and Brown 2000: 38-9 for the family-trees of Assyrian and Babylonian scholars.

[457] On the scholarly lineages and ancestors see Lambert 1957.

[458] SAA 10 160. See Robson 2011: 605-11 for the most recent overview of the role and status of scholars at the Assyrian court (on the example of *bārû*s).

[459] Parpola 1983: 8-9. These records give not only the name and genre of the text but also the number of available copies. See Parpola 1983: 10-12 for the historical context in which this happened and Frame & George 2005: 277-83 for a number of tactics Aššurbanipal used to build up his holdings.

not only provide invaluable information on his royal library, several small private libraries and the question of literacy and the extent of literary and professional competence in the areas in question, but furthermore they show that astronomical/astrological literature was owned not just by the scribes of EAE but also by specialists in other traditional fields of Mesopotamian scholarship.[460] Scholarly material not pertaining to one's own specialism (table 2) was sometimes stored in impressive collections: one Nabû-x […] handed over 435 tablets and 7 complete polythycs; Nabû-apal-iddin 342 tablets and 10 polyptychs etc.[461] Moreover, an analyses of the colophons of Nabû-zuqup-kēna shows that he worked systematically on a variety of related material and his tablets of the i.NAM.giš.ḫur.an.ki.a series further demonstrate how these fields were bound together.[462]

ṭ upšarru	Scribe-diviner
ṭ upšar Enūma Anu Enlil	Celestial diviner[463]
Āsipu	Magician-exorcist, healer-seer
Šā'ilu	Dream interpreter
Bārû	Haruspex/extispicer/diviner
Kalû	Lamentation priest-chanter

Table 2: Mesopotamian scholarly specialisms

That a breadth of learning remained the standard also in the LB period is well demonstrated by the personal library of Iqiša of Uruk (who is designated as a MAŠ.MAŠ and *ereb biti* of gods Anu and Antu) which features texts on celestial and terrestrial, including medical and diagnostic omens, commentaries, incantations, lexical tablets, and astronomical texts (e.g. an ephemeris computed by the scheme of System A). Iqiša also prepared two tablets coordinating celestial omens, zodiacal signs, and incantations.[464] That such wide-ranging knowledge was applied to practice is even more evident

[460] Parpola 1983: 6, 8. Out of the total of about 2000 clay tablets and 300 writing boards, 107 and 6 respectively belong to astrological lore. These 107+ texts must be interpreted in the context just outlined in n. 459 above. It is likely that at least most of them came from professional astrologists.

[461] Parpola 1983: 9.

[462] Livingstone 1998: 218. Translations and commentary of i.NAM.giš.ḫur.an.ki.a tablets (K 2164+2195+3510, K 170 + Rm 520, K 2670, and a later period BM 47860), which contain elements of mathematics, astronomy, philology, religious and mythological speculation, in Livingstone 1986: 17-52.

[463] Reiner's (1995:63) 'expert in celestial matters' is perhaps better in conveying his varied responsibilites. See Rochberg 2000b for a thorough discussion on this translation problem.

[464] Varied writings of *kalû*-priest Anu-uballit or *āšipu* Anu-aha-ušabši serve as alternative examples. See

from a commentary text from Kutha, which relates a number of omen series to astrological elements.[465] That astrology formed the dominant tool on which other practices were dependent is further demonstrated by a text that provides correspondences between liver observations and the heliacal risings of the constellations, as well as other texts that relate the positions of the constellations and planets with the timing of certain rituals.[466] What we understand as 'religion', that is divination and ritual apotropaism, and 'science', referring to observation and prediction of phenomena, 'seem everywhere to overlap.'[467] So Diodorus' source is correct when he says that the same people involved in observational astronomy and astrology are also conducting the apotropaic rites and incantations that complement the practice of divination.[468]

After the fall of the NA and NB empires, these people continued to be employed by the temples. This allowed the scholarly traditions to survive all the major political reconfigurations of the succeeding centuries. A text from Babylon's Esangila archive, for instance, provides evidence for substantial official sponsorship of astral sciences in the 4th cent. BC.[469] Other texts contain the names of 50 individual *kalû*-priests and at least 65 *āšipus.*[470] The interest in, and support given to, Babylonian local cults and the intellectual activity associated with them did not diminish even after Alexander's conquest and the establishment of a Hellenic Empire. The building of two new traditional temple complexes in Uruk during the 3rd cent. BC testifies to Seleucid kings' enormous investment in the local religion.[471] The founding of a new capital Seleucia on the Tigris at the same time could have

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Rochberg 1993: 39 & 2000b: 366-7.

465 Published in Biggs 1968 (in private collection, partial duplicate LBAT 1601 = BM 34647) and dated by him tentatively to the Persian period, and a slightly revised version in Böck 2000. A comprehensive overview of how celestial omens are situated within the literary and intellectual framework of the larger Mesopotamian divinatory context and scholarly tradition can be found in Rochberg 2004: 44-97.

466 W 22666/0 and BRM IV nos. 19-20 respectively.

467 Rochberg 1993: 37.

468 A document giving insight into this arrangement is CT 49 144. The professional affiliations of astronomers are a further testimony to the interrelations between religion and astral sciences: in the late period, 'priest' (*šangû*) and 'scribe' (*ṭ upšarru*) could both be written lú.ŠID (Rochberg 1993: 42).

469 YBC 11549, a list of barley allowances (*kurummatu*) for the astronomers, 14 men altogether. Beaulieu (2006a: 5-22) notes that 'the fact that most, if not indeed all the astronomers mentioned in this text are otherwise unknown opens up exciting vistas on the complexity of scientific research in ancient Babylonia on the eve of Alexander's conquest of the Persian Empire.' Also see Beaulieu 2006a: 12 for a list of people employed by the LB temple.

470 CT 44 84 and HSM 893.5.6 (only half of the tablet survives) respectively. For a lists of all known priests from Babylon see Boiy 2004: 267-275 (esp. 271 for *tupšar Enuma Anu Enlil*).

471 The planned restoration of Esangila on Alexander's orders is mentioned in Diod.Sic. 17.112.3, Strabo 16.1.5,

hindered the hellenisation of Babylon and other local urban centres.[472] The 2nd and 1st cent. BC saw an extensive copying of bilingual Emesal hymns,[473] which show that the scribal and literary activity continued to flourish there in its entirety for a substantial period of time.[474] Perhaps the most interesting finds from this relatively late period are the so-called Greco-Babyloniaca texts that transliterate Akkadian and Sumerian words into Greek script.[475] These tablets appear to be school exercises, probably written by local scribal students and designed to show how the ancient languages were read.[476]

However, despite the seemingly high numbers of temple-staff, associated scholarly activities, especially astronomy, appear to have remained the business of a few select families, e.g. the Sin-leqi-unninnis and Ekur-zakirs in Uruk and the Mušezib in Babylon (although the situation there is less well known).[477] And Strabo, or rather his source, is heading in the right direction when he says that these

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Arrian *Anab.* 3.16.4, 7.17.1, and Josephus *Ap.* 1.192; and in CT 49 5, 6, Iraq 59 172 no. 51 and AION Suppl. 77 69. The Ezida temple of Nabu in Borsippa was renewed under Antiochus I in 267 BC (BM 36277, the so-called 'Antiochus Cylinder'). Works on Esagil and other temples are also mentioned in chronicle TCS 5 120:2, and in astronomical diaries no. 273 (line 38') and no. 270 (on this see Horowitz 1991: 75-7) in Sachs & Hunger 1988-2001.

[472] Rochberg 1993: 32-3.

[473] CTMMA 2, 2-18.

[474] Geller (1997: 53-6; also Boiy 2004: 304-7) has also argued that the Mesopotamian cults and shrines (e.g. of Bēl and Bēltīja, Nabû, Nergal, Šamaš, Tammuz, Nanai and Adad) were popular in neighbouring Syria, especially in Palmyra, until a very late period. Babylon attracted Palmyrene businessmen until the 1st millennium AD (see a Greek-Palmyrene bilingual Inv. IX 11). Geller (1997) has also argued that the script could have been understood as late as the 3rd cent. AD but Westenholz (2007: 294-309) has more recently successfully undermined this view. In particular, the story of Iamblichus' teacher giving him lessons in 'Babylonian' is unlikely to refer to Akkadian; rather, it may refer to a local dialect of Aramaic which was different from Iamblichus' native Syriac. This also moves back the late date Geller (2000: 2-6) supposes for the transmission of Babylonian scientific knowledge into Rabbinic literature, notably the Babylonian Talmud. The appearance of Babylonian mathematical and astronomical, as well as medical and omen material, together with Akkadian loanwords and expressions, is in need of a considerable further study; Geller only offers an overview of some possibilities.

[475] The most recent editions are Geller 1997 and Westenholz 2007. Most of the corpus comes from either the 1st cent. BC or the 1st cent. AD, but the earliest of the tablets (Ash. Mus. 1937.993) has been dated to 2nd cent. BC on palaeographic grounds. However, it differs from the rest of the corpus in size, shape, overturning and content; in addition, its provenance and even whether the language rendered into Greek is actually Akkadian and/or Sumerian is still unknown. Black & Sherwin-White (1984: 131-40) found that local dialects like Uruk Aramaic or Palmyrene are a possibility; Maul (1991: 87-107) identified it as an Akkadian-Sumerian bilingual but see Geller (1997: 84) for the critique of his approach. Geller (1997: 83-5) includes it among his Greco-Babyloniaca and draws parallels with tablet no. 18, which is probably of Egyptian provenance.

[476] Gesche 2000: 184-5.

[477] A judgement from temple court (BOR 4 132) concerns the assignment of the function of temple astronomer to the sons of Itti-Marduk-balāṭ u, the former holder of the post who was sent to king Hyspaosines of Mesene.

clans held slightly varying beliefs: almost all System A lunar tablets (below, ch. 3.2.3) come from Babylon, and about two thirds of the surviving System B tablets originate from Uruk.[478] Valens too distinguishes between the beliefs of Babylonians and those of Chaldeans, saying that whereas the first put the year length at $365\ {}^{1}/_{4}\ {}^{1}/_{144}$ days, the latter allege a slightly longer $365\ {}^{1}/_{4}\ {}^{1}/_{207}$ days.[479] As Jones notes, this confirms not just knowledge among Greeks of elements of Babylonian astronomy, but also their awareness that these elements were in fact Babylonian in origin.'[480] The same applies to astrological doctrines.[481] Moreover, Diodorus' testimony on Babylonian astral sciences provides further interesting insights despite its garbled form.

> Under the course in which these (the planets) move, so they say, are arranged the 30 stars which they call the counselling gods, one half observing the affairs of man at the same time as the occurrences of heaven. Every 10 days one of the stars from above is sent to the stars below as a messenger, as it were, and similarly, one of those below the earth is sent above. This course, which is demarcated and governed by a perpetual circle, holds the stars (in place). Twelve, they say, is the number of those who regulate these gods, and they assign a month to each of them (the gods) as well as one of what are called 12 zodiac(-stars). Among them, they say, the Sun, Moon and five planets travel; the Sun completing its own course in a year, the Moon traversing its own circuit in a month. Beyond the circuit of the zodiac they designate 24 other stars: one half of them, they say, are situate in the northern parts (of the sky) and the other half in the southern.[482]

The text implies the existence of two separate systems for stellar-paths and their slight difference in purpose. This has generally been seen as confusion on Diodorus' part but Horowitz and Oelsner have

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CT 49 144 records a complaint by the son of an astronomer whose father's position had been assigned to another, although he himself was fully capable of performing these duties (Rochberg 2000b: 373-5 for an up-to-date translation).

[478] Although, as Neugebauer (1975: 610) has pointed out, both systems are made use of in both cities, this does not mean that they were originally not associated with either one of them. The origin of planetary theories is more ambigious (Neugebauer 1955: 10).

[479] Vett. Val. 9.11K/12P. According to Britton (2007: 129) these are both based on solar model B.

[480] Jones 1999: 99.

[481] E.g. Pliny, *NH* 2.81: 'According to the doctrine of the Babylonians, earthquakes and clefts of the earth, and occurrences of this kind, are supposed to be produced by the influence of the stars, especially of the three to which they ascribe the thunder; and to be caused by the stars moving with the sun, or being in conjunction with it, and, more particularly, when they are in the quartile aspect.' But see more in ch. 4.3.

[482] Diod. Sic. 2.30.6-7.

recently suggested that this might not be case.[483] Mesopotamian astrolabe texts indeed generally list 36 rising and setting stars, 12 for each traditional path of Ea, Anu and Enlil.[484] However, a Middle Babylonian text HS 1897 and its Late Babylonian parallel BM 55502 both give 30 instead of the more usual 36,[485] as well as some astrological omens associated with them. BM 55502, however, also has a list of 36 stars on the other side of the tablet, verifying that knowledge of both systems survived well into the Hellenistic period. Their co-existence can be explained with the hypothesis that the two sets of lists were used for somewhat different aims. Unlike the 36-star lists, HS 1897 and BM 55502 do not seem to preserve month-star lists but rather aim to locate and identify important stars in the stellar paths and by that to define the limits of these paths.[486] So, despite problems with this passage of Diodorus it seems that the previously postulated error for '30' no longer holds.[487]

Horowitz and Oelsner also suggests that the last part of the quotation above, which obviously is a strong parallel to the three stellar paths, could be a late, but otherwise unattested, version of the well-known system, replacing the middle path of Anu with the zodiac and referring to the Paths of Enlil and Ea as north and south of the former. They find that Diodorus Siculus might thus 'provide us with insight into a very late stage in the development of Babylonian astronomy that still preserved a vestige of the 30 star tradition that is first attested in HS 1897 from Middle Babylonian period Nippur, as well as the 36 star tradition best known from Astrolabes.'[488]

Beyond the texts of Diodorus and Strabo, Maddalena Rumor has recently shown that Pliny's report on Babylonian medicine (more particularly *Dreckapotheke,* i.e. the use of animal parts as medicine) is consistent with the Babylonian local tradition as recorded in the so-called calendar texts.[489] As in Pliny, who claims that the treatment of the ills has been subdivided into 12 signs of the zodiac, 'according to the passage of the sun and again the moon', the cuneiform text in question lists the

[483] Horowitz & Oelsner 1997/98: 176-185.

[484] See ch. 3.2.1.

[485] Horowitz & Oelsner (1997/8: 182-3) suggest that the 30-star system reflects a 2nd millennium BC tradition of listing stars in groups of 10, as evidenced e.g. by AO 6769.

[486] Horowitz & Oelsner 1997/8: 182.

[487] Cf. Rochberg 2010: 8-9 who suggests the 30-star system might be inspired by the misattribution of the Egyptian decans to the Chaldeans, although it does correctly evoke a Babylonian idea of divine agency and its manifestation.

[488] Horowitz & Oelsner 1997/8: 184.

[489] Pliny *NH* 30.95-7. Kalendertext W 22704. Unpublished talk 'From Iqiša to Pliny the Elder: A Case of *Dreckapotheke'*, RAI 59, Ghent 2013.

treatments according to the days of the month, which are then assigned a constellation and a number. The numbers reflect a quadraplicities-based order. Even more telling is the fact that the correspondences between specific cures are approximate, e.g. the mythological Anzu bird is, most probably based on physical resemblance, rendered as a bat in Pliny.[490] Thus, not only were Greeks and Romans aware of Babylonian activities, but they also had access to genuinely Babylonian, in this case astrological-medical, learning. Moreover, this learning was acclimatised to local conditions. This process of the acclimatisation or 'translation' will be examined in the chapters to follow; now, however, a few potential transfer 'agents' must be considered for there is, in fact, sufficient evidence for all of the 'noteworthy men' that Strabo mentions.

First, Cinedas, or Kidinnu in Akkadian, is one of the most important astronomers of antiquity who probably lived in the 4th cent. BC[491] and is said to have discovered the period relation

251 synodic months = 269 anomalistic months[492]

Pliny the Elder connects him with an observation about Mercury,[493] Valens says he got his tables for the moon from Sudines and Cidenas.[494] He is mentioned by name in two LB lunar ephemerides: ACT 122 and ACT 123a, both of which purport to be the '*teršitu* of Kidin(nu)'.[495]

Naburianus, or Nabû-Rîmannu is mentioned in ACT 18, a System A lunar ephemeris for 48/47 BC.[496]

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[490] Both are described as 'lion-headed' birds. According to Rumor, four out of five instances produce a good correspondence.

[491] BM 36304 = ABC 8 obv. 8' mentions that a Kidinnu was killed by a sword, probably in year 330 BC. That this definitely is Cidenas is not certain but he must have enjoyed great fame or been otherwise important to the scribes who recorded his death in a chronicle. A date between 150 and 50 BC can be suggested on the basis of the surviving tablets bearing his name but this too is tentative.

[492] Σ Ptolemy §§ 3-4 (ed. Jones 1990a). See glossary for the explanation of *synodic* and *anomalistic*.

[493] Pliny, *NH* 2.6. Pliny reports that Cidenas and Sosigenes (Caesar's advisor for the calendric reform) say that Mercury never deviates from the sun more than 22° (MSS vary). According to Neugebauer (1975: 612) this value does not appear anywhere in the Babylonian theory, for which it would have been of little interest. He thus finds the reference to Cidenas suspicious.

[494] Vett.Val. 9.11K/12P.

[495] ACT 122 (= BM 34580+42690) gives '*teršitu ša Kidin*', ACT 123a (= BM 45849+46237) '*〃 Kidinnu*'. CAD s.v. 'tersitu [3]' gives them as computed tables, occuring also for instance in CT 49 144: 24.

[496] = VAT 209 + MM 86-11-405 (Nabū-(ri*)*mannu). Identification with Naburianus and discussion on the synodic month length of 29.530641 days in Schnabel 1923: 222-7.

The colophon of a Greco-Babyloniaca text[497] gives some idea as to his importance:

> Belonging to Bēl-īpuš[498] son of Ea-bāni (son) of Bēlšunu: he was pleased(?); Craftsman(?) [..].. of Nabû-Rîmanni, to extend the days of [his] life and well-being, and may the wise one *who* […].. performs the scribal arts…[…]… […]; (as for) *the tablet* [which he] wrote – may it not *break*.[499]

Although the fragmentary state of the texts allows no certain insight into his exact role, Geller makes a sensible suggestion that Bēl-īpuš was probably copying a text written by or attributed to Nabû-Rîmannu, or alternatively, could have been a student at his scribal school.[500]

Next in Strabo's list is Sudines (reconstructed as Šuma-iddina), a *bāru* who performed an extispicy of sorts for Attalus I of Pergamum in 235 BC before the latter's battle with the Gauls.[501] There is no cuneiform evidence for him but, in addition to Valens' reference to his lunar tables, Vatican manuscript attributes to him a year length $365\ {}^{1}/_{4}\ {}^{1}/_{3}\ {}^{1}/_{5}$.[502] A papyrus fragments from the 3rd cent. AD quotes his theory that:

> The Saturn is the annihilator of the elder
> the Jupiter of men,
> the Mars of young men,
> and Venus of women, as Sudines says.[503]

Some fragments of his work also survive in Pliny but these concern the properties of precious stones.[504]

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[497] Text no. 15 in Geller 1997. And possibly no. 14 too but the reconstruction of surviving Ναβο[υ] to Nabû-Rîmannu is speculative.

[498] The name of the owner Bēl-īpuš also occurs in a colophon of a bilingual incantation text dating to 183/2 BC. The name of his father is known from another Greco-Babyloniaca colophon but it is too fragmentary to provide any context.

[499] Trans. Geller 1997: 81; 80-2 for the commentary.

[500] Geller 1997: 49. It was held by Schiaparelly, Cumont, Weidner and Schnabel that Naburinus was the inventor of System A and after couple of corrections his date was fixed by Fortheringham around 500 BC (van der Waerden 1968: 71). However, Neugebauer (1952: 137) has shown these dating efforts to be implausible. Rochberg's ACT 18 based date in *EANS* is seriously undermined by the Greco-Babyloniaca text.

[501] Poly. *Strat.* 4.20 ('Σουδίνου Χαλδαίου μάντεως').

[502] Vat. Gr. 381 fol. 163, see Neugebauer 1975: 601-2 and n. 788.

[503] P. Gen. Inv. 203. Trans. Annus, 'A fragment of Sudines (1)' in MPD. The papyrus is allegedly summarising a commentary by Posidonius on Plato's *Timaeus* (Rochberg 2010: 5). Discussion in Hübner 1988.

[504] Pliny, *NH* 9.56 (pearls), 36.12 & 37.24 (onyx), 37.9 (crystal), 37.11 (amber), 37.25 (*nilios*), and 37.50

Finally, probably the best known and the latest of the listed astronomers is Seleucus, perhaps a slightly older contemporary of Hipparchus and a proponent of the heliocentric theory.[505] To what extent these men served as carriers of culture from one society to another will soon be examined in greater detail.

2.4 Conclusion

The limited evidence we possess indicates that thanks to Greek participation in wider Mediterranean political and cultural networks during the archaic period, they were familiar with the key events and actors of the Near East through various more or less direct channels. These early experiences came to influence the way this geographical land mass, with all its consecutive empires and various nations were later depicted in the Greek (and Roman) literary tradition. As this chapter has shown, the use of the over-arching 'grid' of an eastern barbarian is continuous, showing only limited regard to the changing political and cultural situation in the area in question.

The persistence of the 'cultural grid', once firmly established, is also very clearly observable when it comes to its individual elements. All these point to the fact that as far as the persistence and influence of a 'cultural grid' goes, we have clear evidence that it indeed had more impact on the interpretation of foreign material than this often contractictory material had on the image of the country in question. The effect previous knowledge, and expectations created by it, had on the decoding of the foreign stories, artistic representations and cultural phenomena is difficult to overestimate. Naturally, the characters dictated by the existing 'repertoire' became even more exaggerated and confused as a direct result of their almost violent rationalisation in the light of the new material. In other words, the generalities were arranged into a distinctively Greek framework, which would then accomodate the handpicked, more or less 'factual' evidence. The emergence of the resulting discourse is a complex process, one by no means reducible to a finite analysis especially in so restricted a space, but the interrelating factors can be fathomed to some extent, even if only in extremely faint outline.

(*astrobolos*). Cf. Pliny, *NH* 37.60: 'Zachalias of Babylon, in the volumes which he dedicates to King Mithridates, attributes man's destiny to the influence of precious stones.' First lapidaries were indeed compiled in Babylonia (early DUB.NA$_4$.MEŠ and later *abnu šikinšu*) and the stones became tied to the astrological theory (see Reiner 1995: 25, 29-30, & 119-132 and a general discussion on the development of Mesopotamian pertrology in Postgate 1997); a similar lapidary attributed to Thrasyllus (Cramer 1954: 14).

[505] Neugebauer 1975: 611.

‘Chaldea’ clearly came to occupy different places in different discourses over the course of time, not all of which have been studied here. In the poetic discourse it was the place of romance, exotic landscapes, extraordinary women, vice and decadence. Hyginus (64 BC – AD 17) lists some *fabulae* which constituted key stories projected onto the ‘Babylonian/Assyrian stage’:[506] those of Semiramis and Ninus, the tragic love-story of Pyramus and Thisbe, and that of the handsome king Cinyras who committed suicide because he had lain with his own daughter Smyrna.[507] In historical discourse it had given birth to a long line of great empires and cities that had by now crumbled to dust. The representation was strongly influenced by the contemporary socio-political contexts - for example, that of the preoccupation with the fall of the empires after the Persian wars.

In the religious discourse it was the land of magic, divination and oracles. And this of course bears on the scholarly discourse, which saw Chaldea as the place of origins of advanced mathematical, astronomical and astrological knowledge. It is this last aspect of the Babylonian civilisation that had the deepest effect on the Western world. An allusion to this fact can be seen in Pliny’s insistence that:

> The temple of Jupiter Belus is still in existence; he was the first inventor of the science of Astronomy. In all other respects it has been reduced to a desert, having been drained of its population in consequence of its vicinity to Seleucia…[508]

In the Greek frame of reference, long history implied cultural superiority, and as was explained in the first chapter, perceived authority and prestige of the source culture plays an important role in the transfer process. The admiration for the longevity of Babylonian and Egyptian civilisations and their respective scholarly traditions facilitated Greek willingness to learn from them, and, once the political positions were reversed, gave the priesthoods in question some lewy to negotiate with the

[506] See p. 21 for the metaphor.

[507] Hyginus, *Fab.* 223, 240, 242-3, 270, 274 & 275. Some of Hyginus’ material could be derived from Berossus (e.g. 274: ‘Oannes, who in Chaldea is said to have come from the sea, interpreted astrology’), as Alexander Polyhistor was his mentor. That these stories and views found general favour is clear from Ovid (n. 268 above and *Met.* 4.55-166) and Q. Curtius Rufus (5.1.36-39).

[508] Pliny, *NH* 6.30, also Strabo 16.1.5, Pausanias 1.16.3 and Martianus Capella 6.701, plus the same holds for the Jewish accounts. Note though, that this insistence on Babylon being virtually deserted after the creation of Seleucia-on-Tigris has been proven an incorrect assumption. For evidence of its continued occupation see Boiy 2004: 188-92 and Geller 1997. Boiy (2004: 190) has suggested as one possible reason that Babylonian mud-brick architecture was disappointing to the westerners whose expectations were based on old accounts of an illustrious city filled with luxury and splendour.

new rulers.[509] And as will become evident over the next three chapters, to a significant degree the existing notions about the precise expertise of these scholars also dictated what exactly could and would be learnt from them.

[509] E.g. as Lenzi (2008: 155, 162) notes, Greek interest and appreciation for the antiquity of the Babylonian temples and the knowledge these guarded played an important role in the facilitation of the Seleucid ruler's continued investment in their upkeep; and the local priests were prone to make use of this fact by 'deploying a mythmaking strategy to elevate their position and importance in society.' Although we can of course observe the same strategies being used for a long period of time before that, it is perhaps noteworthy that the previous Persian rulers must have been less symphatetic to them (see p. 171). See also ch. 4.4.1 for similar tactics employed by the Egyptians.

Chapter 3: Astronomy

3.1 Introduction

The astral sciences have been for long considered the most distinct legacy of Mesopotamian culture.[510] As the Greek debt to Babylonia is increasingly better understood, we can turn to current research and focus, in Rochberg's words, not on

> a question of whether Hipparchus went to Babylon and learned mathematical astronomy… but [on] a multifaceted cultural matrix which allowed for the various parts of these interrelated sciences to be understood and significant for the West.[511]

This is where the cultural translation theory should be able to offer valuable insights. The forces we have observed at work on the literary topoi also exercise themselves on a very different kind of material. However, here the 'cultural grid' is important only as far as it enables and encourages the transmission and reception of the imported knowledge. Hence, the focus moves slightly away from the 'cultural grid', or what the Greeks knew about Babylonia and imagined their sciences to be like, more towards the role of 'home repertoire', or what they knew about those sciences in sum. The better preservation of the 'source text' than was available for the most topics considered in the previous chapter, allows us to sketch with more precision the changes that this 'text' undergoes as part of the 'translation process' and the particular differences between the 'source' and 'target' cultures that have the greatest influence on this transformation. Though the mission is somewhat hindered by the paucity of evidence for early Greek astronomy and the possible contamination of later material,[512] these effects can be minimised by treating the subject in each period on its own terms[513] and by examining, in addition to specific astronomical theories, models and their numerical

[510] E.g. Rochberg 1993: 31; Neugebauer (1975: 589) calls the influence 'obvious'; Pingree (1997: 9) has remarked on the 'incredible facility' of the transmission.

[511] Rochberg 2010: 9.

[512] Goldstein & Bowen (1983: 331) note how this 'has made writing the history of Greek astronomy extremely difficult and has introduced into it a considerable amount of reconstruction, much of it highly speculative.'

[513] Although I will try to avoid using evaluative terms, modern scholarship has traditionally differentiated between several stages of 'prescientific' astronomy (from the naming of stars and constellations to the employment of various lunar/solar/planetary cycles) and 'scientific' astronomy. The latter is usually defined as being mathematical or theoretical in nature, an understanding of the heavenly phenomena capable of yielding numerical predictions that can be tested against observations but is no longer dependent on constant consultation of records. This means that it is also possible to predict phenomena that are not directly observable, e.g. their occurrence falls into daytime (Aaboe 1974: 21-3).

results, the religious, philosophical and social contexts in which they occur.

The true focus of the following pages, however, is on determining the aspects or forces that enable or hinder a culture's receptivity to foreign ideas in the long run. As is clear from the last chapter, Greek and cuneiform cultures engaged in a continued dialogue over a long period of time. This chapter thus asks what determined when certain astronomical ideas would be successfully received in Greece. Did this happen when access to them became physically available, or were there other factors in play? How did the Greek culture go about internalising the need for new (semiotic) goods after becoming aware of their existence? And finally, was the transfer's success only determined by how near or far the foreign concept stood to or from the local ideological tradition?

As the field and the material on it is vast, I have had to make strict choices on what and to how much detail can be incorporated into the present study. There are inevitable gaps in the discussion; where those occur, I have tried to give ample references to available sources. The chapter first gives a modern translation of the Mesopotamian astronomical tradition and its development over the first millennium BC. Special emphasis is placed on the religious and divinatory context in which this technical knowledge was embedded, as belief systems encompassing ancient views and concepts of the cosmos will have important ramifications for future arguments.[514] This 'source text' is first compared to the 'translations' used in Greek time-reckoning practices, and secondly, within cosmological theory and geocentric models of the universe; the third and final case study focuses on the use of Mesopotamian planetary schemes by Greco-Roman astrologers. This last subchapter also includes a brief consideration of the agents of transmission. It is important to consider whether they were originally embedded in the source or target culture, as their level of familiarity with either or both has a profound impact on what and how would be first transmitted, how much secondary translation this material requires, and how authoritative it is perceived to be.

3.2 'The Source Text' – Mesopotamian Astronomical Tradition

3.2.1 Early Mesopotamian Astronomy – Ideas and Ideals

As every society has the need for a device and a set terminology to regularise its activities and reckon the passing of time, so in the beginning of every astronomical tradition lies concern with calendars

[514] The discussion here is limited, for a concise overview of Mesopotamian astronomy see Pingree 1997: 12-20, more extensive discussion in e.g. Rochberg 2004.

and calendric cycles. The earliest surviving cuneiform sources with astronomical content, like the ziqpu-star catalogues, Astrolabe texts, the MUL.APIN, and a few tablets from the EAE corpus, all seem principally to be concerned with the course of the observable events in the sky and the correlation of these events with the passage of time.[515] Mesopotamian civil (or cultic) calendar consisted of 29- or 30-day months[516] beginning with the appearance of the new moon on the western horizon. However, not much observation is needed to realise that the lunar month is not quite compatible with the other two natural time intervals: the solar year and the day. One *tropical* year is approx. 365¼ days and one *sidereal* month 29½ days, 12 months amounting to 354 days.[517] That leads the lunar calendar to be removed from the solar year by roughly 11 days per year and the cumulative error of c. 33¾ days in every three years requires an insertion of an extra month in every two or three years to keep the months in phase with the seasonal year, producing a leap year of approx. 384 days.[518] One way to determine if the lunar calendar was correctly aligned with the stellar cycle or if an intercalary month was needed to bring it back into agreement with it, was to correlate the beginnings of months with the rising of certain stars. An elaborate version of this system is recorded in the so-called Astrolabe texts[519] or 'The Three Stars Each' (*kakkabû* $3^{\text{ta.àm}}$). These identify stars that rose each month in the Paths of Anu, Enlil, and Ea (i.e. the northern, central and southern portions of the sky) – as the name indicates, one star for each path, hence 36 stars in sequence of 3

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515 Horowitz 1998: 151.

516 The length of *synodic* lunar months can vary up to c. 13 hours and the first visibility even more, resulting in months of lunar calendars being either 29 or 30 days long. The first variation is caused by the changing speed of the moon as it moves closer to and further from the earth along its elliptical orbit, and the same happens to earth moving around the sun. The first visibility is further influenced by the viewing conditions, the obliquity of the ecliptic, the latitude of the moon and the latitudinal position of the observer (see Samuel 1972: 9-10 fig. 9a, 9b, 10a & 10b for a visualisation of these effects).

517 See the glossary for italicised terms and more precise values.

518 The shortfall can of course be ignored but this will cause all months and holidays with them to shift back through the seasonal year over time (e.g. Ramadan).

519 Earliest evidence for the Astrolabe texts comes from the Kassite period, although it is possible that they were first composed as early as the OB era (see Horowitz 1998: 157-61). Astrolabe B dates to the reign of Tiglath-Pileser I (1115-1077 BC) and his father Assur-Reš-Iši (1133-1116 BC); numerous (including all circular) astrolabes come from the NA period (Horowitz 2007: 104). Examples include HS 1897 (30 stars), KAV 218 = VAT 9416 = Alb B (i.e. Astrolabe B), CT 33 9; also EAE Assumed Tablet 51, BM 82923 (a *mukallimtu* – an esoteric commentary) (See Horowitz 1998: 154 & 2007: 103-6). The Astrolabe group is non-canonical, meaning that it never reached a set form; texts are written in either circular and list format, some preserving extra information (e.g. Alb B gives a bilingual menology of the 12 months, including rites and rituals, agricultural events, and divinities associated with them).

per month over an annual circuit.[520]

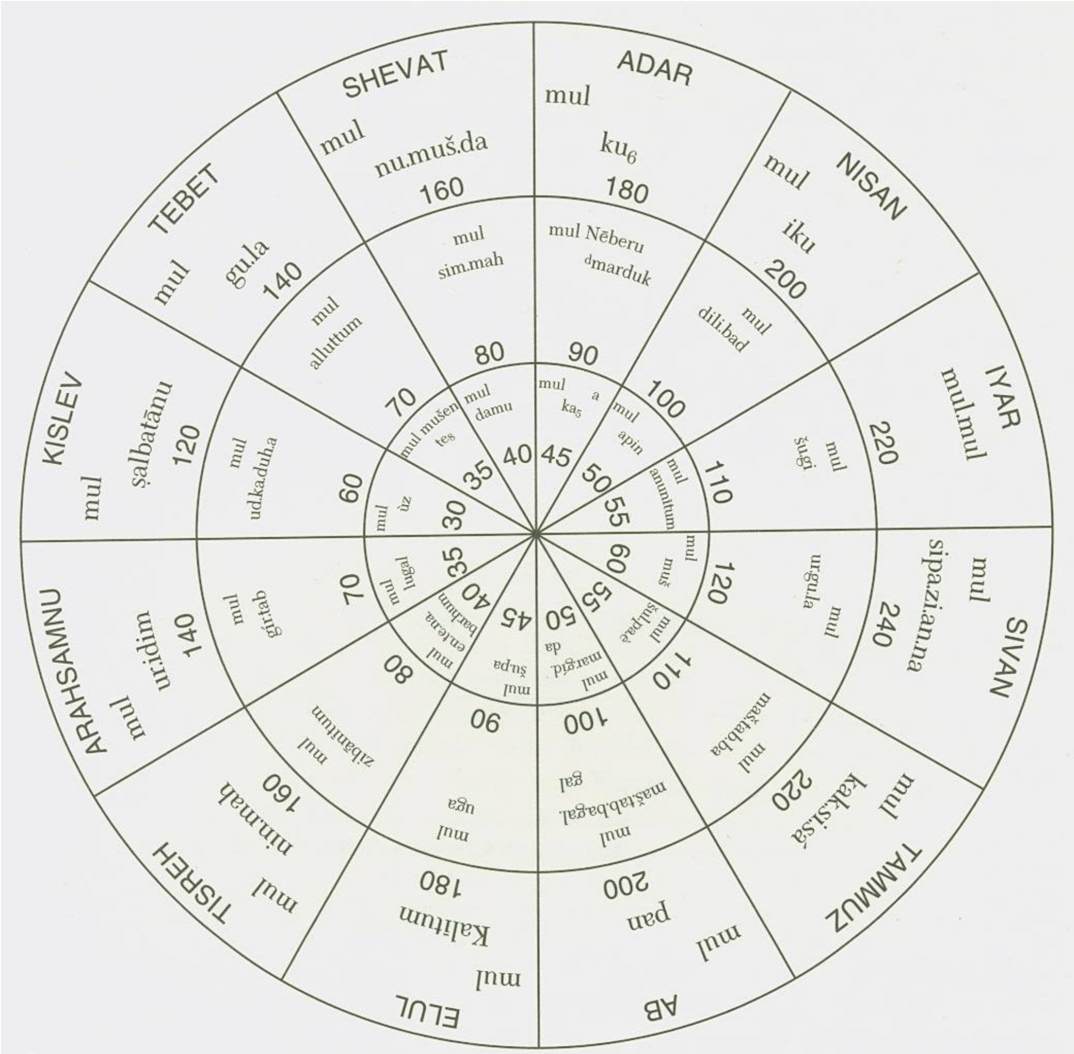

Figure 3: Circular Astrolabe reconstruction[521]

[520] As for the cultural context in which the Astrolabe tradition developed, Horowitz (2007: 106-111) has suggested that Alb B was more than a simple aid for intercalating the calendar: 'rather a sort of astronomical handbook which had some practical application, as well as a purely academic function as a statement of astronomical theory with religious overtones.' He argues that the advances in astrolabe tradition coincide with the rise of Marduk and his glorification in the Babylonian national epic *Enuma eliš* (the system of 12 stars on three paths occurs in 5.1-8). 'It would seem that the author(s) of *Enuma eliš*, writing just a few generations after the scribe of Alb B, knew Alb B, or a text very similar to Alb B.' 'Thus, it would appear that Alb B, in the form we know it from the late second millennium just before the date of the composition of *Enuma eliš*, must have been composed by a man of Marduk who knew the astronomical conventions of his time, and used them in Alb B with the intent of demonstrating that Marduk's star ruled as king over the stars in heaven just as Marduk himself ruled on earth... the close ties between the astronomical theory of Alb B and *Enuma eliš* demonstrate that Alb B is not only an astronomical treatise, a scientific text, but moreover a religious theological work of the highest importance which extolls the central message of *Enuma eliš*: Marduk-ma-šar – Marduk is King.'

A more sophisticated version of these lists, the so-called circular astrolabes,[522] divide the sky into twelve equal 30° segments by means of twelve equidistant radii, marking the borders between twelve 30-day months of the ideal 360-day year,[523] which grew out of the early administrative calendar and coexisted for the most part of its history with the natural civil calendar. Significantly, despite the distinct advances made in astronomy in subsequent periods, the astrolabe tradition survived, in its various forms, down to the Hellenistic era[524] and, as has already been shown, was in all likelihood known to the Greeks.[525]

The cumulative knowledge of the early period, 'held together in common by the entire community of Mesopotamian scribes who used and copied it',[526] is epitomised in the MUL.APIN,[527] whose subject matter ranges from simple star catalogues, like those in the Astrolabes,[528] to detailed description of the lunar, solar, stellar and planetary phenomena. It is a mix of observational science, measurements and calculations, and astrological and mythological material. The astronomical schemes included in this and other texts mentioned are based on the application of simple linear methods. The calculation of lunar visibility makes a striking case.[529] Underlying the system is the observation that the moon remains visible for the entire length of the 15th night of each month. It is logically deduced that on the 1st night of the month the period between sunset and moonset must therefore be $^{1}/_{15}{}^{th}$

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[521] From Horowitz 1998: 156.

[522] Sm. 162 and K 14943 (+) 83-1-18, 608 (CT 33 11-12).

[523] Al-Rawi & Horowitz 2001: 179. More on the boundaries and sectors in Horowitz 1998: 256.

[524] Compendium text BM 55502 preserves a duplicate list of the 36-stars known from Alb B IV and a 30 star-catalogue that is very close to the one known from HS 1897.

[525] See p. 89-91.

[526] Watson & Horowitz 2011: 7. The exact dating remains problematic. The comparisons with EAE corpus do not provide intrinsic criteria for determining when the text was composed. For different estimations and critique see Pingree & Hunger 1989: 10-12. Based on cognitive-linguistic analyses, Watson & Horowitz (2011) propose that although the canonisation probably happened in the early 7th cent. BC, much of the content antedates this, although no descendants have so far been discovered. In short they (2011: 139-47) argue that in terms of rhetorical-indexical clusters the early part of the text is under-marked, the middle over-marked and the marking in the final section is appropriate, conventional and systematic/consistent. The early part suggests an interpretation within an oral scribal tradition, in the later component parts the frame of reference is more explicit, making the text more easily interpretable on its own.

[527] Determinative MUL denotes stars, constellations, planets, and other heavenly phenomena. Generally translated as 'star', Akkadian *kakkabu*. Most examples date to NA or NB, latest to Hellenistic period (Hunger & Pingree 1989: 9).

[528] See Horowitz 1998: 171 for a list of MUL.APIN stars and their modern equivalents.

[529] See n. 821 about Valens using the same scheme.

of the total length of the night.[530] The scheme uses the ideal 30-day month and is also attested in what is currently known as tablet 14 of EAE.[531] On it one table (B) records the computation scheme just outlined, another (A) does the same but with the exception that modified geometrical values for the five first and last days of the month are introduced to accommodate the actual observational data and that the daily change is expressed in UŠ rather than *mina*.[532] When extended over a number of months both formulas produce an almost linear 'zig zag' function.

However, the length of the night also changes over the course of the year and to account for this EAE 14 introduces the '2:1 daylight scheme'. This particular day-night ratio is attested from the OB period onwards[533] and postulates, in short, that the relationship between day and night moves from the ratio of 4:2 (UŠ) at the summer solstice to 3:3 at the equinox and to 2:4 at the winter solstice, changing 40 NINDA per day.[534] When the information from the different tables on this tablet is combined it allows the calculation of the visibility of the moon for any day of the year.[535]

On a superficial glance this system of functions, coefficients and their skilled multiplication can seemingly testify to the existence of profound interest and necessary skills to predict lunar phenomena from quite early on.[536] In the state of our present knowledge, however, it can be easily shown that functions just outlined were fundamentally flawed. Not only is the lunar visibility scheme extremely inaccurate but it is perhaps even more important in this context that the 2:1 daylight scheme is inappropriate for Babylon.[537]

Although Neugebauer tried to demonstrate how the rules of physics could have resulted in the

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[530] MUL.APIN II ii 43 - iii 15.

[531] The numbering system of the EAE is problematic, owing to the fact that the corpus was standardised but not canonised (see n. 910 below).

[532] Babylonian units of time. 1 *mina* = 60 UŠ. The coefficient is given as 12 UŠ, it corresponds to 1/15 ($12 * 15 = 180$ or 3,0 UŠ which corresponds to the value '3' given to the equinoctial month in BM 17175+ (Brown, Fermor & Walker 1999/2000: 133)).

[533] OB tablet BM 17175+, published as an appendix in Hunger & Pingree 1989. The system is also well attested in the MUL.APIN and included on some of the Astrolabes.

[534] 1 (or 60) UŠ = 3600 NINDA; 3 UŠ = 180 degrees, i.e. 12 hours. For the 40 NINDA in an OB coefficient list see Robson 1999: 129-30.

[535] See Al-Rawi & George 1991/2: 63 (BM 45921+46093+46215) and Steele & Brack-Bernsen 2008: 257-60 (BM 49500) for fragmentary commentaries laying out the procedure. Part of the BM 4592+ attempts to reconcile the conflicting data of the first two tables.

[536] For the dates of the texts see n. 519 & 526.

[537] The 2:1 ratio is more appropriate for a geographical latitude about 16° more north than Babyon's 32.5°.

perceived accuracy of the 2:1 ratio,[538] Brown, Fermor and Walker's reconsideration of this theory has revealed weaknesses in this otherwise attractive proposition, concluding that the attempts to account for the adoption of 2:1 ratio in terms of strictly empirical basis are misguided and unfounded.[539] The 2:1 daylight scheme more likely owes its presence to the notions of symmetry and numerical speculation that characterise Babylonian cosmology. Both the lunar visibility function and the daylight scheme are expressing how the ideal universe might run, being 'the examples of mathematical exegesis on the preconceived idea of what ought to happen, and not the result of precise empirical observations.'[540] The same applies to early planetary periods.[541]

The implications of the scholars' inability or unwillingness to correct what, taking into account the existence of workable time-measuring devices by the time of the OB period,[542] must have been fairly easily observable mistakes, are most significant. The fact that the discrepancies with the rough data did not lessen the overall credibility of Mesopotamian experts indicates that the mathematical models were not always goals in and of themselves but were, above all else, in the service of divination. They display a tendency for mathematical idealisation of reality, reflecting the general aim of the Mesopotamian tradition to 'reduce the knowable world to an ordered system on the basis of rational principles of number, symmetry, hierarchy etc.'[543] Brown in particular has argued that the real value of the early star-lists and mathematical schemes was not in their 'astronomical' significance but that they provided an ideal, i.e. the figures against which the observed phenomena could be

[538] Neugebauer 1947a. If the water-clock he proposed had been filled with twice as much water at the winter solstice than it was at the summer solstice, the time it would have taken these amounts of water to drain from the clock would have been in a ratio 1.4:1 (based on the assumption that the time it takes for a cylindrical vessel to empty through a hole in its bottom corresponds to the formula $t = c\sqrt{h}$, where t is time, c the constant and h the original height of the water), which is a considerably closer approximate to the correct observational value of respective night-length.

[539] See Brown, Fermor & Walker 1999/2000: 130-140. Key criticisms include that the practical texts show how Neugebauer's proposed design is unlikely to work in the real life and the alternative model they suggest eliminates the different outflow rates; that the 2:1 ratio must have been understood in terms of time, not just weight (the two often being equivalent), as his model presupposes; and that the repeated experiment with 2:1 implies a serious but unexplained pre-conceived notion of this proportion.

[540] Brown, Fermor & Walker 1999/2000: 138, Brown 2000: 113-22.

[541] Swerdlow 1998: 25-6.

[542] See for instance BM 85194 (=CT 09 08)and BM 85210 (=CT 09 14), two mathematical problem-texts. The devices described in the four exercises there are large, either 133 or 167 cm tall and hold 32, 40 or 135 litres of water. For the design and use of water-clocks in Mesopotamia see Brown, Fermor & Walker 1999/2000.

[543] Larsen 1987: 214.

judged.[544] The diviners, for instance, could 'interpret the occasion of a star's first appearance as good-boding if it corresponded with the scheme and ill-boding if it did not.'[545]

The Babylonian creation-myth *Enuma eliš* relates how Marduk fashioned the universe from the corpse of Tiamat and settled in the Heavens Anu, Enlil and Ea, arranged the stars, moon and the sun in their courses and provided them with gates to enter and leave the visible heavens.[546] K 7076, although poorly preserved, seems to show that the gods were held to have followed some mathematical principles when setting the stars to their course.[547] In that context, astronomy and astrology, just like mathematics or the art of writing, can be construed as attempts to grasp the cosmic order and tools to organise its social counterpart. All this accords very well with the nature of the early astronomical tradition just outlined.

The so-called mystical group of texts[548] are also relevant here. In Beaulieu's words these are

> more purely speculative, being chiefly concerned with establishing correspondences between elements of various areas of Babylonian learning through philological and numerical associations, analogy, and symbolism. The type of speculative thinking represented by expository texts is in fact very close to 'esotericism' if one defines esotericism as an intellectual approach seeking to comprehend the hidden relationship between the constituent elements of knowledge and cosmic order.[549]

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544 Brown 2000, esp. 126-53 and 195-7 where he finds that the intercalation scheme was actually of little calendric interest.

545 Brown 2000: 115-6.

546 *Ee* 4.145-6 & 5.1-46 (follows the astrolabe tradition), and finally adds the Bow-star to the universe (6.90-1). The *Exaltation of Ištar* 25-30 confirms the general structure of the heavens, saying that Anu, Enlil and Ea are the watchmen of heaven and earth, who 'open the Door of Anu' and 'keep all the stars in place as in a furrow, to make the gods at the fore keep to the path like oxen.' That it was the three mentioned gods and not Marduk is also postulated in K 5981+11867 1-7//VAT 9805+14'-17' collated (ed. Weidner 1954-1956: 89) and also in a late bilingual prayer of *kalû*-priests W 20030/6 1-2 (ed. Mayer 1978: 438-443); Ea alone in KAR 252 rev. iii 39; and Anu alone in *When Anu Created the Heavens* in BMisc. 12, 24-26 and medical texts like CT 17 50. For Mesopotamian cosmic geography see Horowitz 1998. The various cosmic regions (including heavens made of stone or water, earth, *apsu* etc.) are held together by cosmic bonds (*Ee* 5.59-68 & 73-6). Noteworthy are the Annunaki who inhabit the underworld (or Lower Earth, see Horowitz 1998: 19) and parallel the defeated enemies of Zeus in Tartarus (Hes. *Theog.* 713-35).

547 '… they multiplied the width by the height [… / omens and oracular-decision [… / the gods divided up the st{ations…]' (trans. Horowitz 1998: 148).

548 Collection in Livingstone 1986, especially i.NAM.giš.ḫur.an.ki.a series, see ch. 2.3.4.

549 Beaulieu 1992: 108.

It is texts like these that 'expose the theological and (pre)philosophical speculation of Babylonian scholars.'[550] Such intermeshing of religion and what modern commentators consider (pre-)scientific ideas is not uncommon in the ancient world and poses absolutely no problem in its original context. Pythagorean tradition or what we know of it (see ch. 5.4.3), for example, displays very similar tendencies: already a blend of Greek religious customs, barbarian cosmology and eschatology, Pythagorean philosophy was spiced with Mesopotamian-style numerical speculations and attempts to find the harmony of the spheres, creating in its later phases a 'tradition of science coloured by poetry and myth [that] continued down to Philolaus and Plato,' to use West's words.[551] According to Burkert, the scale of the music of the spheres is actually taken from Eratosthenes but the idea could ultimately go back to oriental beginnings.[552] Plutarch says that the Chaldeans assigned intervals to the three seasons (spring, autumn, summer) as opposed to the four known to the Greeks, and Diodorus Siculus associates musical harmony and the three season with Hermes.[553]

The above does not imply that sufficiently accurate observations were not made but it does show that the focus of astronomical speculation of this early period lie elsewhere. The water-clocks must have been used to measure certain astronomical periods with perceived precision but not necessarily with accuracy that would satisfy a modern observer.[554] In addition, the measuring of time intervals smaller than a *watch* was limited before the mid-8th cent. BC; where they appear in astronomical texts they are almost invariably the result of mathematical speculation. It is only during the reign of Nabonassar (747-734 BC)[555] that the nightly watch of the sky became a standard Babylonian practice[556] and accuracy rather than only apparent precision started to be desired.[557]

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550 Beaulieu 1992: 107-8.

551 West 1971: 231. On Philolaus see p. 128 & 265.

552 Burkert 1972: 352-3, 356; Diod. Sic. 1.16.1.

553 Plut. *On the Birth of Spirit* 31,

554 Brown, Fermor & Walker 1999/2000: 134.

555 The earliest fragment of what Sachs termed Astronomical Diaries comes from 651 BC but Greek sources (e.g. Ptol. *Alm.* 3.7) give reason to believe that such record-keeping started at least a century earlier.

556 For earlier observational practice see EAE 63, the so-called Venus tablets of Ammiṣaduqa, dating back to the first half of the 2nd millennium BC. The tablet is extensively analysed e.g. by Langdon, Fortheringham & Schoch 1928, Weir 1972, and Reiner & Pingree 1975-2005, Vol.1.

557 Brown, Fermor & Walker 1999/2000: 137 & 142-3. Early eclipse lists, for instance, record times to the nearest 10 UŠ (= 40 min.); from 560 BC onwards (plus one earlier example) they often give times to the nearest UŠ (= 4 min.). But a series of articles by Stephenson et al. in *JHA* show that there was very little improvement in the accuracy of observations in Babylonia between 6th cent. BC and 1st cent. AD, perhaps due to limitations set

The start of meticulous record-keeping brought about a change of direction in Mesopotamian astral sciences, which Brown has likened to a Kuhnian paradigm shift. However, the principal cause behind this development remains debated. Robson has expressed a view that it was the battle to reconcile the ideal 360-day cycle of lunation with the solar and lunar years that was the driving force behind the development of observational astronomy.[558] Brown lays more emphasis on the socio-political forces: in the Assyrian period many of the *ummanu* were supported by the king and the advances must have been spun by a fierce intellectual competition to secure royal patronage: more accurate predictions gave one an advantage over the competitors.[559]

An important aspect of Mesopotamian divination was the determination of favourable and unfavourable, safe and dangerous days to control and manage present and future time. The Diviner's Manual,[560] for instance, shows that the purported ability to predict lunar phenomena was necessary for the performance of the *namburbi* rituals, which constituted the controlling aspect of the science.[561] So too the scribes put great effort into the then nearly impossible task[562] of predicting the length of the coming lunar months in order to determine if they were favourable – i.e. full – or not.[563] Swerdlow has, therefore, suggested that weather conditions might have been the principal motivation behind this development.[564]

3.2.2 Towards More Accurate Functions

The new trend towards more accurate predictions is typified by the appearance of the 3:2 daylight

by the available timing devices.

558 Robson 2004: 82.

559 The letters to the kings, e.g. SAA 10 072, bear witness to fierce disagreements between scholars. Astrological reports to the Assyrian kings can be found in SAA 08. Brown (2000: 45-7) has shown how the scholars were heavily dependent on the royal favour to secure their livelihood and argues (209-11 for a summary chart of his argument) that the change in the paradigm occurred already in the 8th and 7th cent. BC. For the evidence on accurate prediction of celestial phenomena before 612 BC see Brown 2000: 189-195 & 197-206; also relevant is his claim (2000: 163-73) that astronomy remained very much in the service of astrology and the highest precision was never the sole aim of the new predictive methods (hence the co-existence of many more or less accurate models).

560 A text explaining the relations between signs in the sky and on earth, ed. in Oppenheim 1974.

561 See n. 926 below.

562 See n. 516 above.

563 Brack-Bernsen 2007: 93-4.

564 Swerdlow 1998: 18.

scheme, although there is no firm evidence for its use before the 7th cent. BC, and even then it is occasionally applied to the 360-day ideal year.[565] But it is perhaps best exemplified by the search for the perfect intercalation cycle. Though MUL.APIN included various rules for determining when the insertion of an extra month was required, it is clear that by the time it was composed no general scheme of intercalation existed.[566] The discovery of an optimal intercalation cycle was impossible without an accurate estimation of the solar or stellar year. The early sources provide a number of different estimations. Some ziqpu-star texts, which record the series of stars, constellations and constellation parts that culminate near the centre of the sky (on the path of Enlil) when viewed from the latitude of Assyria/Babylonia,[567] also measure the interval between these culminations. The latter is usually expressed in degrees of a 360° or 364° arc,[568] reflecting the belief that the stars, sun and moon travelled along a circuit, moving at the rate of 1° per day.[569] A tablet from Sippar describes a circuit of the ziqpu-stars beginning and ending with the Yoke[570] and includes a diagram of a circular planisphere with a rosette drawn at its centre.[571] From the rosette issue forth lines that divide the round tablet into twelve 30° segments, following the convention already seen on a circular astrolabe above.[572] It is very likely that the segments represent months in the annual cycle of the culminating ziqpu-stars.[573] All this not only provides explicit evidence for a tradition of circular geometric models applied to the movement of the stars,[574] but also implies a 360 or 364-day year[575] and gives a crude template for the development of 12 zodiacal signs of 30°.

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[565] E.g. BM 29371 and BM 29440.

[566] Britton 2007: 119-20.

[567] E.g. K 9794 from Aššurbanipal's library and its LB copy AO 6478 = TCL 6 21 from Uruk, AO 3427, VAT 16436, VAT 16437, BM 38369+38394, BM 77242, BM 61677, LBAT 1499, LBAT 1503, a NB tablet from Sippar published in Al-Rawi & Horowitz 2001, and possibly CT 34 14 = K 16772.

[568] K 9794//AO 6478.

[569] MUL.APIN I iii 49-50. Units of UŠ (1°) or DANNA (=*bēru*, 30°); or as in AO 6478 MA.NA, i.e. minas on a waterclock, whereas 60⅔ minas=364 UŠ *in qaqqari* ('degrees in stellar sector').

[570] MUL.ŠUDUN. Alternative name to Supa (MUL.ŠU.PA) (see Horowitz 1994: 96 n.19). Also starts the list in AO 6478. Modern Boötes, including a very bright star Arcturus (α Boo), which as we have seen, played an important role in the early Greek astronomy.

[571] For figures see Al-Rawi &Horowitz 2001: 172 & 176.

[572] Fig. 3. Another parallel use of the radii on a planisphere is K 8538 = CT 33 10.

[573] Al-Rawi & Horowitz 2001: 179.

[574] Horowitz 1994: 89 & 96-7. Cf. the circles of Ea, Anu and Enlil on circular astrolabes (p. 98-99).

[575] A 364-day stellar year is also implied – 12 lunar months plus 10 additional days - in MUL.APIN II ii 11-12.

With an accumulation of observational data the search for the accurate year length gained momentum during the 6th cent. BC[576] and finally culminated in the discovery of the 19-year intercalation cycle as the most accurate of the proximate alternatives for the required intercalation of 2.7 years on average.[577] Although Bowen and Goldstein have argued that this cycle can be constructed without precise observational data by a purely mathematical procedure,[578] Britton has pointed out that without reliable records spanning at least 60 years its accuracy would have been indistinguishable from those of the 27 and 30-year periods.[579] When this cycle was first officially adopted to regulate the intercalations in the civil calendar is hard to say. Although this intercalation pattern was definitely followed from the second year of Xerxes' reign (483 BC) onwards, it is occasionally attested in earlier texts. The discovery of the cycle dates to the second half of the 6th cent. BC if not earlier.[580] Britton thinks that the superiority of the 19-year cycle was recognised by 530 BC,[581] after which the use of 27- and 30-year cycles evidently disappears.[582] Before the adoption of a regular intercalation cycle, the intercalary months were declared by the king on his scholars' recommendation;[583] it is, therefore, unlikely that the schemes were in the public domain at that time.

The idea of an ideal game of numbers was still transposed onto certain aspects of this 'new' astronomy. Note for example how the ideal calendar came to form the basis of the division of the ecliptic into 360 degrees and the zodiac, which provided a standard reference system for computational astronomy. Heated debate has surrounded not only the question when the zodiac was introduced to Greece – its Mesopotamian origin is demonstrated by table 6 below - but also whether its division into 12 equal parts was perhaps not a Greek invention. However, taking into account the previous discussion, I find that the equal-sign zodiac has Mesopotamia written all over it. The earliest

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[576] See Britton 2007 for in depth discussion.

[577] 19 years = 19*12 + 7 months = 235 months = 6940 days.

[578] Bowen & Goldstein 1988: 42-3.

[579] Britton 2007: 119.

[580] Britton 2007: 122, 126. The earliest direct evidence is W 22801, contra Neugebauer's (1969: 140) outdated theory that it is not attested before 380 BC.

[581] According to Rochberg (2000a: 1938) the intercalary months were inserted in years 1, 3, 6, 9, 11, 14 and 17.

[582] Britton 2007: 127.

[583] E.g. SAA 08 098, rev. 8-10, an astrological report from Balasi to the king ('Let them intercalate a month; all the stars of the sky have fallen behind. Adar (XII) must not pass unfavorably; let them intercalate!'); SAA 10 235 from Marduk-šakin-šumi, which informs the king that the intercalation that he ordered has been implemented; SAA 13 060, which enquires the king about the intercalation; or SAA 10 365. Individual intercalations were still decreed by Nabonid, Cyrus and Cambyses (Neugebauer 1975: 1.354).

evidence for the use of the zodiacal signs come from a text giving zodiacal longitudes of the conjunction of the sun and the moon for the year 475 BC (though written at a later date), the Diaries for 453, 440 and 418 BC, one of the atypical texts from 431 BC and from two horoscopes dated to 410 BC.[584]

3.2.3 Mesopotamian Mathematical Astronomy

The corpus of astronomical material that exhibits the aim of accurately predicting the heavenly phenomena consists of roughly 1500 tablets and covers everything from about 600 BC onwards. These tablets are connected with the older tradition by some of the so-called 'atypical texts'.[585]

Sachs divided the corpus into the following categories:[586]

'Mathematical' astronomy[587]	'Non-mathematical' astronomy[588]
	Almanacs
Numerical table texts (i.e. ephemerides[589])	Normal-star almanacs
Procedure texts	Goal-year texts
	Diaries

Table 3: Categories of cuneiform astronomical texts

[584] Rochberg 2004: 130.

[585] For the texts see Neugebauer & Sachs 1967 & 1968/1969. Also of interest are the Kandalanu Saturn tablet (BM 76738+76813; published in Walker 1999) and the so-called Mercury tablets (BM 37467, K 6153, Rm. 2,303 and Rm. 2,361, all published in Reiner & Pingree 1975). Reiner and Pingree (1975: 176) argue that the recorded information (at least what survives of it) does not allow the reconstruction of a mathematical model of Mercury's motion. Horowitz has also suggested during a masterclass held at the University of Birmingham (Feb. 2013) that a project looking at Mesopotamian predictions of Venus phenomena could potentially date back the emergence of mathematical astronomy if it turns out that the scribes of EAE were able to foretell the planets movements. However, such a project remains to be undertaken.

[586] Sachs 1948.

[587] Also often referred to as the ACT texts after Neugebauer's 1955 *Astronomical Cuneiform Texts*.

[588] Occasionally designated as NMAT – non-mathematical astronomical texts – or as GADEx, an acronym for Goal-year, Almancs, Diaries, Excerpts.

[589] The term 'ephemerides' was applied to these text by Neugebauer, Sachs himself preferred 'astronomical tables'. Note that the earlier scholars like Epping and Kugler used 'ephemerides' to describe what Sachs calls 'almanacs' (Sachs 1948: 277 n.4). Neugebauer (1975: 351) counts under the ephemerides also the 'auxiliary texts' (see glossary).

Forming the base of the entire system are the observations, recorded in the Diaries (Akk. *naṣāru ša ginê,* 'regular watching').[590] These chronicle not only the movements of the stars and planets but also the associated historical events. They have a fairly fixed format: one Diary usually covers the events of 6-7 months, although there are fragments of probably preliminary records for shorter periods that served as the basis for the longer texts.[591] They include the length of the lunar months, the lengths of day and night, solstices and equinoxes, Sirius phenomena, first and last visibilities and the zodiacal sign in which the latter occurs, lunar and solar eclipses, first and second stationary points and the acronychal risings of the planets, conjunctions of the Moon and each of the planets with the so-called 'normal stars' scattered around the zodiacal belt, appearance of meteors and comets, meteorological happenings, certain commodity prices, zodiacal signs in which the planets were in the month under review, changes in the river level at Babylon, and finally a report of significant events such as battles, military expeditions, coronations.[592]

By the second half of the first millennium BC the Diaries, the earliest example of which dates to 651 BC,[593] amounted to centuries of observational data. They were often mined for records on a specific phenomenon[594] allowing scholars to recognize the periodicity of these events and to devise increasingly sophisticated mathematical models to predict their occurrence.[595] So the Diaries provided data for a number of other astronomical-astrological texts and the astronomical phenomena they recorded are principally the same as those predicted by the ephemerides. It is this limited number of phenomena, listed in table 4, whose calculation forms the goal of Babylonian mathematical astronomy.

[590] See n. 555. Sachs 1974: 44 & 47-9, esp. fig. 2 for a diagram of datable diaries that cover 183 years. Sachs managed to date about a third of the available 1200 fragments. These are published in Sachs & Hunger 1988-2001.

[591] E.g. No. 200, No. 191, a reference to these in No. 384 r.6. From here on all diaries will be referred to by their number in Sachs & Hunger 1988-2001.

[592] Sachs 1974: 44-8, Sachs & Hunger 1988-2001: 1.20-36. For a more detailed list of 18 ominous planetary phenomena, including things like colours, conjunctions etc. see Brown 2000: 85-93, for a discussion on their relevance to divination 93-103; for the lunar phenomena of interest Sachs & Hunger 1988-2001: 1.20-4.

[593] No. 651 (= BM 32312).

[594] Collected together in Sachs & Hunger 1988-2001 Vol.5. Short overview of the ones pertaining to eclipses in Steele 2000: 430.

[595] Pingree 1997: 18.

Superior planets	Inferior planets
Γ – first appearance (heliacal rising)	Ξ – first appearance (evening rising)
Φ – fist stationary point	Ψ – first stationary point
Θ – opposition (acronychal rising)	Ω – last appearance (evening setting)
Ψ – second stationary point	Γ – first appearance (heliacal rising)
Ω – last appearance (heliacal setting)	Φ – second stationary point
	Σ – last appearance (morning setting)

Table 4: Astronomical phenomena

Aaboe has demonstrated how, although the observations recorded in the Diaries are rather crude, they contained enough information to derive from them excellent planetary schemes.[596] In the heart of the Babylonian planetary theory lie the period relations that associated the planets' *synodic* phenomena with the time these took to occur. For example, for the first station of Jupiter to fall in the same place in the zodiac once again takes 427 years, during which the planet appears and disappears 391 times. The 391 occurrences of the first station that Jupiter reaches within this period are situated along the ecliptic so that they appear to revolve around it (in the lack of a better non-spherical world-view specific term) 36 times. The period relation turns out to be:

391 occurrences = 36 revolutions = 427 (i.e. 391+36[597]) years

For other planets they are:

Saturn: 256 occ. = 9 rev. = 265 yrs

Mars: 133 occ. = 151 rev. = 284 yrs

Venus: 720 occ. = 1511 yrs

Mercury: 1513 occ. = 480 yrs

From these relations the *mean synodic period*, i.e. the time between two occurrences of a specific

[596] Aaboe 1974: 33-6, futhered by Swerdlow 1998 (30-1 for a summary). E.g. BM 37236, which lists the undated phases of Mars according to a System A scheme; a Greek adaptation of this scheme comes from an auxuliary table on P.Mich. 151 (3rd cent. AD; see below p. 153).

[597] The goal-year periods of the outer planets (table 5 below) have a similar underlying structure: e.g. for Saturn 57 synodic cycles = 2 longitudinal revolutions = 59 (57+2) years.

synodic situation, which in Jupiter's case is around 398 days, and the *mean synodic arc* - that is, the average distance between two consecutive occurrences of these stations - are also easily determined by dividing the number of revolutions by the number of occurrences and multiplying it by 360°:[598]

$$\text{Jupiter's } \textit{mean synodic arc} = \frac{36}{391} * 360° \approx 33°$$

For others planets:

Saturn: 12;39,22,30[599]

Mars: 48;43,18,29…

Venus: 3,35;30

Mercury: 1,54;12,36,38…

However, the apparent speed of Jupiter (like all the planets) varies over its course and in reality the *true synodic arc* can be roughly anywhere between 28° and 38°. Moreover, the speed with which the planets move between the syzygies is not linear either. For instance, Jupiter slows down considerably before coming to a complete halt in its first and second stations. To account for the fluctuating speeds and the respective lengths of the synodic arcs[600] Babylonians devised schemes that form the focal point of the *ephemerides*, which give times and locations of specific phenomena from table 4 in their regular order.

Rochberg's summarises that the aim of these ephemerides and related tests

> was not to devise a model of a planet's motion such that visible synodic phenomena, such as first and last visibilities, stations and retrogradations would be secondarily derived from the model; rather, the synodic moment, and particularly the horizon phenomena of risings and settings, were central and any position of the body of arbitrary moments in between the special appearances would be derived by interpolation. In contrast to the interest in the

[598] For a longer explanation see Neugebauer 1975: 1.388-91.

[599] Values expressed in sexagesimal notation – see appendix 2.

[600] Mathematical accounts of this variation rely on the conviction that the length of the synodic arc is based solely on the longitude where it takes place, i.e. that the synodic arcs repeat themselves when they fall into the same position in the ecliptic. To help compute the longitudes of a particular phase of a planet, System A divided the ecliptic into two or more zones. Depending on which zone the synodic phenomena in question fell, an adjustment was introduced to predict its next location.

position (geocentric ecliptical longitude) of a celestial body in some given time *t,* later to be developed in one of the branches of Greek astronomy, the Babylonian interest was in the position of celestial body when *t* is one of the planet's synodic appearances (or disappearances)… Underlying the Babylonian astronomy was an understanding of and arithmetical control over the variable 'velocities'… variable inclination between the ecliptic and the horizon…. and also visibility conditions…[601]

In other words, the ephemerides, which form the bulk of the nearly 300 texts of mathematical astronomy,[602] contain parallel columns of numbers that represent dates or positions of synodic phenomena or entities relating to the computation of these phenomena. Their day-to-day planetary longitudes are achieved by interpolation between the positions and times of the synodic phenomena.[603] However, the fact that daily locations are presented at all indicates a strong connection with horoscopy. How these schemes were transferred to Egypt and the Greek world will be discussed in chapter 3.4.2 below.

Although some earlier, especially Achaemenid, texts already attest this kind of astronomical method and even certain characteristic parameters,[604] the development of a mature mathematical astronomy is nevertheless a rather late phenomenon. In particular, the lunar ephemerides,[605] which predict certain events for the coming years by calculation of a large among of complex data, followed two different methods and set of parameters. When these lunar (and planetary) theories were developed remains debated. Both are well attested by the Seleucid period but Britton has argued that the theories were worked out and perfected over the course of two preceding centuries.[606] System A appears to have been preferred in Babylon,[607] where the key player was the Mušezib

[601] Rochberg 2002: 668, also 2004: 24.

[602] Rochberg 2000a: 1933.

[603] Neugebauer 1975: 1.412.

[604] See Rochberg 1993: 35. For pre-Achaemenid period Brown 2000: 189-207.

[605] There is no such clear correlation between the systems and locality in regard to the planetary systems, as there are many more variants than just A and B (Neugebauer 1955: 10). For a detailed study of the planetary theory see Swerdlow 1998, for an overview of the lunar theory Neugebauer 1955: 41-85.

[606] Britton 1993. Around 400 BC and 300 BC are often arbitrarily given for Systems A and B respectively, alternative suggestions include e.g. between 620 and 440 BC for System A lunar theory and the reign of Dareios (522-486 BC) for its planetary theory (van der Waerden 1968), but cf. Neugebauer 1955: 11 for problems with dating and related speculation.

[607] For lists of longitudes of characteristic planetary phenomena computed according to System A see Aaboe & Sachs 1966.

family; and System B in Uruk, where the relevant scholarly activities were centred on the Ekur-zakir and Sin-leqi-unninni families.[608] One of the characteristic differences between the two systems is the manner of computing longitudes: whereas System A uses the step-function whose synodic arcs are the precise function of longitude, System B resorts to the zigzag function to determine the monthly progress of a *syzygy* in the ecliptic.[609] In addition, System B uses a modified approximation of the mean month length, one derived from the refinement of the 19-year cycle[610] and adopted by Hipparchus and Ptolemy (see below).[611] The two systems also disagree on where to put the vernal equinox: it is located at 10° Aries in System A, but System B places it at 8°.[612]

The instructions and rules for computing the various columns of the ephemerides are given in the Procedure texts.[613] ACT 122 (fig. 4 below[614]) serves to illustrate the complexity that the late mathematical theories achieved. It is one of the most complete examples of a lunar text, displaying 17 columns of highly accurate calculations,[615] taking into account a great number of variables that affect the lunar visibility. The daylight variation scheme, for instance, is no longer calculated on the basis of the schematic calendar but on the position of the sun in the ecliptic by means of linear interpolation.[616]

Also characteristic of the new cycles-based astronomy was the compilation of the so-called 'Goal-Year Texts'. These date from about 250 BC onwards and, based on the realisation that the stellar events are recurring (see table 5 for the cycles), give predictions about the planets and the Moon, relying on past observational records.

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[608] See n. 456 for references.

[609] Concise explanation in e.g. Rochberg 2000a: 1934-6 or Neugebauer 1975: 1.373; for a more accessible explanation of how the precise celestial prediction worked see Brown 2000: 173-89 and for a through study of how Systems A and B treated the planetary phenomena Neugebauer 1975: 380-473.

[610] Britton 2007: 128.

[611] Both Greek astronomers also take the tropical year length of 365;14,48 derived from combining the month lengths from either System A or B with the 19-year cycle (Britton 2007: 128 and p. 143 below).

[612] For an explanation of how the Babylonian zodiac was sidereally fixed see e.g. Rochberg 2004: 131-3. Both 8° and 10° were well known to Greco-Roman authors, see n. 795 below.

[613] ACT 200-211 and CTMMA 2.81 (= MMA 86.11.363) for the moon, ACT 800-805 & 810-819c for the planets. For a thorough explanation see Ossendrijver 2012.

[614] Image from Aaboe 1974: 29.

[615] Throughout the entire text the difference between ancient and modern computed values is 1.5 ± 1h, where part of the 1.5h is accounted for by the deviation of the initial value (Aaboe 1974: 30).

[616] Rochberg 2000a: 1929.

Planet	Period in years
Jupiter	71 or 83
Venus	8
Mercury	46
Saturn	59
Mars	79 or 47
Moon	18

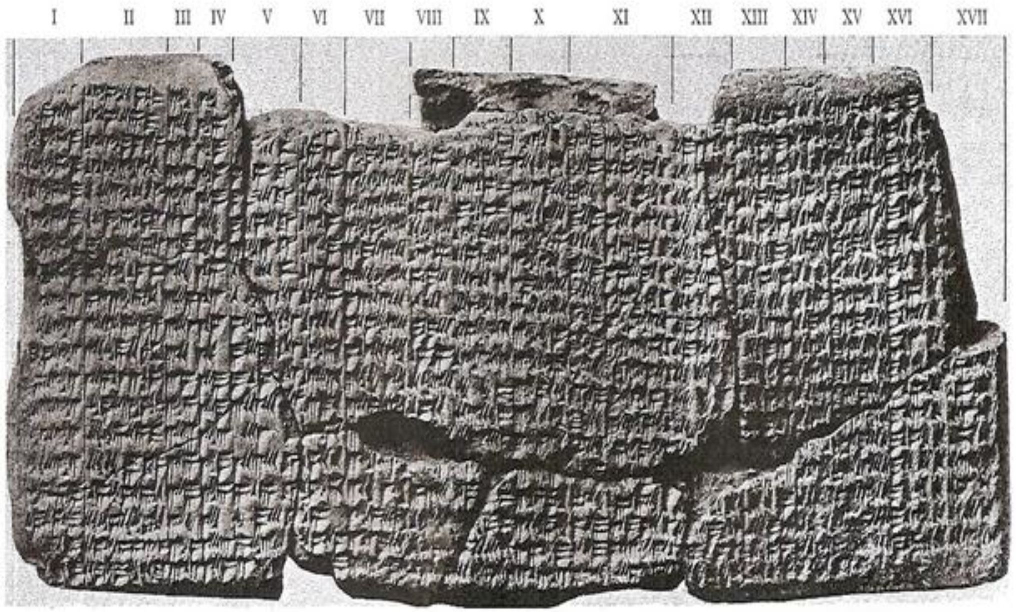
Table 5: Goal-year periods

Similar in date are the almanacs (262 BC – AD 75), which present, usually in 12-month sections, the movement of each planet though the zodiac. The standard order of the planets in which the information is given for the first day of each month and the predicted entry into the next sign is Jupiter, Venus, Mercury, Saturn and Mars.[617] The normal-star almanacs have a similar organisation but, rather than predicting the planetary movements, they record synodic phenomena found in the diaries in normal-star conjunctions.[618]

As above all the Goal-Year texts show, the relationship between astronomy and astrology is important and persistent. Similar statement can be made about its Greek counterpart although there the interest in heavens took multiple forms. The following chapters take a closer look at two of them: the development of the calendar and the emergence of mathematical astronomy. It will be shown that in both cases the underlying motivations differed from the largely divination-driven pursuits of ancient Babylonia and this had a profound effect on which aspects of its astral lore were translated into the Greek context.

[617] Rochberg 2000a: 1938.

[618] Rochberg 2000a: 1938.



	Date			Length of day	Length of night	Lunar velocity				
Obv.	[0]	I	II	III	IV	V	VI	VII	VIII	IX
	XII	[29,8,3]9,18	2,2,6,20 [ḫ]un	2,56	1,32	6,5,30 sig	[11,30]	3,59,52,30	[20,20]	[7,19 lal]
	3,28 I	[28,50,39]18	[5]2,45,38 múl	3,14	1,23	9,46,30 sig	[11,16,10]	4,22,22,30	[14,52,30]	[22,11,30 lal]
	II	[28,3]2,39,18	29,25,24,56 múl	3,26	1,17	5,54 sig	11,[52,10]	4,14,1,40	[8,5]	[30,16,30 lal]
	III	…	…	…	…	… …	…	…	…	…
	…									

X	XI	XII	XIII	XIV	XV	XVI	XVII
[3,52,33,30]	[še 29 1,2,43,50 šú]	[29, .,30 kúr]	[kúr 30 9,26]	[be] 14,15	bar 1 15,40	26 17,30 k[ur]	[/// be]
[4, .,11]	[bar 28 5,2,54,50 šú]	29, .,26 d]u	kúr 30 11,35	[be] 17,40	gu_4 1 17,30	26 17,50 kur	[23,4[0 be]
[3,43,45,10]	[gu_4 28 2,46]40 šú	28,1,2[9 n]im	kúr 29 7,57	[be] 13,10	sig 30 13	27 17,30 kur	18,3[0 be]
…	…	…	…	…	…	…	…

Figure 4: ACT 122

3.3 Greek Reckoning of Time: Parapēgmata and the Intercalation Cycles

Jones is of course right when he notes that the Hesiodic farmer, or indeed any other practitioner following the same rather rudimentary tradition, could and should not be called an astronomer.[619] However, the time-reckoning practices displayed by Hesiod and his successors not only presume some knowledge of the stars but their approaches lay the foundations for later astronomical study, especially the branch of it inspired by the need to construct an accurate natural calendar by correlating fixed stellar events with dates and other associated phenomena. Time-reckoning not only forms the framework of the *Works and Days,* but evolves into the *parapēgma*[620] tradition in the 5th cent. BC that, as Ptolemy's *Phaseis* shows, persists throughout Greek history well into the Roman period.[621]

Hesiod also gives us the first glimpse into the early Greek astronomical repertoire. The *Works and Days* delineates the year in terms of cycles of natural, including astronomical, 'signal events' that provide a sound guide to the agricultural and cultic year.[622] Considering the arbitrary nature of this system, it is perhaps not surprising that although Hesiod on the whole draws substantially on foreign traditions,[623] he displays no serious debt to Mesopotamian, at that time superior, astronomical knowledge.[624] The events included by Hesiod are primarily the solstices[625] and heliacal risings and/or settings of a small number of stars or star-groups[626] - the Pleiades, the Hyades, Sirius, Orion and

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[619] Jones 2007: 153.

[620] See glossary.

[621] Ptolemy (*Phaseis,* ed. Heiberg 66-7) cites twelve parapegmatists belonging to different periods: Meton, Euctemon, Democritus (5th cent. BC); Eudoxus, Philip, Callippus (4th cent. BC); Conon, Dositheos, Metrodorus (3rd cent. BC); 'the Egyptians', Hipparchus (2nd cent. BC), and Caesar (1st cent. BC) (Neugebauer 1975: 929).

[622] According to Aeschylus' *Pr.* 454-8*,* it was Prometheus, who taught humans to 'discern the risings of the stars and their settings, which are difficult to distinguish' in order to measure the passing of time.

[623] See Walcot 1966 and for the Myth of Ages in the *Works and Days* West 1978a: 27-8.

[624] Suggested influences on early Greek astronomy include the notion of stations and paths (*manzanu* or *nanzanu* and *ḫarrānu*) (Ferrari 2008: 36-7, 124-5; for the paths in Mesopotamian tradition see Horowitz 1998: 254) but these may be an independent development, derived ultimately from the crude observation that the Sun, Moon and planets all follow one and the same course through the fixed stars. Considerably more likely is the belief that the Sun and Moon entered the visible sky through gateways: Homeric *Hymns* 31 and 32 tell how Helios (the sun), Selene (the moon) and Eos (the goddess of dawn) enter and leave the waters of Oceanus/the House of Night (also *Il.* 14.201, 246) through a gateway at the end of the earth. In Mesopotamia e.g. the Etana myth (tablet 4 l. 3-4, '...the gates of Anu, Enlil and Ea... the gates of Sin, Shamash, Adad and Ištar').

[625] *Works and Days* 479, 564-67 ('When Zeus completes sixty days of winter after the solstice, then the star Arcturus leaves the holy stream of Oceanus and for the first time rises shining just at dusk'), and 663 ('Fifty days after the solstice…').

[626] Heliacal rising occurs just before sunrise and heliacal setting slightly after sunset. See glossary.

Arcturus.[627] The focus from this short and specific list of important stars/star-clusters seems to have moved very little during the late archaic and early Classical periods. The same list, with the addition of the ever-visible Great Bear, appears on the Shield of Achilles,

> He wrought the earth, the heavens, and the sea; the moon also at her full and the untiring sun, with all the signs that glorify the face of heaven - the Pleiades, the Hyades, huge Orion, and the Bear, which men also call the Wain and which turns round ever in one place, facing Orion, and alone never dips into the stream of Oceanus.[628]

and still centuries later in the Hippocratic corpus, Peripatetic writings, the history of Thucydides[629] and with only slight emendations on Euripides' Amazonian tapestry.[630] Although the Hesiodic *Astronomia*[631] gave information on the shapes as well as the rising and setting times of many more constellations, the interest in these seems to have remained for the time being primarily in the sphere of mythology.[632]

Nevertheless, some Mesopotamian influence on the early calendrical tradition is implied by the formal similarities of the literary genre. West has found that in some respects the *Works and Days* has better analogues outside the Greco-Roman literature than within it.[633] Bowen and Goldstein have insisted on the same basis that as 'an attempt to synthesise the literary conventions of the didactic almanac and astral omens,' Hesiod brought to Greece the 'intellectual motifs and conventions' which were necessary for the subsequent development of more refined time-reckoning practices.[634]

This subsequent development, however, must be viewed within a wider context. Before we move on

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[627] Pleiades: *Works and Days* 383-91, 572, 615 (and Hyades), 619-20. Sirius: 414-19, 587, 609. Arcturus: 564-7, 610. Orion: 598, 609, 615, 619-20.

[628] *Il.* 18.484-9 (also alluded to in Eur. *El.* 464-70), cf. *Od.* 5.272-5 ('as he watched the Pleiades, and late-setting Bootes [i.e. constellation of Arcturus], and the Bear, which men also call the Wain, which ever circles where it is and watches Orion, and alone has no part in the baths of Ocean'); also *Il.* 22.26-9 (Orion's Hound, i.e. Sirius).

[629] Jones 2007: 154.

[630] Eur. *Ion* 1147-58; also *IA* 1-8 (Sirius), *Or.* 1005-7, *Phaeth.* 63 (the Pleiades).

[631] Athen. 11.

[632] West 1978a: 22-3. West notes that the inclusion of Draco (F 293), which neither rises nor sets, seems to go beyond any merely utilitarian end, meaning the collection functioned as more than an aid for farmers and sailors.

[633] West 1978a: 3-15, 27.

[634] Bowen & Goldstein 1988: 58.

to discussing the particulars of the resulting calendars, it is important first to note that although some festivals and their ritual poetics were marking the change of seasons and were thus loosely tied to the astronomical cycle,[635] on the whole, traditional Greek religion can be characterised as markedly non-astral, i.e. rather unconcerned with stars or planets as divinities,[636] this especially in comparison with Assyrian state cult, which was greatly concerned with showing loyalty to the heavenly powers in order to maintain the cosmic order.[637] The second profound difference between the two traditions is the lack of a priestly class within the Greek society. Nowhere in the classical Greek world can we find a situation comparable to that in the Mesopotamian or Egyptian temples where specialised professionals practiced astral investigation as an established part of the official cult. The importance of this difference not only for the transfer of astronomical doctrines but also for other spheres of life, should not be underestimated. As we saw in the previous chapter, the Greeks themselves were acutely aware of their lack of an equivalent institution: curious men in exotic temples quickly became a literary *topos* and occupied a central role in the Greek cultural *imaginaire*.[638] Yet in practice, the lack of priests and astral religion meant that there was no ready-made *space* or *agents* that would be able to absorb knowledge easily from their eastern peers.[639] Such a situation leaves any society with two options: either to accommodate the imported goods to their existing needs, or to create the need for them first.

So, in the period in question there was no need on the part of the Greeks for the adoption of complicated mathematical methods (e.g. the daylight or lunar visibility schemes) introduced in the

[635] E.g. the Thargelia and Pyanepsia in Athens (Ferrari 2008: 129).

[636] Nilsson 1940: 1, although some rather ambitious speculations regarding the interrelationship between heavenly phenomena and religious practice have been put forward recently (Salt & Boutsikas 2005, Boutsikas 2007 & 2009, Boutsikas & Ruggles 2011) not least about the extent to which cosmic imagery runs through and governs the staging of Alcman's *Partheneion* (e.g. Ferrari 2008, Boutsikas 2007, but see also Burnett 1964 and Segal 1983, cf. Calame 1997 and Eckerman's 2009 review of Ferrari).

[637] E.g. cylinder seals, boundary stones and monumental inscriptions typically include astral symbols like the crescent moon, the eight-rayed Venus-star representing Ištar and the seven dots of the Pleiades. For the latter see Keel & Uehlinger 1998: 288-98. The motif of Ištar as the Queen of Heaven also relates back to Semiramis (see p. 61). The *d.Sibitti* (d.VII-*bi*), a group of seven gods, became associated with the Pleiades and were depicted as seven dots, sometimes organised into a rosette-star (Van Buren 1941: 277, for iconographical evidence see 279 and 283), appearing together with the signs of Sin, Shamas, Adad, Marduk, Nabu, Nergal(?) and Ištar, below the symbols of Ashur, Anu, Enlil and Ea on a rock relief at Bavian from Sennacherib's reign (Black & Green 1992: 17 fig. 10) as well as on innumerable examples on cylinder and stamp seals (assembled by Van Buren 1941).

[638] See ch. 2.3.4.

[639] Cf. The situation in Egpyt, ch. 4.4.1.

previous chapter; there was simply no sphere of life for which these would have had any practical value. There was, however, increasing need for an accurately aligned calendar. With different Greek regions using lunisolar calendars for religious purposes,[640] often widely out of step with each other, the observation of solstices and the movement of certain stars or star-groups, coupled with some other signal events as done in the *Works and Days*, provided a shared guide and control mechanism for the cultic year.[641] Mikalson has argued that the calendar in ancient Greek society, although also used for secular purposes, was, as 'an attempt to systematise and regularise the celebrations of religious festivals within the city-state', first and foremost a 'religious institution'.[642] Remarks by Aristophanes and Plato indeed draw attention to religious considerations as an important socio-political force behind the emergence of more refined calendars in the 5th cent. BC[643] and the interlocking relationship between the successful running of the state and preservation of the cosmic order.[644] Yet there were also other concerns that played their part in the search for an improved calendar; one can detect a need for a more accurate system in connection with contemporary trends in medical literature, as their emergence coincides with increasing interest in the relationship between climatic changes, astral events that signal, or even cause them, and patterns of illness.[645]

It is then in this context that we observe the next stage in the development of Greek astronomy: the appearance of the so-called *parapēgma* tradition in the late 5th cent. BC Athens. The *parapēgmata* were almanacs, originally published in the form of public inscriptions on stone (or perhaps wood) stele with 365 holes, along which a peg would be moved on a daily basis. Some of the holes were accompanied by a list of solar and stellar phenomena (e.g. the star risings and settings, solstices and

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[640] Hom. *Od.* 14.162, 19.307; Hdt. 2.4; Aristoph. *Clouds* 615-24. In Athens an ideal calendar was also in use for political purposes.

[641] West 1978: 377, Jones 2007: 149.

[642] Mikalson 1975: ix. Judging from the the Athenian example, Greek religious festivals were as a rule celebrated on the same day of the same moon each year although many were closely tied to the changing of the seasons (Davidson 2007: 205-7).

[643] E.g. the use of the eight-year cycle, the so-called Octaeteris (see e.g. Evans & Berggren 2006: 82-7 for explanation) , the discovery of which was attributed to Cleostratus of Tenedos (among others) by Censorinus, who adds that 'it is from this cycle that in Greece many religious festivals were celebrated with great ceremony' (*De die natali* 18). In the same passage he attributes to the Chaldeans a 12 year cycle and mentions a number of other 'Great Year' periods.

[644] Aristoph. *Clouds* 615-626, Pl. *Laws* 809c-d.

[645] E.g. pseudo-Hippocrates, *Epidemics* 4.20; *Airs, Waters, Places* 11; *Regimen* book 3. The idea of causal connection is also expressed in parts of Hippocratic corpus and the Peripatetic tradition. A contrary opinion is expressed in Gem. 17.7-11, but Jones (2007: 155-7 & 160) dismisses it as 'patent fiction'.

equinoxes), crude weather prognostications and/or other related observations.[646] Connected to their introduction are two names, Meton[647] and Euctemon. Little is known of Meton's *parapēgma* but Euctemon's work survives fragmentarily in various versions.[648] As for Meton, however, there is a consensus among scholars[649] that it was he who in 432 BC first made the originally Mesopotamian 19-year lunisolar intercalation cycle (*ennekaidekaeteris,* also referred to as the 'Metonic cycle' ever since), discussed above, known in Athens.[650]

The two innovations seem to have been intertwined; Evans and Berggren have argued that the 19-year cycle was used to regulate the *parapēgma,*[651] as the latter probably also included holes for the new moons and allowed to align the cultic calendar and the solar year[652] over long periods of time. All this provides an explanation as to why the state would have been so interested in monumentalising a public calendar. It appears increasingly more likely that the Metonic *parapēgma* was initially set up as a cycle of 19 inscriptions; the same slab would serve again after 19 years thus eliminating the need to compile a new calendar every year.[653]

Scholarly views on the contribution of Meton and Euctemon to Greek astronomical tradition, and especially on the scientific context in which those contributions were made, has fluctuated over time.

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[646] E.g. Euctemon's *parapēgma* contained at least two ornithological observations (Hannah 2002: 123). For surviving inscriptions on the *parapēgma* from Athens, Miletos and Pozzuoli see Hannah 2001: 143-7, for other examples and illustrations Hannah 2002: 114-8.

[647] Early sources depict him not as an astronomer *per se* but rather as a land-surveyor (Aristoph. *Birds* 992-1020) and city-planner (Phyr. *Monotropos* F 3 (21) - a builder of a fountain; both written in 414-3 BC).

[648] See Hannah 2002.

[649] E.g. Goldstein & Bowen 1983; cf. Samuel 1972 but his stance is explicitly pro-Greek and arguments based on outdated information (e.g. from Neugebauer, n. 580 above).

[650] Its introduction is ascribed to Meton by Diod. Sic. (12.36.1-3) and Censorinus (*De die nat.* 28.8) although alternative claims exist, e.g. Gem. 8.50-6 credits Euctemon instead.

[651] And not the Athenian civic calendar (Evans & Berggren 2006: 89-90; cf. Freeth et al. 2008: 614 about the Antikythera mechanism showing that the Metonic cycle was used to regulate the civil calendar at least by 100 BC, although this provides no conclusive evidence for the earlier period) or to provide a calendric scheme for recording astronomical data, like Toomer (1974: 338) suggested.

[652] Neugbauer (1975: 587) says that 'because of the irregular fluctuations of the Greek lunar calendars the dates of the phases in the civil calendar of the current year were shown on pegs which were inserted in little wholes' and this probably accounts for the name παράπηγμα which comes from a verb meaning 'to fix beside, or near'.

[653] Σ Arat. *Ph.* 753 (Martin 1974: 381) talks of 19 inscriptions. A similar claim is made about Oenopides (Theo. Smyrn. P. 322 Martin = Oinopides A 7 Diels-Kranz) who allegedly set up a 59-year 'great year' cycle in Olympia. A practical example is provided by a bronze calendar of Coligny (2nd cent. AD), which carried a 5-year cycle, and a Gallic or Celtic calendar, complete with holes for each of the 1,835 days (see McCluskey 1998: 54-7).

In the early 1980s Bowen and Goldstein started to revise the hitherto standard views on the nature of early Greek astronomy. They argued against the old consensus that already in these initial stages classical Greek astronomers primarily aimed to explain planetary phenomena by accumulating and analysing observational data. In their view, planetary theory was not central to this part of Greek astronomy as it was not concerned with cosmological speculation (below).[654] The *parapēgmata* demonstrate very little theoretical knowledge: there is as yet no model of cosmos, no allusion to a celestial sphere; no precise measures/coordinates are involved in determining the risings and the settings of the stars; and there is no mention of planetary motion or eclipses.[655] It was, and remained for the time being, a *techne,* not yet an *episteme*.

Thus Bowen and Goldstein also found that what some earlier scholars held to be Meton's original contribution to Greek astronomy did not fit into this redefined cultural context. Instead they argued that Meton's innovations 'may be better understood in the light of Babylonian computational schemes and literary genres, among which the construction of a *parapēgma* played a central role' and where, as was shown above, the 19-year cycle had been in use for around a century.[656] As the Greeks also evidently lacked a sufficient amount of observational data,[657] it is indeed highly likely that Meton, and possibly Euctemon, used 'imported' knowledge to fulfil their agenda. That the Near East would have been their first point of call for the acquisition of necessary information should come as no surprise: we have seen how rumours of their superior astronomical knowledge must have been circulating for some time by the then.

Nonetheless, how and when the transmission took place is hard to say. Bowen and Goldstein propose that Meton 'got this information in a report that included numerical data organized according to an earlier version of what is now called the Uruk scheme', which is purely arithmetical and appears in the diaries and almanacs, giving a matrix of dates for solstices etc.[658] The usage of terminology arguably has some parallels in cuneiform sources but there is no conclusive evidence that access to Babylonian material was so direct.[659] Theophrastus mentions that Meton was a pupil

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[654] Goldstein & Bowen 1983: 330-1.

[655] Goldstein & Bowen 1983: 331-2.

[656] Bowen & Goldstein 1988: 41-3 and p. 107 above.

[657] Bowen & Goldstein 1988: 48.

[658] Bowen & Goldstein 1988: 48-51.

[659] Bowen & Goldstein 1988: 54-5, who compare the use of words *epitellei* (rises) and *ekphanees* (is apparent) by Euctemon with IGI.IGI.LÁ and SAR (rise(s) heliacally; rise(s); is/are not visible) as well as NU.IGI in the EAE.

of Phaeinos, a metic in Athens.[660] Although his provenance is not disclosed, some have argued that he could have been an Asian Greek who served as a transmitter of the Babylonian astronomical tradition.[661]

However, the incorporation of the new knowledge was a complex process; as the fragments of these new type of calendars (many of which come from the *parapēgmata* attached to the *Eisagoge* of Geminus and from Ptolemy's *Phaseis*) demonstrate, it did not at once replace the old systems but was carefully tweaked so that it nicely fitted into the local tradition. Neither can we talk of uninformed copying from Babylonia in the case of the 'Metonic cycle'. Meton tried to accommodate it to a calendar year of 365 days with a system of hollow and unhollow months to correlate the dates in the *parapēgma* with the dates in the lunar calendar.[662] The knowledge of hollow and unhollow months could, however, also stem from a Babylonian source.[663]

It is also becoming increasingly apparent that Meton, Euctemon and perhaps a few parapegmatists after them followed to a large extent the older Hesiodic tradition. The surviving *parapēgmata* have no strict format; the exact presentation of the observational data fluctuates between different organisational arrangements.[664] The collection of observations in the *Eisagoge* is structured according to the artificial signs of the zodiac and this has been generally accepted as the original organisation used by Euctemon, to whom many of the observations are attributed. However, Hannah has more recently argued against this view and proposed that Euctemon could have instead used the day-count method, known from Hesiod and other early writers.[665] Hannah's theory, however, has serious ramifications for the question of when the zodiac was first introduced into Greece.

Columella (11.1.31) connects the parapēgma tradition to the Chaldeans and Neugebuaer (1975: 612) has no doubt that he was familiar with examples (rightly or wrongly) ascribed to them.

[660] Theophr. *De Sign. Temp.* 1.4.

[661] Toomer 1974: 339.

[662] Not to the astronomical calendar as sometimes thought and not to reform the civil calendar. Bowen & Goldstein 1988: 43-8 & 52.

[663] Bowen & Goldstein 1988: 50-1.

[664] A *parapēgma* recorded in cod. Vind. Gr. philos. 108 fol. 282v, 283r uses day counts to list the star sightings; the *parapēgma* attached to Geminus' *Introduction to Phaenomena* arranges them according to the zodiac; and Ptolemy in *Phases of Fixed Stars* follows the civil calendar.

[665] Hannah 2001: 147, supported by Jones 2007: 155. Pliny, *NH* 18.57 might be of relevance here: 'Hesiod [i.e. the Hesiodic *Astronomia*] … has stated that the morning setting of the Vergilae takes place at the moment of the autumnal equinox; whereas Thales, we find, makes it the twenty-fifth day after the equinox, Anaximander the twenty-ninth, and Euctemon the forty-eighth.'

Euctemon's choice of stars clearly follows the traditional Greek system; he is largely ignoring the zodiac signs - out of the 12 constellations only Scorpius and possibly Vindemiatrix in Virgo are mentioned – which makes little sense had he used the zodiac as a reference framework. To the five signallers known from Hesiod are added Pegasus, Aquila, Delphinus, Haedi, Corona, Lyra, Capella and Sagitta, bringing the total of star-groups up to 15.[666] This choice of stellar objects is not inspired by any known Mesopotamian list[667] but might well be influenced by the *Astronomia* even if the lack of surviving fragments makes a positive identification impossible.[668]

The same list was used by Eudoxus (first half of the 4th cent. BC[669]), who, if Hipparchus is to be trusted, was aware of the zodiac signs but did not apply them to his *parapēgma*.[670] Still, Bowen & Goldstein have argued that Hipparchus' description of Eudoxus' work involves a considerable amount of modernisation on his part and Eudoxus most definitely did not divide the ecliptic into equal arcs.[671] Aratus' use of the signs only as visible constellations in his Eudoxus-inspired *Phaenomena* certainly points towards this conclusion. As can be clearly seen from table 6 below, the signs were clearly borrowed from Mesopotamia,[672] where the zodiac system had been established 'with complete clarity and precision' at least by the mid-5th cent. BC.[673] Among other evidence one can cite BM 36746 that dates to around 400 BC and uses a trine system that presupposes a zodiac of twelve equal-length signs.[674]

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666 Hannah 2002: 121-3.

667 Jones 2007: 155.

668 Hannah 2001: 151, for Hesiodic *Astronomia* see p. 117.

669 Exact dates are not known, he is said to have flourished in the 103rd Olympiad (i.e. 368-365 BC) and died at the age of 53 (Diog. Laert. 8.90). See e.g. Huxley 1963: 83-4, who finds that he cannot have been born before 400 BC and must have died a little after 347 BC.

670 Hipp. 2.1-3. Kidd 1997: 20, Jones 2007: 157-8 & 162.

671 Bowen & Goldstein 1991: 241-5, contra older opinion expressed e.g. by Huxley 1963: 90-91.

672 It cannot be determined when, or by whom, the constellations and their use as zodiac signs were first introduced to Greece. As for when, I strongly doubt we can even argue for a one off introduction. Boll (1903: 193-4) suggested that at least parts of it (Aries and Sagittarius) could have been introduced by Cleostratus, which would put the *terminus ante quem* to 432 BC. The accuracy of this claim was debated by Fotheringham and Webb in the course of a series of articles published between 1919 and 1928 but without a satisfying conclusion.

673 Van der Waerden 1952-1953: 224-5 & p. 107-8 above.

674 Hunger & Pingree 1999: 17, Rochberg-Halton 1984: 118, 121, see also Sachs 1952: 52.

LATIN	ENGLISH	SUMERO-BABYLONIAN	
		Transcription[675]	*Translation*
Aries	The Ram	MUL LU□UN.GA	The Agrarian Worker
Taurus*	The Bull	^{MUL}GU$_4$.AN.NA	The Steer of Heaven
Gemini	The Twins	^{MUL}MAŠ.TAB.BA.GAL.GAL	The Great Twins
Cancer	The Crab	^{MUL}AL.LUL	The Crayfish
Leo*	The Lion	^{MUL}UR.GU.LA	The Lion
Virgo	The Virgin	^{MUL}AB.SIN	The Seed-Furrow
Libra	The Scales	*zibanītum*[676]	The Scales
Scorpio*	The Scorpion	^{MUL}GIR.TAB	The Scorpion
Sagittarius	Centaur the Archer	^{MUL}PA.BIL.SAG	*Nedu* 'soldier'
Capricorn*	The Sea-Goat ('Goat-horned')	^{MUL}SU□UR.MAŠ	The Goat-fish
Aquarius	The Water-bearer	^{MUL}GU.LA	The Great One
Pisces	Fish	^{MUL}KUN.MEŠ / DU.NU.NU	The Tails / fish-tail

Table 6: Zodiac signs

The innovation of using 12 equal signs was, then, probably not introduced until Callippus in the late 4th cent. BC.[677] The earliest surviving *parapēgma* in Papyrus Hibeh 1.27 definitely sets a *terminus ante quem* for the active use made of the zodiacal signs (as opposed to the constellations) of around 300 BC.[678] Each entry is for an Egyptian month and associated with some stellar phenomena, e.g.:

Tybi, in Aries, [day] 20, vernal equinox, the night 12 hours and day 12 hours, and feast of

[675] Given are the MUL.APIN names. See Rochberg-Halton 1984: 119 for the development of the names of zodiacal constellations.

[676] The epithet of the Scales in cuneiform sources is the 'Star of Šamaš'. In Greece Virgo, which lies beside the Scales is connected to Dike, the goddess of justice (see table 7 below; Kasak & Veede 2001: 9).

[677] Jones 2007: 158, 162.

[678] The calendar concerns the period between 301 and 298 BC. Grenfell & Hunt 1906: 139-40.

Phitorois.[679]

So if previously it could be argued that Callippus' contribution to Greek astronomy was primarily the revision of the intercalation cycle to accommodate the 365¼-day year,[680] then after Hannah's arguments about the structure of the first *parapēgmata* are taken into account, his role as the mediator between Greek and Mesopotamian traditions seems exponentially more important.

It can be concluded that the knowledge of the 19-year intercalation cycle and an idea of public calendars were not simply inserted into a rudimental Hesiod-style tradition when knowledge of them became available. The impetus for the construction of public calendars and a need for an effective intercalation cycle emerged from within the Greek tradition itself; and the technical knowledge was not simply imported because it suddenly became available. But the process through which foreign material was incorporated into the local tradition provides invaluable insights into the practical aspects of cultural translation. In the words of Bowen and Goldstein, 'the very process of adapting these [Mesopotamian] results to alien assumptions (e.g. that the day is a basic unit of time) and transforming them by ignoring the arithmetical schemes needed to justify and interpret these results, is momentous in the history of early Greek astronomy: it was a critical stage in the evolution of that peculiar Greek way of doing astronomy.'[681]

3.4 'Home Repertoire' – from Cosmological Speculation to Mathematical Astronomy

Cosmological speculation has generally been distinguished from 'proper' astronomy but in this case they are merely two sides of the same coin. Greek reasoning, which finally led to the emergence of mathematical models, had its roots, much like its Mesopotamian counterpart, deep in natural philosophy. Although there is no *one* cosmology in Greece and almost every aspect of any theory was contradicted by another Greek philosopher,[682] aiding the development of rational argument but

[679] Col. iv. II 62-4.

[680] The 76-year Calliptic cycle is essentially a quadruple Metonic cycle ($4 * 19 = 76$). As the year is slighly more than 365 days, quadrupling disposes of the fractions and allows us to work with a more convenient integer number of days. By removing one day from the final 19-year cycle, the total is made more accurate (76 years = 940 syn. m. = 27,759 days). A number of other cycles were proposed by other astronomers but the Callipptic cycle remained the standard in astronomy.

[681] Bowen & Goldstein 1988: 81.

[682] Indicative of the situation is Lloyd's (1975: 209) saying that 'Greek cosmology is nothing if not dialectical.'

making it at the same time impossible for us to give a comprehensive and meaningful summary of the development of cosmological speculation, some important trends and assumptions merit attention. Although there is not enough room here to discuss the development of Greek cosmology and philosophy in any sufficient length,[683] an overview of its main stages[684] is nevertheless necessarily to explain the key factors of the complex thought-system any foreign 'import' would have to have been assimilated into. Moreover, it serves to highlight the fundamental implications of the differences this system had compared to the Mesopotamian religious context of its own astronomical system (above) when we consider the translation process.

Astronomical investigation distinguishes in general lines between two questions, how and why: *how to get satisfactory results* (not *how does it work*); and *why does this method yield good results.* It is generally held that despite the astonishingly accurate predictions yielded by Babylonian lunar and planetary theories, local scholars never really asked the *why*-question: there was supposedly no physical theory comparable to the Greek spherical models, involved in Babylonian astral investigation that we know. The modern view, however, is not shared by the Greco-Roman sources. The source(s) of Diodorus Siculus must have outlined 'many plausible arguments about both the earth and all other bodies in the firmament', unfortunately, Diodorus finds that these are too 'alien' to his history to be repeated.[685] Any strong statements about Babylonians lacking physical theories about the movement of the stars should therefore be approached with due caution, and a significant oral tradition doubtless accompanied the written records which preserve only the technical side of its astronomical tradition. Nevertheless, we have seen above that the surviving material does indeed allow the assertion that it was the period relations that formed the backbone of Babylonian astronomy.[686] This, and the underlying ideas about the nature of the universe, is where the Babylonian and Greek traditions presumably diverge.

[683] See West 1971. In short he postulates that Greek philosophy saw a period of active Iranian influence between 550-480 BC, preceded by about a century of milder, what appears to be more Babylonian, influence. Note, however, that much like in the *East Face of Helicon,* the argument in his *Early Greek Philosophy and the Orient* is cumulative. No doubt, genuine oriental influences can be found among his numerous suggestions, but his treatment of the cuneiform material in particular highlights the need to be aware of the many instances of pure speculation.

[684] Despite the chronological structure of this sub-chapter, it is important to bear in mind that the development of Greek cosmological-astronomical thought was not necessarily linear and encompassed methods other than the creation of geometrical cinematic models.

[685] Diod.Sic. 2.31.7.

[686] I.e. the dates and locations of particular phenomena, which have been listed in table 4.

The latter is characterised by the transition from mythology to philosophical cosmology, the pluralism of the resulting ideas and the development of the critical method, which all play a part in the development of its planetary theory.[687] Cosmological theories first arose in the eastern Aegean, which was home to a number of influential Greek thinkers[688] (many of whom were allegedly of foreign extraction),[689] and developed into a tradition that would eventually accommodate the creation of the Hipparchean-Ptolemaic theory of the planets. The influx of foreign ideas seems to have instigated a change in the pre-classical Greek thought, which had major significance for the development of cosmological speculation and astronomy with it. West describes Pherecydes, for instance, as creating a novel theology by combining Greek traditions with barbarian cosmological and eschatological conceptions (which he may have inherited from his parents),[690] the influence of which can best be felt on the Pythagoreans.[691] What we know of Thales'[692] cosmogony points to the conclusion that his doctrines – water as first principle, a cosmic whirlwind as the force behind the rotary movement of the heavenly bodies – as well as those features of Anaximander's system that West believes can be traced back to Thales – e.g. Time as a divine agent and a sphere of flame enclosing the space around the earth from which pieces of fire split off to form the sun, moon and stars – were more or less demythologised forms of similar Phoenician ideas.[693] The emphasis here is on the concept of

[687] Lloyd 1975: 198.

[688] These thinkers have been divided into two categories: the *theologoi* and the *physiologoi*. Although from our point of view these are competing world views, in Greek context they are very much co-existent and even overlapping, serving essentially the same aim.

[689] Thales has been claimed to be of Phoenician ancestry in Hdt. 1.170. West (1971: 214) further speculates that Bias of Priene's father was probably a Phrygian, and Babys, the father of Pherecydes of Syros, could have been of Anatolian origin as well.

[690] West 1971: 9, 52, 75 & 1994: 289-307. Among the alleged foreign elements are the concepts of (a cloaked) world tree, the seed of Time, the world-serpent Ophioneus in *Heptamychia,* and the archetypal myth of the 'Time-Egg', features of which also appear in the Orphic theogonies and in connection to Epicurus in Epiphanus, *Panarion* 1.8.1.2-3). Cf. Kirk 1974: 83-4.

[691] West 1971: 2 & 77.

[692] Hdt. 1.74 attributes the prediction of the solar eclipse on 28 May 584 BC (or 585 according to a more popular designation) to Thales. Clarke (1962: 65-9, cf. Neugebauer 1963: 533-4) has argued that if Thales was aware of the solar eclipse that was visible 18 years earlier (18 May 602 BC) in Scythia and southern Persia, that might have helped him to predict the one in 584 BC. However, in order to do that he should have been aware of some principles covered by the method of the Saros cycle. Thales' prediction was at best a guess based on the knowledge that an eclipse around that time was possible. However, there is no evidence that the Babylonians had discovered the Saros cycle by this time (Neugebauer 1975: 604). Even centuries later, although the Saros allows for relatively secure predictions of the lunar eclipses (see Steele 2000), Diod. Sic. (2.31.6) says that the Chaldeans do not purport to predict the solar eclipses with any precision.

[693] For its hypothetical reconstruction see West 1971: 212. Cf. Lloyd 1991: 286-7 who points out the problems with the Near Eastern connection and the conjectural nature of the argument.

demythologisation, perhaps due to Anaximander and finished by later excerptors.[694] However, Thales himself can probably be credited with the elimination of personalised divinity from the process; the water that creates the cosmic spin is, although in a sense still divine, now only bound by the laws of nature. In other words, the movement of the heavenly bodies is made automatic.[695]

To this native materialistic speculation Anaximander[696] added another important innovation: the heavenly bodies were no longer treated as self-contained free-moving entities but attached to invisible wheels that control their regular rotation.[697] This aspect of Anaximander's system was taken over by the later authors who, despite discrepancies in other details, all preserve 'the basic concept of the cosmos as a globule created and maintained in the infinite surrounding continuum by vertical forces.'[698] The empirical cosmology of Xenophanes, for instance, achieved a simplification of the periodicity-centred cosmic model as we know it today.[699]

Details about the planets, including the knowledge that they have definite orbital periods like the sun and the moon, evidently came to Greece from Babylon sometime after Anaximander but before Philolaus (c. 470-385 BC) and Democritus (c. 460-370).[700]

The planets were fully included in Philolaus' peculiar astronomical system of the ten heavenly bodies.[701] His work, though, was still 'a mythology in scientific clothing' with the focus of the theory resting on the ethical and aesthetic order that the planetary system exhibits and not on the physical phenomena that it purports to describe; his scheme did not aim to provide any precise measurements of the latter.[702] The same applies to the atomists – interestingly, Democritus (c. 460-370 BC) postulated a disc-like earth, basically flat but slightly hollowed in the middle, something very

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694 West 1994: 305-6.

695 West 1971: 213.

696 In simplistic terms, Anaximander's cosmology postulates a sphere of fire with earth in the middle, surrounded by the luminaries as revolving rings of fire. Compare Ezekiel's (1:15-21, 3:13, 10:6-22) description of his vision of the heavens as seen during his exile to Babylon in 593-2 BC. Cf. Lloyd 1991: 287-8.

697 West 1971: 88.

698 West 1994: 307.

699 Fragments with English trans. in Lesher 1992; for the role of Xenophanes in Greek cosmology see for instance Heitsch 1994.

700 Burkert 1972: 310, 313.

701 See p. 265.

702 Burkert 1972: 348, Goldstein & Bowen 1983: 333.

similar to the one mentioned in connection with the Mesopotamian tradition by Diodorus Siculus.[703] To put it briefly, Greek astronomical speculation was still at a stage where its main purpose was to provide an explanatory framework for observed events.

	MOON	**MARS**	**MERCURY**	**JUPITER**	**VENUS**	**SATURN**	**SUN**
SUMERIAN	Nanna	Gugalanna	Enki[704]/ (Ninurta)	Enlil	Inanna	Ninurta	Utu
BABYLONIAN [705]	Sin[706]	Nergal	Nabu/Nebu[707]	Marduk	Ištar	Ninurta	Šamaš
In Hesychius	Α◻δώς[708]	βελέβατος [709]	Σεχές[710]	Μολοβόβαρ [711]	Δελέφατ[712]	-[713]	Σαώς[714]
GREEK	Selene	Ares	Hermes	Zeus	Aphrodite	Cronos	Helios
Influence[715]	*Moon god, fertility*	*War*	*Trade/wisdom, writing*	*Main god, Power*	*Fecundity*	*Agriculture*	*Sun god, justice*

Table 7: Planetary gods

[703] Diod. Sic. 2.31.7. Democritus F 96a-b Taylor.

[704] Enki – god of water but also crafts and mischief.

[705] For a discussion and list of designations of names of planets see Kasak & Veede 2001.

[706] The moon god *Sin* is depicted, among other things, as a horned bull (*qarnû*) (Kasak & Veede 2001: 17).

[707] Nebo (or Nabo) - the Babylonian god of wisdom and writing.

[708] From the Assyrio-Babylonian standard epithet *Edēšu* or *Eddešû* – 'new' (Stieglitz 1988: 444).

[709] Should be emended to Σελέβατος (Jastrow 1908: 156 n.53), from *Ṣalbatanu*.

[710] From Akk. *šiḫṭ u* ('jump', 'the jumpy planet' or 'the Leaping One'; GU_4.UD), with the final ς supposedly being a misreading for τ, *iḫ* regularly becoming εχ (eḫ) in Greek transliteration, and an extra doubling vowel inserted between a diphthong – cf. *Delebat = Dilbat* in the next note, and the final *u* lost (see Westenholz 2007: 283 for the Σεχές identification). Cf. Τηλέφασσα in Greek mythology.

[711] From Akk. MUL.BABBAR, 'the white star'.

[712] From $^{d/mul}$*dele◻bat=Delebat* (previously thought to have been *Dilbat*), which is the standard name for Venus in the Diaries from 651 BC onwards (Brown 2000: 55).

[713] Hesychius does not include a term for Saturn (Akk. *kajamanu* (GENNA)) but Diodorus gives it as 'Star of Helios', which is in accord with the interchangeable use of the same cuneiform sign to denote both Sun and Saturn (Stieglitz 1988: 446).

[714] Akk. *Šamaš,* the *m* being absorbed into the ω, which is well attested in the Greco-Babyloniaca tablets as well, where m is often missed out (e.g. οξ (10:1) = *muḫḫi*; οσειρ (10:2) = *muširri*).

[715] Based on Richards 1999: 280, table 21.2. Also see Kasak & Veede 2001: 14 for how the Mesopotamian natures of planets match those in the Greek tradition.

Nonetheless, by the time we first find a sustained discussion of astronomical matters, in Plato (427-347 BC), the general structure of the universe has acquired its set features: the earth is spherical and rests at the centre of the sphere of the fixed stars, the planets are stationed in concentric paths at varying distances in a fixed order (moon, sun, Venus, Mercury, Mars, Jupiter, Saturn), and their apparent irregularities are explained by mathematical principles.[716] Moreover, the growing self-sufficiency of Greek rationalism and mature philosophical system allowed for any knowledge imported from now on to be employed in a way rather different from the previous syncretic engagement.

Lloyd has noted that one of the exceptions that Plato talks of when he says that

> Of the other stars the revolutions have not been discovered by men (save for a few out of the many); wherefore they have no names for them, nor do they compute and compare their relative measurements, so that they are not aware, as a rule, that the 'wanderings' of these bodies, which are hard to calculate and of wondrous complexity, constitute Time.[717]

must be Eudoxus, a younger contemporary of Plato, whom modern commentators hold responsible for turning Greek astronomy into a mathematical science.[718] Eudoxus is said to have studied geometry with Archytas the Pythagorean,[719] spent sixteen months with the priests of Heliopolis in Egypt[720] and to have been aware of the Babylonian astronomical achievements.[721] Seneca (4 BC – AD

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[716] E.g. Plato *Phd.* 108e, *Rep.* 616c-617d, *Tim.* 39c-e.

[717] Pl. *Tim.* 39c.

[718] Lloyd 1979: 144 n. 253. The planetary periods must have been discussed in this book *On Speeds*.

[719] On Archytas see p. 268, 289 & n. 1490.

[720] Diog. Laert. 8.8, Strabo 17.29-30. Reports are conflicting: Huxley (1963: 84-88) believes that although the tradition is 'surrounded by legend' he 'undoubtedly went there' but not to learn theoretical astronomy and the planetary theory, rather to make observations and master the language. Yet, international travel is a literary *leitmotif* and its myth-making properties should not be underestimated. Visiting Egypt is a *topos* in the biographies of poets, seers, wise men, tyrants and heroes (e.g., Solon or Pythagoras (n. 1448); see Kivilo 2010, esp. 221 table). But although they are, as Raaflaub (2004: 200) suggests, often the 'result of rationalization and constructions intended to explain phenomena that seemed similar in both cultures', some may still be based on 'vague memories and genuine traditions' and they definitely reflect the very mobile world of the ancient Greeks.

[721] Cic. *Div.* 2.42 (on the unreliability of their astrology). An anonymous commentator on Aratus says that Eudoxus brought to the Greeks the Assyrian spheres (F 2 Lasserre = Anon. *In Arati Phaenomena isag.* 318 Maass). Some Babylonian influence is possible in terms of the stellar paths providing a prototype for the four circles of the celestial sphere (tropics, equator, ecliptic; Aratus 462-558). Lloyd (1979: 178) further speculates that Eudoxus could have derived some major periodicities of the planets from Babylon. Once can only very tentatively read anything into the fact that Simplicius (*In Cael.* 495.28-9 Heiberg) gives the Babylonian name of

64) reports that:

> Democritus, the most acute of all the ancient philosophers, says he suspects there are several stars [i.e. comets?] whose orbits are erratic. But he has given neither their number or their names, as the motions of the five planets were not in his time understood. Eudoxus was, in fact, the first to import from Egypt into Greece the knowledge of these motions…[722]

Eudoxus' research into celestial matters resulted in the introduction of the celestial circles (i.e. the circles of the always-visible and always-invisible stars) and a geometrical model to explain planetary motion, which was a significant step forward from just describing the heavens.[723] His most outstanding contribution – the doctrine of concentric spheres, in which the inner sphere represents the earth and the outer the orb of the fixed stars – was not, as we have just seen, in itself a novel theory; his innovation lay in removing it from the realm of cosmological-moral theory (e.g. in Philolaus or Plato) and using it to account for actual celestial phenomena.

According to Aristotle's account of Eudoxus' model, he postulated nests of revolving spheres, three for the sun and moon, and four for each of the five planets. The first sphere always accounted for the daily rotation, and the second for the yearly rotation, of the fixed stars along the ecliptic. The remaining sphere, for the sun and the moon, explained their motion in latitude, and the four spheres for the planets were needed to account for the phenomena such as stationary points, and retrogradation.[724] All this laid the foundation for the further application of geometry to the study of planetary movements, as for example in Autolycus' (c. 390-290 BC) *De Ortibus,* which is the earliest surviving work on astronomy, or in Euclid's *Phaenomena*.[725] Contemporaries and followers of Eudoxus also included Hicetas (c. 408-335 BC), Philip of Opus/Medma (a disciple of Plato),[726] Ecphantus (4th cent. BC), and Heraclides Ponticus (387-312 BC); but little or nothing is known of their

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Saturn ('the star of the Sun') in his report of Eudoxus (see Dicks 1970: 167).

[722] Sen. *NQ* 7.3.1. The link with Egypt is further indicated by the fact that in the *parapēgmata* Eudoxus and 'the Egyptians' are frequently mentioned together. And the meteorological predictions in his work show close parallels with the cuneiform omens which, as will be shown in the next chapter, he could have accessed through Egypt.

[723] Arat. *Phaen.* 19-25, 462-558. Goldstein & Bowen 1983: 333. They also estimate that the celestial circles were introduced some time between 372 and 340 BC.

[724] Arist. *Metaph.* 1073b.

[725] Goldstein & Bowen 1983: 333-4. Autolycus, for example, criticised Eudoxus' model for failing to account for the apparent variation in the sizes of Mars and Venus.

[726] See p. 155 for the report of the Chaldean in Athens, attributed Philip of Opus.

ideas. Callippus (c. 370-300 BC) has already been discussed in relation to the *parapēgma* tradition and the zodiac but he also added more spheres to Eudoxus' model.[727]

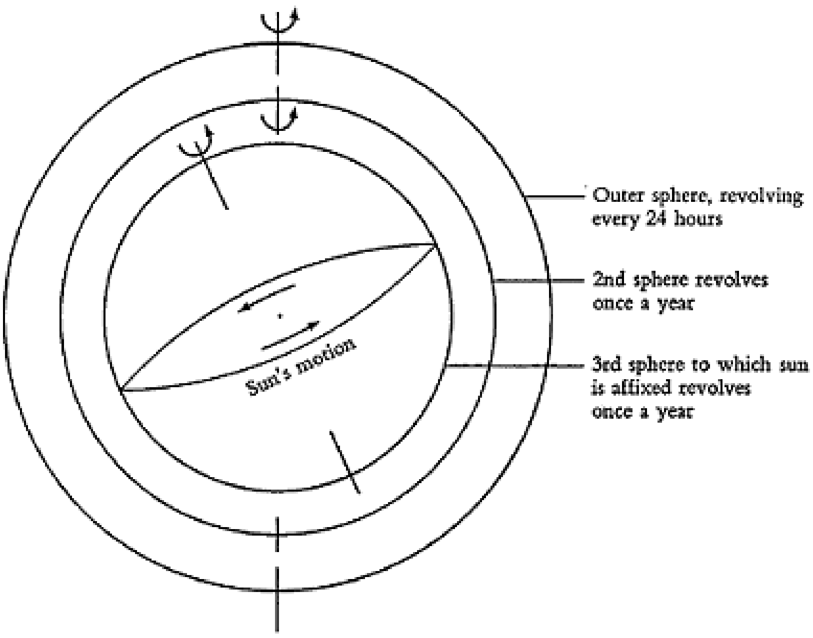

Figure 5: Eudoxus' model of homocentric spheres for the Sun[728]

However, Aaboe has shown how these early geometrical models were qualitative in nature, i.e. they served to describe how the planetary motions might be generated, but they were still unsuitable for quantitative use, meaning that they did not enable the calculation of real planetary positions.[729] In other words, the early astronomical texts from 5th and 4th cent. BC were still concerned with explanation and not interested in prediction. Things like foretelling the dates and magnitudes of future eclipses, appearances of planets and other heavenly events did not interest scholars of the time. Hence, it is not surprising to find only very limited Babylonian influence on Greek astronomy of the period.

Eudoxus' theories were propounded, among other texts, in his *Octaeteris, Phaenomena* and *Enoptron.* Although none survives, Aratus' (c. 310-240 BC) *Phaenomena*[730] is largely a retelling of his

[727] Arist. *Metaph.* 1073b; p. 124-5 above.

[728] From Samuel 1972: 30.

[729] Aaboe 1974: 37-40. The spherical trigonometry needed to get meaningful results did not yet exist.

[730] For detailed analyses of the poem and its reception see e.g. Gee 2000: 66-91 or Possanza 2004: 79-99.

book by the same name;[731] detailed information is also yielded by Hipparchus *In Arati et Eudoxi Phaenomena* and other commentaries. As Aratus' book is written in the revived tradition of didactic poetry in artificial epic dialect - a direct result of dramatic increase of literacy and consequently a demand for intellectual entertainment in the form of compendia and handbooks on inherently interesting subjects during the early Hellenistic period[732] - it is not very technical, but it does highlight well the intertextuality of Greek astronomy-inspired writing and the 'translation' of material across genres (in this case scientific prose to didactic poetry), as well as the prevailing world-view of its intended audience. In terms of astronomy, it is restricted to information required for time measurement, sitting firmly within the *parapēgma* tradition, whilst still going significantly beyond it by describing not just the rising and setting signs, but also giving a detailed description of all 48 constellations.[733]

Nevertheless, regardless of the probable popularity of Eudoxus' system with lay readers[734] it soon became evident that from a purely technical point of view it was severely inadequate in accounting for the actual phenomena.[735] So the doctrine of concentric spheres came to be superseded by the model of epicycles (fig. 6) and eccentric motion, originally proposed by Apollonius of Perga (c. 262 – c. 190 BC).[736] All the same, Eudoxus' underlying principle that the celestial phenomena can be explained by employing combinations of uniform circular motions became fundamental to Greek

[731] Hipp. 1.2.1-16. See Kidd 1997: 16-7 for a discussion on where Aratus parts from Eudoxus.

[732] Toohey 1996: 49-51, 76-77.

[733] According to Hipparchus (1.2.17), Aratus follows the arrangement and descriptions given by Eudoxus. Inspired by the *Works and Days* (and I would also suggest the Hesiodic *Astronomia*) it can be viewed as an update of the genre, one that keeps the character and language of the Hesiodic epic hexameter, but takes into account the progress of Greek scientific and philosophical thought, as much as these can be distinguished from each other, over the past half century, especially the cosmic beliefs of the Old Stoa (e.g. the Golden, Silver and Bronze races (96-136) but see Kidd 1997: 8-10 for specific lines where Aratus alludes to the themes of the *Works and Days* and the *Theogony*, 10-12 for the Stoic connection and 36-43 for relations with contemporary and later poets). But unlike Hesiod's work, it is no longer based on real life and first-hand experience, but on book-knowledge, and quite self-consciously so. Cic. *De Or.* 1.69 points out that it was commonly agreed in learned circles that Aratus knew no astronomy, and the same lack of personal knowledge also applied to Nicander.

[734] Aratus' book enjoyed great popularity. Contemporary praise comes from Callimachus (27 Pfeiffer = 56 GP) and Leonidas of Tarentum (101 GP). 27 commentaries are known (e.g. by Attalus of Rhodes) and 4 translations into Latin (by Cicero, Ovid, Germanicus, and Avienus), as well as a translation into Arabic.

[735] E.g. Eudoxus' model did not take into account the inequality of seasons and was incapable of accommodating the variations in the length and shapes of the retrograde arcs (Lloyd 1979: 179). See also Evans & Carman 2014 for the role of mechanics in its emergence and development.

[736] For a short description of the epicycles see Neugebauer 1969: 149-50, for Apollonius of Perga ibid, 262-73. The models are basically equivalent.

astronomy.[737]

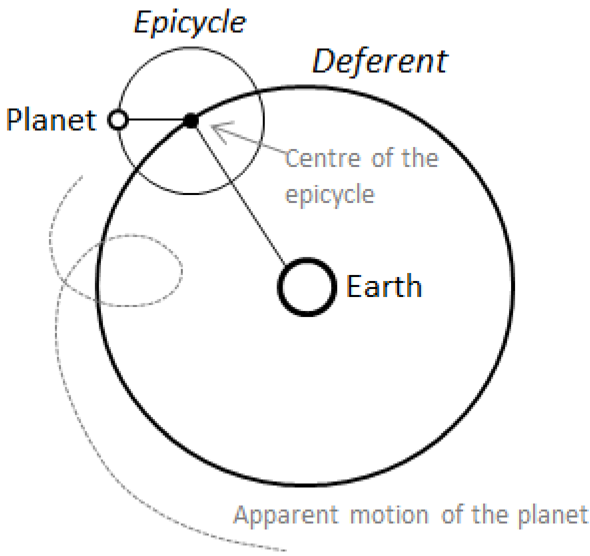

Figure 6: Epicycle movement of a planet

However, the progress of this theory, or the natural sciences in general, did not occur in a contextual vacuum and contemporary intellectual trends would also come to influence the development of astronomical theory, including dictating what new material would be needed to take the next step. Greek analytical thought had continued to mature over the centuries, growing more and more distinct from the Mesopotamian allegedly religious-esoteric world-view. Burkert offers a summary:

> That which had emerged as everyday activity and bold speculation in the 6th century, was discussed, sifted, and gradually brought into a logical system. In the process, natural philosophy drifted into a dilemma between eclecticism and scepticism… In discussing Being, Parmenides discovered the independence of thought; and deductive mathematics as well as logic took rise from this beginning; from the point of view of the development of thought, ontology is prior to the formal schematism.[738]

The importance of Parmenides (c. 540-480 BC) in this process is instrumental: due to the second-order problems raised in his work, anybody interested in putting forward a physical or cosmological doctrine had from then on first to consider

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[737] Jones 2003: 331.

[738] Burkert 1972: 424-6.

> … certain preliminary, but fundamental, philosophical issues. He could no longer take common sense for granted, but had to give an account both of the foundations of knowledge (the problem of epistemology) and of the nature of change and coming-to-be.[739]

The ensuing epistemological debate gave preference to reason over perception, to the extent that the prevailing mind-set became fixated on proof and not just obtaining seemingly correct results. Lloyd has emphasised the role played in this process by the local political situation: whereas the constitutional systems of the Near East remained generally static, many of the Greek city-states experienced several constitutional changes which culminated in the introduction of democracy – 'an exceptional political situation' in its contemporary world.[740] However, he rightly finds that is not democracy as a form of government itself but the very peculiar form it took in Greece that favoured the growth of rhetoric and argumentation skills through open debates.[741]

So the seeds of the axiomatic principle that came to shape the face of all subsequent Greek scientific speculation were sown by the local philosophical tradition. Although a comprehensive axiomatic-deductive theory was available for example in Aristotle's *Logic* from the mid-4th cent. BC onwards and the method had indeed been applied to mathematical and other similar fields before, it was only around the turn of the 3rd cent. BC that Euclid came to provide a defining practical ideal model for its use (ch. 5.4.2).[742] The theory and practice of demonstration were of key importance not only to the subsequent development of Greek practical astronomy but also to the way foreign knowledge would be applied within it. Perhaps most importantly, however, it determined to a great extent the kind of knowledge that would be used.[743] The realisation that the accuracy of astronomical models can be

[739] Lloyd 1970: 36.

[740] For the political situation and the origins of democracy in Greek polis society see Raaflaub 2004b and Raaflaub, Ober & Wallace 2007.

[741] Lloyd 1979: 59-125, 240-64; 1987: 78-103.

[742] For the influence of this on other fields of scientific inquiry see Lloyd 1979: 118-22.

[743] Cf. the prediction of the phenomena. Leaving aside astrology, Bowen (2002) has tried to determine when and why the Greeks first felt the need to be able to give accurate predictions for the eclipses. Apart from the one allegedly made by Thales (n. 692), the earliest datable prediction was reportedly made by Ser. Sulpicius Gallus in the eve of the battle of Pydna in 167 BC. The story, related in one version or another by Plutarch (*Aem.* 17.7-12), Cicero (*Rep.* 1.23-4), Livy (44.37.5-9), Pliny (*NH* 2.53), Valerius Maximus (8.11.1), Quintilian (*Inst.* 1.10.46-8), and Iulius Frontinus (*Strat.* 1.12.1.8), is in all likelihood fictitious; Bowen (2002; 76-111) has shown that all accounts of Gallus and the eclipse episode hark back to Cicero's fabricated conversation between Tubero and Scipio in *De re Publica* and through him to Polybius (9.19.1-4, 39.16). Read in their proper literary contexts it appears that the emergence of the Gallus-motif is related to the belief that a successful army general should be able to relieve the fear of his troops induced by superstitions related to the eclipses by

demonstrated by observing the period relations of its constituent elements meant that these relations took precedence in the borrowed material. So the misnamed Saros cycle, used to predict possible eclipses, was known to Greek astronomers at least by the time of Aristarchus of Samos (c. 310-230 BC),[744] the first astronomer to put forward a heliocentric theory.[745] The cycle specifies the number of times the Moon returns to its closest position to the earth together with the number of times it reaches a conjunction with the Sun, i.e.:

223 *synodic months* = 239 *anomalistic months*

The values differ by about two days. Whereas the real length of the latter was thought to be constant, the length of the real value of the *synodic month* fluctuates quite significantly due to the variation in the Moon's speed.[746]

In Greek tradition the values were tripled[747] and the relation named *exeligmos*:[748]

669 syn. m. = 717 anom. m. = 726 drac. m. = 19 756 days = 723 longitudinal revolutions + 32°

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having basic expertise in astronomy and geometry, or at least employ people with necessary expertise (on Gallus see also Cicero *Off.* 1.19, and *Sen* 14.49). So, although there were means to predict eclipses with considerable accuracy known to Greeks at least by the 3rd cent. BC, the idea that foretelling them was the proper task of the astronomers only explicitly appears in the middle of the 1st cent. AD in Pliny (*NH* 2.24) in relation to Hipparchus. However, the Antikythera mechanism (see p. 137 immediately below), which allowed for the prediction of eclipses, shows that a 2nd cent. BC date for this development is indeed realistic.

[744] The sidereal year length $365\ {}^{1}/_{4} + {}^{1}/_{1623}$ that underlies the Saros and *exeligmos* cycles is ascribed to Aristarchus by ms D of Censorinus. That the transmission of the Saros cycle took place fairly early is also hinted by Ptolemy (*Alm.* 4.2) who says that it was known to astronomers more ancient than Hipparchus. Huxley (1964: 124) speculates that as no other astronomer is connected to he specific year-length, the introduction of the *exeligmos* could be attributed to Aristarchus himself. Cf. different, unexplained, year-lengths given for Aristarchus in Vettius Valens and a related text (n. 788). For a short overview of the use of the Saros cycle in Babylonia see Britton 1993: 64-6, and refs. in n. 692 above.

[745] Archim. *Aren.* 4-6; Plutarch, *De facie* 932a = SVF 1.500; Diog. Laert. 7.174 = SVF 1.481. For reasons why many still preferred a geocentric model (e.g. Pliny 2.69) see Lloyd 1975: 214-5.

[746] See n. 516.

[747] The tripled value gives an advantage of whole number of days (see n. 757). While the Saros cycle merely determines the oppositions of the sun and moon, i.e. the condition under which lunar eclipses become possible, these conjunctions always happen 8 hours later than the last observed eclipse of the cycle. This means that the next eclipse might not be observable due to its happening during the day. *Exeligmos* eliminates this problem.

[748] Ptol. *Alm.* 4.2, Gem. 18.3, 18.6. For the explanation of various months and terms see the glossary. Although the *exeligmos* is not explicitly associated with Chaldea by either author, the latter does so with the mean daily motion derived from it (see p. 146-7 below) and the rest of chapter 18 concerns the application of the *exeligmos* to Babylonian lunar theory, the values of which are the same as the ACT 190-196 values (below).

The way these cycles were translated into a Greek geocentric system is demonstrated by one of the most fascinating finds in the history of technology: both Saros and *exeligmos* are used in the so-called 'Antikythera mechanism', a mechanical *sphaira* of astonishing technical complexity discovered in 1901 in a Roman shipwreck near the Greek island of Antikythera.[749] The device, dating to between 150 and 100 BC,[750] allows calculations based on the cycles of solar system by an intricate system of gear trains that move a number of displays. The front includes two concentric circles for the zodiac (inner, 360°) and the Egyptian calendar (outer, 365 days[751]), flanked above and below by a *parapēgma*-style list of star risings. The display included revolving pointers for the sun and the moon, and as has now been recognised, also for the five planets, showing their position in the zodiac at any calendar date. The respective planets were identified by 'little spheres', i.e. probably symbolic stones, arranged from the centre in the order of their distance from the earth.[752] Thus they created an arrangement highly reminiscent of the Aristotelian cosmos of nests of geocentric spheres.[753] The sophisticated gearing system for the planets allows for the stationary points and was based in all likelihood on Babylonian period relations.[754]

On the other side of the machine the upper back dial is divided in spiral formation into the 235 months of the Metonic cycle.[755] The lower dial, a four-turn spiral of 223 divisions, supplemented by a

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[749] Important technical investigations have been undertaken as part of the Antikythera Mechanism Research Project which has led to new discoveries of immense importance (see www.antikythera-mechanism.gr). The device is broken into 82 fragments (A-G, 1-75).

[750] Freeth et al. 2006: 578.

[751] This circle was movable so that the additional fraction of the year could be taken into account (Freeth & Jones 2012: 1.4.1).

[752] The evidence for the inclusion of planets comes from the inscription in the back inner side of the back cover that gave an inventory and the purpose of every dial included on the mechanism (Freeth & Jones 2012: 1.6, 2.3.1-2 & 3.1.1). *P.Wash.Univ.inv.* 181-221 provides an example of a possible distribution of stones (Saturn – obsidian, Mars – reddish onyx, Venus – lapis lazuli, Mercury – turquoise, Jupiter – white crystal).

[753] Freeth & Jones 2012: 1.5.

[754] Different reconstructions of the now lost gearing trains are proposed in Evans, Carman & Thorndike 2010: 22-32 & 2012 and Freeth & Jones 2012, but both groups agree that Babylonian period relations played an important role.

[755] The month-names on this dial are of Corinthian heritage, suggesting Syracuse or any of the Corinthian colonies (as opposed to the previous supposition of Rhodes) as a possible place of origin; a connection with Archimedes (c. 287-212 BC) has been therefore been proposed (Freeth et al. 2008: 614-6). Inside the Metonic dial was a little subsidiary dial for Olympiads (not for the Calliptic cycle as previous thought), indicating that the mechanism was probably meant for the public (perhaps as a wonder) and not so much for scientific use (Freeth et al. 2008: 616).

little dial for the *exeligmos*, allows the prediction of lunar and solar eclipses.[756] The glyphs inside the divisions indicate the nature and time of the eclipse.[757] So the Antikythera mechanism made ample use of Babylonian periodic relations, although it included Greek innovations and refinements; but it was distinctively Greek in its geocentric layout.[758]

3.4.1 Hipparchus (c.190-120 BC)

A number of other Babylonian period relations appear in the work of Hipparchus,[759] who forms the key case study of this chapter, for several reasons. Hipparchus' debt to Babylonian methods has been acknowledged for over a century. We have seen how Babylonian influences trickled though before him, but as Toomer insists, these cases were isolated, 'restricted to the use of simple period relations (Meton and Aristarchus) or of classification and perhaps iconography and nomenclature (Eudoxus) and it is only in Hipparchus that we see a more complex and systematic exploitation of the resources of Babylonian astronomers… extensive observations and, most notably, mathematical methods.'[760] And moreover, as we have just shown, by his 2nd cent. BC date Greek scientific thinking and astronomy had acquired most of its characteristic features, and the technical side of any further

[756] The exact generation of the glyph times remains a little obscure (Freeth et al. 2008: 616).

[757] The *exeligmos* dial allows the addition of 8 or 16 hours to the time indicated in the glyph, to arrive at a precise hour when the eclipse was supposed to take place (Freeth et al. 2008: 616, see n. 747 above for an explanation).

[758] E.g. Hipparchus' theory of the Moon's first anomaly (Freeth et al. 2006: 590-1), although it has more recently been suggested by Evans, Carman & Thorndike (2010: 33-5) that evidence for Hipparchus' role is mixed. The latter also do not agree with the epicyclic gearing proposed by some members of the Antikythera Mechanism Research Project and propose that the mechanism might reflect an earlier stage in the development of Greek astronomy, one in which 'geometrical models and Babylonian arithmetical methods were still in the beginning stages of the process of integration' (2010: 35).

[759] Born in Nicaea (Bithynia) and worked at Rhodes. On the misunderstanding that he worked also in Alexandria see Toomer 1978: 208, 221 n.5. He is considered the founder of trigonometry, the discoverer of the precession of the equinoxes, and a constructor of solar and lunar theories. In addition, he established the distances and sizes of the sun and the moon, studied and predicted eclipses etc. An accessible overview of Hipparchus' astronomical investigations can be found at Toomer 1978: 207-19. One of his key contributions is also the development of the idea that the positions of the stars can be fixed by reference to celestial meridians. Although Aristyllus and Timocharis are said to have recorded a few declinations earlier, a systematic arrangement seems to come down to Hipparchus. His use of technical terminology in these matters was primitive and not consistent (Neugebauer 1975: 278), indicating that the system with which he worked was still relatively new and unsettled. However, the idea of declination circles is inherent in BM 78161, which may reflect a Babylonian origin of the use of the same circles to determine the coordinates of the fixed stars (Pingree & Walker 1988: 318).

[760] Toomer 1988: 354, an opinion also expressed by Jones 1991: 442.

study had become complex enough to exclude with certainty coincidence as an alternative to borrowing. The influence of Euclid and the new axiomatic-deductive method on astronomy moved the field away from mere speculation about the structure of the universe towards mechanical proof that the proposed ideas were indeed correct. In other words, he was the first to apply numerical parameters to the proposed models and criticised and in some cases corrected the latter accordingly.[761] Although Aaboe has suggested that Hipparchus 'got the idea of the possibility and desirability of a qualitative description of astronomical phenomena that could yield fine numerical predictions' from Babylonia,[762] it is rather more likely that he was able to adopt the Babylonian idea only because Greek astronomy had first developed an innate need for it.

But first of all, Hipparchus' use of sophisticated Babylonian material was accommodated by the previous incorporation of basic Babylonian astronomical vocabulary and concepts into the Greek repertoire. His astronomy relied heavily on sexagesimal arithmetic and the degree measure (celestial co-ordinates). Both have undeniable Babylonian origins and, as far as we know, first appear in their traditional format in Greece in the *Anaphorikos*[763] of Hypsicles of Alexandria,[764] a treatise on the rising-times of constellations. Because the earth's axis is tilted, the time it takes for constellations to rise and set is not constant;[765] the sign or degree rising over the eastern horizon, however, is of key concern to astrology (its importance will become more evident later). Ancient astronomers connected the rising times of arcs with the length of daylight at the latitude in question,[766] so Hypsicles' approximations of the rising-times are first of all based on the assumption that the daylight scheme for Lower Egypt follows the 7:5[767] pattern (cf. 2:1 and 3:2 in Mesopotamia above)

[761] Toomer 1978: 211-3, see this also for his solar and lunar theories.

[762] Aaboe 1974: 41, a view supported by Toomer 1988: 361 and Jones 1991: 444.

[763] German trans. from Greek and Arabic versions in De Falco, Krause & Neugebauer 1966.

[764] *Anaph.* 55-59, μοῖ ραι χρονικαί. Hypsicles has been dated to c. 175 BC on the grounds of his introduction of Euclid *Elements* 14 (Folkerts, s.v. 'Hypsicles' in BNP). Jones (1991: 442 n. 5) thinks he probably wrote a generation or so later than Apollonius, which makes him roughly contemporary with, though perhaps slightly older than, Hipparchus.

[765] The closer to the pole one is the greater the difference. E.g. at 60° N 30°E Pisces and Aries cross the horizon in 30 minutes, whereas Leo, Scorpion, Libra and Virgo take 3h 15min each. At 47°N 2°E the time difference is considerably smaller: 55 min. and 2h 45min. respectively.

[766] Based on the belief that 6 signs (or 180°) always cross the horizon, i.e. rise and set, in one day/night (Gem. 7.12).

[767] See n. 1054 for possible earlier attestation. Also used in P. Hibeh 27 (c. 300 BC, for more see p. 124 above) in which the constant change of daylight is estimated as 1/45 of an hour (Grenfell & Hunt 1906: 140, 144). Cf. India, where an unaltered set of Babylonian rising times of System A were in use until the 6th cent. AD, without

and, secondly, that the signs rise and set in an arithmetical progression.[768] To find the values he makes use of the linear peak functions, the very same known from the Babylonian ephemerides.[769] The resulting table of ascensions is based on and allows the calculation of day-length and the horoscopic point.

This adaptation highlights a number of key concerns: its extraction from its original context in the syzygy tables where it formed a part of a significantly more complex lunar scheme but where the horoscopic point appears to have been of no importance; the interpretation of this scheme from a geometrical viewpoint; and the route of its transmission to Hypsicles. Jones argues that

> its extension to other latitudinal belts, was motivated, and indeed only made possible, by a reinterpretation of what this scheme meant – a reinterpretation, moreover, so natural to anyone trained to think in terms of the geometry of the celestial sphere that it may have been unconscious.[770]

Vettius Valens remarks how the 'rising times of the signs in the *Tables of Rising Times* of Hypsicles are in error if the period <in question> amounts to one or two years… but the King has revealed the rising times only for the first klima', i.e. Lower Egypt in the astrological tradition.[771] Roman sources also associate Hipparchus with the creation of these tables and a horoscope mentions the 'table of ascensions for the first hour of the day from the compilation of Hipparchus.'[772] Pappus records that Hipparchus used 'arithmetical methods' to demonstrate 'the oblique ascensions with respect to the

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any consideration for its more southern position (Neugebauer 1975: 371).

[768] It follows the assumption that the change in the rising times is a constant d, i.e. $sign_2 = sign_1 + d$; $sign_3 = sign_2 + d$ etc. whereas for symmetry $sign_6 = sign_7$; $sign_5 = sign_8$ etc. Hence the length of the longest daylight (e.g. in Alexandria 14h) is $sign_4 + \ldots + sign_9 = 6 * sign_1 + 24d$ and the minimum is $6 * sign_1 + 6d$. Cf. the same principle (System B) used in Manilius 3.443-82, for Rome where $sign_1 = 9h$ and $d = {}^{1}/_{2}$. For a longer overview of the arithmetical progression used in the construction of the ascension tables see Evans & Berggren 2006: 73-82.

[769] Hypsicles follows system A (Evans & Berggren 2006: 74-79. See n. 869 for possible transmission.

[770] Jones 1996: 151. That the day/night depends on the location of the earth is easy to observe and was definitely long known. The doctrine of *climata*, however, presupposes a belief that these times vary because the earth is spherical.

[771] Vett. Val. 3.15K/13P. The *climata* are basically latitudinal belts of earth determined by rising times, see Neugebauer & van Hoesen 1959: 3-5 for a thorough explanation of the term. Differentiation is made between geographical and astrological *climata* (the development of the concepts has been debated, see e.g. Dicks 1955) but in this context it refers to the latter and the calculation of the ascension tables.

[772] Strabo 2.1.18, 2.5.43; Oxy. 4276.

equinoxes' and speaks of the length of ecliptic arcs for different geographical regions.[773] A possible transmission route for this scheme will be discussed below in connection with its relevance for astrology.

The sexagesimal system of numbers and degrees, on the other hand, was in general lines known and used up to a century before Hypsicles: Strabo refers to Eratosthenes (c. 276-195 BC) dividing the equator of the earth into sixty intervals[774] and the 360° circle is implied by Aristarchus.[775] Moreover, in an inscription from Rhodes[776] the circle is divided not only into 360° but also into 9720 στιγμαί.[777]

This inscription is of further interest, as it points towards the changed nature of the degree. The degrees as they are used in Babylonia can hardly be interpreted as degrees of the arc: the ÚŠ must rather be considered as a purely arithmetical unit of time. Although the planetary table on the Rhodes inscription is about time, it is followed by a metrological line about the measurement of angles of arcs. The expression of fractional period as 360ths within the table also hints that 'the various planetary periods are conceived of as effected by circular revolutions.'[778] Hence, only when transferred to Greek astronomy is the geometrical value given to the degrees.[779] Such an interpretation could have been instant, and much like the application of a daylight scheme to a oblique ascensions, almost unconscious. Moreover, the degree is not the only measure taken from Babylonia and applied to angles. The same goes for cubit (KÙŠ = *ammatu,* Gr. πήχεις) and its subdivision into fingers (ŠU.SI = *ubānu,* Gr. δάκτυλοι), both of which occur as angular measurements

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[773] Pappus 4.55,109-13 (= Hultsch 1876-1878: 600). For discussion see Neugebauer 1975: 301, 304-6.

[774] Strabo 2.5.7. See Neugebauer 1975: 590 n.2 and n.6-8 for the use of the same norm and problems with Timocharis as a possibly earlier source. For a discussion of the earliest occurences of degrees in Greece see Bowen & Goldstein 1991: 246-8.

[775] Neugebauer 1975: 590 ('less than a quadrant by one-thirtieth of a quadrant', i.e. 87°).

[776] *IG* 12.1 no. 913 (also known as the 'Keskinto(s) Inscription'). For the latest publication see Jones 2006a, for analyses Jones 2006b. The date of the inscription is uncertain. Neugebauer (1975: 590) suggested it is earlier than Hypsicles, Jones (2006a: 105) does not reject Hiller's opinion of any time between 150 and 50 BC but based on the content holds a date around a generation after Hipparchus to be more likely. The inscription might have accompanied a visual representation of the cosmos or even a mobile device (Jones 2006a: 108). It records planetary motions associated with the planets (e.g. longitudinal, latitudinal and synodic periods) and also the period of the so-called 'Great Year' as 291,400 solar years (for a detailed study of the idea itself see Callatay 1996) and Jones (2006a: 107) says this value, not attested anywhere else, is derived by conversion into solar years of 291,600 Egyptian calendar years of 365 days.

[777] Neugebauer (1975: 590) thought it was 720 but Jones's (2006a & b) recent re-examination proves that the number should be 9720, which is one thirtieth of 291,600, the Egyptian 'Great Year'.

[778] Jones 2006a: 107.

[779] Swerdlow 1998: 35-7.

in Hipparchus and other sources.[780] In cuneiform tradition the pre-Hellenistic value for one cubit was 30 fingers or 2.5°, during the Hellenistic period this changed to 24 fingers and 2°; in both cases: 12 fingers = 1°. Of interest in our context is that an incorrect evaluation of δάκτυλοι forms the basis of the norm for the 'digits' used for measuring eclipse magnitudes; Neugebauer remarks that the δάκτυλοι are by then completely detached from the distance measurements for which they were first used.[781] Furthermore, P.Oslo 73 (1st or 2nd cent. AD) shows that the Greeks had successfully incorporated other Babylonian units such as the 'barley-corn' into their metrological system. It is remarkable that although Greek astronomers worked with the sexagesimal system they never developed a strictly sexagesimal notation.[782]

So it appears evident that the prerequisites of Hipparchus' theory, ultimately deriving from Mesopotamia, had been introduced to Greece slightly before his time. Their incorporation into local astronomical practice allowed Hipparchus to start utilising more complex Babylonian material. Hipparchus' own theory centred on the development of lunar and solar models.[783] In so doing he made use of a number of values for the length of the month and the year[784] known to Babylonians. Kugler determined back in 1900 that Hipparchus' value

mean synodic month = 29; 31, 50, 8, 20

and its ratio to the anomalistic and draconic months

251 *synodic months* = 269 *anomalistic months*; 5458 *synodic months* = 5923 *draconic months*[785]

which is a more accurate approximation than the 223 syn. m. = 239 anom. m. of the Saros cycle,

[780] See Neugebauer 1975: 591-2 for a list.

[781] Neugebauer 1975: 592. According to Williams (2008: 313) there is some evidence, not in the omens themselves but in the letters and commentaries, that it was used in this capacity in Mesopotamia too, but she gives no references to validate this claim.

[782] Neugebauer 1975: 591. E.g. Ptolemy would write 125;15° instead of the properly sexagesimal 2,5;15° (see appendix 2) and later authors sometimes use a mixed notation with unit fractions.

[783] Whereas he failed to solve the planetary problem, see Aaboe 1974: 37-40 for an overview. Ptolemy (*Alm.* 9.2) says that as far as he knows, Hipparchus only made compilations of planetary observations 'arranged in a more useful way' (i.e. translated into the Egyptian calendar (Toomer 1984: 421 n.11)).

[784] Hipparchus wrote a whole book on the length of synodic month (Galen, *On Epidemics* 17.1 p. 23, 13 Kühn), although it is probably the same work as *On intercalary Months and Days*. A separate treatise was written on the dragonitic month (*On the monthly motion of the Moon in latitude*) (Neugebauer 1975: 308-9).

[785] Ptol. *Alm.* 4.2. Ptolemy's explanation for its retrieval, however, is unlikely (Boiy 2004: 308 and also see p. 146-7 below).

were taken from Babylonian System B.[786] Since then, Aaboe and Toomer among others have shown that many more parameters and aspects of his astronomy had Babylonian origins:[787] the standard System B year-length,[788] equivalent to shortfall of roughly 7.5 degrees in 4267 months, was definitely known to him, as was probably the sidereal year of 365;12,25 days,[789] and the planetary periods attested in the goal-year texts (table 5).[790] In addition, he adopted the value for a tropical year[791] that was reached by the combination of the 19-year cycle and with the System B month length.[792]

Hipparchus' reliance on Babylonian parameters is not surprising: unable to draw such information from any local sources he would have otherwise had to 'invent new ways of dealing with subsidiary problems that were only incidental to the topics of his researches.'[793] However, Jones has shown how Hipparchus first checked and proved the borrowed period relations with the help of the also borrowed eclipse data.[794] Naturally, the data was also adjusted to fit the local calendar and the locations of the solstices and equinoxes were moved from the System B 8° to the beginning of the sign.[795]

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[786] Kugler 1900: 21-53.

[787] See Aaboe 1955 and 1974, Toomer 1988. The value of the synodic months is still in use in the 11th cent. AD Toledan Tables.

[788] On the year-lengths there are two related tables (CCAG 5.2,127, 17-19 = Vett. Val. 9.11; and Vat. Gr. 381 fol. 163, published Maass 1892: 140) which give values by Chaldeans and Babylonians and Babylonians and Sudines respectively. Neugebauer (1975: 601-2) claims that they are corrupt; no such values are known from other sources. But he does not rule out that they might have been known to Valens and see the next note.

[789] $= 365\ {}^{1}/_{4}\ {}^{1}/_{144}$. The exact value attributed to Hipparchus is actually $365\ {}^{1}/_{4}\ {}^{1}/_{288}$ but this is reached by an extra doubling of the last denominator. The difference would amount to 5 minutes but the doubling is probably insignificant. $365\ {}^{1}/_{4}\ {}^{1}/_{144}$ is given by Valens as a value used by the 'Babylonians' (see n. 788). Although no known cuneiform sources are known to use this value, in the light of how little we know of Babylonian solar theory, the possibility that it was Babylonian cannot be ruled out (Neugebauer 1975: 293).

[790] Ptol. *Alm.* 9.3.

[791] $365\ {}^{1}/_{4} - {}^{1}/_{300} = 365;14,48$.

[792] Also used in U 107+124, see Neugebauer 1947b: 146-7.

[793] Jones 1991: 452-3.

[794] Ptol., *Alm.* 6.9.

[795] Hipparchus says in his commentary to Aratus (132, 7 Manitius) that he follows 'most of the old mathematicians' in doing so. Both 8° and 10° equinoctial points were well known to Greeks and Romans. Although already Meton and Eudoxus are credited by Columella (*On Agri.* 9.14.12) with the knowledge of the 8° point, these claims merit caution. Eudoxus put the solstitial and equinoctial points in the middle of the zodiacal constellation, Aratus put them at the beginning. Doing that, Eudoxus seems to have followed the Mesopotamian tradition as evident from the MUL.APIN. The beginning of the signs as cardinal points seems to be a genuinely Greek norm, possibly used by Euctemon, Callippus and underlying the era of Dionysius but not

However, Hipparchus borrowed more than just parameters. He did not have at his disposal the refined tools of spherical trigonometry that would have permitted the calculation of satisfactory numerical values for past, present and future planetary positions.[796] We have already seen how Hipparchus made use of the same linear functions to construct a table of ascensions as Hypsicles had done probably before him,[797] but to what extent he was really dependent on Babylonian arithmetical methods has recently come into clearer focus. Hipparchus' debt to Babylonian astronomy extends to a reliance on predictive schemes that were not derived from his supposed theoretical models.[798] Jones suspects that Hipparchus rarely disclosed the methods through which he acquired certain results, which in turn implies that he could have used arithmetical schemes as ready-made methods to find solar and lunar longitudes.[799] A striking case is his highly probable use of a lunar scheme, which can be seen when Ptolemy, speaking of Hipparchus' observation of the Moon's position, cites him directly: ''the speed was 241' he says'.[800] The '241' refers to day 241 in a scheme that accounted for the longitudinal progress of the Moon over a 248-day, or 9-month (anomalistic), period, a scheme that undoubtedly hails from Babylonia and for which enough evidence survives in the papyri to allow a full reconstruction.[801]

The characteristic linear zigzag function used to account for the Moon's fluctuating velocity is

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attested in any Babylonian source (Neugebauer 1975: 600). However, in the later period the 8° norm is widely used again especially in the astrological literature. Manilius, although showing knowledge of the Babyonian values, still chooses to use the first degree; Valens, allegedly following Sudines and Cidenas, opts for 8°, as do Thrasyllus, Geminus, pseudo-Manetho, Firmicus Maternus and others. Of literary authors, Pliny, Columella, Varro and Vitruvius talk of the 8° tradition, also showing that Romans were well aware of its Chaldean origins. See Neugebauer 1975: 594-600 for precise references.

[796] Hipparchus developed trigonometry (see Toomer 1973 for his chord tables and 1978: 208-9 for a shorter overview of his methods) that helped to determine the position of the heavenly bodies using geometrical models but there is no evidence for the existence of the application of trigonometry to the spheres before Menelaus (1st cent. AD). This does not imply that Hipparchus did not make use of geometrical methods at all: for his use of chords and *analemma* see Neugebauer 1975: 299-303 and Toomer 1978: 201-11.

[797] P. 140-2 above.

[798] Jones 1991: 448.

[799] Jones 1991: 447-9.

[800] Ptol. *Alm.* 5.3.

[801] For the reconstructed Standard Lunar Scheme table see Jones 1999: 323-43. Astronomical texts making use of it include Oxy. 4136 (which has horoscopes, Oxy. 4241, on the reverse), a procedure text for the moon that tells how to lunar motion in the templates using the zigzag function (see Jones 1997a: 11-18). Epoch tables with the lunar scheme: Oxy. 4149-4151, P. Lund. inv. 35a, templates: Oxy. 4164, 4164a and 4150, P.S.I. XV 1493, P. Carlsberg 726. A demotic version P. Carlsberg 638 (ed. Hoffmann 2006/2007: 10-17, date Jones 2006/2007: 17-20).

manifest in the Seleucid tablet ACT 190,[802] which gives a value for the change in the Moon's speed for every day over a period of 248 days, with a constant decrement of 18 minutes.[803] This allows us to generate a lunar longitude for any day in the future or the past, provided one knows when and where the lunar cycle began (such texts will be explained more fully in the next chapter).[804] The 248-day scheme is characterised by the following parameters in ACT 190-196, the values in System B to which the former are clearly related, [805] the corresponding arrangement in the Indian *Pancasiddhāntikā*, and in two texts from Roman Egypt:

Parameter	**System B**	**ACT 190-196**	***Pancasid.***	**P.S.I 1493**	**Oxy. 4136**
linear change in the daily progress of the Moon's longitude	0;36,0	0;18,0	≈0;12,51,52	0;12,50	0;12,50
maximum daily progress	15;16,5	15;14,35	≈14;39,8,34	14;38,59,18,37	*not given*
minimum daily progress	11;5,5	11;6,35	11;42	11;42,10,25,17	11;42,10,37
mean daily progress	13;10,35	13;10,35	13;10,34,17	13;10,34,51,57	13;10,34,52

Table 8: Parameters of the lunar cycle

The material in the *Pancasiddhāntikā* is closely related to both cuneiform schemes and those in the papyri.[806] Judging on the linguistic grounds, the transmission of Babylonian astronomical ideas to

[802] ACT 190 is connected with ACT 191-196 which all involve the same scheme, though some differ in arrangement and variables. Nos 191-194 date to the 2nd cent. BC, 194a from the 1st cent. BC; no date can be assigned to the others. Nos 194a & b and 196 come from Babylon, the rest from Uruk (Jones 1983: 6-9).

[803] Jones 1983: 2-6. A change is inserted in every 14 days, i.e. the value for daily motion increases by 18 minutes for 14 days after which it is adjusted to allow for the in reality non-linear increase, and then decreases by 18 minutes a day for the next 14 days, followed by an adjustment and another increase, all this between the maximum of 15;14,35 and minimum of 11;6,35 degrees.

[804] Templates can be used for several years before the approximations inherent in them will lead to intolerable error (Jones 1983: 6).

[805] For system B values Kugler 1900: 16-20. In Neugebauer (1955: 76-7 & 1975: 480) they are designated as F (System B; the column on the lunar ephemerides concerning the velocity of the moon in degrees per day) and F*.

[806] Jones 1983: 23 finds that there is no fundamental difference between the two methods, also see

India must have happened through Hellenistic Greece. Neugebauer has noted that 'much of the Hellenistic material in Hindu astronomy reflects the situation of astronomical knowledge in the time of Hipparchus' and that the Babylonian components in it can be taken as evidence for a corresponding influence of Hellenistic astronomy.[807] Hence there is potential indirect evidence for wider knowledge of Babylonian techniques in the Greek-speaking world than we are able to gather from the meagre surviving local sources. The velocity schemes in question for instance, are much more extensively attested and used in India.[808] In the *Pancasiddhāntikā* then the procedure for finding the lunar longitude is converted into a direct quadratic function of time that avoids the compilation of long auxiliary tables.[809] Yet, in Jones's opinion, the Indian way is a ''simplification' of the parameters rather than an attempt to improve them.'[810]

The tables were, however, present in Roman Egypt;[811] P.S.I 1493, the parameters of which are given in the table, is a case in point. Although the zigzag scheme in it does not follow the linear pattern of ACT 190, the underlying model is the same. A link between the Babylonian prototype and this more refined Standard Lunar Scheme is found on a template from Tebtunis, which uses the Babylonian values.[812] Literary evidence from Geminus confirms that the ACT 190-196 values were well known to the Greeks and, moreover, that these were explicitly associated with the Chaldeans.[813]

In his discussion of the application of the *exeligmos* (above) to the Babylonia lunar theory Geminus relates that the Chaldeans on the basis of this relation made the mean velocity of the moon 13;10,35° and the length of the anomalistic month 27;33,20 days. However, the second calculation in particular is inaccurate and involves a fair amount of rounding, implying that he applied a fictitious

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Neugebauer 1975: 817-9 for the Tamil methods.

[807] Neugebauer 1963: 532; 1969: 158-60, 165-9, also see 1975: 299-300 on trigonometry and Neugebauer & Pingree 1970-1971: 1.41-2, 85 on *analemma*, Jones 1993: 83 on planetary motions.

[808] Jones 1991: 451.

[809] Jones 1983: 11-14, 23.

[810] Jones 1983: 23.

[811] See n. 801 above for references.

[812] P. Fay. ined. G^{C}36 (2), ed. Jones 2001: 217-20, and 218-9 for a reconstructed table of the resulting scheme. The template starts, following Geminus, with the minimum value of 11;6,35 instead of the slightly higher 11;7,10 that begins its cuneiform models. Also Oxy. 4175, an almanac-ephemeris from 24 BC, whose results for the moon are not in accordance with the Standard scheme but that could have used the function of ACT 190-196 instead (Jones 1999: 177-8).

[813] Geminus 18.4-19. For discussion on book 18 see Bowen & Goldstein 1996.

derivation to a value that was predetermined.[814] In the concluding discussion, the minimum and maximum for daily velocity are given as 11;6,35 and 15;14,35 degrees per day respectively, with a daily difference of 0;18, although his methods of arriving at these values are again both historically and arithmetically incorrect.[815] The same phenomenon appears in Ptolemy's *Almagest,* when he tries (mistakenly) to explain Hipparchus' System B-derived value for the synodic month.[816]

Geminus is the earliest extant authority to exhibit detailed knowledge of Babylonian planetary theory. Moreover, he mentions a 2-degree eclipse zone which also comes from Babylonia - his knowledge of Babylonian astrology will be dealt with later.[817] But all this leads to the question of the source of his knowledge. Evans and Berggren argue that Geminus' material 'consists largely of notions that were the common property of all astronomers.'[818] The 'tables of the Moon' that Valens used were probably the kind of tables under consideration here[819] and as has been mentioned in a number of times by now, the compilation of these was assigned to none other than Sudines and Cidenas, with an additional remark that Apollonius[820] too constructed such charts but was off, by his own reckoning, by one or two degrees, and that Valens adds 8° to all his values to keep them in line

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814 *Exeligmos* 669 syn.m = 19756 days = 717 anom.m.= 260312°. So, for the mean velocity according to Geminus, the equation would be 260312°/19756 = 13;10,34,51,55… degrees per day and the month length 19756/717 = 27;33,13,18… days. The latter is actually derived from the relation of 9 anom.m = 248 days that underlies the entire scheme (Neugebauer 1975: 586, esp. n. 56 for a comparand from Ptolemy, 602-3). See Bowen & Goldstein 1996: 173 for the explanation of this phenomenon.

815 Neugebauer 1975: 586-7.

816 Neugebauer 1975: 309-10. Cf. also the same tendency displayed in his astrological writings, p. 222.

817 Evans & Berggren 2006: 15. Geminus' *floruit* in estimated to have been in the 1st cent. BC; Folkerts (s.v. 'Geminus' in *BNP*) gives 70 BC.

818 Evans & Berggren 2006: 13.

819 Valens certainly made use of such tables: 1.4 ('… the motion of the moon in its <204th> day from epoch was 13;52°. I consulted from the table under 14 in the first row and found below in the first column of hours, 16…') and 1.16K/15P ('From the <tables of> lunar epoch and daily motion the ascending node and the sign of its latitude will be as follows: … From the epoch the nativity date is 204. Next to the epoch is entered 12;18 of latitude. Next to 204 is entered 11;37 of latitude. The total is 23;55…') in regard to the lunar scheme and a further reference to its use in 9.19. When he talks of Sudines and Cidenas he says he 'tried to construct a table of the sun and moon using eclipses', which implies that the tables were not eclipse tables *per se* but were based on the period relations that the eclipses imply. He follows this with a quote from the King (i.e. Nechepsos): 'Others have beaten these paths, and because of this I omit mention of them' (9.11K/12P). This clearly implies that the introduction of the tables predates Nechepsos and Petosiris, i.e. the mid-2nd cent. BC, which is consistent with the date of Hipparchus use of the lunar scheme.

820 Probably a scribal error for Apollinarius (Jones 1983: 31, 1990a: 14-7), although Apollonius of Myndos is also a possibility.

with the Babylonian System B in the tables of Sudines and Cidenas.[821]

That Valens' attribution of the authorship of the tables is correct I see no reason to doubt. That Cidenas was associated with the lunar scheme is further shown by that attribution of its underlying period relation of 251 syn. m = 269 anom. m. to him by a commentator of Ptolemy. Some caution as to the actual authorship of the relation is of course warranted – it cannot be ruled out that Greeks, who learned about the lunar scheme through his writings, simply attributed its discovery to Cidenas.[822]

There is every reason to suppose that the transfer of the lunar scheme outside Babylonia first took place in the context of astrology and it was applied to what we call Greek theoretical astronomy only secondarily. This transfer resulted in a number of changes in the scheme, mainly as the result of its translation into a geometrical model - Jones observes that 'the fact that argument of latitude is made to vary anomalistically in the tables is itself significant; this effect was surely deduced theoretically, from consideration of the epicyclic or eccentric lunar models, and has no precedent in Babylonian lunar theory'.[823] The innovations, partly motivated by the need for greater accuracy, include:[824]

a. A fundamental mean lunar motion in longitude 13;10,34,52° per day and latitude of 13;13,45,41,15° (or 0;52,55,2,45 'steps') per day.
b. An anomalistic month of 27;33,16,21 days.

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[821] Valens also uses the simple lunar visibility scheme attested in the MUL.APIN, discussed on p. 100-1. The maximum visibility according to this in day five is given as 12h, the procedure for finding any visibility 'by multiplying the days <since new moon> by 4, then dividing by 5.' I.e. the visibility step is 4/5 of an hour = 48 minutes, 48 min. = 1/15 of 12 hours. The difference is that Valens alleges he used 29 ½ day months, although the table he gives still calculates using 30 days.

[822] See p. 91-2. The ephemerides, the so-called '*teršitu* of Kidinnu' do not use the F* parameters. Whereas ACT 122 (fig. 4) uses the unabbreviated System B F values, 123a uses the abbreviated versions. So the attribution cannot be taken too seriously: an astronomical period relation like this would have been exactly what the Greek expected to have been a 'Chaldean discovery'. Oxy. 4139, though fragmentary, preserves the number 6695 which must refer to a fundamental period relation for lunar anomaly of System A: 6247 synodic months = 6695 anomalistic months (Jones 1999: 97). This is the first explicit attestation of a System A lunar parameter in a Greek text. And the same text preserves]ορχη in line 8, which could possibly be restored as Orchenoi. If the restoration is correct we have them associated with a System A lunar scheme, which from an assyriological point of view must be incorrect. However, the fragmentary state of the text could be misleading here.

[823] Jones 1990a: 16.

[824] Summarised from Jones 1990a: 16.

c. An improved period relation 3031 days = 110 anom. months that allows one to deal with longer periods of time.[825]
d. Zigzag functions for both longitude and latitude that give a max. lunar equations of around 5° 4’ 30’’ which is considerably less than the Babylonian 7° 7’.

However, the question arises as to when and by whom these changes were implemented. Jones has found that they are not attributable to Hipparchus, who probably used a table quite close to the original Babylonian prototype, if not the very same attributed to Cidenas and Sudines. But at some point after him, perhaps gradually, perhaps abruptly, the scheme got ‘translated’ into the Hipparchic system. Fortunately, Valens again gives us a clue as to at least one possible interpolator, Apollonius. However, a similar statement is made by Valens about Apollinarius in another book:

> Note that even Apollinarius, who calculated the visible motions using the old observations and publications of many returns and spheres, and who met with criticism from many readers, confesses that his calculations were one or two degrees in error.[826]

One of the two names must be a scribal error. Apollonius, a well-known astrologer we will talk more of in the next chapter, is an attractive possibility as a user and compiler of such tables but in all likelihood too early to have implemented the changes we can observe in the surviving material. Apollinarius, on the other hand, is attested as an influential 1st-2nd cent. AD ‘modern’ (as opposed to ‘ancient’, i.e. user of arithmetical methods) astronomer by Porphyry and Paul of Alexandria.[827] In Jones’ view this points strongly towards Apollinarius as the compiler of lunar motion tables.[828] However, the more recent publication of a demotic version of the scheme, which Jones himself has dated to AD 13, pushes the date back to the 1st cent. BC, thus casting a shadow on his Apollinarious theory.[829]

3.4.2 Linear Methods of Practical Astronomy

The use of this kind of numerical analysis of the lunar motion by Greek astronomers drastically

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825 E.g. P. Ryl. 27 includes set of parameters for 248, 303, 3031 (11*248+303) and 9093 days.

826 Vett. Val. 6.3K/4P.

827 CCAG 5.4.212 (= Porph. *In Ptol.* 41); Paulus Al. 1 Boer.

828 Jones 1990a: 12-7.

829 See n. 801 above for the reference.

changed the modern view on Babylonian transmission.[830] The understanding of just how much more than an observation record[831] and a few period relations trickled through to (late) Greco-Roman astronomy has grown substantially over the last decades as an increasing number of papyri and ostraca with astronomical contents have been identified and published.[832] A landmark in this area was the publication of the astronomical texts from Oxyrhynchus by Jones in 1999.

Jones observed that some groups of these papyri are analogues with groups of cuneiform texts.[833] While the strictly astrological material will be discussed in the next chapter, for now we turn to the most technical of these texts, the so-called Epoch Tables and Templates, as they represent the clearest and most ingenious adaption of cuneiform astronomical methods. The underlying idea of these tables is essentially the same as with the lunar motion scheme. The Epoch Tables give a sequence of dates and positions (i.e. longitudes) of the planets at a specific stage of its anomalistic period (e.g. first stationary point). As such they are in effect the Hellenistic version of the ACT tables of planetary phases, with dates converted from Babylonian lunar into an Egyptian or Alexandrian solar calendar.[834] In Jones' opinion this was done 'in an economical way that demonstrates understanding of the theory behind the rules on the part of the adaptors.'[835]

The subsequent course of the planet's movement can then be conjectured by counting the days to the immediately preceding epoch date that this table provides, looking up the corresponding day in the Template (i.e. like the 248-day template for the Moon) and adding the given longitudinal value to the one recorded for the epoch date in question.[836] The given change in the longitudinal values to describe the acceleration or deceleration of the planets in the various phases of their movement through the zodiac is sometimes linear, sometimes fixed in steps.[837] So the information on both the Epoch tables and the templates is achieved by using the computational methods that are either

[830] E.g. the realisation expressed in Neugebauer 1988: 301-2.

[831] In particular, the eclipse observations, a canon of solar and lunar eclipses for Babylon for a period between 750 BC to AD 1, has been published by Steele & Stephenson 1997/8.

[832] Especially Jones 1999 is a significant step forward.

[833] Numerical tables, almanacs and horoscopes. Jones 1996: 143; for descriptions of each group Jones 1999: 113-9, 175-7, 249-50. For a list of almanacs not from Oxyrhychus, Neugebauer 1975: 787-8.

[834] 11 out of 15 known tables use Babylonian schemes (A, A' or B) or variants of these (Jones 1999: 114), see table 9 below.

[835] Jones 1999: 114.

[836] Jones 1999: 17-8 & 36-7. Practical example of how this works, see n. 819 above.

[837] Jones 1998: 216-7.

identical to those in the cuneiform sources or slightly modified (examples in tables 9 and 10). We should not find the appearance of these schemes in bulk the least bit surprising. Greek geometrical planetary theory might have been the norm when it came to an underlying model, but it was until Ptolemy's refined methods severely incapable of yielding precise numerical values.

Planet	*Templates*[838]	*Underlying scheme*	*Commentary*
Saturn	Oxy. 4166	A	Jones 1999: 117, 158-60
	P.S.I 1492	cf. ACT 801 & 802	Jones 1984
Jupiter	Oxy. 4165a	A (A')	Jones 1999: 118, 157-8
Mars	Oxy. 4165	A	Jones 1999: 118, 155-7
	P. Berol. 21236	Not known	Neugebauer & Brashear 1976
Mercury	Oxy. 4152-4156c	A + A'[839]	Jones 1999: 114-5, 123-34
	P. Carlsberg 32	Cf. ACT 310[840]	Neugebauer & Parker 1969: 240-1

Table 9: Planetary Templates from Roman Egypt[841]

Planet	*Epoch Table*	*Underlying scheme*	*Commentary*
Saturn	Oxy. 4161	B	Jones 1999: 148-50
Jupiter	Oxy. 4160 (+P. Berol. 16511)	Modified A + non-Baby. material	Brashear & Jones 1999; Britton & Jones 2000
Mars	Oxy. 4158, 4159, 4159a	A	Jones 1999: 137-44
	Oxy. 4160a	B	Jones 1999: 148

838 Also see Dublin Inv. TCD Pap. F.7, which gives daily progress of the planets for Jupiter, Mars, Venus and Mercury during the last days of April, AD 100 (in Jones 1995).

839 Systems A and A' (A_1 and A_2 according to Jones's preferred designation) are used together although this never happens in the surviving cuneiform tablets.

840 = A 3425, a table of Mercury's daily motion. Similar tables for Jupiter ACT 650-655.

841 Tables 9 & 10 do not purport to cover all evidence - they present what I have been able to discover.

	P.Mich.151 + P.Heid.4144	A	Neugebauer 1975: 946-8; Jones 1990b
Mercury	Oxy. 4152-4156c	A, A’	
Venus	Oxy. 4157	Cf. ACT col. Φ	Jones 1999: 135-6.
	Oxy. 4157a	Not Baby.	Jones 1999: 137.

Table 10: Epoch tables from Roman Egypt

On the one hand, Jones’s remark that ‘the fidelity with which the Greco-Egyptian tradition kept these half-a-millennium old technical procedures in working order is... almost as remarkable as the fact of transmission’ is most definitely noteworthy.[842] On the other hand, despite the limited availability of data[843] we can still recognise a twofold trend of further development in the reception of these systems. First is the slight change in format: the templates themselves were an important modification of the complicated Babylonian methods for finding the planetary positions at any given time and as such they represent a step towards a more convenient way of finding the planets locations, one that requires considerably less technical understanding of the underlying processes of the planets’ movements. The Babylonian prototypes that we possess, like ACT 190 discussed in the last chapter, only list the progress that the body, in this case the Moon, makes each day, meaning that the calculation of any desired position involves the addition of all previous days to the initial longitude – a tedious process to say the least, especially if one is looking for the value for day 247. The schemes used in the papyri, however, already give the total (although usually also preserving the daily progress). Yet their computation was initially based on those same methods, if not always the same parameters.

On a more technical side, however, the schemes were at some point altered and non-Babylonian material incorporated into the computation. A point in case is a procedure text[844] for Venus (2nd cent. AD), which set out a velocity scheme that forms an important part of Babylonian planetary theory, and even uses the complete synodic cycle 215;30° in 584 days, which equals the underlying Babylonian periodicity 1151 sidereal years = 720 synodic phenomena, attested for example in ACT

842 Jones 1999: 114.

843 The material comes from Egypt and dates almost without exception to the Roman period.

844 See glossary.

400.[845] Moreover, the parameter of the maximum speed between the last and the first appearance, 1;15° per day, is Babylonian as well.[846] However, included in this same text is material that has no parallel in the Babylonian sources.[847] Other good examples are P.Mich. 151 + P.Heid. Inv. 4144 (3rd cent. AD), which uses an adapted Babylonian system A step function (e.g. like in BM 37236),[848] whose constants have been changed to bring the foreign arithmetical scheme into agreement with the Greek geocentric model for the phenomena of Mars.

On a similar note, Britton and Jones have argued that the scheme that underlies the Jupiter Epoch Table, for example, is a 'surprisingly sophisticated and successful extension of Babylonian methods, which reflects a complete and intimate familiarity not only with the conventional applications of System A, but also its underlying fundamentals'; and furthermore, 'an active engagement with the contemporary [i.e. post-Hipparchean but pre-Ptolemaic] empirical record, all within the context of purely Babylonian methods.'[849] There is a very distinct divide in the literary record between these arithmetic-based texts and the newer, technically more difficult methodology built on cinematic models and trigonometric functions (Ptolemy's *Handy Tables*);[850] the latter only appear in the papyri in the 3rd cent. AD and do not take precedence in the archaeological record until the late-4th.[851] So, the Greek geometrical cinematic models clearly did not replace the Babylonian arithmetical systems for a very long time, at least when it came to practical computation.

The use of Babylonian arithmetical tools by contemporary astronomers-astrologers is not indicative of their lack of spherical world-view.[852] Not only is the latter demonstrated by the incorporation of Hipparchus-inspired innovations into the planetary schemes,[853] but Neugebauer and Parker have also pointed out how the mention in one of the texts about Mercury being in perigee in Taurus 10°

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[845] Oxy. 4135.

[846] Line 32.

[847] Jones 1999: 82.

[848] Neugebauer 1975: 946-8.

[849] Britton & Jones 2000: 372.

[850] Jones 1994: 37.

[851] Jones 1996: 144.

[852] The distinction between the two might have of course mattered little to their original users. The dichotomous reading we apply to these computational techniques from our modern viewpoint may be to some extent unwarranted in their original Hellenistic context, where both were applied within the same geometrical framework.

[853] Most of the material dates to after Hipparchus but is uninfluenced by Ptolemy (Jones 1991: 450).

implies that its author's model of reference is inherently geometrical.[854] Hence, these documents are a symbiosis of arithmetical and geometrical methods. In Jones' words:

> Theoretical work operated with geometrical hypotheses but did not disdain to employ initial data derived from arithmetical schemes; the predictive schemes, for their part, readily absorbed new parameters from geometrical theory without casting off their arithmetical structure.[855]

The tables must have been almost invariably used in the service of astrology.[856] The texts we have are preeminently concerned with determining instantaneous planetary positions for the use in the horoscopes; an aim that coincidentally has no practical application outside this very tradition. In other words, no purely scientific concerns would explain the existence of these methods in the contemporary tradition.[857] This helps to explain the choice of elements of the Babylonian systems we find transmitted to the Hellenistic context. I tend to agree more with Jones that the system we find communicated from Babylonia was part of its astrological practice and as such easily transferable because it did not need observational activity to sustain itself.[858] This accounts for the lack of any texts outside Mesopotamia that are comparable to the *Astronomical Diaries*: these had already allowed for a way to gain sufficiently accurate prediction to be developed, and the resulting system meant that there was no longer need for the raw data.

What we have learned of Cidenas and Sudines also indicates that an important transmission route ran initially through astrology and the material was in all likelihood extracted from the complicated cuneiform ephemerides before it reached Greece.[859] These methods, especially its lunar scheme, were then applied to the more theoretical side of Greek astronomy. Yet, the question of access still begs attention.[860] Neugebauer has pointed out that the transmission of mathematics - a topic that

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[854] Neugebauer & Parker 1969: 236.

[855] Jones 1991: 452.

[856] This also accounts for their large number and advanced content in comparison to other sciences (e.g. mathematics) (Jones 1994: 38).

[857] Jones 1994: 39.

[858] Jones 1996: 143-4.

[859] E.g. it is clear from what we know of Hipparchus that he derived his material straight from the ephemerides. 'Rather, they must have been excerpted and translated by someone in Mesopotamia who was well acquinted with Babylonian astronomical method' (Toomer 1978: 212).

[860] See also ch. 2.3.4 & 5.5.

will be discussed in chapter 5 - and astronomy must have been very different. Whereas mathematics provided relatively straightforward material, probably 'accessible in countless elementary treatises at all periods and in all areas of the Near East', astronomy was a much more complex matter. In his view, no treatise would have been able to convey with sufficient precision the intricacies of Late Babylonian theories - proper training was necessary to understand them.[861] From that point of view it would be more reasonable to believe that Babylon-trained scribes occasionally carried their business elsewhere.[862] Popović has also suggested that the Babylonian élite might have been much more open to direct contacts with Greeks and the Greek language than with Aramaic and Jews.[863] The reception of such (travelling) cuneiform scholars by the Greek (and Egyptian) communities might have been facilitated by the already high status of Babylonian astronomy and astrology in the Greek world.[864]

Boiy alleges that all references to 'Chaldeans' can be reduced to a treatise or group of treatises in Greek that contained a summary of Babylonian astronomy and astrology, written sometime between 330 and 170 BC.[865] According to Vitruvius, Berossus was the first to leave behind such a treatise and after him came Antipater and Achinapolus.[866] Whereas Berossus' highly questionable presence in Greece will be discussed in detail in the next chapter (for now, we can state the general opinion that he can hardly be held responsible for the transmission of Babylonian mathematical astronomy[867] although see below), more solid evidence exists for Antipater, who must be the very man mentioned in a 2nd cent. BC inscription from Larissa in Thessaly, which refers to an Antipater from Hierapolis in Seleucia as a Chaldean astronomer who had lived and practised there.[868] Before him, we have

[861] Neugebauer 1963: 534.

[862] Jones 1991: 444, 1993: 88.

[863] Popović; forthcoming: 18-20.

[864] Popović, forthcoming: 19. Consider for example the report in a papyrus from Herculaneum (Col. III (15.732 O. 164 N) and Col V (17 734 O. 166 N), Melker 1902: 12-15) that Plato, when dying, had as a guest in his house a certain Chaldean who entertained him in his final hours. For a discussion on this anectote, said to have come from Plato's pupil and secretary Philip of Opus, especially on the extent to which the designation 'Chaldean' might indicate a Babylonian, see Kingsley 1995: 199-207. It is worth recalling in this context Seleucus of Seleucia.

[865] Boiy 2004: 310.

[866] Vitr. *De Arch.* 9.6.2. The manuscript reading of the second name is in doubt. Achinapolus is usually used but Verbrugghe & Wickersham 2001: 35 give an emendation Athenodorus, though noting that this is far from certain. De Breucker (*BNJ* 680 5a comm.) says Archinapolus is another variant.

[867] E.g. Neugebauer 1963: 529, or Huxley 1964: 128. This does not apply to astrology.

[868] *SEG* 31.576 & 40.477. Bowersock 1983: 491.

already seen how Sudines could have easily formed the link between transmission of the Babylonian lunar tables to the Hellenistic world; and Seleucus, although he lived slightly later (c. 150 BC), provides our perhaps most certain example. They all predate or are contemporary with Hypsicles and Hipparchus.

In reference once more to the role of astrology in the transmission of technical astronomy one must consider the connection between the length of life and the daylight and rising-times scheme.[869] If the connection to Epigenes is indeed true and his conjectured 3rd cent. BC date is correct,[870] then as Neugebauer admits, it would provide one of the earliest references to the use of linear rising times in Alexandria,[871] where it would have been then available to Hypsicles.[872] That Hipparchus was similarly dependent on early astrological writers is hinted by his association with the doctrine of *antiscia* and through that Critodemus (see n. 1186 below) and the fact that he definitely dabbled in chorography. The system attributed to him and 'the old ones of Egypt' by Hephaestio displays intriguing similarities with the one presented by Vettius Valens.[873]

All this would seem to constradict the argument that the mass of information in Babylonia was so vast that its translation into Greek is inconceivable and so the only plausible explanation would be that a Greek astronomer, having acquired enough technical competence on his own, extracted necessary information from the Babylon archive with the help of local experts.[874] Yet, this model of

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[869] Pliny, *NH* 7.49 and Censorinus, *De die nat.* 17.4. Although the doctrine is associated with Nechepso and Petosiris, values are given also for Epigenes and Berossus. The maximum length of life is according to this scheme determined by the formula $\frac{1}{2M} + 2d$, where M is the maximum daylight length of the given *klima* and d the constant difference by which each day differs from the next. E.g., Epigenes proposed a maximum length of life for the latitude of Alexandria (the first *klima*) of 112 years. Alexandria's longest to shortest day ration is 7:5, hence max. 14 hours = 3,30;0° and knowing that the daily change is 3;20° we arrive at 111;40° or 111 years 8 months, rounded to 112 years. 116 (117 in Pliny) is given for Berossus, which is in accordance with the latitude of Babylon, and unnamed 'others' have apparently suggested an even greater number of years. Honigmann (1936: 309) gives a calculation for each astrological *klima,* from Egypt and Babylon already mentioned to *klima* 7 = 129 years.

[870] See p. 213.

[871] Neugebauer 1975: 721 but see his n. 8 for caution on Honigmann's (1936: 316) theory that Epigenes is also the creator of the seven astrological *climata*. On the possible relations between Epigenes and Berossus see also p. 214.

[872] Honigmann 1936: 301-21.

[873] Both associate regions with physical parts (e.g. head, left leg etc.) of the zodiacal signs and not the whole signs. Rehm (1913: 1680-1) also argues that their choice of similar geographical entities (see appendix 3)) indicates a date before 146 BC.

[874] Jones 1991: 443. On access see ch. 5.5.

transmission should not be dismissed out of hand: we still have not accounted for the vast amount of observational data available to Hipparchus.

One possibility is suggested by Simplicius (AD c. 490-560), who says that Callisthenes of Olynthus, cousin of Aristotle and a personal historian of Alexander, had the Babylonian astronomical diaries translated into Greek on Aristotle's request.[875] As Burstein has noted, in terms of the historicity of this claim, arguments can be brought both for and against it.[876] Lendering has argued that Simplicius might well be right as he correctly translates the Akkadian title *massartu* as *têrêseis,* which is illogical in Greek but keeps the double meaning of 'guarding' and 'observing' it has in Akkadian.[877]

3.5 Conclusions

Mesopotamian astronomy, with its specific techniques and concepts which have formed the 'source text' for this chapter, was deeply embedded in the local philosophico-religious tradition, where it primarily served the interests of astrology. This is especially true of the early period, the focus of which was not so much on the creation of physical models of celestial motions but rather on the comparision of these motions against a numerical ideal. The ability to predict both movements with considerable accuracy only took precedence in the second half of the first millennium BC.

No equivalent star cult or deep-seated belief in astral prognostication can be found in the contemporary Greek world. Any attempt to introduce a technical astronomical element to its religion would have, therefore, encountered a number of difficulties. Some related Mesopotamian ideas, however, did nevertheless find their way into certain philosophico-religious branches of Greek thought, in particular Pythagoreanism, as will be argued in chapter 5.4.3 on number theory. For now, however, it suffices to conclude that if Mesopotamian astronomical material was to be incorporated into the Greek 'home repertoire', it had to find slightly different outlets.

Early Babylonian influence on Greek calendar making has been downplayed with the argument that the Greeks, although they seem to have had sufficient access to the cuneiform tradition, fail to make any apparent use of the latter's comparatively more elaborate insights into star movements until

[875] *FGrH* 124 T3.

[876] Burstein 1984: 71.

[877] Lendering, livius.org s.v. Kidinnu.

after the Persian wars, and thus the Greek astronomical tradition remains considerably more rudimentary than its Near Eastern counterpart. However, such reasoning is futile: the consideration of context that we have just outlined explains this phenomenon. In short, Greek culture lacked a need and hence a proper *space* where it might insert the technically superior Babylonian material until one opened up in connection with problems of accurate timekeeping. Nonethless, it is clear that knowledge of the 19-year intercalation cycle and an idea of public calendars were not simply incorporated into a rudimentary Hesiod-style tradition. Moreover, they continued to lack the need for the most of the Babylonian data (e.g. daylight and moonlight schemes), as still only stars were at this point being used as a reliable guide to the seasons; the philosophical and scientific musings applied to them were not yet in a state that would require any precise measurement of their movement.

Moreover, in the case of technical knowledge, the translation is also limited by the fact that the target culture cannot absorb information beyond its capacity to understand and the tools it has at its command at any given time. So, even if the Greeks were to have been interested in replicating the personal astrology that had emerged in Babylonia by the late-5th cent. BC, they would have found themselves currently unable to do so. The translation of astronomical material could, therefore, only move from simple concepts to increasingly complex exercises; the basic ideas had to be sufficiently accommodated, and only then could the next step in knowledge be successful. Greeks of the archaic and classical periods did not have the necessary skill or vocabulary to adopt the Babylonian schemes. It is then not surprising that when distinctive borrowings were first made from Babylonia, they were typically rather basic. Among them are the transmission of the zodiac, the identification of planets with certain deties, and the adoption of the idea that the heavenly bodies enter the visible heavens though gates.

However, the development of cosmological speculation finally led to a new kind of, very much star-centred, world view (more on this in ch. 4.5) and to the emergence of new astronomical aims with it. Over the centuries more and more Babylonian ideas made their way into Greek tradition, which, not least due to the great prestige that Chaldean astronomy enjoyed, became part and parcel of the Greek repertoire. However, the transfer, quite expectedly, resulted in significant variances between 'source' and 'target texts': measurements of time in the Babylonian context, when applied to the Greek spherical universe, become angles of arcs, the daylight scheme was developed into a system of *climata*, and, more tentatively, the stellar paths of Babylonian astronomy took the guise of celestial circles. The building up of vocabulary allowed more and more intricate material to be borrowed with greater ease.

Yet Greek cosmological and philosophical debates resulted in the emergence of a model of the universe totally different from what we can assert for Babylonia. Nevertheless, the developments within this tradition led to the need to once again make use of Babylonian discoveries which by this time probably had considerable circulation in the Greek world, especially in Egypt. We cannot rule out that this material lies to some extent behind Hipparchus' idea that qualitative predictions were possible and even desirable,[878] but the importance of the Greek notion of proof and its relevance to debate on the structure of the universe must have at least provided a fertile soil for this idea. Hipparchus' aim, and some of the methods to achieve it - i.e. the newly created trigonometric tools - differed significantly from the Babylonian ones, which focused on the planet in its characteristic synodic situations,[879] but the evidence is sufficient to conclude that Hipparchus was reliant on the Babylonian material not only in terms of raw data and specific parameters but also in regard to practical computation.[880] Nevertheless, Hipparchus and astronomers-astrologers after him did not utilise the borrowed material blindly. Jones acknowledges that 'the lunar template scheme is an especially successful fusion of Babylonian and Greek concepts that well deserved its wide reception in antiquity', whereas the attempts to tamper with the planetary schemes were, on the other hand, 'less happy and mark a step backwards, both in accuracy of prediction and in theoretical sophistication, from the Babylonian originals.'[881]

Nevertheless, attention must also be paid to what was not borrowed from Babylonia, as it provides further insight into the interests of Greek astronomers of the time. In addition we need to take into account the effect that such interests have on the translation process as a whole. Greek use of the Babylonian solar theory is limited to the norm of the vernal equinox and schemes for the rising times of the ecliptic;[882] planetary theory is until the Roman period only attested by the basic parameters of

[878] As argued by Goldstein & Bowen 1983: 339.

[879] See table 4.

[880] Jones 1983: 24-7, Jones hypothesises that the accuracy that the 3031 provided would have been irrelevant to the Babylonians but necessary for Hipparchean astronomy. He has shown that although theoretically it would have been possible for Hipparchus to make the correction, it was probably made some time after him.

[881] Jones 1991: 453.

[882] For the Babylonian solar theory see Neugebauer 1975: 371-3, for Greek solar theory 626-34 and Hipparchus' solar model 306-8. Especially noteworthy is the lack of Babylonian methods in accounting for solar anomaly.

period relations (table 5, above). This was probably caused by the fact that Babylonian practice, centred around the determination of planetary phases, although its straightforward methods were of great use to the astrologers, contained little that was useful for the cinematic theory, e.g. no values for planetary latitudes, which were very important for Greeks.[883] In short, what got translated into the Greek cinematic astronomical system was determined by what this system had some sort of need for – mere access or awareness was not enough for instant incorporation. This does not mean, however, that material neglected at first could not and would not be utilized within a slightly different context, when the home repertoire and its needs had changed. So, the long-term translation process which has been the focus of this chapter follows the pattern: idea first, then the necessary vocabulary, and finally the technical detail. The idea that something is possible or desirable must first find a need in the receiving culture.

It seem very likely that a considerable part of the astronomical material that appears especially strongly in the mid-2nd cent. BC, not least in the work of Hipparchus, owes its transmission to astrology and had, as such, found its way to Egypt and Greece at a slightly earlier date (more on this in the next chapter). However, the evidence we have of the linear schemes comes almost invariably from the Roman period. The exact relationship between the Babylonian and Hellenistic during the preceding period-traditions is therefore difficult to establish. A possible avenue of research in this field is to look for relevant astronomical models and parameters in the Indian material. Generally, however, Rochberg must be right in asserting that

> The Greek astronomical papyri do not undermine the assessment of the theoretical character of theoretic model-making form of ancient astronomy, but in showing that Greek astronomy was methodologically more diverse than previously acknowledged they mitigate any attempts to draw cognitive historical conclusions about the nature of Babylonian 'mind' in contradiction to the Greek, or our own.[884]

Moreover, the standard belief that the practical aims of the two traditions are fundamentally different, with Babylonians concentrating on their period relations and Greeks ultimately aiming to answer the question 'given the time, where is the planet?' does not apply to most of their concurrent history. Although probably conceived earlier, this idea, fundamental to both Babylonian and Greek

[883] Neugebauer 1975: 603-4 & 613.

[884] Rochberg 2002: 676.

astrologies, is not made explicit in Greek astronomy until Ptolemy.[885] The aims of both astronomies fluctuate and evolve as progress is made. As Jones says about the Babylonian methods, 'even before their transmission into Greece they had been extended to address the problem of predicting day-to-day positions and the dates when a planet entered a new zodiac sign'.[886] This served the interests of personal and other forms of astrology, to which the attention will now turn.

[885] Aaboe 1974: 33. And even he never explicitly talks of predicting eclipses, only expresses the general idea. See n. 743 on the desirability of eclipse predictions.

[886] Jones 1991: 451; and Swerdlow 1998: 29: 'the position of the planets within zodiacal signs and with respect to normal stars are found for given times, partly by computation and partly, it appears, by consultation of observational records.'

Chapter 4: Astrology

4.1 Introduction

If for the modern reader astronomy deserves due study on its own account for what it can tell us about the structure of the universe – a notion shared by some of the Greek astronomers – Mesopotamian astronomy was above all the by-product of astral divination.[887] The birth-charts compiled by Babylonian and later Greek astrologers were only possible because the mathematical schemes of the former allowed the calculation of instantaneous planetary positions.[888] So too the word 'Chaldean' has been from early times extensively used to denote an astrologer.[889] That the 'Chaldeans' were the priests of Babylon was already known to Herodotus, and although he seems to be aware of the Babylonians' supreme knowledge of astronomy and offers general associations between Orientals and astral omens, he does not as yet make any explicit mention of the priests' deep-seated interest in astrological prognostication.[890] Ctesias, however, was more eager to make the connection clear in his story about Arbaces' and Belesys' plot against Sardanapallus.[891] And this Belesys was

> the most distinguished of the priests whom the Babylonians call Chaldeans. And so since he had great experience of both astrology and divination he was accustomed to predicting the future to the masses with unerring accuracy.[892]

By the time Alexander conquered Babylon, the ability of its priests to foretell the future was well known[893] and Chaldeans subsequently become a compulsory element in the Alexander histories.[894]

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[887] As shown in chapters 3.2 and 3.4.2.

[888] Jones 1996: 148.

[889] E.g. Cleitarchus *FGrH* 137 F6 = Diog. Laert. 1.6; Cato, *On Agri.* 5.4; Cic. *Mur.* 11.25, Horace, *Ode* 1.11 (futile Babylonian calculations); Sen. *NQ* 2.32.6, 6.28.2 ('Chaldean soothsayers who tell what sorrow or joy is determined by the natal star'); Plut. *Mar.* 42.5 ('Chaldean chart'), *Galba* 23.3 ('soothsayers and Chaldeans'), *Isis* 48.1; Suet. *Vit.* 14.4.

[890] Hdt. 2.109 (gnomon, πόλος and the twelve divisions of the day); Hdt. 7.38-40 (Persian magoi and a solar eclipse).

[891] Diod. Sic. 24.1-28.8.

[892] Diod. Sic. 24.2.

[893] Cic. *De Div.* 2.42 gives a quote about the Chaldean astrologers by Eudoxus, saying that no trust should be placed in them when 'they profess to forecast a man's future from the position of the stars on the day of his birth'.

[894] E.g. Theophrastus (see n. 413 above), Cleitarchus *FGrH* 137 F6 (= Diog. Laer. 1.6), Nearchus *FGrH* 133 T10a (=

The first allusions to astrology in Roman literature occur in Ennius (239-169 BC), Plautus (254-184 BC) and Cato the Elder (234-149 BC).[895] It is then all the more interesting that it took centuries before astrology as a technical art finally formed an integral part of the Greek 'home repertoire' as opposed to only a literary *topos* in its 'Chaldean discourse'. Greek horoscopes and the surviving astrological texts - Manilius' *Astronomica,* Dorotheus of Sidon's *Carmen Astrologicum* (*Pentateuch*)*,* Ptolemy's *Tetrabiblos* and Vettius Valens' *Anthologiae* – all date to the first two centuries AD.[896] By this time astrology was clearly structurally canonised, even if still largely negotiable in detail. But, with the exception of Valens, these authors make little to no reference to the authorities responsible for this adaptation of originally Babylonian divinatory methods into a system that would be employable within the Greek cultural context. This issue is, however, of the utmost theoretical importance for this study.

Hence this chapter addresses two key questions. First is the context within which the 'translation' took place. It will be argued that this was deliberately alienised and it is in this aspect that the influence of the wider cultural discourse on the Near East, as examined in chapter 2, becomes especially noticeable. Secondly, this chapter will examine what elements in this purposefully 'exoticised' art defied direct translation and can only be described as inherently Greek (or in Manilius' case Roman). Although just how much this Hellenistic version of astrology relied on the Babylonian methods has become increasingly clear over the past decades, the general view still runs very much in the line with that expressed by Neugebauer:

> With the exception of some typical Mesopotamian relics the doctrine was changed in Greek hands to a universal system in which form alone it could spread all over the world. Hence, astrology in the modern sense of the term, with its vastly expanded set of 'methods' is a truly

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Diod. Sic. 17.112,3). Later also in Arrian 7.16-8, Q. Curtius Rufus 5.1.19 & 22, Justin 12.13.3-6, Plutarch, *Alex.* 73.1-2.

[895] Ennius, *Iphigenia* ('astrologi' F 185-6 Jocelyn); Plautus, *Rudens* 1-29 (Arcturus); Cato the Elder, *Agr.* 1.5.4 ('chaldaei'); later Propertius 4.1 and Horace, *Odes* 1.11, *Carm.* 2.17.17-30 among others.

[896] For horoscopes see n. 951. English translations of Manilius' *Astronomica* and Ptolemy's *Tetrabiblos* have been published in the Loeb series by Goold (1977) and Robbins (1940) respectively. A translation of the Arabic version of Dorotheus of Sidon with the addition of the Greek and Latin fragments mainly from Hephaestio and Firmicus Maternus, was made by Pingree (1976), who also edited the Greek text of Valens' *Anthologiae* (1986; there was an earlier edition by Kroll in 1908 – the references here give paragraphs according to both, noted by P and K respectively). For a French translation of the first book of the *Anthologiaexi,* see Bara 1989; an unpublished English translation by Riley is available online at http://www.csus.edu/indiv/r/rileymt/Vettius%20Valens%20entire.pdf.

Greek creation, in many respects parallel to the development of Christian theology a few centuries later.[897]

I argue, however, that rather than being a new creation, the 'birth' of Hellenistic astrology must be viewed as a result of a prolonged process by which the Babylonian idea and its methods (and Egyptian ones) were translated into a new repertoire, one that was based on a spherical world-view, examined in the last chapter, and very different religio-philosophical beliefs. Views like Neugebauer's will prove to be simplistic: they are often based on a comparison of Babylonian cosmological ideas, as we can infer them from relatively early texts like the *Enuma eliš*, with Greek astrological theory *par excellence* as advocated by Ptolemy. Of course, from the modern point of view, Ptolemy is *ideal* – his work is undoubtedly the most accessible of the surviving astrological treatises, and it conforms best to modern standards. But this ideal is distracting. Ptolemy's astrology was by all accounts not the standard approach in his own time.[898] And even though he does present an interesting case study, which definitely yields significant insights into the 'translation practice' (chapter 4.5 below) in the context of a Euclidean empirical paradigm, he stands at the end of a long line of such 'translations' and treating him as a norm diverts attention from the much larger corpus of astrological methods and ideas that were present and practised in the Greco-Roman world.

The same applies to the preoccupation with personal astrology (horoscopy, or genethiaology as it is called in its Hellenistic format). The energy spent by modern commentators on trying to determine when and where this first emerged has denied other astrological sub-fields due attention. These fields include: (1) 'general astrology' – i.e. the astrology relating to the whole regions, races and cities, with its methods characterised by a preoccupation with eclipses, comets, weather and atmospheric signs[899] - which provides an amount of comparative material comparable with cuneiform omens;[900] and (2) *katarchic* astrology, which is the determination of the outcome of a venture, based on the situation in the heavens at its beginning. In this context, however, perhaps the best example is astral medicine, which occupied an important part in both Babylonian and Egyptian traditions and enjoyed some popularity in the Greco-Roman world. Consideration of what exactly was written in the at least fifteen books of Nechepsos and Petosiris (as opposed to only the

[897] Neugebauer 1975: 613.

[898] For a comparison of Ptolemy and practising astrologers see Riley 1987.

[899] This fills Ptol. *Tetr.* book 2, weather signs also in Germanicus F 3 & 4, 1-163.

[900] See p. 178-82 below.

thirteenth)[901] promises a more balanced view of what early 'Hellenistic' astrology was actually like and how older astrological traditions were embraced by the Western societies.

The question of definitions has similarly obscured the matter. As Greenbaum and Ross remark, different definitions of 'horoscope' produce diverse accounts of its development.[902] If we define 'Hellenistic astrology' only by the reference to its use of the Aristotelian spheres and four elements then we divorce Hellenistic horoscopy from its predecessors and detach important issues from the discussion.[903] So the fluidity of the tradition and of modern attitudes to it are an important factor for this study. We have already seen how the Greco-Roman world-view is characterised by a multiplicity of beliefs and approaches; in terms of astral determination we can for instance distinguish between hard and soft views.[904] And though room must be left for these divergent attitudes, it will also be argued that outside of the philosophical schools there existed an amalgam of syncretistic core principles that characterise the general Greco-Roman world-view. These were applied to, and easily accommodated, ideas about the possibility of astral determinism and, by extension, prognostication of one's fate.

In order to achieve the aims outlined above, this chapter will first provide an overview of the 'Source Text', then compare that to the 'Target text' in form of a Hellenistic horoscope, and analyse the

[901] Valens (3.14K/11P = N&P F 19 Riess; also see F +5, +11 and +12 in Heilen 2011) says that 'in his thirteenth book, after his preface and his description of the signs, the King introduces the Lot of Fortune <and its derivation> from the sun, the moon, and the Ascendant'. So the Book 13 must have contained horoscopy. Book 14 concerned iatromathematics (F 29 Riess) and Book 15 astral magic (F +19 Heilen).

[902] Greenbaum & Ross 2010: 147-8. E.g. the approach of Sachs and Rochberg (who talk of Babylonian 'horoscopes') is underpinned by the view of a 'horoscope' as a forecast based on a chart that contains the positions of relevant celestial bodies. Pingree's definition, on the other hand, is conditioned by the use of the word ὡροσκόπος as *hour-maker*, i.e. the ascendant or the sign/degree rising above the horizon at an examined moment. As this has no counterpart in the Babylonian text, he can argue that the cuneiform *horoscopic texts* share many elements of horoscopic astrology, but do not constitute true horoscopes because they do not contain an ascendant. His definition (1997: 26) of genethlialogical astrology then becomes something that assumes an Aristotelian universe consisting of the four sub-lunar elements and with an earth at its centre, surrounded by the eternally circling spheres of the seven planets in the so-called Hellenistic order. But as Greenbaum & Ross (2010: 149) note, such an approach inevitably divorces 'horoscopic astrology' from its Babylonian predecessors.

[903] Greenbaum & Ross 2010: 149.

[904] The distinction between hard and soft views depends on the extent to which everything is held to be immutably pre-written in the stars. Manilius, for instance, supports hard determinism, evident e.g. in 4.14-15: 'fate rules the world, all things stand fixed by its immutable laws, and the long ages are assigned a predestined course of events'. Soft determinism, on the other hand, views the stars as signs and/or reckons with the multiplicity of causes which 'reduces the conception of one single body acting upon another a mere abstractions' (Sambursky 1959: 54; in Ptolemy p. 222-3 below).

technical concepts employed by either or both. Attention will then be turned to Egypt and especially to the alleged 'founding fathers' of Hellenistic astrology, Nechepsos and Petosiris. It will be shown that Babylonian astral sciences indeed found a receptive environment in the Egyptian temple, but although Babylonian omens were transmitted to Egypt during the Persian era, if not even earlier, horoscopy itself did not become part of its repertoire until the late Ptolemaic/Roman period. The question thus emerges of the direction of cross-cultural transfer when it comes to personal astrology and by extension mathematical astronomy in Hellenistic Egypt. Hence, other known authorities, especially Berossus, will be considered as possible alternative channels for information movement.

The final section of the chapter analyses Manilius' *Astronomica* and Ptolemy's *Tetrabiblos* in an attempt to determine how the very Hellenistic philosophical rationale (i.e. the 'home repertoire') behind their astrological doctrines conditioned their respective analytical bodies. Manilius, although arguably the worst authority on the actual workings of Hellenistic astrology,[905] has been chosen on the basis that his is perhaps the most interesting work to untangle as a composition, and the changes he makes in the technical details of the otherwise canonical art are most revealing in this respect. While the *Astronomica* is essentially a work of poetry, Ptolemy, in his endeavour to offer a scientific explanation for astral influences, represents the other extreme.

4.2 Reconstruction of the 'Source Text': Babylonian Astrological Doctrines

Babylonian celestial divination enjoyed thousands of years of success, dating back at least to the OB period.[906] For the sake of convenience I have followed here the usual division of its development into two distinct phases: the general astrology concerned with the fate of the king and the country and based on the omen-series *Enuma Anu Enlil* (EAE), and personal astrology, which developed during the 5th century BC. However, astrology imbued many more areas of life and evidence for this will be incorporated as much as possible.

Whereas the earliest surviving omens deal primarily with the lunar phenomena,[907] by the time we get

[905] Manilius has undergone a noteworthy reassessment. Traditionally he has been belittled both as a poet as and as an astrologer (Housman 1937: 'third rate poet'). See MacGregor 2004: 143, esp. n. 2 & 3 for criticism of Housman's approach and his reasons. The unpopularity probably results at least partly from the modern distaste for his subject matter.

[906] No Sumerian omens are known (Koch-Westenholz 1995: 33-4).

[907] Hunger & Pingree 1999: 7.

a standardised *Enuma Anu Enlil* series of celestial omens during the Kassite period,[908] they make up four categories:[909]

a) Sin (EAE 1-22[910]) – Moon (dates and duration of lunar visibility, the appearance of the 'horns' of the lunar crescent, halos around the moon, eclipses, conjunctions with the sun, stars, and planets etc.)
b) Šamaš (EAE 23-36) – Sun (coronas, parhelia, eclipses etc.)
c) Adad (EAE 37-49/50) – 'Meteorological' omens (lightning, thunder, rainbows, cloud formations, earthquakes and winds)
d) Ištar (EAE 50/51-70) – Constellations and planets (positions of the planets, visibilities, luminosity, colour, prognostication for fixed stars)

The following examples should give a general idea of the nature of these omens:

> If an eclipse begins in the east and clears in the south: downfall of Subartu; it (the evil of the eclipse) will not approach Elam and Guti.[911]

> If the day, when the sun becomes visible on the first day of Elūlu, is gloomy and the south wind blows: a light rain will fall at midday; if in that month Adad thunders, the day will be gloomy but it will not rain.[912]

> If a disk *when it rises* stands next to the moon and Venus is visible in front of it at noon: a

[908] The corpus consists of more than 70 tablets. Surviving tablets come from MB, MA and the majority from NA periods. There are also Hittite and Hurrian versions from different periods, which suggest that a primitive version of the *EAE* might have existed even earlier (Koch-Westenholz 1995: 45).

[909] The total number of omens included in the EAE amounts to roughly around 7000. The publication of the series is still an ongoing process. For tablets 1-6 see Verdérame 2002 (in Italian); 15-22 Rochberg-Halton 1988a; 23-29 van Soldt 1995; 44-49 Gehlken 2012; 50-51, 59-60 and 64-65 Reiner & Pingree 1975-2005; for tablet 63 see n. 556.

[910] The process was clearly a standardisation, hence the tablet numbers must be treated with care. Although organised into a compendium the contents were not rigidly fixed. Non-canonical local versions of the omens and entire tablets remained in existence and were accompanied by a lively oral tradition (see for example Al-Rawi & George 1991/2: 53-4 concerning EAE 14; SAA 10 008 = ABL 519 includes the words 'This omen is not from the series; it is from the oral traditions of the masters (r.1-2, repeated on r.8). The Nineveh collection of the EAE represented traditions from all over Mesopotamia and beyond, see esp. Fincke 2001.

[911] EAE 15 III 4.1 (trans. Rochberg-Halton 1988a: 73).

[912] EAE 23(24) V 9 (trans. van Soldt 1995: 9).

well-known important person will rebel against his lord.[913]

If Venus rises in month IV and the Twins stand toward her front: the king of Akkad will perish.[914]

If Adad thunders and a rainbow which is like a sulphur flame in its appearance can be seen, there will be fire in the land, (but) towns, (where) men (live), will be spared.[915]

As Rochberg has noted, the organised and systematic nature of the omens reflects the importance of the subject in the contemporary scholarly tradition.[916] Whereas some of the omens were based on schematic arrangements according to strict 'scholastic' criteria – i.e. as a result of organisation into formal schemata - others were the result of careful correlation between the heavenly signs and earthly events.[917] Drews has shown how a direct relationship existed between Mesopotamian chronicles[918] and astrological divination; the former provided apodosis-material to omens and prophecies which relied on the belief that mundane events concurred with the heavenly cycles.[919] Hence the later Greek claim that astrology is the most empirical of sciences – 'experience created this art' to quote Manilius[920] - is not at all off the mark.

The reports (*u'ilātu*) of the scholars to the Assyrian kings attest to a learned and religious, yet

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[913] EAE 24(25) III 8 (trans. van Soldt 1995: 23).

[914] EAE 59 IV 2 (trans. Reiner & Pingree 1975-2005: 3.127).

[915] EAE 45 5' (trans. Gehlken 2012: 47).

[916] Rochberg 2000a: 1925.

[917] Rochberg 2000a: 1926 & 2004: 68. Some criteria expressed in the protasis cannot occur in nature (e.g. the onset of the lunar eclipse from certain quarters of the moon, an eclipse occurring on certain days, or the sun coming out at night – see Rochberg 1999: 562 for more particular examples, and 563-9 for the discussion on the empiricism aspect). The same empirical principle applies to liver omens. See Rutten (1938) and Snell (1974) for 2nd millennium BC omen texts from Mari that demonstrate the move from observation to prediction. However, like the EAE, the haruspicy compendium includes omens artificially created to fill the gap in the tradition (Larsen 1987: 214). Cf. Brown 2000: 105-160, esp. 152, who contests the emphasis laid on the empirical origin of the omens and Reiner 1995: 62 for the observable patterns.

[918] Published in Grayson 1975, Glassner 1993 (in French, Eng. trans. 2004), Finkel & Van der Spek (forthcoming but accessible though www.livius.org).

[919] Drews 1975: 44-50. See Grayson & Lambert 1964 for the collection of the so-called Prophecy texts and especially p. 9 for a short list of references in those texts to identifiable historical events; Hallo 1966: 235-9 for proof that 'Prophecy A' from Aššur (VAT 10179 = KAR 421) was based on the events that happened during the reigns of Marduk-nadin-ahhe, Marduk-šapik-zeri and their successors (Second Dynasty of Isin).

[920] Man. 1.61-5.

politically charged activity.[921] Almost all of the recorded omens are described in modern scholarship as judicial, i.e. of public concern, relating to the king and the country.[922] The system is underpinned by an assumed connection between celestial and mundane events, perhaps best exemplified by the Akkadian phrases *šiṭir šamê/šiṭirti šamāmī* – 'heavenly writing' – and *uṣurāt šamê u erṣeti* – 'plans of heaven or earth' or just 'cosmic designs'. These plans or designs are often associated with what are called the cosmic 'destinies', as in the divine epithet 'lord of cosmic destinies and designs'.[923] This is based on the already discussed belief that though Marduk did not *per se* 'create' the world, he organised it;[924] and that this organisation can be understood with the help of the key that he provided for its unlocking. It is, however, this conception of divinely created order that underlies the various forms of Babylonian divination and the regard for observable heavenly phenomena as the 'writing' of the gods. Nevertheless, the formulation of the EAE omens indicates that the relationship between the sign (protasis) and the event (apodosis) was not causal but rather a simple association or correlation (i.e. if *x* occurs, expect also *y*), thus making the celestial phenomena a mere indicator and limiting the agencies of cause to god.[925] And the god providing the 'warnings' in the form of astral movements could be persuaded to alter the outcome of the events by using appropriate rituals.[926] Hence there is no inherent concept of determinism as such in the Babylonian world-view that created the EAE corpus.[927] However, prayers and mythological texts also show that the planets themselves were often seen as gods[928] but as we lack such references from strictly divinatory contexts it is impossible to say if this came to bear on the way astral influences were explained or

[921] See Hunger 1992 (SAA 8), Parpola 1993a (SAA 10) and Cole & Machinist 1998 (SAA 12) for collections of reports and letters.

[922] This has misled many classicists commenting on the emergence of Hellenistic astrology, see remarks made on this issue e.g. by Sachs 1952: 52 or Aaboe 1991: 281.

[923] Rochberg 2000a: 1926. E.g. LKA 109 (= VAT 13652).

[924] See p. 103.

[925] Rochberg 2004: 58-60. Also see Reiner 1995: 15-24 for stars as messengers between man and gods.

[926] The rites are known as the *namburbû* (or nam-búr-bi in Sumerian), 'its (i.e. announced evil's) loosening'. For an exhaustive discussion and the collection of relevant texts see Maul 1994, for their use for apotropaic purposes Reiner 1995: 81-96. Also relevant here is the substitute king ritual mentioned in SAA 10 012, SAA 10 002, SAA 10 351 etc. and described in more considerable length in K 2600+9512+10216 (ed. Lambert 1957-1958); for discussion see Labat 1945-1946. A reminiscent Greek story of a stranger on Alexander's throne is found in Arrian *Anab.* 7.24.1.3 (based on Aristoboulous *FGrH* 139 F 58), Diod.Sic. 17.116.2-4, and Plutarch *Alex.* 73.7-9.

[927] Hunger & Pingree 1999: 5, for a comprehensive discussion on the Mesopotamian astrological rationale Rochberg 2003.

[928] See Rochberg 2003: 173-6.

perceived.

Judging from the surviving astrological reports and letters, the EAE-style celestial divination reached its *floruit* during the Sargonid kings in the 7th cent. BC. However, after c. 500 BC onwards the astrological corpus starts displaying a greater diversity, soon incorporating a more personal type of astrology in the form of nativity omens and horoscopes.[929] This increased range of concerns of astral divination is demonstrated for instance by an occurrence of EAE-derived public omens and personal predictions on a same tablet from Seleucid Uruk.[930] BM 36746 (from c. 400 BC) provides another good example. It is a collection of twelve lunar eclipse omens combined with the zodiacal signs (not physical constellations) and planetary positions in the following manner:

> If a lunar eclipse occurs in zodiacal $sign_1$ and the night watch comes to an end and the wind (north, south, east, west) blows, Jupiter (or Venus) is (or: is not) present and Saturn or Mars stands in zodiacal $sign_2$ and zodiacal $sign_3$ respectively.

Although ultimately a move away from the EAE tradition that considered eclipses only in regard to date, time, duration, appearance and associated weather and stellar phenomena, the constitutive elements of the omens can still be tracked back to the old prototype.[931]

That god-sent signs apply to others besides the king and the country was of course not an entirely novel idea, calendar texts from Babylonia (plus the Hittite versions of these texts) and Egypt contain from quite early times predictions based on the month or day (lucky or unlucky) when the native was born.[932] Moreover, omens for individuals formed part of the physiognomic omen collections like the *Šumma alamdimmu* and to a slightly lesser extent of the *Šumma alu,* a collection of omens that could

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[929] The reports that come back to Greece after Alexander's conquest of Babylon are very explicit about the kind of astrology practiced by the priests in this period: 'But Theophrastus says, that in his time, the theory of the Chaldeans, about these things, was most admirable, as it predicted both other particulars, and the life and death of each individual, and not common events only, such as stormy and fair weather. For he adds, that according to them, the planet Mercury, when it is seen in winter, signifies cold, but when in summer excessive heat. In his treatise *On Signs* therefore, he says that they predicted all things, both such as are particular, and such as are common, from the celestial bodies' (Proclus, *On Tim.* 3.151 (285 E), trans. Taylor 1820).

[930] TCL 6 13, for a latest edition see Rochberg-Halton 1987.

[931] Rochberg-Halton 1984: 124 & 128.

[932] Neugebauer 1975: 609 n.13a & b. E.g. a menology in Labat 1965: 132-5 gives a list of predictions for a child born on a specific month (e.g. §64 1-2 'If in the month of Nisan, a child is born into this world, his father's house will disperse at its feet. If [he is born] in the month of Aiar: he will die suddenly') (my rendition of Labat's French trans.). Compare Hesiod (n. 1001) and on Egyptian equivalents see Bakir 1966, Bács 1990 and some remarks on p. 184-5 below).

be observed within a city.

It is difficult to establish what exactly brought about this change in astral sciences and if it was accompanied by a shift in the Babylonian philosophical/cosmological/religious outlook.[933] On the one hand, it is possible that the changed socio-political setting resulted in the pressure to 'reconfigure' the old sciences for a wider appeal, leading to the rise of readily 'marketable' personal astrology.[934] Achaemenid rulers' refusal to provide the Babylonian temples with the level of subsidies these had grown accustomed to under the NB empire must have created sufficient financial strain for the scholar-priests to look for additional sources of income.[935] Such attempts at modernisation are implied by a text making a yearly economic forecast based on the position of the planets.[936] On the other hand, it cannot be ruled out that the change can be at least partly explained by either internal philosophical or religious developments. Geller has suggested that after the Persian conquest the realisation of cyclical movements replaced the old god-related beliefs, leading the astral sciences to 'turn a corner'.[937] Kuhrt has speculated that the rise of the sky-god Anu to prominence in Uruk can be dated to the reign of Artaxerxes II, that is roughly around the period that astral sciences undergo a change, and become connected to the influence of the Iranian cult of Ahuramazda.[938] Rochberg finds it impossible to decide which explanation to favour, holding that 'one can only observe that the change in the cult seems to correlate with a change in scribal activities in the field of celestial inquiry.'[939] However, as the local autocracy disappears there is a distinct shift in focus from the state to the cosmos.

The earliest horoscopic texts, however, date slightly earlier than Artaxerxes II.[940] Such 'proto-

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[933] See p. 104-5 above. Cf. Brown 2000 who argues that the change was the result of internal developments, although he does not rule out that changes in rulership played some part after 612 BC; and a different approach by Van der Waerden (1968: 77-8) who believes that the astronomical advances were made under Darius who acted as a sponsor of science.

[934] As Annus (2007: 34) remarks, the suggestion that horoscopy was first developed to secure income for the temple that had now lost its royal patronage is certainly appealing.

[935] See Beaulieu 2006b: 202-5 for the diminished support and the terms of assistance to the temples by the Achaemenid rulers. Also compare the situation in Egypt a few centuries later on p. 198.

[936] Pingree 1997: 19-20.

[937] A remark made as part of his comments on a paper presented at RAI 2013.

[938] Kuhrt 1987b: 151.

[939] Rochberg 1993: 33-5.

[940] Rochberg dates both BH 1 = AO 17649 and BH 2 to 409 BC. The texts are sufficiently different, whereas the first does not refer to the heavenly events taking place on the date of birth but presents synodic phenomena

horoscopes', as they have sometimes been termed, aimed at recording the positions of the seven known planets during the birth, but in so doing relied on mathematical prediction of the planetary and lunar phenomena rather than empirical observation. The fact that all planets are always accounted for and this is done with reference to the zodiacal longitudes is a good indication that arithmetical calculation was the standard procedure.[941] Apart from the position of the planets some horoscopes also record whether the month of birth was full or hollow, the so-called NA (= *nanmurtu*) and KUR periods,[942] solar and lunar eclipses, solstices and equinoxes, and the conjunction of the moon with normal stars.[943]

The six known Babylonian personal horoscopes (dating to between 409 and 142 BC) were published by Sachs in 1952; since then nearly two dozen more have been identified (the latest from 68 BC).[944] The format of the horoscopes is quite fluid. One of the few to include actual predictions is a horoscope belonging to Anu-Bēlšunu.[945] The predictions come in the form of omen apodoses – much like in the EAE - following specific planetary entries.

> Year 63 (Seleucid Era), month Ṭebētu, evening of (?) day 2,[946]
>
> Anu-bēlšunu was born.
>
> That day, the sun was in 9;30° Capricorn,
>
> The moon was in 12° Aquarius: his days will be long.
>
> [Jupiter] was in the beginning of Scorpius: someone will help the prince.
>
> [The child?] was born [i]n? Aquarius with/ (or 'in the region of') Venus: he will have sons.

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instead (cf. BH 4 = BM 33382 and BH 18 in n. 943 below; the latter gives planetary positions in zodiac signs as becomes an expected norm).

941 Rochberg 2000a: 1932-3. For the methods see ch. 3.2.3.

942 NA – the date and time interval around the full moon, usually on the 14th day, which measured the time between sunrise and moonset; KUR – a date of the time interval of last lunar visibility before sunrise (Rochberg 1998: 11).

943 Rochberg 1998: 11, 39-46. E.g. BH 18 = BM 35516 (8-13) from 141 BC: 'That month, (the moon was) visible (for the first time in the morning after sunrise on the) 14th; last visibility of the moon (on the) 27th. Year 170 (of the Seleucid Era, month) Nisan, 4th day: (vernal) equinox. The child was born in the brilliant (?) house of Jupiter.'

944 All published in Rochberg 1998.

945 BH 9 = NCBT 1231. First published in Beaulieu & Rochberg 1996.

946 I.e. 29 Dec. 248 BC.

[Merc]ury was in Capricorn; Saturn was in Capricorn;

[Mars] in Cancer.[947]

Another that preserves some interpretation of the planetary positions is BH 5 = MLC 1870 but in its case the predictions follow the astronomical information. BH 10 = MLC 2190, a horoscope of Aristocrates (235 BC), again opts to give predictions straight after the planetary longitudes: e.g. 'Venus in 4° Taurus. The Place of Venus (means): Wherever he may go, it will be favourable (for him); he will have sons and daughters.'[948] Nevertheless, too little survives to draw any conclusions on the interpretative nature of the Babylonian genethialogy. Sachs does conclude, however, that there must have been in existence general documents with lists of omens from which these apodoses were drawn.[949] TCL 6 14 gives some idea as to what these might have included: I quote an excerpt:

> If a child is born when the moon has come forth, (then his life? will be) bright, excellent, regular, and long. […] If a child is born when Jupiter has come forth, (then his life? will be) regular, well; he will become rich, he will grow old, (his) day(s) will be long.[950]

4.3 'Target Text' – the Hellenistic Horoscopes

The earliest Greek literary horoscopes, preserved in the fragments of Balbillos' *Astrologumena* and dating to 72 and 43 BC, narrowly overlap the last surviving cuneiform prototypes.[951] The earliest of the Demotic versions comes from 38 BC and is concomitantly the earliest attestation of the cardine points (below).[952] In structure they do not seemingly differ much from the Akkadian ones. The vast majority of the specimens is rather basic, simply recording the locations of the planets during the birth with more or less precision. To quote a random example from AD 212:

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[947] Trans. Beaulieu & Rochberg 1996: 91.

[948] Sachs 1952: 60.

[949] Sachs 1952: 61.

[950] TCL 6 14, trans. Sachs 1952: 67-70.

[951] CCAG 8.4, 232-8 & 240-44. Earliest monumental horoscope from the tomb of Antiochus in Nimrud Dagh dates to 61 BC (Neugebauer & van Hoesen 1959: 14-16). The Greek corpus currently amounts to a few hundred specimens altogether, published primarily in Neugebauer & van Hoesen 1959, Baccani 1992 and Jones 1999: 1.250-95, 2.372-447. For a list of those published elsewhere see Jones 1999: 1.308-309. The number of Demotic horoscopes is much smaller; publications include Neugebauer 1943 (5 specimens), Neugebauer & Parker 1968 (2), and Quack 2008/2009.

[952] Ash. D.O. 633, published in Neugebauer & Parker 1968: 231-4.

Good Fortune.] Nativity of …, year 14 of Hadrian[953]

Aelius the] lord, Tybi 19, hour 5(?) of day according to the Greeks.

Sun in] Capricorn 20°. Mars in Capricorn 10°.

xx'.] Mercury in Capricorn 3(?)° 3'. Moon in

Leo] 9° 25'. Jupiter in Leo 9°.

Saturn in] Scorpio [xx]° 2'. Venus in Aquarius [x]°…[954]

Yet, considerably more elaborate examples, which Jones has called *deluxe horoscopes,* exist:[955]

Fr. 1

Mercury

Stilbon, the star of Mercury, which has been allotted the

belt of the air, has been found making

its longitudinal motion in the

feminine, **tropical**, **terrestrial** sign Capricorn,

at 6 degrees 22 minutes of the sixty, its own **house**

and its own **terms**, single degree of Venus,

triangle of the moon shared with

Saturn, **exaltation** of Mars, **depression**

of Jupiter, ... from the **dodecatemorion**

fell in Pisces, the **feminine**

bicorporal sign, 14 degrees 12 minutes of the sixty.

Step 6, wind Lips, zodiacal place

Sagittarius, at the second change of direction of anomaly,

[953] I.e. AD 130.

[954] *Oxy*. 4239 (trans. Jones 1999: 2.377)

[955] *Oxy*. 4277 (trans. Jones 1999: 2.420-7; for discussion and notes 1.284-6). Late 2nd or early 3rd cent. AD. There is also an unusual horoscope in oGlasgow D 1925.96 from Medinet Habu, which says 'this is good' after every astronomical entry (Quack 2008/2009).

decan 1

Ascendant

The rudder called ‘ascendant; ...

steersman ...

accurately computed has been found making

its longitudinal motion in the

solid, masculine, royal sign Leo, at 22 degrees

11 minutes of the sixty, **house** of the sun,

terms of Mercury, **triangle** of Jupiter shared with

Mars, in segment 5, in step [x],

zodiacal **place** Virgo, in a **feminine** degree,

decan [3.

27- ii.2 **Setting point** [...] **Midheaven** [...]

ii.3-iii.8 **Lower Midheaven** [...] **Lot of Fortune** [...] **Lot of Daimon** [...] **Lot [of Eros?]** [...] **Lot [of necessit**y] [...]

Fr. 2 [...]

The second example mentions most key doctrines, which I have highlighted in bold, that characterise Hellenistic astrology but do not explicitly appear in the cuneiform horoscopes. Of these we shall now give a short overview to help the reader navigate the subsequent discussion.

The Greek system is, first of all, dependent upon finding the *ascendant* or the *horoscopos*, i.e. the degree of the zodiac rising above the eastern horizon at the moment of conception or birth.[956] It can also be defined as the point of intersection of the ecliptic with the Eastern horizon of any given location. The ascendant is the most important of the four *cardinal points* (or cardines) of the horoscope, the others being the *descendant*, i.e. setting degree of the zodiac, the *midheaven* (Medium Caeli), which as the name indicates is the culminating degree of the zodiac, and the *lower midheaven* (Imum Caeli, Hypogeion), which lies directly opposite it below the horizon. Such a system

[956] Man. 3.203-509 presents two methods (three but Brind’Amour 1983 has argued that the third, which is virtually identical to the first, is spurious).

naturally presupposes a spherical universe and so has no conceptual basis within the Babylonian tradition.[957] However, as the last chapter took pains to demonstrate, the methods by which the positions not only of the planets but also of the rising and setting stars (i.e. ascendant and descendant) were found were nevertheless taken over from Babylonia. Moreover, the way the necessarily calculations were presented in the *Anthologiae* is highly reminiscent of the Babylonian style mathematical step-by-step algorithms to be discussed in chapter five.[958]

The four cardinal points and the planets are marked on the birth chart as figure 7 shows.

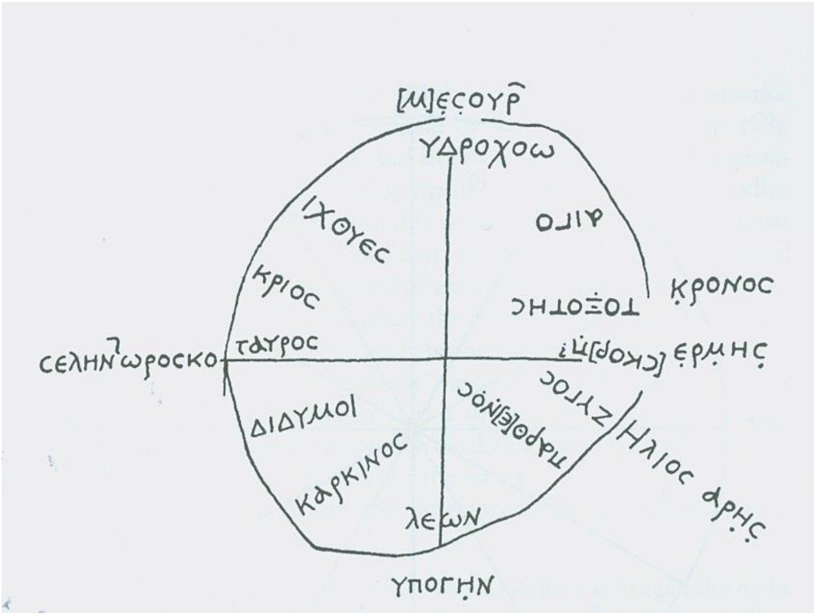

Figure 7: Papyrus horoscope (P.Oxy. 235; early 1st cent. BC).[959]

This chart is then given meaning by analysing the physical relationships between the planets and their more specific positions within the zodiacal signs. The first include *oppositions*, *triangles (trine)*, *squares (quartile)* and *sextiles*, but also *antiscia* and *contra-antiscia* (or seeing or hearing signs as they are sometimes known).[960] These aspects are best explained visually:

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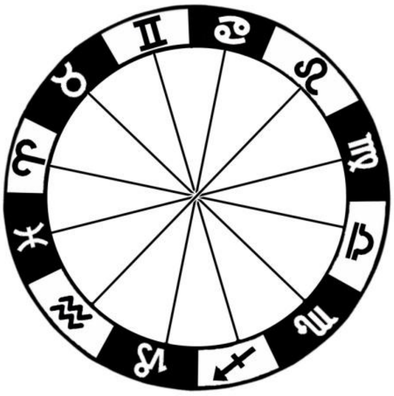
[957] Rochberg 2010: 7.

[958] The *Anthologiae* is riddled with examples, take for instance 1.4 on finding the descendant, 1.16K/15P on finding the ascending node.

[959] From Neugebauer & van Hoesen 1959: 18.

[960] For an explanation of all these aspects see glossary. Longer overviews on individual aspects e.g. in Ptol. *Tetr.* 1.18 and Man. 2.278-86, 673-83 on trines or Ptol. *Tetr.* 1.13 and Man. 3.395-443 on opposition. Also Gem. 2 and hearing and seeing signs in P. Mich. inv. 1 col. 12 (previously published as P.Mich. 148 in Winter 1936: 59-117).

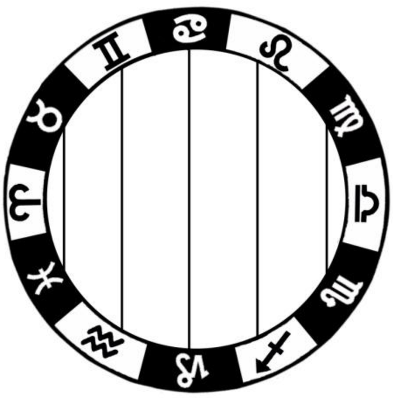


1. Oppostion

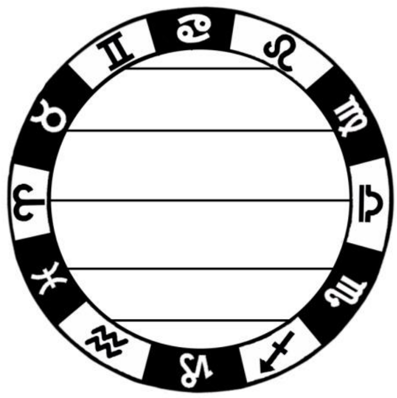
2. Trine aspect

3. Quartile aspect

4. Sextile aspect



5. Antiscia (audientia)[961]



6. Contra-antiscia (videntia)

Figure 8: Astrological aspects

[961] A slightly different system exists which takes as the reference line 0° Cancer / 0° Capricorn. Same for contra-antiscia with 0° Aries / 0° Libra, so eliminating the single signs.

Both the planets and signs are divided into categories and given characteristics which determine their influence and relations with each other. The illustrations above show the allocation of the signs into feminine and masculine groups (black signs with white background – masculine, white signs with black background – feminine). As the *trine* and *sextile* aspects bring together signs of the same gender, their influence is believed to be positive; *opposition* and *quartile* with the same reasoning are negative. Other categories involve segregation into nocturnal/diurnal (for both signs and planets), benefic/malefic/mixed (planets), fertile/sterile/mixed (signs) sects etc.[962]

Contemporary astrologers also made use of smaller divisions of the zodiac. These include the decans (3 per sign, 10° each), the terms (5 per sign, unequally distributed) and the dodecatemories (12 per sign, 2.5° each[963]). Every smaller division is assigned a 'ruler' known as the *chronocrator*. Hence in the example information like 'the *dodecatemorion* fell in Pisces'. This is usually a planet but as will be discussed below may also be another sign. The entire sign 'ruled' by the planet is known as its *house.* As there are more signs than planets, the five planets are assigned two houses each, one for the day (solar) and one for the night (lunar).[964] Each planet also has a zodiacal degree, known as an *exaltation* (or *hypsoma*), in which its power is the greatest.

There are, in addition, specific degrees and regions in the zodiac which have special effect on certain areas of the native's life. The ones given in the above example include the *Lots* of Fortune and Daimon, which are degrees determined by the distances between certain planets at the moment of birth. The *places*, on the other hand, are 30° segments, visualised as a fixed wheel rotating through the zodiac. The starting point of the *place*-wheel is usually calculated from the ascendant.[965]

Despite the lack of any attestation of these concepts in the cuneiform horoscopes above, it has become increasingly clear over the last half a century that many still have their origin in Mesopotamia. The most straightforward evidence is the idea of exaltations as places where the planets have their most potent influence. The equivalent idea of the Akkadian *bīt/ašar niṣirti* ('house/place of the secret') dates back at least to the 7th cent. BC when it is first attested in the

[962] Valens distinguishes over 20 ways to group the signs but not all of them form a coherent system that cover all 12.

[963] Interpretation varies in individual authors, see Barton 1994a: 97.

[964] See glossary for the distribution.

[965] Again see glossary for more information.

inscription of Esarhaddon and in a star list from Sippar.[966] The first records the *ašar niṣirti* as particularly favourable. It is also one of the earliest astrological doctrines attested in Egypt, in the temple of Khnum at Esna (c. 200 BC).[967] As the table below demonstrates, the locations of the Hellenistic *hypsomata*, although more particular, are clearly based on the Babylonian prototype.

Planet	***ašar niṣirti***[968]	**Esna A**	**Hypsoma**
Sun	Aries	Aries	19° Aries
Moon	Pleiades (Taurus)	Taurus	3° Taurus
Jupiter	Cancer[969]	Cancer	15° Cancer
Venus	Pisces/Leo	Pisces	27° Pisces
Saturn	Libra	*Libra*[970]	21° Libra
Mercury	Virgo	*Virgo*	15° Virgo
Mars	Capricorn	Capricorn	28° Capricorn

Table 11: Exaltations in Babylonia, Egypt and Greece

Geminus, who gives the earliest description of the system of aspects in Greek, associates it explicitly with the 'Chaldeans' and correlates the trines with the four winds.[971] This is paralleled by BM 36746, which has already briefly been considered and quoted above as exhibiting a number of traits used in the Hellenistic tradition.[972] In it eclipse predictions are given in relation to the four winds and applied to one of the four lands,[973] following the traditional system of the shadow movement across the

[966] See Rochberg-Halton 1988b: 53-57. Pingree (in Reiner & Pingree 1975-2005: 3.14) suggests that the system might well go back to around 1000 BC.

[967] Esna A (Neugebauer & Parker 1969: 62-4). Also in Dendera B (*ibid.,* 72-4) and partly in Esna B (1st cent. AD) (*ibid,* 82-4).

[968] Where the *bīt niṣirti* is mentioned in the horoscopes it does not accord with the system attested in other sources and given in the table. The term must serve a double meaning. See Rochberg 1998: 46-50.

[969] For slight problems with Jupiter see Rochberg-Halton 1988b: 55.

[970] Scorpio, Virgo and Libra do not survive but Saturn and Mercury must have been placed in these signs.

[971] Gem. 2.5-11 ('Signs in opposition are considered by the Chaldeans in connection with sympathies in nativities'); Pliny, *NH* 2.81 associates the quartile aspect with the Babylonians ('…and to be caused by the stars moving with the sun, or being in conjunction with it, and, more particularly, when they are in the quartile aspect'). Both may go back to the same source, Pliny lists all key astrological authors, including Epigenes and Critodemus (but not Berossus) and Posidonius as sources for book 2.

[972] See p. 123 & 170.

[973] Akkad, Subartu, Elam or Amurru. In the contemporary political climate these were probably equated with

lunar disc. However, what is significant here is that the omens are organised into groups of three according to the zodiac signs. The association of the signs and winds is highly reminiscent of Geminus' equivalent applications.[974] Moreover, tablet TCL 6 13 includes a geometrical illustration of a circle, divided into four equilateral triangles, structurally identical to fig. 8.2 above. However, the triangles connect not the signs as in Greek horoscopes but months and associated planets according to a yet undeterminable scheme.[975] It is therefore unlikely that the specific example depicts a trine aspect as we find it in the Hellenistic sources but there is enough evidence to conclude that both the idea of set of tree signs and an equivalent geometrical schema were used by the Babylonian scholars.

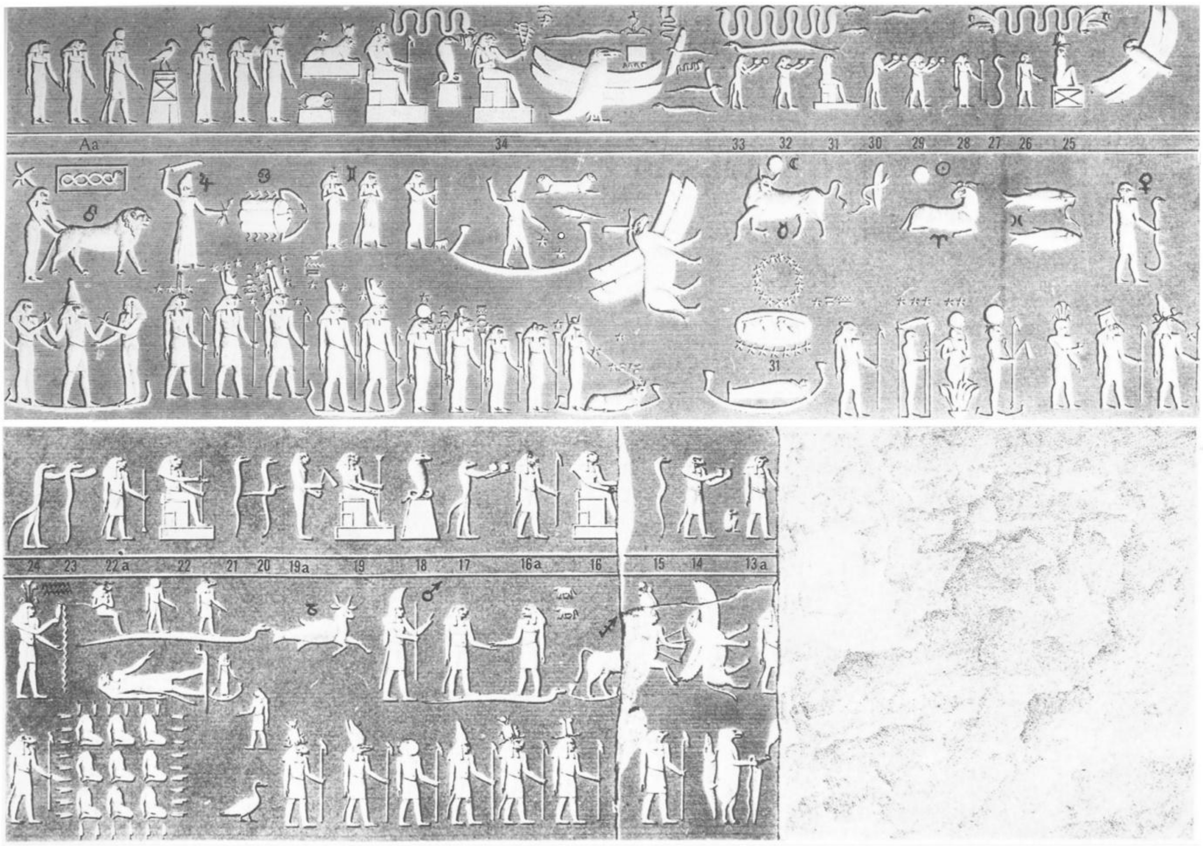


Figure 9: Ceiling of Esna A depicting the decans, zodiac, and planets in their exaltations[976]

Babylonia, Assyria, Elam and any chosen country in the West of Mesopotamia (Hunger & Pingree 1999: 16). The country affected is the one associated with the quarter that darkened first. Connection with the regions is reminiscent of the later Hellenistic tradition of chorography (Rochberg-Halton 1984: 129).

[974] Gem. 2.7-11 gives: Aries – Leo – Sagittarius (N); Taurus – Virgo – Capricorn (S); Gemini – Libra – Aquarius (W); and Cancer – Scorpion – Pisces (E). For BM 36746 see Rochberg-Halton 1984: 121. The correlations between directions and the four lands are Akkad – N; Elam – S; Subartu – E; Amurru – W.

[975] Rochberg-Halton 1987: 226-8.

[976] From Neugebauer & Parker 1969: plate 29.

Moreover, another text gives the triplicates of months,[977] and also determines them as either 'male' (odd numbered) and 'female' (even numbered) - a designation identical with the division into feminine and masculine signs as shown on the illustrations above.[978] Similarly Babylonian-derived is the division of planets into benefics (ἀγαθοποιοί/*damqat*) and malefics (κακοποιοί/*ḫaṭât, laptat*).[979] This division is connected to the sequence in which the planets appear in late cuneiform tradition:[980]

Jupiter	Venus	Mercury	Saturn	Mars
	Favourable		Unfavourable	

Figure 10: Favourable and unfavourable planets

In Greek tradition Mercury assumes a mixed influence and the planetary order is based on the distance from the earth (as used from Eudoxus onwards).[981] This change in the preferred planetary order in Hellenistic astrological texts presents a nice example of how Babylonian material was adapted to local tradition. A demotic ostracon from the Roman period shows that astrological material had initially been transmitted with the standard Babylonian order: the planets in it are given in relation to gods and the zodiac to months of the Egyptian calendar as it stood at about 250 BC.[982] It is also the earliest evidence of the zodiac in the Egyptian context.[983]

The *dodecatemoria*, i.e. the subdivision of the 30° signs into 12*2½°, has grown out of the Babylonian microzodiac, which also divides the signs into equal parts and assigns other parts of the zodiac to

[977] The *Excerpt* text in CCAG 8.2 shows that the EAE-type omens were catalogued according to months and only later according to signs, showing that these two were easily interchangeable. Moreover, the list starts with April, which began the Mesopotamian year (hence also the beginning of zodiac with Aries) (Williams 2008: 305-6).

[978] LBAT 1593. Rochberg-Halton 1987: 228 n.22.

[979] E.g. TCL 6 13 (obv. ii 1-4 & 11-28). These aspects are also indicated by the designation of Mars as 'Enemy' and that of Jupiter as 'Heroic' (Reiner 1995: 3-4).

[980] Rochberg-Halton 1988c: 323-8. The order is the one followed in Seleucid astronomy (e.g. in the almanacs) and in the horoscopes. In some texts Mars and Saturn appear in the reversed order. The list is completed by the Moon and the Sun.

[981] For quick discussion of other planetary orders used in Greek and Demotic sources and especially their point that the use of these is not as consistent as some wish to think, see Greenbaum & Ross 2010: 151-3.

[982] Ost. Strasbourg D 521. See Neugebauer & Parker 1969: 217 & 236.

[983] Greenbaum & Ross 2010: 156.

these (i.e. Aries of Aries, Taurus of Aries etc.).[984] The concept is best, although not exclusively, attested in medico-astrological texts.[985] The segments are also sometimes associated with a city, tree, plant or stone, and occasionally accompanied by apodosis-like omens, mentions of cultic events or hemerology-style lists of activities to be either undertaken or avoided.[986] Some of these associations have been found in Hellenistic astrology.[987] The correspondences in these texts are very obscure but according to Hunger some are evidently 'based on the creatures forming the zodiac as it was in use in Hellenistic times.'[988]

However, as the last section already demonstrates, there are other sub-disciplines of astrology which stemmed from Mesopotamia. The tradition of associating the deities with different regions of the world is well attested in the cuneiform record.[989] The most basic format of the astrology-laden associations is the assignment of the four cardinal and wind directions, eclipsed quadrants of the moon, watches, certain days of the month and so on with the four countries (Akkad, Elam, Subartu and Amurru). The NA and LB sources have allowed Weidner to reconstruct a list of cities assigned to 22 different constellations.[990] The ready adoption of the system on behalf of the Greeks must have been accommodated by the existing interest in the effects of climate on people's appearance, customs and character.[991] Nevertheless, as the choice of cities in Weidner's list is very Mesopotamia specific, we should not be surprised to find that particulars of chorographical association find almost no counterpart in the later Hellenistic tradition which shows great fluidity in its attempt to

[984] Neugebauer & Sachs 1952-3: 65-6.

[985] Twelve such texts are known - for a full list see Hunger 2007: 145.

[986] E.g. VAT 7851, VAT 7847 + AO 6448, BM 34572 or BM 56605. Also see the other associated *Kalendertexte,* which bond signs with the same things. W 22704 has already been mentioned above in connection with Pliny (p. 91). For the list and overall description see Hunger 2007: 147. On the popularity of the menologies and hemerologies, see Robson 2004: 65-9, who shows that they formed an active and important part of the Mesopotamian everyday life. Connected to this is Reiner's (1995: 108-12) discussion of the *lunaria* (an early form of catarchic astrology) and its Babylonian origin.

[987] Geller (2010: 56-9) has fleetingly shown that BRM 4 20 shows similarities between Babylonian medical and later Hellenistic astrology and Reiner (1995: 59-60; also see Geller 2010: 64-80) that the idea and elements of Hellenistic *melothesia* was present in Babylonia (e.g. in Babylonia Jupiter is associated with spleen, Mars with kidneys; compare a similar system in CCAG 7.216, 5 & 6.83, 9-13). Rochberg (2010: 7) finds that the association of planets and parts of the body in the style of *melothesia* is a clear borrowing from the cuneiform tradition. Other systems of *melothesia* exist, notably the decanal one.

[988] Hunger 2007: 147.

[989] E.g. RA 60 73 7-10 (seas and rivers serving Enlil, Ea and Šamaš).

[990] Weidner 1963.

[991] As discussed on p. 39.

incorporate ever-expanding geographical horizons into the existing general scheme. Surviving Greek and Latin examples display significant variations in their respective attempts to divide the known world into *climata* with different astral patrons but they all seem to be influenced by local ethnographical considerations.[992] Yet, Rochberg has shown how one relevant mention by Ptolemy, tying the Chaldeans and Orchinians (i.e. Babylonians and Urukeans) to Leo and the sun 'so that they are simpler, kindly, addicted to astrology', is akin to an association of Akkad (i.e. the same area) with the same zodiacal sign in a list of cities and lands from Uruk.[993]

From all this we can conclude that astrology retained many of its Babylonian features even after it was transferred to the West and was adapted there to new cultural and scientific paradigms. Moreover, by the time we first get extended records of Hellenistic astrology there clearly exists a sort of astrological vulgate of methods from which to draw.[994] The next chapter concentrates on the questions of how Hellenistic astrologers first become acquainted with this material, when and where the canonisation took place and what effect this had on the originally Babylonian ideas.

4.4 Transmission

4.4.1 The Egyptian Mirage

Greeks attributed interest in the heavenly sciences with pretty much equal vigour to both Chaldeans and Egyptians. The modern view leans towards seeing the link with the latter as an extension of the Oriental wisdom discourse. Although it is fairly certain that Hellenistic astrology as such originated from Egypt, its exact nature and the way it fitted into both the Greek and the indigenous cultural contexts is spurious. I argue that the earliest layer of Babylonian astrology, that is the EAE-style omens, indeed moved to Greece through Egypt and that the Egyptian temples formed the focal points of astrological practice during the Late Hellenistic and Roman periods, but the question of the direction of cross-cultural transfer in the interim period is considerably harder to establish.

The earliest direct evidence for the transmission of Mesopotamian astrological lore to Egypt comes

[992] See appendix 3.

[993] VAT 7847 obv. 11 (+ AO 6448). Rochberg 2010: 1.

[994] Barton's remark (1994a: 78) is relevant here, that the astrological authors often seem to be 'not gradually refining or even elaborating a method but, rather, indulging in free improvisation on certain themes.'

from a 3rd cent. BC[995] mortuary statue of Harkhebi from Buto,

> Hereditary prince and count, sole companion, wise in the sacred writings, who observes everything observable in heaven and earth… who announces rising and setting at their times, with the gods who foretell the future, for which he purified himself in their days when Akh [decan] rose heliacally beside Benu (Venus) from earth and he contended the lands with his utterances; who observes the culmination of every star in the sky, who knows the heliacal rising of every… [section on Sothis and the Sun]… knowledgeable in everything which is seen in the sky, for which he has waited, skilled with respect to their conjunctions(s) and their regular movement(s); who does not disclose (anything) at all concerning his report after judgment, discreet with all he has seen...[996]

Several mentions in the text are reminiscent of Babylonian astronomy-astrology. The rising of Venus in the decan of Akh could be a potential reference to its exaltation, the culmination of every star in the sky is reminiscent of the *ziqpu*-stars and the heliacal rising of the stars doubtless to the decans which have a parallel in the Mesopotamian astrolabes. But equally important hints are given by the non-astronomy-related parts of the inscription. Harkhebi was a priest of Sekhmet, a type of medical priest specialising in addition to astral sciences in the treatment of snake bites and scorpion stings. Moreover, his duties probably also included advising the king on when it was safe to travel.[997] Taken together his responsibilities included those of the traditional Egyptian 'hour-priest'. This office is attested already in the Middle and New Kingdom texts as *wnw.tì* (lit. 'he from the hour') and *ỉ m.y wnw.t* ('he who is within the hour') respectively.[998] The duties of these priests included keeping time by observing the decanal stars at night with the help of a special measuring rod called in Egyptian 'the palm leaf of the hour priest' and determining lucky and unlucky days. Such hemerologies, however, were then not based on astrology but on mythological considerations instead; there is no

[995] Date given in Neugebauer & Parker 1969: 214. According to Dieleman (2003b: 280 n.25) Derchain has dated the Akh and Benu reference to the second half of the 2nd cent. BC but I have no access to his article and hence cannot assess his claims.

[996] Cairo JE 38545, trans. Neugebauer & Parker 1969: 214-6. For a full translation of the text (Neugebauer & Parker's one is restricted to the astronomical material) Clagett 1995: 495-6.

[997] Clagett 1995: 492.

[998] Dieleman 2003a: 138; 2004b: 278. See Moyer 2011: 237 n. 113 for a list of known figures. However, the astronomical interests of these priests were limited and the Egyptian situation was not comparable with the systematic records of Babylonia. For an overview of pre-Hellenistic Egyptian astronomy see Parker 1974: 51-61.

reference in Egyptian mythology to ideas of astral prognostication at all.[999] This is more or less corroborated by Herodotus' remark that

> these other things have been invented by the Egyptians: to which of the gods each month and day belongs, and what kinds of things a man born on a certain day will encounter, and how he will die, and what kind of person he will be. Those of the Greeks engaged in poetry made use of these.[1000]

What Herodotus has in mind by the last sentence must be the hemerology-style list at the end of Hesiod's *Works and Days*.[1001] Clement of Alexandria's testimony, moreover, shows that the 'hour-priests' continued to occupy an important place in the temple administration down to the late Roman period and that the insignia associated with the office remained traditionally Egyptian: the ὡροσκόπος (or ὡρολόγος) is said to have been carrying a ὡρολόγιον and a φοῖ νιξ ἀστρολογίας.[1002]

Now according to Clement it was these 'hour-priests' who also had to memorise the ἀστρολογούμενα of Hermes: four books containing (1) the arrangement of the fixed stars, (2) the movement of the sun, moon and the planets, (3) encounters and illuminations of the sun and moon (i.e. syzygies and phases), and (4) the rising of the stars.[1003] A library list from the Ptolemaic temple of Edfu, built between 145 and 116 BC, records the existence of books entitled *Knowledge of the Periodic Returns of the Two Celestial Spirits: The Sun and the Moon* and *The Governing of the Periodic Returns of the Stars.*[1004] Moreover, *The Book of Nut* (or *Fundamentals of the Course of the Stars*), an Egyptian theological-astronomical treatise from the New Kingdom period survives in five hieratic manuscripts and two demotic commentaries.[1005] All these books probably contained a mix of

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[999] Dieleman 2003a: 139-40; 2003b: 278-8.

[1000] Hdt. 2.82.1.

[1001] Hes. *Works and Days*, 765-824 provides a substantial list of good and bad days not only for certain tasks but also on births. A few entries predict the character of the people born on a specific day (e.g. 792-3).

[1002] Clement, *Strom.* 6.4. Cf. Chaeremon of Alexandria *FGrH* 618 F6 (= Porphyr. *On abs.* 4.8, '…the *horologi*, or calculators of nativities'), P. Hibeh 1.27 iii 41-6 ('The astronomers and sacred scribes (ἱ ερογραμματεῖ ς) use the lunar days for the setting and rising of the stars') which is duplicated in P. Paris 1 iii 8 (= the 'Eudoxus papyrus' or 'Ars Eudoxi'). A 6th cent. BC sundial-like instrument, owned by 'hour-priest' Horus, is adorned with an inscription reading 'I know the course of the sun, the moon and all stars to their site.' Together with a sight rod from a date palm frond it served to determine the hours according to the position of the stars (Berl. Mus. No. 14085 and 14084 respectively).

[1003] Ibid.

[1004] Clagett 1995: 491.

[1005] All published in von Lieven 2007. For an analysis of the astronomical content of the text see Leitz

Egyptian and Mesopotamian astronomy.[1006]

An inscription from the statue from the Sobek temple at Khenty enhances the evidence of what it entailed to be a 'star-watcher' and adds a dimension of more personal astrology:

> [I have been designated among the chiefs] of men, the guides of the country chosen by the king. One will not find anyone more favoured than I, [since] telling the hour conforms to the desire of the god so that he [i.e. the king] may give the order to erect constructions [such as temples, at the right time]. [My duties include] announcing to man his future, telling him about his youth and his death; telling the years, the months, the days, and the hours, the course of every star by the observation of its path… I have been an astronomer (*wnwnw*) in the temple of his lord. [I] Senty, son of the same Pen-Sobek, justified.[1007]

Both Harkhebi's and Senty's positions within the Egyptian society are highly reminiscent of those of the Babylonian scholars in the royal circle: a member of the priesthood, concerned with astral observations and medicine, giving advice to the king.[1008] In brief, the overall nature of the Egyptian priest not just as a religious official but also as the keeper of astronomical, medical and magical knowledge meant that there was readily available in Egypt both a 'space' where the new information from the East could be inserted, and people who would show some familiarity with the fields in question.[1009] This is very different from the situation in Greece, where, as we saw in the chapter on astronomy, such a 'space' had first to be opened up.

Yet the type of astrology that Harkhebi practices is distinctly of the judicial kind, the kind that the earliest layer of the Nechepsos and Petosiris tradition is concerned with.[1010] Indirect evidence that such astrology had been introduced into Egypt much earlier comes from a 2nd cent. AD demotic

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2008/2009.

[1006] Jones 1994: 42-4.

[1007] Trans. Clagett 1995: 490. Another statue from the Ptolemaic period (3rd/2nd cent. BC) of one 'Ashaikhy, born of Isetweryt' gives an unparalleled epithet of an astronomer as 'the one who knows the sky' (Depauw 2001: 1-2).

[1008] On Egyptian priests and sacerdotal medicine see e.g. Ghalioungui 1973.

[1009] Jones (1996: 145) too has pointed out that the Mesopotamian sciences were 'maintained by roughly the same kind of practitioners before and after the transplantation, and surely conveyed from Mesopotamia to Hellenistic Egypt by these same people.' On Egyptian divination see von Lieven 1999. An interesting magical charm directed at Hecate Ereshkigal (a Babylonian goddess of Hades coupled with Hecate or often also with Kore-Persephone) is P.Mich. 154.

[1010] Moyer 2011: 241.

papyrus copy of two earlier texts concerning the eclipse and lunar omina applied to Egypt and its neighbouring countries (including Crete, Syria, Amor and the Hebrews), which Parker has dated to the Persian period.[1011] Moreover, Ryholt has now restored the name of Nechepsos, which is mentioned as a source for the information and which Parker had originally interpreted as Darius, in this very document.[1012] Demotic P. Cairo 31222 also records omens that apply to Egypt and its neighbouring countries in relation to the rising of Sirius when the planets are in the opposing signs of Sagittarius or Gemini.[1013] It comes from the same tradition as the material in Hephaestio of Thebes derived from Nechepsos and Petosiris (below).[1014] Another text from the same genre is BM 10661 from the Ptolemaic period, which makes a reference to the land of Syria and a ruler of Pelem and the death of a Persian king.[1015]

Moreover, the biographical inscription of Udyahoresne, the chief physician of Darius I (521-486 BC), records that he was sent back[1016] to Egypt 'in order to restore the establishment of 'the house of life' (*pr.ᶜnḫ*) - - -, after it had decayed'.[1017] 'The house of life' was the temple's cultic library and scriptoria, where ritual texts were composed, copied and kept. Such reorganisation undertaken on the orders of foreign rulers might potentially have led to the introduction of new extraneous material, especially Mesopotamian omens into Egypt.[1018] An earlier exchange of ideas cannot be ruled out either: Egyptian scribes (*harṭibi,* from Egyptian *ḫry-tb*) are attested in the NA court and a comparison with the Jewish scribes described in Daniel 1:4 indicates that they might have been taught the local learning.[1019]

[1011] P. Vienna D 6286, published and analysed in Parker 1959. The Babylonian material in it was adapted to Egyptian conditions.

[1012] Ryholt 2011: 63.

[1013] Hughes 1951. The papyrus is very badly preserved. There arre a number of mentions of Egypt, Syria and at least one more country, perhaps Parthia.

[1014] Although the predictions are not identical (Hughes 1951: 257).

[1015] Andrews 1992: 13-4.

[1016] Udyahoresne first served as a naval officer under Amasis and Psammetichus III but was made a courtier, priest of Neith and chief physician by Cambyses and evidently based in Persia when Darius I assumed power. The text dates to the early years of Darius (Lichtheim 1980: 36-7).

[1017] Vat. Mus. 158 §43, trans. Lichtheim 1980: 37-40. For possible reconstructions of the lacuna see *ibid.,* 41 n.17.

[1018] Dieleman 2003a: 145 & 2003b: 281.

[1019] CAD gives *harṭ ibi* as an 'interpreter of dreams'. The word appears in SAA 07 001 = ADD 851 rev. i 12- ii 6, which records the court personnel, including astrologers, lamentation priests etc. The two sections give

According to Greco-Roman and early Jewish accounts, however, astrology was first brought to Egypt by the Jewish forefather Abraham who came from the 'Ur of the Chaldees'.[1020] This claim perhaps reflects an attempt by the Jews, who formed a sizable population group especially in Alexandria, to weigh in on the current popular intercultural debates and claim some of the prestige that association with the origins of astrology promised (more on this below). As part of this movement, there were astrological texts allegedly circulating under the name of Abraham: Valens cites him as an authority and Firmicus Maternus refers to specific 'calculations' of Abraham when talking about the positions of the Sun and the Moon.[1021] However, at least Valens seems to lack direct access to any such text and references them through the intermediacy of a certain Hermippus. This man is probably Hermippus of Beirut (2nd cent. AD) - a prolific Jewish author and a student of Philo of Byblos - who is cited in connection with Abraham by Eusebius.[1022] Hence I would not rule out that the *astrologumena* of Abraham were entirely fictitious.[1023]

4.4.2 Nechepsos and Petosiris

Are we perhaps facing a similar phenomenon with some of the arguably 'Egyptian' material? More

'[…]guršî; Ra'sî' Ṣiḥû; total, 3 Egyptian scholars (*ḫar-ṭ i-bi*). Huru; Nimmarau; [Hu]ruaṣu; [total, 3] Egyptian scribes (A.BA-MEŠ *mu-ṣur-a-a*).' The LÚ.A.BA.MEŠ kur*Mu-ṣu-ra-aju* also appears in ND 10048 rev. 9 between scribes from Aššur and those of Aramaic (see Kinnier Wilson 1972: 62-3, 138). Moreover, a 'Puṭ iš[iri, Eg]yptian' is recorded in SAA 07 005 rev. i 20 (= ADD 857) from Nineveh. Greenbaum & Ross (2010: 176-7) have attractively proposed reading Petosiris. In Egypt the *ḫry-tb* was involved in the production of texts and the performance of temple rituals and was also an expert in certain mantic practices. For the mutual influence between Mesopotamia and Egypt see Noegel 2007: 103-5. Contacts between Egypt and Mesopotamian civilisations of course existed much earlier and exchange of literature is attested in the Amarna archive (see Izre'el 1997 for all cuneiform scholarly tablets in the Amarna collection, esp. EA 356 = VAT 348 – the myth of Adapa and the South Wind; and EA 357 = BM E29865 – the myth of Nergal and Ereškigal). More tentative are exchanges in oneiromancy and hemerology (Noegel 2007: 95-106).

[1020] Josephus claimed that Abraham was first mentioned in this role by Berossus (*BNJ* 680 F6) although not by name: 'In the tenth generation after the flood there was among the Chaldeans a righteous and great man, experienced also in heavenly things'. This is probably a misreading, not to say deliberate. Eus. *Ev. Praep.* 9.17-18, allegedly from Alexander Polyhistor and Artabanus but I doubt that, must have been influenced by Eusebius' reading of Josephus.

[1021] Vett. Val. 2.28K/29P & 2.29K/30P. The reference is to his distribution of operative chronocratorships and travel. Firm. Mat. 2.493-4, 543, 631.

[1022] *Ev. Praep.* 9.19.

[1023] For a list of sources and discussion of Abraham in Greco-Roman tradition see Siker 1988. Similar pseudephigrapha are attributed to Zoroaster (Vett. Val. 9.3K/4P – teachings on successful and unsuccessful days and life in relation to the Moon) but in the light of our discussion at p. 78 this is perhaps not surprising.

particularly with parts of the *Astrologumena*,[1024] an 'eigentliche Astrologenbibel'[1025] as it is often described, but in reality by the Roman period perhaps a slightly looser corpus of texts circulating under the names Nechepsos and Petosiris, or 'the ancients' (οἱ παλαιοί) as they were known together, written in the mid-1st cent. BC, in iambic senarii,[1026] which must have served a mnemonic purpose.[1027] Our current view of these alleged founders of Hellenistic astrology has been extensively reconfigured thanks to new discoveries (rare though they now are). The material found by Ryholt among the unpublished demotic papyri has finally allowed for positive identifications, albeit only for the literary personae rather than historical authors behind the books. Added efforts by Dieleman, Moyer and Heilen have also opened up new dimensions in the discussion of the literary and cultural context within which their work was situated.[1028]

Nechepsos, or 'the King' as he is habitually referred to, had for long been tentatively recognised as pharaoh Necho II (610-595 BC) of the 26th dynasty.[1029] Some confusion was caused by Manetho's insistence that there were two separate kings: Nechepsos (ruled 6 years) and Neckhao (8 years) but Ryholt has recently proved that the first - *Ny-kꜣ.w pꜣ šš* - is just a rendering of the latter with an additional epithet 'wise', thus confirming Eusebius' claim that Necho was also called Nechepsos.[1030]

[1024] Vett. Val. 2.3, 3.14K/11P & 9.1K/2P (including the mentions of volumes entitled *Definitions (*or *Terms)* and *Factors (Oroi)* attributed to Petosiris alone). Fragments were first collected by Riess in 1892. For an up-to-date list, which now amounts to 82 fragments, see Heilen 2011: 31-4. Where I refer to additions to Riess's collection in Heilen, the fragments are marked with a '+' sign).

[1025] Boll, Bezold & Gundel 1977: 24.

[1026] The dating is confirmed by the use of the iambic trimeter (for examples and potential reconstructions see Heilen 2011: 38-80, although note that some of the allegedly direct quotations that Valens provides are in prose (*ibid.,* 81)), which was first used in didactic poetry by Apollodorus of Athens (c. 180-110 BC; *FGrH* 244), followed by Pseudo-Scymnus (ed. Diller 1952: 165-76.) in the 130s BC. So Heilen (2011: 36) deduces that the Nechepso literature must date to around the same period and the author of the *Astrologumena* could have been associated with the library of Alexandria, and 'maybe even an acquaintance of Apollodorus'. Further evidence for a mid-2nd cent. BC date is summarised in Moyer 2011: 233-4.

[1027] Yet Valens often (e.g. 3.12K/9P, 7.3K/4P, 8.5, 9.1P, 9.2K/3P) criticises the ancients and Critodemus for their obscurity and artificiality of style, which he finds deliberately clouds the truth from the students. Although it is possible that disparaging old treatises was part of Valens' programmatic agenda, I do not think we can rule out the possibility that the texts were riddled with archaisms or even that the choice of wording was deliberately alienating. Such a choice could have been carried by an intention to give a more ancient character to the texts.

[1028] Dieleman 2003a, 2003b, Moyer 2011, Heilen 2011.

[1029] The spelling of the name varies is different sources, including *Neceus, Nechao, Necho, Notopso.* See Gundel 1966: 28 and Pingree 1974: 547, and also Heilen 2011: 27-9, who argues that the variant adopted by the author of the *Astrologumena* was probably *Nechepsos*, hence its use here as opposed to the more common form Nechepso.

[1030] Manetho, *FGrH* 609 F2, F3a-c. Ryholt 2011: 64-7. For earlier theories on Nechepso see Ryholt 2011: 63-4 or

Among the seven demotic sources that mention Nechepsos[1031] is an unpublished story forming an introduction to an astrological manual from the Tebtunis temple library that narrates how a block of stone fell out of the wall and revealed a papyrus that contained an astrological treatise by Imhotep.[1032] The text was interpreted and presented to the king Nechepsos by the sage Petese.[1033] Hence Petosiris can now be identified with the deified legendary priest Petese about whom a whole series of narratives were composed in Demotic Egyptian as early as the 4th century BC.[1034] This renders futile attempts to recognise Petosiris as any of the historical persons bearing that fairly popular name.[1035] It is perhaps not a coincidence, though, that barring the earliest of the 'tombs of Petosiris' all others are adorned with astral symbols. The now lost tomb near Aṭ fih from c. 150 BC, for instance, had a ceiling covered with traditional Egyptian depictions of the sky, and Petosiris himself was drawn with five stars around his head and another five around his left arm.[1036] The Dakhla tomb (early 2nd cent. AD) also had a zodiacal ceiling, much like those in the so-called 'zodiac tombs' of Athribis and Sâlamûni although more personal and nuanced.[1037]

The motif of the story – a priest revealing divine knowledge to the king - is recognisably Egyptian.[1038] The Nechepsos and Petosiris literature thus applied an indigenous strategy to endow 'their texts with

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Moyer 2011: 232, esp. n. 83. Ryholt (2011: 67) believes that Eusebius' information comes from the so-called Sothis Book.

[1031] Ryholt 2011: 62-3.

[1032] P. CtYBR 422 verso – P. Lund 2058 verso (1st or 2nd cent. AD).

[1033] Ryholt 2011: 62.

[1034] Ryholt 2011: 70 says that the names Petesis and Petosiris are very similar in the demotic script, separated only by a divine determinative, also Heilen 2011: 30 and see Quack 2002: 89-90. The Petese series have been published by Ryholt in 1999 and 2006. The oldest versions come from the Sacred Animal Necropolis at Saqqara; so the texts were actively copied for over half a century.

[1035] A number of men bearing that name are attested in the archaeological and literary record. There are 3 known 'tombs of Petosiris': the earliest, belonging to a priest of Thoth and a royal secretary, is located in Tuna el-Gebel, west of Hermopolis and dated to c. 320 BC. For a translation of its biographical inscriptions, none of which allude to astral interest, see Lictheim 1980: 45-8. For other tombs see n. 1036 & 1037. *P. Hibeh* 1.72. (c. 241 BC) mentions another Petosiris, a high priest of Herakles in Phedichis; another appears on O. Cairo JdE 67047 and O. Wien DO 284, both from 243 BC. Petesis too continued in use: Alexander appointed a man bearing this name as one of the governors of Egypt (Arrian 3.5); it appears also, e.g., in a mysterious early Roman signature (Bernard 1969 no. 308).

[1036] Daressy 1902: 160-80, Neugebauer & Parker 1969: 64-7, 216.

[1037] Whitehouse 1998: 262-5. For the 'zodiacal tombs', see Neugebauer & Parker 1969: 98-102.

[1038] Moyer 2011: 244-5.

divine and royal authority, and an Egyptian pedigree'.[1039] Theirs is not an isolated case: the medical section of a handbook on snake bites from the Ptolemaic period is said to be based on an ancient manuscript found during the reign of Nefer-ka Re.[1040] The form of pseudo-epigraphic literary letters of instruction from a sage to a king were used in the Hermetic tradition and related literature.[1041] And it is very much the same narrative framework that appears in the work of Thessalos (below), the preserved letter of (pseudo-)Petosiris and by extension Manilius too. Another recurring motif, e.g. in the works of Manetho, and in Isis and Sarapis aretologies among others, is the claim that these texts were translations of Egyptian originals, which in some cases is definitely true.[1042] On the other hand, Dieleman and Moyer have found that, at least in the case of aretological material, both in terms of form and content, this is drawn from both Egyptian and Greek traditions, grounded in the mixed cultural milieu of Ptolemaic Egypt.[1043]

The alleged work of Imhotep, however, as discovered by Petese, consisted of twelve books, so Heilen has suggested that the books 13-15 – the only ones ever mentioned by number in the later texts – might have been a purported continuation of this tradition.[1044] Book 13, which Valens says gave an outline of the zodiacal signs would have actually been the first of the cycle in question. Whether the first twelve were entirely fictitious or referred to already existing Egyptian astronomical compositions like those mentioned above is difficult to say. Later astrologers attribute to Imhotep-Asclepius the system of the *places.*[1045]

But why Nechepsos? Ryholt and Moyer believe that the association of astrological literature with Nechepsos was devised during the Ptolemaic period. Ryholt has identified two interconnecting fragments of papyri that present a story, designated in modern literature as the *Neue demotische*

[1039] Moyer 2011: 245-6.

[1040] Dieleman 2003b: 280.

[1041] For a list of examples see Moyer 2011: 247 n.160.

[1042] Dieleman & Moyer 2010: 434-5

[1043] Dieleman & Moyer 2010: 442-4, and 430-2 for a short overview of the linguistic, literary, intellectual and cultural contacts between Egyptians and Greeks in Ptolemaic Egypt. Manetho's work also provides a good example of knowledge moving between Egyptian temple and Greek literati, as do the hymns of Isidorus.

[1044] Heilen 2011: 24.

[1045] Vett. Val. 9.2K/3P ('Asclepius, beginning with this topic [i.e. XII Places], composed the most; then many Egyptians and Chaldeans did likewise'). On the possibly Egyptian origin of 'places' see p. 199 below. P. Mich. inv. 1 col. 9 confirms that 8 places were ascribed to Asclepius. Riley (n.d: 47 n.17) says that a *De Horoscopo* of Asclepius is known.

Erzählung, of a scribe who in an appeal to the king says that he wrote an obituary on the previous pharaoh, whose death was preceded by an eclipse.[1046] The deceased king turns out to be Psammetichus and the living one Nechepsos; hence Ryholt speculates that the story of his ascent to the throne might account for his association with the astral omens in the later tradition.[1047] Moyer has argued that

> In the wider Mediterranean discourse on astrology, Nechepso could serve to contest the authoritative position and priority of the 'Chaldeans' as founders of the art. But while the astrological authority of Nechepso may have become implicated in a more general Greek exoticizing discourse on Egyptian wisdom, the specific choice of Nechepso was originally an Egyptian choice intended to 'Egyptianize' astrology.[1048]

Astrology had obviously gained considerable popularity by the mid-2nd cent. BC by which time the question of its origins had become a politically charged *topos* around the Mediterranean and beyond. If Diodorus' remarks that 'according to them [the Egyptians] the Chaldeans of Babylon, being colonists from Egypt, enjoy the fame which they have for their astrology because they learned that science from the priests of Egypt', that is indisputable testimony to the struggle for the title of 'first discoverer'[1049] of astrology and to the prestige, respect and favour this association promised.[1050] That the 'Egyptian mirage' was created to the advantage of Egypt was already proposed by Bouché-Leclerq.[1051]

The 'egyptianization' of astrology played on outward appearances that would please the Greek élite who supposedly played judge and jury in this game. Hence, despite its Egyptian narrative framework and exotic subject matter, we can expect the *Astrologumena* to be equally deeply rooted in the Greek tradition. Heilen's study of the senarii has shown that 'the preserved fragments were written at least partially in Greek verse, presupposed good knowledge of the major Greek dramatic authors

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[1046] P. Berlin P. 13588 + P. Carlsberg 710 recto.

[1047] Ryholt 2011: 68-70; supported by Moyer 2011: 233 and Heilen 2011: 26.

[1048] Moyer 2011: 242. The strategy was certainly successful, later astrologers continually refer to a number of methods and tables as being 'Egyptian', e.g. Titus Pitenus, the author of the horoscope in P. Lond. 1.130 ascribes to the 'Egyptian men of old' the 'aeon-tables' (i.e. probably the templates) that he used for computing the planetary positions.

[1049] On Greek fascination with the *prōtos heuretēs* see Kleingünther 1933.

[1050] Diod. Sic. 1.81.6. See p. 188 for Abraham and the participation of the Jews.

[1051] Bouché-Leclerq 1899: 564.

from the classical period, and drew upon elements of Greek physics, mathematics, and astronomy.'[1052] I wonder in connection with this clearly Greek orientation, if the choice of Nechepsos is not similarly carried by political considerations, bearing in mind that the audience for the piece was quite decidedly Greek. Perhaps it is not a mere coincidence that Necho II is also one of the first pharaohs to appear in the Greek historical accounts: Herodotus records him dedicating gifts to the sanctuary of Branchidae-Didyma, perhaps in return for military assistance.[1053] On the other hand, he is also the same pharaoh to whose reign the earliest attestation in Egypt of a water-clock and a daylight-scheme have been, if very tentatively, dated.[1054]

However, returning to the work itself, the surviving fragments of the purported books of Nechepsos and Petosiris show that these texts were concerned with a whole array of astrological subfields, forming an umbrella work that covered all aspects of contemporary celestial divination. They outlined the elementary astrological principles (planets and their aspects, rising times of the signs, 'bright degrees' and 'bright fixed stars'), astral omina from eclipses, comets, Sirius phenomena etc., the horoscope of the world (*thema mundi*), genethialogy, catarchic astrology, iatromathematics including astrological botany and decanal medicine, astral magic and numerology.[1055] In addition, Keyser has argued that there must have been a treatise, or at least a section, on cometary prognosis.[1056] More particular knowledge and doctrines attributed to the two include the Egyptian system of the decans, values for planetary orbits, magnitude of the lunar orbit, terms, the relationship between the Moon's position at conception and birth, ascendant, Lot of Fortune, length

[1052] Heilen 2011: 24.

[1053] Hdt. 1.81 & 2.159. Two Greek weapons found in Carchemish have been interpreted as evidence for Greek mercenaries fighting for Necho II in the battle of Carchemish against Nebuchadnezzar II of Babylon in 605 BC (Braun 1982: 49; for photos see Niemeier 2001: 19-20 figs 2 and 3), hence the speculation on the dedications (Greaves 2010: 92, 155).

[1054] Neugebauer & Parker 1969: 44-8. In their opinion the two may come from a same workshop in Tanis. The slab records four lists, including two tables of lengths of day and night (table II) that uses the max. daylight length of 14h (from a 7:5 daylight ratio; still used in the Hellenistic period for this latitude) but a non-corresponding minimum of 9⅓h instead of 10h. Hoffmann (forthcoming a) finds that it uses a 3:2 scheme as used in Mesopotamia instead. Neither does it follow the linear zigzag pattern one would expect to see were the table derived from a Babylonian prototype. Neugebauer and Parker suspect that this is caused by an incorrectly applied arithmetical process as its basis (as opposed to observations), as the equinoxes are spaced exactly 6 months apart, concluding that it was 'poorly computed and poorly copied'. Hoffmann (forthcoming a) agrees that a date from the 26th dynasty is sensible and argues that the text fits the cuneiform tradition much better than local Egyptian models.

[1055] See Heilen 2011: 25 for the list of particular fragments pertaining to each category.

[1056] Keyser 1994: 625.

of life calculations, critical points of life, house rulers, operative months, and the *catarchai* (i.e. the prediction of the course or the outcome of an event based on the configuration of the stars at the beginning of the event in question).[1057] Generally then, most of the key features that characterise 'Hellenistic astrology' and its various subfields, especially genethiaology, were quite firmly in place.

Most extensive, however, is the material on the interpretation of eclipse, comet and Sirius and planetary omens – exactly what we have seen constituted the Egyptian astrological 'home repertoire' in the Ptolemaic period.[1058] The fragments come largely from the late antique astrological authors like Hephaestio of Thebes and John Lydus, who ascribe them to Petosiris but often present some radical reworkings of the source material. Nonetheless, there is enough evidence to conclude that these omens must have been developed by the Egyptians in the Achaemenid and Ptolemaic periods from the Mesopotamian prototypes:[1059] similarities with Babylonian astral omens are still easily observable.[1060] Moreover, the parallels are not only seen in respective eclipse, earthquake and thunder omens but also for example in the correlation of planets and colours.[1061] Williams has provided a very useful comparison of the Mesopotamian colour tradition with that found in Hephaestio and Lydus,[1062] but to her material must be added an equivalent section from Valens'

[1057] Getty 1941 has argued, based on Lucan 1.651ff, that the *catarchai* were known and used by Nigidius Figulus (98-45 BC).

[1058] The Greek view of Egyptian astrology even nearly a century later confirms the continued importance of general astrology: 'And while they are often successful in predicting to men the events which are going to befall them in the course of their lives, not infrequently they foretell destructions of the crops or, on the other hand, abundant yields, and pestilences that are to attack men or beasts, and as a result of their long observations they have prior knowledge of earthquakes and floods, of the risings of the comets, and of all things which ordinary man looks upon as beyond all finding out' (Diod. Sic. 1.81.5, also 1.50.2). See also Long's (2003) discussion on the nature of astrology in this period as known to the Greeks and Romans, especially his insistence that Cicero's arguments against the art, no doubt derived from Panaetius and Carneades, and the simplicity of his example in *De Fato* 8.15, point towards general astrology and not yet so much to its horoscopic derivative (2003: 339).

[1059] For evidence for an Egyptian import, see e.g.: Heph. *Apotel.* 1.22 where omens are applied mostly to Egypt, although 1.21 refers to nearly 50 different countries; the division of the night into 4 x 3 hours, instead of the 3 x 4-hour watches as in Mesopotamia, is paralleled in the Vienna Papyrus (n. 1011)).

[1060] Pingree 1974: 547. Heph. *Apotel.* 1.21-3, 25; Lydus *de. Ost.* 9; and the so-called *Excerpt* text in CCAG 8.2 which mirrors Heph. 1.21; both must rely on a common source, the *Excerpt* being closer to the original (Williams 2008: 296-7).

[1061] For the latest analyses see Williams 2008: 295-314. She discusses among other things the use of the four-quadrant eclipse scheme (see n. 973 & 974 and p. 182), the association of eclipses with shooting stars, division of the night, and the concept of *adannu* (see glossary). Closest in content to the material preserved in the abovementioned sources is EAE 16 but many omens must come from other sources or be later developments. She finds that the most likely sources were commentaries or adaptations of the original EAE omen texts.

[1062] Williams 2008: 297-300.

Anthologiae, in which the author explicitly states that 'the Ancients were correct in comparing the stars to colours' and gives the same key associations (esp. Jupiter = white, Saturn = black, Mars = red/orange).[1063] It is perhaps even more noteworthy that he adds a comment on Saturn that 'the god is slow, and therefore the Babylonians called it Phainon <Illuminator>, since everything is illuminated in time' (Kronos = Chronos) and when discussing Mars that 'the Egyptians called it Artes <The Hook>, since it is the diminisher of goods and life.'[1064] One can recall here Seneca's report that Epigenes, who allegedly studied among the Chaldeans,[1065] gave Saturn special pre-eminence among the heavenly bodies.[1066]

Another important topic, however, is medical astrology. The purportedly autobiographical section of *De Virtutibus Herbarum,*[1067] a popular work on the horoscopic herbs ascribed to Thessalos,[1068] relates how the author, while browsing the libraries of Alexandria, came across a work of Nechepsos, 'containing twenty-four remedies for the entire body and every disease, according to the zodiac, by means of stones and plants'.[1069] But he adds that 'having prepared the 'solar pill' (τροχίσκον ἡλιακόν), much admired by him, and the rest of the medicines, I failed in all the treatments of

[1063] Vett. Val. 6.2K/3P.

[1064] *Ibid.*

[1065] See below p. 213.

[1066] Sen. *NQ* 7.4 & 8.

[1067] Translation of the Madrid Manuscript (*Codex Matritensis Bibl. Nat. 4631)* of *De virtitibus herbarum* in Moyer 2011: 287-92.

[1068] Various other traditions attribute the same text to Hermes Trismegistus, Orpheus, Alexander the Great or Harpokration of Alexandria (see Moyer 2011: 211-3, esp. n.9). Cumont (1918) took Thessalos to be the 1st. cent. AD Methodist physician Thessalos of Tralles but this identification has been contested on the basis that nothing in it accords with what is otherwise known of him (Tecusan 2002: 61-2). Moyer (2011: 211-9, 293-7) has recently re-evaluated the evidence and found that it is probably not a pseudepigraphical text but simply written by a man bearing the same name as the famous doctor, and, based on the analysis of the astronomical material in the text, assigned it a date around AD 100-150 (cf. Nutton, s.v. 'Thessalos [6]' in *BNP* (4-6th cent. AD); and Pingree 1976: 83 (3-4th cent. AD)).

[1069] *De virt. herb.* prooem. 6. Other evidence that Nechepso was an authority on iatromathematics comes e.g. from F 27-28 Riess (= Firmicus Maternus 8.4.13-14, 4.22.2), F 29 (= Galen *De Simpl.* 10.2.19) and F 30-31 (= Aetius of Amida 1.38, 2.19). In addition, less direct reference in Juvenal's 6th satire (= T 4): '…if there is a sore place in the corner of her eye, she will not call a slave until she consulted her horoscope; and if she be ill in bed, deems no hour so suitable for taking food as that prescribed to her by Petosiris'; cf. Reiner 1995: 35-9 for when medicine has to be administered according to Mesopotamian practices. Pingree (1974: 548) thinks that beside the treatise on astrological botany there was also one on decanic medicine. It is also worth remembering Pliny and his *Dreckapotheke* here (p. 91).

illness.'[1070] Later on, the god Asclepius gives the reason for this failure as follows:

> King Nechepso, a man of most sound mind and adorned with every virtue, did not obtain from a divine voice anything which you seek to learn; having made use of a noble nature, he observed the sympathies of stones and planets, but the times and places in which it is necessary to pick the plants, he did not know. For according to the seasons, everything waxes and wanes with the emanation of the stars; and that divine, most refined spirit which exists throughout all substance especially pervades those places where the emanations of the stars were in the time of the cosmic nativity.[1071]

Thessalos, then, agrees with Nechepso's correlation between signs and plants but supplements him by applying to them some more complex astrological rules, especially a version of the doctrine of chorography.[1072] Hence Moyer has seen the treatise as being not so much a rejection or reversal, but a unique transmission and completion of the wisdom of Nechepsos.[1073] Thessalos' approach to his subject matter and its presentation reveal several important aspects of the contemporary astrological tradition. First, it leads us to question the cultural identity of the authors of the *Astrologumena*. As in the case of Thessalos, Greco-Roman writers of the Hellenistic and Roman periods could and would easily make use of foreign motifs and strategies to gain authority for their own work. So, were 'Nechepsos' and 'Petosiris' Greek or Egyptian? And dependent on that, who can we really credit with the introduction of 'Hellenistic astrology', especially horoscopy? Answers to these questions are not straightforward. On the one hand, Egyptian temples were the locus of astral sciences over a substantial period of time and much of the evidence pertaining to horoscopy comes from a temple context. The material from the Sobek temple in Tebtunis has been mentioned already; the Carlsberg papyrological collection, a significant part of which comes from there, has a great

[1070] *De virt. herb.* prooem. 7.

[1071] *De virt. herb.* prooem. 27-8.

[1072] He brings an example of hemlock, which 'rose from the emanation of Mars that at the cosmic nativity cast its ray in Scorpio' (i.e. Scorpio is the day house of Mars). Scorpio, in turn, is related to the *klima* of Italy and also to Crete (prooem. 29-34). Thessalos' association of Scorpio and Italy finds no parallel in Manilius, Dorotheus, Ptolemy or Valens, but does in Paul of Alexandria (4th cent. AD), whose list has been compared to the list of nations in *Acts* 2:9-11 (first in Weinstock 1948; cf. Metzger 1970: 131-3); and also in Hipparchus and 'the ancients' although there it is associated with only one part of the sign. No match is found for Crete. See appendix 3.

[1073] Moyer 2011: 229-30.

number of unpublished astrological fragments in Demotic.[1074] Moreover, although only an estimated 1% of the material from there is in Greek, this is made up of two medical treatises and two astrological calendars, one of which is secondarily inscribed with Egyptian texts but the other is written on the back of a demotic astrological manual.[1075] The temple of serpent-goddess in Medinet Madi (Narmouthis) has yielded a significant number of 2nd cent. AD Demotic and Greek ostraca with both astronomical and astrological content.[1076] Less direct proof is offered by a number of the temple ceilings that were adorned with depictions of the zodiac.[1077]

That Greek and Demotic texts have been found in the same temple deposits suggests that the translation of the texts was most probably done by the Egyptian priests.[1078] The bi- or even trilingualism of the priests is also evident in the so-called 'Theban Magical Library' which consists of magical handbooks and alchemical treatises in Demotic, Greek and Old Coptic.[1079] However, the only astrology-related text in this series, a ritual for casting a horoscope, raises the question of the actual direction of the translation.[1080] The manuscript gives instructions of the ritual in Demotic but an accompanying prayer in Greek. Moreover, a few of the Demotic words are supplemented with Greek glosses. The nature of these glosses has led Dieleman to argue that the text was probably composed in Greek and only then translated into Demotic.[1081] However, the story is more complicated.

[1074] Jones 1994: 40-1. Ryholt (2005: 147, 152-4) says that scientific texts make up about a quarter of the material, c. 60 manuscripts altogether; 45 of these are concerned with divination, mostly with astrology but also with dream interpretation; the rest are astronomical, medical, wisdom texts, plus one mathematical and one legal manual.

[1075] Ryholt 2005: 142-5. Ryholt estimates that rest of the deposit is 63% Demotic, 32% Hieratic, and 4% Hieroglypic. Many of these texts are actually written on the other side of reused documentary Greek texts but these have been excluded from the count as they served no purpose of their own in the temple library context.

[1076] Jones 1994: 39-40. Some of these have been published by D. Baccani ('Appunti per oroscopi negli ostraca di Medinet Madi I & II' in 1989 and 1995, *APapyrol* 1 and 7 respectively) but her work remains inaccessible to me at present.

[1077] E.g. Temple of Khnum (Esna; see n. 967), Temple of Montu and Raʿt-tawi (Armant, 1st cent. BC), Temple of Hathor (Dendera).

[1078] Jones 1994: 44-5, Moyer 2011: 217, 236.

[1079] In terms of the narrative literature as well, Dieleman & Moyer (2010: 441) have concluded that 'there were also clearly some individuals, predominantly among the indigenous élite, who could participate in both communities, and they were undoubtedly the ones producing translations of Egyptian narratives or composing new ones in Greek. In such texts, it is possible to detect continuities with Egyptian narrative literature, but also efforts to translate these traditions for a Greek audience while exploring new literary possibilities and complexities of a dual Greco-Egyptian readership.'

[1080] PDM 14, 93-114.

[1081] Dieleman 2003a: 148-50 & 2003b: 282-4.

Although the astrological elements in the ritual are 'Hellenistic' in nature, the basic structure of the ritual is Pharaonic. It is also ascribed to Imhotep, which is not at all surprising considering his close association with astrological knowledge, but it again shows that the 'author consciously inscribes the ritual into an Egyptian tradition.'[1082] P. Louvre 2342 (P. Salt) too says that Nechepsos and Petosiris transmit knowledge from Hermes and Asclepios, or 'Imouthes son of Hephastios', i.e. Imhotep the son of Ptah.[1083]

Nevertheless, another text discussed by Dieleman also uses Greek glosses.[1084] As these are technical terms – μοιρολόγος (trans. in Dem. 'one who foretells fate') and χρονοκράτωρ ('dominant heavenly body') – he has concluded that they are included because Egyptian language lacked an appropriate terminology that could express these foreign concepts.[1085] This would then suggest that horoscopy was adopted by native Egyptian priests in the late period and not developed by them. However, the Egyptian priesthood was obviously very willing to take on board such developments.[1086] Frankfurter has suggested a possibility that the priests might have deliberately acted out the role assigned to them by the wider Mediterranean discourse in order to gain social and political advantage and prestige, or simply because the economic restrictions created by the reorganisation of the temple administration pushed them to find additional sources of income.[1087] If this holds then the new kind of astrology was successfully translated into the indigenous Egyptian context and came to form a strong element of the local élite's identity and self-representation. The astronomical-astrological material from Egypt collected by Neugebauer and Parker shows a very clear tendency to use very traditional depictions of the sky in their mortuary practices throughout the Ptolemaic and Roman periods.[1088]

[1082] Dieleman 2003b: 284.

[1083] Ryholt 2011: 71 identifies Hermes as Amenhotep son of Hapu.

[1084] Demotic ostracon OMM 1156 from the temple of Narmouthis.

[1085] Dieleman 2003b: 277, 284-5. Cf. speculation by Ross (2008) that the *twr* attested in early Demotic horoscopes might be Akk. DUR, but as he himself admits, there is not sufficient evidence and both terms remain too much of a mystery to make a positive identification.

[1086] Moyer 2011: 238-9. This tendency is also evident in the astronomical material as discussed in ch. 3.4.2. Further examples include P. Berlin 13146 and 13147 that calculate the eclipses using the Calliptic cycle. For foreign influences on Egyptian names of the planets, esp. Jupiter, see Goebs 1995: 218-21.

[1087] Frankfurter 1998: 198-237. For potential economic gain see Valens (7.1P, 7.5K/6P) and the ostracon just discussed OMM 1156, 12-15 from a temple context, which mentions that an astrologer will make ten obols minus the costs.

[1088] E.g. the 'zodiac tombs', see n. 1037 above.

Further indication that the initial translation of Babylonian horoscopy did not happen via Egypt is provided by the fact that the earliest attested zodiacs, on which the entire horoscopic system was based on, show clear Greek mediation,[1089] and furthermore, that there is hardly anything beyond the decans[1090] in the Hellenistic system that is of Egyptian derivation. The only other example I have been able to find is the Egyptian lunar cycle with basic period relation 309 lunations = 9125 days = 25 Egyptian years underlying many numerological constructions in Greek astrology.[1091] However, Greenbaum and Ross have recently argued that the Egyptian traditions played an important role in the development of the interest in cardinal points and the dodecatropos (i.e. the places, above).[1092] From a later period, through Teucer and Rhetorios, comes the dodecaoros, i.e. a list of animals associated with each sign, which bears strong Egyptian markers.[1093]

Still, where does this leave us with Nechepsos and Petosiris? As with the astronomical material we have already discussed, the surviving horoscopes also date to the late Ptolemaic and Roman periods. The earlier evidence strongly favours the view that the nature of this astrological tradition was judicial, and I feel inclined to agree that astral omens became available to the Greek-speaking audiences through Egypt. However, this leaves the introduction of horoscopic astrology technically unaccounted for. So, who introduced the new form of personal astrology to this equation, and when?

4.4.3 Berossus

'Chaldean' was from the very beginning a byword for an astrologer. As much as knowledge of the

[1089] Hoffmann (forthcoming b).

[1090] The association between decans and zodiac signs occurs from early Hellenistic period on and is especially well attested as part of tomb and temple decorations. Teucer of Babylon's *Parantellonta tois dekanois* recorded the rising of the constellations simultaneously with each decan and was 'instrumental in the transmission of Hellenistic system of the decans' Rochberg writes (2005, s.v. 'Teukros of Egyptian Babylon' in *EANS*). The fragments preserve Egyptian and Babylonian names of the stars and constellations, testifying to his role as an intermediary between the two tradition. However, he is too late to account for the initial introduction of the Babylonian system: Rochberg (*ibid*) dates him to c. AD 30-100, Neugebauer (1975: 779) gives around AD 50. The former has also suggested he came from the Egyptian 'Babylon (Strabo 17.1.40), a town near or 'opposite' the Great Pyramids (Sethe, s.v. 'Babylon [2]' in *RE* 2.2699-700).

[1091] The 25 year cycle dates back to the 4th cent. BC, appears e.g. in P. Carlsberg 9, and was known to Ptolemy (*Alm.* 6.2).

[1092] Greenbaum & Ross 2010: 153-76. They find that rising and transit decans offer a precursor to the Ascendant and the Midheaven. Compare Hephaestio 1.167.1-4 with the system of the twelve places.

[1093] CCAG 7, 194-213; 5.4, 123-54.

stars is linked to the Egyptians, there is clear knowledge on the part of the Greek and Romans that astrology, especially personal astrology, hailed from Babylonia. Some of the evidence for the native Babylonian diaspora in Greece and adjacent areas has already been discussed in chapter 3.4.2; let us simply recall the names of Antipater, Sudines and Seleucus. The name, however, of greatest interest in the present discussion is that of Berossus, who is depicted by Greco-Roman authors as the actual man who first introduced the Western audiences to astrology.

As with Nechepso and Petosiris, recent discoveries allow a thorough reconsideration of the prevailing view of the persona and the aims of Berossus, one that tends to stand on a few key beliefs.[1094] It is universally held that Berossus' *Babyloniaca* (or *Chaldaica* as it is referred to by some excerptors) was written in Greek for Antiochus I (294-261 BC), perhaps partly under the patronage of, and in order to give ideological support to, the Seleucid dynasty.[1095] So it is also collectively accepted by modern scholars that the fundamental reason for the composition of the *Babyloniaca* was to persuade the Greek overlords and its élite of the great antiquity of Mesopotamian culture.[1096] Secondly, being allegedly strongly influenced by Greek historiography and ethnography[1097] as well as by Greek oral and written traditions on Mesopotamia, it is believed to have aimed to 'correct the Greeks'

[1094] Most fall back on opinions expressed by a few key authorities, e.g. Schwartz 1897, Kuhrt 1987a.

[1095] See a list of relevant authorities in de Breucker comm. to *BNJ* 680 T2. E.g. Cramer 1954: 14, Murray 1972: 208; Kuhrt 1987a: 33 although she argues that it cannot be determined whether the work was 'written under the royal patronage to provide a further strut in the structure of political propaganda.'

[1096] De Breucker 2003: 25-7. This is not least based on the fact that such tendencies can be observed in Manetho, and as we have seen in later Egyptian and Jewish (above, and Hecataeus of Abdera) authors. However, as Geller says (2012: 103), the 'Berossus-Manetho equation takes no note of the enormous differences between Seleucid Babylonia and Ptolemaic Egypt in the 3rd cent. BC.'

[1097] See e.g. Verbrugghe & Wickersham 2001: 25-6, De Breucker 2003: 26, Bichler 2004: 499, 507-15. The key arguments for Greek orientation and comparisons are: (1) self-identification at the beginning – cf. Herodotus; (2) a narrative account of the sacred myths – cf. Hellanicus and Pherecydes; (3) geographical description of Babylonia – cf. Herodotus again; (4) terms and descriptions typical of Greek classifications, e.g. the list of grains; (5) *historie,* i.e. material based on written evidence. Verbrugghe & Wickersham (2001: 16-8) believe that Berossus had no native narrative history to follow and he was thus writing in a form alien to the literary traditions of Babylon: 'even in the last stages of their civilization under the Neo-Babylonians or the Persians, [the ancient Mesopotamians did not develop] a narrative in any way similar to that which the ancient Israélites had in the biblical books of Samuel or Kings'. However, if Dalley is right about the Assyrian/Babylonian origin of some of the biblical narratives and others that circulated (ch. 2.3.2 above), then this argument is severely undermined. Eusebius (*BNJ* 680 F10) remarks on the style, saying that 'Berossus transmits brief summaries, one after another, of the reigns of the Chaldeans, just as Polyhistor writes his account in the same way.' And Tuplin 2013: 181 agrees that Berossus' is very much a narrative-free history. Verbrugghe & Wickersham (2001: 32) realise that Berossus did not exactly write a narrative that would adhere to Greek expectations but used this to explain his unpopularity with the Greek audience.

misapprehensions about Babylon and thus to enhance the image of the Chaldeans'.[1098]

Kuhrt has noted how as such it had 'curiously little impact' and it was not Berossus' (as the insider's) account of the history of his own country which came to form the basis of later classical views on oriental tradition' but earlier Greek versions which, as has been shown, had considerable gaps in them or were sometimes plain wrong, with some expansion as a result of new contacts.[1099] It was not until the first century BC that specialists on Mesopotamian history (e.g., Alexander Polyhistor and writers of *Assyriaca* such as Abydenus and King Juba of Mauretania) began to take note of Berossus' account.[1100] The earliest sources - Vitruvius Pollio, Pliny the Elder and Seneca the Younger[1101] – only mention Berossus in connection with his interest in the stars.

That Berossus was 'a priest of the god Bēl'[1102] was known from the Greek testimonia but now Bach has identified Berossus with a Bēl-re'û-šunu[1103] who is attested as a *šatammu* of the Esangila temple in Babylon in documents dated to 258 and 253 BC.[1104] He would have served at this highest of administrative positions in Babylon between those dates.[1105] This moves him down from the time of Antiochus I (281-261 BC) to Antiochus II (261-246 BC) and means that he was born not under

[1098] Drews 1965: 130, Teixidor 1990: 68. Compare Murray (1972: 209-10) saying exactly the same thing about Manetho.

[1099] Kuhrt 1987a: 33, followed by Teixidor 1990: 68 and Bichler 2004: 507 among others (see also Verbrugghe & Wickersham 2001: 27, 31-3 for possible reasons), and picked up as established fact by Beaulieu 2006b: 207. The view is based very much on *BNJ* 680 F8a (=Josephus *Apion* 1.20): 'Berossus gives this account about the above-mentioned king [Nebuchadnezzar] and many things in addition in the third book of his *Chaldaica,* in which *he censures the Greek historians for wrongly thinking that* Babylon was founded by Semiramis of Assyria and for falsely writing that the marvellous constructions within it were built by her' (my italics).

[1100] Drews 1965: 130-1, De Breucker 2003: 31. Berossus survives mostly in Jewish and Christian authors who used him, and other 'native' authors, with an agenda 'to demonstrate the truth of the Bible.'

[1101] Only a few allusions to Berossus can be found in Greek and Latin authors, although these seem to testify that he did enjoy some esteem among the Greeks and Romans: *BNJ* 680 T6 (Pliny, *NH* 7.123), T5a (Vitruvius *On Arch*. 9.6.2), T5b (Vitr. 9.8.1), T9 (Seneca, *NQ* 3.29.1).

[1102] Berossus T7 (Tatian, *Or. ad Graec.* 36).

[1103] The Akkadian form previously assumed was the singular Bēl-re'û-šu – Bēl is his Shepherd – as opposed to the one now found in the cuneiform Bēl is their Shepherd. The final u in šunu would not be pronounced (Bach 2013: 158). Various Greek spellings are attested because Akkadian *š* and *lr* sounds have no equivalents in Greek (Verbrugghe & Wickersham 2001: 13). For a linguistic analysis of letter equivalents in cuneiform forms of Greek names see Röllig 1960.

[1104] Bach 2013: 157-60. The 258 BC text names 'Marduk-šuma-iddina, a *šatammu* of Esangila, father of Bēl-re'û-šunu , a *šatammu* of Esangila. As Bach points out, the inverted filiation points to Berossus' great importance.

[1105] Boiy 2004: 199.

Alexander the Great, as so far presumed,[1106] but during the rule of the latter's son Alexander IV instead. His work is then brought down from the hitherto assumed 280 BC by couple of decades. As a high official of Babylonian temple economy he would also have received the education outlined in chapter 2.3.4.

Moreover, Geller has recently challenged the common conviction that Berossus wrote in Greek for a Greek readership, arguing that such a view is not substantiated by the available evidence but solely based on a circular argument that takes Berossus as both its start and end-point.[1107] He suggests that Berossus wrote in Aramaic for a local public[1108] and his work was only later translated into Greek,[1109] much like that of Josephus' first draft of the *Jewish War*. Hence he also proposes the possibility that Josephus, who made ample use of the *Babyloniaca*, instead of reading him through Alexander

[1106] Based on *BNJ* 680 T2 (Tatian, *Or. ad Graec.* 36, and Eusebius *Praep. Ev.* 10.11.8) 'Berossus… who was born in the time of Alexander, composed the history of the Chaldeans in three books for Antiochus, the third successor after him'. Schwartz (1897: 309) understood this to mean Antiochus II but thought that Eusebius had it wrong. De Breucher too in his commentary to T2 recognises that the 'third after Alexander' is problematic and Antiochus II would suit better but prefers Antiochus I on chronological grounds. Glassner (2004: n.3) prefers a date around 250 BC but gives no reason. Eusebius (*BNJ* 680 T1) gives 'of the age of Alexander, [son] of Philip' but such information dates to half a millennia after Berossus and its trustworthiness is questionable. Bach (2013: 159-60) suggests that Eusebius' reference could perhaps be altered to 'Alexander and Philip', making it refer to Philip III, the uncle of Alexander IV.

[1107] Geller 2012: 103. It is also relying on the belief that Ptolemaic Egypt and Manetho could provide a model for a comparable situation in the Seleucid Babylonia. But despite a similar practices of adopting double names (in Egypt demonstrated e.g. by the Hassaia stelae – see Dieleman & Moyer 2010: 446; for Babylonia see Boiy 2005 and n. 1491) and Greek rulers' investment in local religions, the contexts are really very different – see the next note.

[1108] Also see Geller 2012: 103-4 for the argument that Babylonia, unlike Egypt, lacked a large Greek-speaking audience and an Alexandria-like Greek intellectual centre at that period; 'no comparable Greek readership would have welcomed Berossus' *Babyloniaca* in Babylon itself, in such a few short years after the Macedonian conquest.' Moreover, the 'Hellenisation' of Babylonia seems to be confined to the Seleucid administration. Apart from the use of double names (a standard practice in Babylonia also during the Persian period) and the later Greco-Babyloniaca texts (ch. 2.3.4 above), there is almost no evidence of widespread Greek influence. Temple architecture retains the local style, no Greek inscriptions are known, no clearly Greek burials etc. See Sherwin-White & Kuhrt 1993: 149-61 for a longer discussion of the limits of Hellenisation in Babylonia.

[1109] Translation probably took place in Alexandria, where this was a common practice (Geller 2012: 104). Moses of Chorene, *Hist. of Armenia* 1.1 (*BNJ* 680 T4) seemed to have made this connection: 'many famous and illustrious men of letters from Greece have not only actively sought to have works that were housed in the royal archives and temples of other peoples translated into Greek, as we understand Ptolemy (II) Philadelphos urged on a Bersossos, a Chaldean, skilled in every discipline…' (trans. Verbrugghe & Wickersham 2001: 39-40) but his testimony has been hitherto dismissed (e.g. Verbrugghe & Wickersham 2001: 40 n.12). De Breucker removes the part about Ptolemy on the basis that its insertion was based on a Latin translation known to Jacoby, and translates: 'but also many famous scholars from the land of Greece were concerned not merely to translate into Greek the archives of other nations' kings and temples – as we find the ones who urged to this task Berossus, the Chaldean skilled in all wisdom…' instead.

Polyhistor's Greek abridgment, had access to its Aramaic original.[1110] The repercussions of Geller's theory to this study are hard to underestimate. In Geller's own words: 'the difference is crucial, since one reads Berossus differently if one thinks of it as a work written by a Babylonian for Babylonians,[1111] rather than for foreign consumption.'[1112] The idea that Berossus deliberately translated the local culture for the Greeks would be automatically invalidated; his aims require thorough reassessment and the focus would have to be shifted to the translation of his original text into Greek.[1113] It seems likely that Berossus can be situated in the local context argued for in connection with the Uruk list of Kings and Sages (the 'mythology of scribal succession', inspired, some believe, by thier diminishing political and social influence)[1114] in chapter 2.3.4.[1115]

The alternative view of Bach and Geller, deriving from the identification of Berossus as Bēl-re'û-šunu, is still very recent, and nothing can be said of its reception as of yet. Although very appealing, it is nevertheless plagued by significant contradictions. For instance, Josephus, whom Geller assumes could have had access to the Aramaic version of the *Babyloniaca* says that Berossus was 'famed among those who are engaged in learning, because he published for the Greeks works on astronomy and on the philosophy of the Chaldeans.'[1116] So, it certainly needs considerable elaboration and further analysis. However, even at this stage, it draws attention to how much the contemporary approach to Berossus has been conditioned by the assumptions we have mentioned (as already

[1110] Geller 2012: 104-8. It is unlikely that the original was written in Akkadian as it was no longer widely spoken in this period and 'since the proper names are usually badly corrupted and there are virtually no Akkadian loanwords recognisable in his text.' Although see p. 209-12 about Akkadian words in Greek lexicons.

[1111] Some insight into changing local identities of multi-cultural Mesopotamia is provided by Beaulieu 2006b although his section about Hellenistic Babylonia relies to a great extent on Berossus and related views outlined above. However, he does point out (2006b: 194-5) that the NB Empire saw the integration of Aramaic and especially Chaldean ethnic groups into the by that time waning minority Babylonian culture and religion, creating a common dominant identity. So, 'it is probable that the high culture of the Chaldeans remained Babylonian until the Hellenistic period', whereas Aramaic culture in his opinion remained largely oral, a language of communication and administration, but never 'a dominant cultural vehicle' (Beaulieu 2006b: 197, 208).

[1112] Geller 2012: 108.

[1113] For the translation of dates, geographical entities and certain terms (what Tuplin calls 'Hellenic veneer at a verbal level') see Tuplin 2013: 188-9.

[1114] Beaulieu 2006b: 206, for instance, claims that Berossus' 'chief interest is to demonstrate the cosmic centrality of Babylon and its destiny as navel of the world.' Doubtless true but is this not so for almost every society's mythology?

[1115] See Bach 2013: 163-77. Cf. De Breucker's (*BNJ* 680 F1b comm.) Greek 'first inventor' suggestion for the prolonged treatment of Oannes.

[1116] *BNJ* 680 T3 (=Josephus, *Ap.* 1.128).

shown in connection with the Hanging Gardens): the local intelligentsia, with its own literary history (even if nothing survives, surely comparable to the Demotic literature in Egypt) has effectively been written out of the equation by limiting statements like the following by Edwards:

> The conquests of Alexander had annexed to the Greek world a number of ancient kingdoms, whose usurping potentates were soon at war. Nation was thus induced to compete with nation, and the works of such men as Berossus, Manetho and Hecataeus of Abdera are the progeny of cultures with long histories which had suffered the eclipse of political power. On the one hand, those cultures sought the esteem of foreign masters, correcting the disingenuous representations by which they had hitherto been deceived; on the other hand, peoples who had been rivals for a millennium could be expected to strive as earnestly for literary pre-eminence as once for dominion over lands and men.[1117]

Although Edwards is doubtless correct in some aspects, views like his are still as Hellenocentred as they have ever been;[1118] despite appearances, they are not truly giving any consideration to the local Akkadian-Aramaic élite that was comparable to that of the indigenous intelligentsia in Egypt and still very much active in the Seleucid Empire. Their concern for preserving their cultural identity must have been at least as strong as their assumed wish to secure political influence. We assume that works like Manetho's and Berossus' are a contribution to the essentially Greek game of asserting cultural supremacy but historical tendencies would suggests that conquered peoples are just as much, if not more so, motivated by the need to reassert their own national identity for their own sake.[1119] It is, therefore, if only to achieve a more balanced view, necessary at least to consider the thought that Berossus' work is not directed to the Greeks but to the local élite. That Berossus did not adopt a Greek name could be a significant argument in itself.

It is only in an article published in 2013 that the extent to which Berossus engaged with Greek

[1117] Edwards 1991: 214, see also De Breucker 2003: 25, 27.

[1118] This leads to a prejudiced way of interpreting the fragments. E.g. Bichler (2004: 514) argues that Berossus' claim that Nebuchadnezzar 'taking thought for the fact that besiegers should no longer be able to turn back the river and array it against the city, ... surrounded the inner city with three walls and the other city with three' (*BNJ* 680 F 8a = Josephus, *Ap.* 1.131), is inspired by Herodotean tradition about Nitocris and Cyrus and the river-diverting episode, whereas a grounding in a similar local tradition is an equally valid possibility.

[1119] Dieleman & Moyer (2010: 436) have, for instance, found that the Demotic narratives composed and/or preserved by the indigenous priests fostered cultural and social Egyptian identity and served as role models from the more glorious pharaonic past, among other things.

historiography and a Greek audience at all was first seriously brought into question.[1120] And the author finds that in respect of both style and substance Greek tradition actually has very little bearing on the *Babyloniaca*.[1121] It shows that the transmission of the idea of writing a local history does not presuppose that the resulting text itself is dependent on particular predecessors. Or in other words, awareness does not guarantee direct engagement.[1122] On the basis of what can be inferred from the surviving fragments, we are dealing with a translation of a Greek idea into Babylonia where it then receives a distinctly local face, rather than with an attempt to translate Babylonian traditions into Greek historiography. There is very little evidence that Berossus ever made a deliberate effort to engage with the Greek traditions at all. The usually cited references to 'Greek fables' of the Hanging Gardens and Semiramis may be skewing our perspective on where the focus of the *Babyloniaca* actually lay (see ch. 2.3.3 again on this issue). Murray has attributed Berossus' 'failing' as a 'Greek historiographer' to include in his books the description of Babylonian customs to the fact that as a native he 'perhaps could not distance himself enough to be able to describe his culture from the outside, as a foreigner would see it.'[1123] However, considering all the above, it is an equally valid suggestion that he never aimed to do that in the first place. Berossus was aware of some aspects of Greek history-writing and especially the stories told about Babylon by the Greeks, and even alluded to these stories, but that does not mean his project was formed by these traditions.[1124] So in brief, Tuplin's work shows that what is 'not Greek' in Berossus, amounts to much more than what is 'Greek'; or in his words; '*as the evidence stands,* Berossus was not in this respect at the supposed Greek end of the spectrum of historical narrative.'[1125] The arguably 'cool' reception of his work in the Greco-Roman world would then be partly accounted for by the limited availability of the translation of his work, partly indeed by the fact that the material included in the *Babyloniaca* was of very little interest to the Greeks. Perhaps only parts of it, those that were of interest to the

[1120] See n. 1097 for the arguments used for the Greek link. They are all rather simplistic, perhaps enough to claim that we are sometimes too quick to say that something is a 'Hellenistic phenomenon'. That a local history aimed at the indigenous population might not have needed a geographical description is a fair point, but not a conclusive one. And Greeks surely do not have a monopoly on identifying oneself as author at the beginning of a book.

[1121] Tuplin 2013: 179-195. See esp. 192-3 for a comparison with chronicle and non-chronicle cuneiform texts.

[1122] In terms of awareness, Tuplin (2013: 194) supposes that Megasthenes could have been known to Berossus but perhaps more in a political context; his awareness of Herodotus is much more doubtful; some engagement with the Ctesian tradition is possible.

[1123] Murray 1972: 209.

[1124] Tuplin 2013: 186. This again applies to discussion on Semiramis and the Hanging Gardens.

[1125] Tuplin 2013: 191, author's italics.

Greek audience, had wider circulation.

These parts, as already mentioned, were above all concerned with Babylonian astral lore. Jacoby attributed these 'astrological' fragments to pseudo-Berossus, though whether the distinction of 'Berossus the astrologer' from 'Berossus the historian' actually holds is still debated.[1126] The contemporary supporters of the division hold that the former was a Greco-Roman creation. Kuhrt explains the creation process as follows:

> astrologer Berossus was created by Greeks using a figure who was known to have existed and possess exactly the right qualifications to provide the revelations they wanted: i.e. he was a priest of Bēl, a Babylonian, and writing in Greek a Babylonian history based on old records, but who had actually failed to do so. Some time in the first century BC when Babylonia formed a centrally important area of the Parthian empire and had shifted to the margins of Graeco-Roman world, the testimonials for Berossus and his by then little known work were exploited and he was transposed to Cos, where the hoary antiquity of his arcane material could be used to guarantee the genuineness of his predictions which may have consisted of little more than resuscitating out-of-date notions and adding an astrological element to existing ones.[1127]

This opinion is largely based on the fact that the fragments with astronomical-astrological material do not contain the 'expected', i.e. mathematical astronomy or anything else one is used to seeing in the cuneiform sources but, rather, material that allegedly reflects Greek concepts and ideas.[1128] The possibility that the *Babyloniaca* did include a section on Babylonian astral sciences as part of the discussion of the local culture is not in itself excluded by these authors.[1129]

[1126] Jacoby (*FGrH* 680). The divide has been contested by Schnabel (1923: 17-9), Drews (1975: 51-2), Verbrugghe & Wickersham (2001: 15), and Steele (2013); but affirmed by Kuhrt (1987a: 36-44) and De Breucker (*BNJ* 680).

[1127] Kuhrt 1987a: 43-4. She thinks the link with Cos comes down to the rivalry with the medical school of Eudoxus on Cnidos. Geller (2012: 101-2) supposes his works could have arrived there on their own and indeed initiated a new *disciplinam* as Vitruvius says (*FGrH* 680 T5a = *De Arch.* 9.6.2). In Drews' (1975: 51-2) view there is no real *raison d'être* for pseudo-Berossus.

[1128] E.g. Neugebauer (1963: 529) argued on the grounds of Berossus' 'primitive' account of the lunar theory that he could not have been well versed in Babylonian astronomy and cannot be held accountable for its transmission to Greece – a fair but unnecessary observation.

[1129] E.g. Neugebauer 1969: 151. Cf. the account of Diodorus quoted on p. 90 above. Drews (1975: 53) has suggested that the astronomical and astrological material came at the end of Book 3. De Breucker (*BNJ* 680 F15 comm.) finds it unconvincing and suggests that if any astrological overview was included, it must have been in

The discussion of Berossus as a source for Chaldean astronomical-astrological doctrines has therefore been skewed by excessively rigid labelling of the fragments in question.[1130] These include the theory that the moon has its own light.[1131] The earliest attribution of this concept to the Chaldeans comes from Lucretius (c. 97-55 BC) although he does not mention Berossus as a direct source.[1132] Yet the accounts are so similar that they must come from the same source.[1133] The other relevant idea attributed to Berossus is the theory of the conflagration and the flood that take place when the planets converge in Cancer and Capricorn respectively.[1134] Berossus' opinion that a man cannot live longer than 116 years is mentioned by Pliny next to the equivalent claims of Epigenes and Nechepsos-Petosiris.[1135] In short, what we have is primarily philosophical-cosmological material, rather than what we term astronomy.

I have identified a few problems with the supposition that one still finds of a pseudo-Berossus. First is an indiscriminate approach to most references to particular Chaldean astrologers as entirely fictional. The connection of Antipater with Greece is ignored by even most modern work on Berossus.[1136] This allows the whole testimony of Vitruvius to be brushed aside as a later rationalisation made to account for the transmission of astrological doctrines. Granted that Vitruvius should not be discounted, attention should also be paid to his assertion that Berossus initiated a new *disciplinam* on Cos and that he 'also revealed the Chaldean learning in Asia'.[1137]

The second is the refutation of the Babylonian origin of doctrines by statements along the lines of 'no cuneiform text gives such a description of the Moon.'[1138] Although technically true, it is misapplied here. As has been pointed out in chapters 3.2 and 4.2, cuneiform sources are notoriously renowned

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Book 1.

1130 Steele 2013: 109.

1131 *BNJ* 680 F18 (Cleomedes 2.4 BT), F19a, b, c Aetius, *De Plac.* 2.25.12, 2.28.1, 2.29.2 respectively), F20 (Vitr. *de Arch.* 9.2.1).

1132 Lucr. *De Rerum Nat.* 720-7. Same attribution, Apuleius, *de deo Soc.* 1.1.

1133 Steele 2013: 109.

1134 *BNJ* 680 F21 (Seneca, *NQ* 3.29.1).

1135 *BNJ* 680 F22a and repeated by F22b (see n. 869).

1136 E.g. De Breucher *BNJ* 680 T5a comm., also Verbrugghe & Wickersham 2001: 35 n.2.

1137 *BNJ* 680 T 5b: *Berosus, qui ab Chaldeorum civitate sive natione progressus in Asia etiam disciplinam Chaldaicam patefecit.*

1138 E.g. De Breucker in *BNJ* 680 F18, F19a comm. on the 'Moon fragments'.

for including absolutely no theoretical background. For all we (do not) know, the half-fire theory of the Moon could perfectly well be of Babylonian origin. In fact, Steele has shown that sufficient parallels for this belief do exist outside the strictly astronomical sources. He concludes that the model for Lucretius and Vitruvius is a mixture of Babylonian and Greek ideas – 'an attempt perhaps to clothe the Babylonian cosmology of *Enuma eliš* in Greek garb to make it understandable, or perhaps palatable, to a Greek audience.'[1139] Indeed, if the theory as it appears in the Greek sources has a Hellenistic guise and an earlier precedent,[1140] that does not automatically mean that it was of Hellenistic origin. Changes in the terminology and presentation could have occurred during its transmission through a number of sources, which inevitably involved a repeated process of 'translation', whether initiated by Berossus himself or not.[1141]

As for the cycles of world-destruction, any Babylonian connection has been similarly denied on the grounds that the idea appears in Greek sources[1142] long before it is attributed to Berossus and that there is once again no evidence for such a concept in the cuneiform texts.[1143] However, this last claim has been more recently called into question. Van der Sluijs has detected the joint motifs of destruction by a flood and fire with an added theme of stars changing their course, in the story of *Erra and Išum*. He argues that although essentially a poetic narrative tied to the contemporary political situation, it makes use of a motif derived from an old myth, perhaps part of the myth of world eras.[1144] That the motif, if it indeed was incorporated into the *Babyloniaca* in some form, is seriously reworked in Seneca is clear; it is indeed of distinctly Greek character, relying on the concept of planetary spheres which we have seen has no demonstrable equivalent in Babylonia. Furthermore, Lambert has suggested that the wording of the paragraph hints that the original did not use the plural, hence does not imply a cyclical world-view on the part of the Babylonians, but just one flood

[1139] Steele 2013: 111 & 114-7. Connection with *Enuma eliš* suggests a place in Book 1.

[1140] *BNJ* 680 F19b (Aetius, *De Placitis* 2.28.1): 'Anaximander, Xenophanes, Berossus say: it (the moon) has its own light.'

[1141] De Breucker *BNJ* 680 F20 comm. ('denying the spatial relationships between celestial bodies in terms of 'below' and 'above' is typically Greek'); cf. Steele (2013: 112-3), who finds the opposite, arguing that 'height' and 'depth' used to describe the situation, is an almost direct parallel to cuneiform. The accounts in Lucretius and Vitruvius are translations into Latin from a Greek text, which if Geller is right, was based on an Aramaic one.

[1142] It is arguably a typically Stoic concept and is common in Greek and Latin literature. See de Breucker *BNJ* 680 F21 comm. for references to relevant authors.

[1143] Lambert 1976: 172 n.5, Kuhrt 1987a: 39-40.

[1144] Van der Sluijs 2005: 7-19.

and one conflagration.[1145] So what we have here is perhaps once again better understood as a form of translation, with some added material, rather than an outright falsification.[1146] Opitz has suggested that the authors in whose work these allegedly Berossean ideas have survived draw their material from an already fragmentary rendering of what Berossus actually said.[1147] These out-of-context references were given new culture and ideology-dependent readings.

What we can infer from all this is that Berossus' work indeed introduced to the Greeks the core tenets of Babylonian intellectual, including genethialogical, tradition. There is no need to assume that it did much more than this. But as an introduction, it paved the way for the introduction of more technical elements. We can assume here a situation similar to what we have argued for astronomy: Greeks first had to learn the basics; transmission of mathematical particulars would have been nearly impossible in this period.

Some further insight into the kind of material transmitted by Berossus can be gained from Greek glossaries. Schironi has recently published an edition of fragments of the so-called *Oxyrhynchus Glossary*, which is unique in being primarily concerned with foreign, including Persian and Chaldean, lemmas.[1148] The surviving fragments mention Berossus twice and give three more references to what can be presumed to be his work on Babylonia.[1149] The lemmata for which Berossus is cited by name have unfortunately been destroyed[1150] but three 'Chaldean' words remain:[1151]

[1145] Lambert 1976: 172-3.

[1146] Cf. Schwartz 1897: 316 (Greek concept to which a 'typical' Chaldean method of astrological calculation has been applied).

[1147] Opitz 1932-1933: 46. He suspects the source to be Posidonius.

[1148] P.Oxy 1802+4812, Schironi 2009. The best preserved fragments give lemmata for letters λ and μ. The papyri has been dated to the second half of the 2nd cent. AD on palaeographical grounds, but as the works quoted in it do not go beyond the 1st cent. BC, we can expect the core of the work to come from the Hellenistic period (Schironi 2009: 5, 13).

[1149] Berossus: F 5.20; F 10a.9-10 (references to Books 3 and 1 respectively); Chaldeans (*On Babylon?*): F 3 iii.10, 14-15, 19-20. Plus F 5.6 'eyelids among the Chaldeans'. There is a slight distinction made between the Βαβυλωνιακῶν that appears with Berossus and the κατα Βαβυλῶνα that follows an attribution to the 'Chaldeans', but it is unlikely to refer to separate sources. Similarly, Hesychius (μ 1391) omits a reference to Berossus where he attributes the same lemma that appears here to the Chaldeans.

[1150] One does mention θάλασσα κατὰ Πέρσας; so we can assume that the lemma might have been Ὀμορκα (Schironi 2009: 122-4)

[1151] See n. 1149 for references.

Μιθοργ[1152] – 'a kind of harmony among the Chaldeans'

Μινοδολόεσσα[1153] – 'a numerical system among the Chaldeans… (of the work?) *On Babylon*'

Μισαι[1154] – 'the fore-knowledge of future among Chaldeans… (in Book…) of the work *On Babylon*'

A number of other glosses attributed to either the 'Chaldeans' or 'Babylonians' are given by Hesychius, who draws from the same tradition.[1155] Hesychius preserves accurate transliterations of the cuneiform names, as they were used between the 6th and 3rd cent. BC.[1156] The phonological evidence therefore confirms that they came directly from a Babylonian source, instead of through either a Phoenician or Hebrew intermediary.[1157] The only entry in Hesychius' lexicon that gives Berossus as the source is σ 197: σαραχηρώ – a female adorner of Hera. But with the others we find a strong pattern of words that reflects the one above: they are all connected to Chaldean astrological-astronomical tradition or what can otherwise be attributed to Berossus.[1158] The table, for the sake of space, only gives the lemma and reference, meanings and etymologies (where possible) are included in the footnotes.

[1152] Probably from *mitḫurtu,* which among others things means '[1] opposition (of sun and moon)' and [2] correspondence'; or *mitḫartu,* '[1] square (as a geometric term), side of square; [2] totality, mankind', in which case I would suspect it appears in the first meaning as an astrological quartile aspect (see glossary, fig. 8.3 & n. 975). Alternatively it could also be *mitḫāru,* 'of equal size, amount or degree, square' etc. but the Greek ending -ργ, perhaps a case of Aramaic-influenced sound shift, would favour the first two options. In any case, the root is well attested in cuneiform mathematical and astronomical literature see n. 1418 below. The reading of it as 'harmony', either in the sense of 'opposition' or 'square' might be carried by Greek astrological considerations.

[1153] Variant μινδαλόεσσα in Hesychius (table 12 below), who gives it as ἀριθμά. καὶ περὶ τὰ οὐράνια σύνταξις. Most probably from Akkadian *mindatu (middatu),* measure of capacity, length, area or time, or a measuring rod, from *madādu,* 'to measure'. Could be related to NINDÁ, esp. in BM 36712 obv. 2' NINDÁ-*at* AN-ú (= *mindat same*), where NINDÁ might stand for either *mindatu* or *nindānu* (CAD, s.v. 'mindanu'), and which Sachs & Neugebauer (1956: 132) translate as 'dimensions? of the sky'. *Mindatu* was first suggested in Schnabel 1923: 133 (idea from Weissbach), the Λ in both μινοδολόεσσα and μινδαλόεσσα is probably a copyist mistake for Δ, the ending -εσσα cannot come from *ša šame* (see n. 1162 below) as Schnabel assumed but is more likely to be a Greek suffix.

[1154] Origin obscure but potentially derived from Sumerian MÁŠ, which denotes extispicy. It is not known how Sumerian glosses would have been pronounced during the late period.

[1155] Hesychius' material comes largely from the Pamphilus-Vestinus-Diogenianus tradition. Schironi (2009: 43-52) argues that the Oxy. Glossary must come from the Pamphilus tradition as well.

[1156] Stieglitz 1988: 443. For the transliteration conventions see Knudsen 1990: 151-61 and Westenholz 2007: 281-6.

[1157] Stieglitz 1988: 444, 446.

[1158] Schnabel (1923: 260) too has counted the lemma from Hesychius among the fragments of Berossus but they have been excluded from later collections. Stieglitz (1988: 446-7) has supported the idea that the names of the planets might be derived from Berossus.

'Chaldean'		'Babylonian'	
Mathematical terms	μισσυνή[1159] (μ 1467) πικόν[1160] (π 2278)?	Mathematical and astronomical terms	σαρός (σ 226)[1161] μινδαλόεσσα (μ 1391) σαύη (var. σανη)[1162] (σ 260)
Planets[1163]	Aἰ δώς (α 1800) Μολοβόβαρ (μ 1568) Δελέφατ (δ 590)	Planets	Βελέβατος (β 479) Σαώς (σ 302) Σεχές (σ 469) [Σίν (σ 674)][1164]
Animals	δαβούλ[1165] (δ 3) διάλ[1166] (δ 1107) γαμάλη[1167] (γ 113)	Cult	Σαλαμβώ (σ 102)[1168] Σαραχηρώ (σ 197) Ἀδά (α 969)
Months[1169]	Ἀδάρ (α 972) Σιόαν (σ 701)		

Table 12: Lemmata in Hesychius' dictionary

1159 ἡ ὀξύτης – 'sharpness, pointedness', used for acute angles; as a metaphor also cleverness (LSJ, s.v. ὀξύτης). Akk. root not recognisable.

1160 Trans. as Gr. Πικρόν, but in which precise meaning remains obscure. Livingstone suggests perhaps a possible derivation from *pirku*, which has a mathematical meaning 'transversal or chord' (CAD s.v. pirku (B)).

1161 See p. 136.

1162 Hsch. gives 'cosmos', Akk. *šame* 'heaven'. Also attested in Greco-Babyloniaca tablet 16: 4' and 5'.

1163 See table 7 for translations and etymologies. That the names are described varyingly as 'Chaldean' and 'Babylonian' could be the result of Hesychius' reliance on second-hand sources, which changed the '*On Babylon/Babyloniaca*' to 'according to Babylonians' (also see n. 1150 above).

1164 Manuscript gives: σίν. τήν σεμνην (emended to σεληνην, 'Moon'). ββῶλ.

1165 'Bear'. Akk. *Dabū*. See Opitz 1932-1933: 47-8.

1166 'Deer'. Must be emended to αιαλ (Opitz 1932-1933: 46), from Akk. a*yyalu* (= Lu.LIM) 'stag, deer'.

1167 'Camel'. Akk. *gammalu (gamlu)*.

1168 'Aphrodite of the Babylonians'. See Müller, s.v. 'Salambo' in *BNP*.

1169 *Adar* and *Simanu* are the two explicitly stated as being Chaldean. However, a few others are included in the lexicon: α 41, τ 737, ν 587. The given equivalents are Macedonian months (not Egyptian; note that sometimes the Macedonian months themselves are given as glosses, e.g. δ 2675). As *Nisan* is equalled with Artemisios etc., the source must pre-1st cent. AD, when a one month shift took place between the Macedonian and Babylonian months (Stern 2002: 111). See fig. 3 for Akkadian month-names.

A number of these words come from Akkadian roots and above all the names of planets show close affinity with the native Akkadian tradition. This constitutes sufficient grounds to argue that even if this material did not come from Berossus, it came from or through a source that actively translated Babylonian astral lore into Greek 'syntax'. If Schironi's theory that the *Oxyrhynchus Glossary* was composed in Alexandria is correct,[1170] then the authors of the Nechepsos-literature are very likely to have had access to it.[1171] Perhaps they followed the general practice of not naming sources, or perhaps they deliberately tried to write the 'Chaldean' out of astrological history as part of the attempt to 'egyptianize' the imported tradition.

Hence, I would not exclude the possibility that general knowledge of Babylonian scholarly lore, its preoccupations and core traditions, together with its religio-philosophical underpinnings and simpler astrological doctrines, became better known to Greeks through the work of Berossus. However, just how much technical detail Berossus' writing involved is open to question. One should not overplay the pre-eminence given to him by the Greeks, as illustrated in Pliny's report that he was the first in astrology 'to whom, on account of his divine predictions, the Athenians at public expense set up a statue with a gilded tongue in the gymnasium'.[1172] As has been mentioned above, there were other Chaldeans who transmitted the knowledge on how to construct and analyse birth-charts. Vitruvius' insistence that Achinapolus 'left rules to cast horoscopes that were based not on the moment of birth, but of conception' may be an accurate testimony.[1173] A cuneiform horoscope gives a conception in S.E. 53 and a birth in S.E. 54, suggesting that both birth and conception dates were considered by the Chaldeans as of importance.[1174]

But in addition to the native Chaldeans, we also find a number of Greek astrologers who, when trying to legitimate their claims of being able to tell the future from the stars, often used the claim that they were transmitting genuine Babylonian knowledge. It is just about possible that some of them even acted as intermediaries between Berossus and the Greek tradition. Palchos[1175]reports that:

[1170] Schironi 2009: 15-9, Pergamum is a less likely option.

[1171] See n. 1026 above for the possible connection of *Astrologumena'*s authors with the library of Alexandria.

[1172] *BNJ* 680 T 6.

[1173] Vitr. *De Arch.* 9.6.2.

[1174] BH 7 = BM 33667, dated S.E. 54 = 257 BC.

[1175] Palchos has been identified as the medieval Persian astrologer Abu Ma'shar al-Balkhi (c. 787-886), e.g. in Hübern, s.v. 'Horoscope [2]' in *BNP*.

> now, the Babylonians and the Chaldeans were more or less the first to discover knowledge about astronomical phenomena, as we learned from our predecessors. For they record Apollonios of Myndus as well as Artemidoros [*lacuna*] Berossus too wrote about these things and others after him.[1176]

Seneca gives more insight into the activities of the first and adds Epigenes to our list:

> So much is certain: two authors, Epigenes and Apollonius of Myndus, the latter highly skilled in casting horoscopes, who say that they studied among the Chaldeans, are at variance in their accounts. The latter asserts that comets are placed by the Chaldeans among the number of the wandering stars (i.e. planets), and that their orbits have been determined. Epigenes, on the contrary, asserts that the Chaldeans have ascertained nothing regarding comets, which are thought by them to be fires produced by a kind of eddy of violently rotating air.[1177]

Dating these figures is highly problematic.[1178] The nature of the doctrine Seneca attributes to Apollonius of Myndus has led to a presumption in some quarters that he must have succeeded Hipparchus' theory of the comets.[1179] Yet, others have assumed a much earlier date. Neugebauer has suggested a *floruit* about 200 BC and Cramer an even earlier c. 225 BC, believing he should not be dated long after Berossus.[1180] It has been inferred from Seneca that Epigenes must have been a slightly younger contemporary of Apollonius.[1181] More recent commentators prefer a later *floruit*, around the 2nd cent. BC.[1182] Rehm cultivated a strong belief that knowledge of Epigenes' book (perhaps entitled *Chaldaica*) too was transmitted via Posidonius,[1183] who is, moreover, believed to have made extensive use of Berossus. Pliny informs us that

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1176 CCAG 5.1. p. 204 (Palchos, *Lib. Apoteles.* 135). Βαβυλώνιοι μὲν οὖν καὶ Χαλδαῖοι σχεδὸν πρῶτοι ἐφεῦρον τὴν τῶν φαινομένων γνῶσιν, καθὼς ἔγνωμεν ἐκ τῶν προγενεστέρων ἡμῶν. Ἱστοροῦσι γὰρ οὗτοι καὶ Ἀπολλώνιον τὸν Μύνδιον καὶ Ἀρτεμίδωρον ***, συνέγραψε δὲ καὶ περὶ αὐτῶν ὁ Βηρωσὸς καὶ οἱ ἐφεξῆς.

1177 Sen. *Nat. Quest.* 7.3.2.

1178 Neugebauer 1975: 263.

1179 Keyser 1994: 648.

1180 Neugebauer 1952: 183, Cramer 1954: 15.

1181 Cramer 1954: 15.

1182 Hübner, s.v. 'Epigenes [5]' in BNP; Rochberg (2005, s.v. 'Epigenēs of Byzantion' in *EANS*) offers around 120-30 BC.

1183 Rehm, s.v. 'Epigenes [13] in RE. Supported by Schnabel 1923: 109, Kroll 1930.

> Epigenes used to maintain that human life could not be possibly prolonged to one hundred and twelve years, and Berossus that it could exceed one hundred and seventeen. The system is still in existence which Petosiris and Nechepso transmitted to us, and called by them 'tetartemorion', from the division of the signs into four portions; …[1184]

That the two are cited together also in connection with the length of Babylonian observations, would indeed give support to an assumption that Pliny and Censorinus derived their information from a secondary source.[1185] That the sources were collated much earlier is implicitly suggested by Honigmann's speculation, inspired by a mention that wide scale translation of foreign books was being undertaken on request of Ptolemy Philadelphus in Alexandria, that Epigenes might have rendered the 'Chaldean books' into Greek.[1186]

Some insight into what such renditions would have entailed in terms of cultural translation is provided by a reference to Artemidorus of Parium,[1187] also mentioned in the Palchos fragment, who

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[1184] Pliny, *NH* 7.49.

[1185] Both are claimed to be more or less directly dependent on Varro, who is in turn indebted to Posidonius (Schnabel 1923: 110).

[1186] Honigmann 1936: 311; Syncellus 516, 3-10 Dindorf. Cf. Pliny's association of Berossus with Critodemus (n. 448 above), a significant part of whose work has been transmitted to us by Valens and an otherwise unknown epitomist who summarised the contents of his *Vision* (CCAG 8.3.102). The latter's account shows that Valens owes considerably more to Critodemus than his 12 direct acknowledgments suggest (Gundel 1966: 107; Riley n.d: 9). Heph. *Apotel.* 114.21 attributes to him another work entitled *Table*. However, nothing is known of the life of Critodemus or his date. In terms of the first, Arrian (7.11) says that there was a Critodemus, a physician of Cos, in the entourage of Alexander the Great, who saved the king's life and enjoyed great esteem as a result. I wonder if the work by 'Critodemus' might then not be pseudephigraphical, attributed to a famous doctor with a first-hand connection to Babylonia. He is definitely grouped with such pseudephigrapha – Abraham, Nechepso and Petosiris, Berossus forming a possible exception here – by Firmicus Maternus (*Mathesis,* 4 pr), which suggests that he was seens as one of the pioneers of the field. Hence, Gundel (1966: 106) has suggested Critodemus might have lived as early as the 3rd cent. BC. Cramer 1954: 14 also speculates that he flourished between 290-250 BC but this suggestion is made on the very spurious grounds of making him contemporary with Achinapolus and Antipater (p. 155), whose dates follow from a mistaken view of the date of Berossus; yet, more recent estimates give any time between 50 BC and AD 5 (Rochberg, 2005 s.v. 'Critodemus' in *EANS*). The problem is also discussed in Neugebauer & van Hoesen 1959: 185-6, but they find that the date deduced from the horoscopes associated with him in Valens' *Anthologiae* contradict a date before Pliny. These must, therefore, be later additions by Valens. Valens attributes to him the doctrine of antiscia (above). If, but only if, this is true, then its appearance in Geminus (2.1, 27ff) provides an earlier *terminus*. An even earlier possible *terminus* is given by Firm. Mat. (*Mathesis* 2 pr), who attributes knowledge of it to Hipparchus, saying that Fronto followed him in his theory of *antiscia*. Neugebauer (1975: 331) doubts the accuracy of the account. However, there is room for speculation as Hipparchus' astronomical material must clearly be at least partly derived from astrological writers and his reliance on Critodemus is a possibility.

[1187] Artemidorus is tentatively dated to the 1st cent. BC and/or 1st cent. AD, Keyser (2005, s.v. 'Artemidōros of Parion' in *EANS*) offers a *floruit* around 70-50 BC.

wrote a *Phaenomena* where he offered a collection of opinions by Anaxagoras and Apollonius of Myndus among others. His views on the heavens received ample, though pejorative, attention from Seneca, who says that according to Artemidorus

> upper regions of heaven are perfectly solid, a lofty thick vault, as hard as the roof of a house, formed by the accumulation of masses of atoms. The surface immediately above it is of fire so compact that it cannot be broken up or altered. Nevertheless, it has certain ventilators and, as it were, windows through which portions of the fire stream from the outer part of the universe [and back again]…[1188]

As incredible as this theory seems to Seneca, we can recognise in it an attempt to explain the appearance of the comets from the vantage point of the age-old Babylonian belief that the heavens were made of stone, a notion that is only made acceptable to a Greek audience by subordinating it to the theory of atomism.[1189] Markedly different too is Artemidorus' unawareness or deliberate neglect of the standard division of the heavens into several levels.[1190] It is, then, an ideal example of the kind of interpolation Berossus', or any other Chaldean theories and writings, would have undergone as part of their 'translation' into Greek discourse.

4.5 The Disappearing Planets or What is 'Hellenistic' about 'Hellenistic astrology'?

It was argued in Chapter 1 that 'translation' of foreign ideas is not a one-time event; a total assimilation of the new material into a 'home repertoire' requires a continuous reworking of the imported notions. Hence, although a fairly stable astrological system existed and had gained considerable popularity all over the Roman Empire by the beginning of the Common Era, it was open to interpretation and manipulation: it could be tweaked to fit specific criteria rooted in the different

1188 Sen. *NQ* 7.13.2-3.

1189 Horowitz 1998: 246-7, for a general overview of the idea of heavens made of water or stone 262-3. Relevant texts include SAA 03 039 = VAT 8917 (obv. 30-33: 'The upper heaven is *Luludanītu* stone of Anu. He settled the 300 Igīgū inside. The middle heaven is *Saggilmut* stone of the Igīgū. Bēl sat on a throne within, on a dais of lapis lazuli. He made glass and crystal shine inside (it). The lower heaven is jasper of the stars. He drew the constellations of the gods on it' (trans. Livingstone 1986: 83).

1190 See previous note. Although Mesopotamian texts disagree about the precise number, order and location of various 'heavens' (e.g. the Heaven of Anu; or references in the *Enuma Eliš* to the Ešarra of Enlil being situated between the region of the stars and Anu's heaven), they generally agree on the existence of a number of cosmic regions held together by special bonds (e.g. *Ee* 5.59-68, 73-6).

scientific/literary terrains and varying philosophical/religious conventions. Each of the four surviving treatises, therefore, has a context and an agenda within which they too serve as a peculiar set of 'translations'. This chapter focuses on Manilius' *Astronomica* and Ptolemy's *Tetrabiblos*, because it is in them that we see at their most obvious the changes astrology had to undergo - not just to become known and accessible to the Greek and Roman intelligentsia, but, more important, to become part of a Greco-Roman 'home repertoire'.

Manilius, the earliest of the surviving authors writing on astrology,[1191] set out to put astrological doctrine into Latin verse. He follows the tradition of didactic poetry exemplified among others by Aratus[1192] and Lucretius,[1193] a genre much concerned with nature and the place of the humans in it.[1194] As a didactic work it is not really concerned so much with how to *do* astrology but rather with the idea of astrology itself, especially its implications on the plan and workings of the universe.[1195] Volk has aptly described the resulting edifice as 'an astrological alphabet but not a text, a storehouse of building materials but not a structure',[1196] referring to the fact that although Manilius dutifully presents all the technical fundamentals considered above, he never moves forward to the promised 'mixture'. In other words, one never learns what to make of these single elements.

Manilius' choice of subject matter must have been, on the one hand, inspired by the use of astral determinism and horoscopy as an effective tool of propaganda by Augustus, to whom the poem is dedicated;[1197] on the other, Manilius, in his attempt to establish for himself a place in literary history,

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[1191] The *Astronomica* was begun before AD 14 but probably finished after this (Goold 1977: xii).

[1192] For a comparative study of Manilius and Aratus see Abry 2007: 1-14. The two texts, as Abry shows, have a 'complex and subtle intertextual relationship' but generally Manilius displays the developments in religion and science during the period that separate the two authors.

[1193] For Lucretius' Epicurean atomism, his aims and how it fitted into Roman literary and socio-political contexts see Toohey 1996: 89-108. Toohey (1996: 180) sees the *Astronomica* as a corrective to the *De rerum natura* since Manilius does not agree with Lucretius' Epicurean programme. The disagreement is evident at, e.g., 1.438-47. See Goold 1977: xvii and Toohey 1996: 183-4 for philosophical differences, Volk 2002: 240 for poetic rivalry, and Volk 2009: 182-97 for the intertextual connections between Manilius, Aratus, Lucretius and Vergil in terms of style, genre, content and philosophical outlook, and Wilson 1985: 289-95 for the same in proem 1.

[1194] On Manilius as a didactic poet see Volk 2009: 174-82.

[1195] Manilius' prime interest lies in personal astrology but he does display some familiarity with other astrological subfields. Included are a list bodyparts allotted to zodiacal signs (2.453-65) and allusion to the fact that *lots* are used to choose a correct remedy and the moment for administrating it (3.142-4); chorography (4.585-817); and 3.145-58 relates to the *katarchic* side of astrology.

[1196] Volk 2009: 125.

[1197] Wray 2002. For the use of Augustus (and Tiberius) as addressees, see Neuburg 1993: 243-82. On astrology in the service of Roman politics, see Cramer 1954 and Barton 1994b: 38-47, 54-62. Astrology was, in Barton's was deeply entrenched in the Callimachean game of 'untrodden paths' (or the *primus* motif).[1198] Moreover, Manilius clearly aims to present astrology as a candidate for universal religion, expecting his audience 'to embrace it, not to analyse it.'[1199] One of the overarching themes in the *Astronomica* is the belief in the microcosmic nature of the divine in a man and through that the possibility of quasi-mythical union with God and astral immortality.[1200] This derives from ideas already expressed by Plato who speculated that human souls come from and return to the stars.[1201] In Manilius this takes the form of outstanding individuals being turned into stars and entering heaven as new gods[1202] and the popular idea that astral immortality can be acquired through the study of the heavens.[1203] The latter is also expressed by Vettius Valens who connects it to the Orphic doctrines[1204] and reflected in Ptolemy's seeking of poetic grandeur by declaring that:

> I know that I am mortal, a creature of one day; but when I follow in my mind the circular

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words, 'a suitable reservoir of power, with its familiar, condensed symbols and its ability to assume the guise of religious, mythical, scientific, or political discourse.' The projection of the Roman political structure to the sky (5.710-45, cf. Pliny 2.6) can also be perceived behind the text. 2.136-44 implies an elitist group of readers, restricted to those able to follow his technical arguments. For the question of audience, see Neuburg 1993 and Volk 2002: 198-209. For the reception of the *Astronomica*, see Volk 2009: 1-3 (that Manilius was read more widely is implied by echoes in Lucan, Petronius' *Satyricon* and a few other authors, although he is never mentioned by name; Firmicus Maternus too drew on him).

[1198] Callimachus, *Aetia* proem. See Volk 2009: 198-211. Cf. Lucr. 1.927-8. Manilius uses a great number of other *topoi* (e.g. the heavenly journey of the poet, see MacGregor 2004: 148 for earlier and mythological comparisons of the motif and Vett. Val. 6.1P - a relevant quote from Nechepso); the poverty of Latin *topos,* symptomatic of cultural translation of Greek to Roman (intellectual Greeks v. practical Romans), cf. Lucr. 1.832)*,* and, as Wilson (1985: 283-95) finds, appears in this sense to be a highly self-aware and self-conscious poet, able to use a great wealth of strategies and methods. See Volk (2009: 13, 33, 39-40, 46-7) who finds that the evident self-contradictions within the text can be explained by the poet's participation in a number of different discourses which follow different rules, making him adopt different personas or suddenly write as if in a different genre (e.g. caring teacher v. an elitist *mystagetes,* or the refutation of Aratus et al. on the grounds that 'in their songs is heaven naught but fable and earth fashioner of the skies in which it depends' (2.37-8) and his use of the characteristics often based on these same catasterism myths he has just disparaged (see below); see also Neuburg 1993: 279-82 on Manilius the determinist v. Manilius the pedagogue).

[1199] Neuburg 1993: 282.

[1200] E.g. 2.105-135, 4.915-21.

[1201] Pl. *Tim.* 41d-42b.

[1202] Man. 1.925-6, 4.933-35.

[1203] Expressed thoughout Manilius. Going back at least to Plato (*Laws,* 967d-e, *Ep.* 986c-987d), present among others in Cicero *Nat. D.* 2.61.153 ('through contemplating the heavenly bodies the mind arrives at knowledge of the gods'). The idea that wonder of divine creation can be comprehended through the study of natural sciences had wider circulation. See Lloyd 1987: 46-8 n. 160-2 for the 'correct apprehansion of the divine' question.

[1204] Vett. Val. 9.1, 9.8K/9P.

movements of the stars, I no longer touch the earth with my feet, but at the side of Zeus himself I partake of god-nourishing ambrosia.[1205]

Astronomical discoveries and growth of scientific reasoning (chapter 3.4) had resulted in the rise of what can be described as either a cosmic religion or a religious cosmology in the Greco-Roman world. The exact nature of divinity in this discourse is complicated but the decline of the traditional anthropomorphic deities is evident. The idea that God is manifest in heaven and is the all-pervading force in the universe had become mainstream at least by the Roman period[1206] and this realisation is consciously connected to the evolution of human reason - which in this context must be understood as mathematical and logical competence – not just by Manilius who writes how reason 'freed men's minds from wondering at portents by wrestling from Jupiter his bolts and power of thunder' but as a much more common motif.[1207] Taking it a step further, one can postulate a kind of 'god playing a geometer' theology that in Plutarch's opinion goes back to Plato.[1208]

However, the view that the heavenly alignments are a message that requires deciphering in order to discover the true God[1209] not only appears already in Aratus' *Phaenomena* ('comprehensible and communicable' order)[1210] but is also highly reminiscent of the Mesopotamian approach. Manilius expresses it thus:

> God grudges not to the earth the sight of heaven but reveals his face and form by ceaseless revolution, offering, nay impressing, himself upon us to the end that he can be truly known, can teach his nature to those who have eyes to see, and can compel them to mark his laws…[1211]

[1205] Ptol. *Alm.* 1.1.

[1206] See MacGregor 2004: 145-6.

[1207] Man. 1.104-5; Ovid, *Fasti* 1.297-310; Pliny, *NH* 2.9 ('Hail to you genius, ye interpreters of heaven, ye who comprehend the nature of things, and who have discovered the mode of reasoning by which you have conquered both gods and men').

[1208] Plut. *Conv. Quest.* 8.2.1. See Plato *Laws* 967a-e, *Ep.* 985a-8, *Timaeus* 40b-d, *Rep.* 616b-617d, who indeed holds that the universe as a whole was a product of intelligent design.

[1209] Toohey 1996: 182-3.

[1210] Toohey 1996: 59-62. Cf. Lucretius, e.g. 1.63-80.

[1211] Man. 4.915-9, cf. Vett. Val. 7.3K/4P: 'Of all the lovely elements of the numerous great creations in the world, none seems to me to have been begrudged by God for man's daily use. God would not have revealed it if He had not wished to provide it for use.'

A similar idea is expressed by Vettius Valens when he proclaims that while discovering another astrological law:

> … - the compiler was in ecstasy … and he felt that he was meeting God face to face.[1212]

However, the way we approach the rationale behind astrology has recently been questioned. MacGregor found faults with designating Manilius as a Stoic[1213] and argued that ideas like this had been around for so long that they had become, to use Volk's words who elaborated on MacGregor's theory, 'free-floating commonplaces', 'part and parcel of a particular place and time' incorporated into many and varied thought-systems.[1214] The syncretism and eclecticism characterising the Greek explanatory rationale behind astrology serves to prove this point. Greek astrological cosmology was a mix of elements from different philosophical schools, most notably from the Stoics, the Peripatetics and the Platonists. Stoics, willingly or unwillingly, contributed to astrology its first axiom: the concept of cosmic sympathy based on their belief that the active principle (God, reason, divine fire, *aether,* 'breath', or *pneuma*) is fully blended with the passive and inert principle and is thus responsible for the movement of matter. As this divine reason or *pneuma* permeates the whole cosmos it accounts for the unity of cosmos: it ties all things together, making them interdependent:

> This fabric, which forms the body of the boundless universe, together with its members composed of nature's diverse elements, air and fire, earth and level sea, is ruled by the force of divine spirit; by sacred dispensation the deity brings harmony and governs with hidden purpose, arranging mutual bonds between all parts, so that each may furnish and receive another's strength and that the whole may stand fast in kinship despite its variety of forms.[1215]

Microcosm-macrocosm analogy, that is the belief that a man is the reflection of cosmos, or more particularly, that a man's soul is tied to the cosmic soul, provides another rationale for direct stellar influence on individual and the society. The idea dates back at least to Democritus and Diogenes of

[1212] 6.1P, cf. 6.8.

[1213] Manilius does share many Stoic dogmas but he also favours views that many Stoics, in Macgregor's (2005: 45-65) opinion, would have found impossible to accept. In addition, Stoicism was a fluid thought-system by all accounts and identifying someone as a Stoic is complicated if there is no evidence of such self-designation (2005: 47).

[1214] Volk 2009: 9-10, 239. Idea from MacGregor 2005: 46. The convention of calling Manilius a Stoic has persisted e.g. in Abry 2007.

[1215] Man. 1.247-54, also 2.60-83.

Apollonia in the 5th cent. BC.[1216]

Yet, as said, all these theories had so wide a currency in the Classical world that they had probably become mainstream beliefs, more or less dissociated from any specific philosophical creeds. It is therefore unlikely that the first Greek or Roman practitioners of astrology (as opposed to philosophers who discussed astral determinism and prognostication) tried to adapt their science to fit a particular philosophical school. More likely, the mixed nature of applied arguments was derived from the generally accepted Greco-Roman world-view, which, although subject to fluctuation and variation, had some core tenets.[1217]

All this has ramifications for the translatability of the Babylonian 'source text'. As Rochberg puts it:

> Babylonian ideas of an astro-theological nature were fully part of this integrated scientific culture and we see a widespread general association of heaven with the divine across the ancient Near Eastern and Mediterranean cultural arena during this period, no doubt accounting for the receptivity of Greek intellectuals to similar Near Eastern ideas.[1218]

What this implies is not that one system was necessarily derived or greatly influenced by the other but that the generally imagined philosophical gap between the two astrological traditions was not as substantial as hitherto thought.[1219] The basic ideas are then rather similar in essence, leaving more room for mutual understanding than generally acknowledged. Hence there is little point in arguing that Hellenistic astrology required complete reorientation to a new philosophical rationale,[1220] it merely needed some tweaking.

There were, nevertheless, significant differences in the specifics of astral influences and the impact the underlying explanatory system had on the mechanical aspects of the astrological systems should not be underestimated. This is first of all evident in Manilius. Although Manilius constantly dips into

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[1216] See Guthrie 1965: 471.

[1217] A striking number of parallels with Manilius and other astrological writings appear in the Hermetic tradition. As the astrological Hermetica does not survive, claiming dependence in the case of Manilius is tricky (Salemme 2000: 21-6), although Volk (2009: 234-9) is willing to consider the possibility. Common descent from the same intellectual context explains the similarities better.

[1218] Rochberg 2010: 9.

[1219] Although Annus (2007: 38) has pointed out that many of the Stoic philosophers originated from territories east of Greece, e.g. Diogenes and Apollodorus came from Mesopotamia; hence, the possibility of direct influence cannot be ruled out.

[1220] This goes against the general consensus and the opinion I earlier expressed in my MPhil dissertation.

what can only be described as an astrological vulgate to derive his material, there are significant idiosyncrasies between certain aspects of his astrology and those presented in the other surviving texts. Namely, the *Astronomica* as we have it, almost completely omits one of the standard aspects of Hellenistic astrology: the planets and the influence these have on the nativity. Even granted that a short description was featured in the lacuna at 5.709,[1221] the deliberate minimising of the planetary influences is obvious: their rulership of the decans and dodecatemorie has been deliberately replaced by a system that uses the zodiacal signs instead; and the trigon, square and other aspects remain futile in the non-planetary way they are described.[1222] Volk has explained this act of the disappearing planets in part by reference to poetic inhibitions (complexity of the material, cf. Aratus) but also by their inability to fit into the picture of a perfectly ordered universe, an order that can only have come about through a divine *ratio*.[1223]

Even better examples are offered by Ptolemy. Being the most methodical of astrological authors he serves best to highlight where his received tradition diverges from the expected standard of a concrete system of scientific thought as developed by Aristotle, Euclid, Archimedes and the like. Like the *Astronomica,* the *Tetrabiblos* too is clearly a work of theoretical astrology: it meticulously examines the technical details of geometrical relationships but largely neglects the practical or interpretative side of astrology that we find in Dorotheus' *Pentateuch* or Valens' *Anthologiae*.[1224] Ptolemy has excluded from discussion an entire area of forecasting - the influence of temporary configurations of the stars at the beginning of an activity (*katarchai* – 'elections' or 'initiatives', and interrogations) - in addition to certain doctrines like most *lots* and *places* and numerological methods; and he never really discusses the mythical attributes of the planets.[1225] And this is done because they belong, according to some modern commentators, to the part of astrology that does

[1221] Manilius expresses his intention to write about the planets in 2.965, 2.750, 3.156-9, 3.587-9. Since these promises remain unfulfilled it is theoretically possible that one or more books were planned, or even written and are now lost. However, Volk (2009: 117-21) thinks it unlikely that additional books existed or that the lacuna in Book 5 is large enough to have included a significant amount of information.

[1222] Volk 2009: 89 n.66, 116-7.

[1223] Volk 2009: 52-7.

[1224] The best key to the world of the practicing astrologer is provided by Vettius Valens. With the majority of the 125 example horoscopes in the *Anthologiae* dating between AD 152 and 162 (Neugebauer 1954), Valens was a contemporary of Ptolemy. With both men working in Alexandria it is highly likely that they shared some source material, so the differences between the two texts should be most telling. These have been discussed to some extent in Riley 1987.

[1225] The planetary influences are mostly explained in terms of the four humours; cf. Valens' extensive list of planetary characteristics.

not rest on the 'rational scientific base' that Ptolemy expects but is rooted in convention instead.[1226]

This need for a rationale is also evident in the artificial explanation he provides to account for the discrepancy between the traditional assignments of Saturn into the diurnal and Mars into the nocturnal sect[1227] and even more so in the discussion on the disposition of the *terms*.[1228] The ready-made 'Egyptian' and 'Chaldean' systems that he presents lack sufficient consistency and logic; hence, he introduces a third option, one that he allegedly found in an ancient manuscript.[1229] Although this claim has been generally dismissed as fictitious, reflecting a need to appeal to an older tradition to give credibility to one's writings, the possibility that Ptolemy really had access to such manuscripts in Alexandria cannot be ruled out in the light of what we have learned in chapter 3.4.2. Nevertheless, the explanations accompanying the points of planetary exaltations (above) also look like his personal attempts to find some logic behind otherwise apparently random locations.

However, what constitutes satisfactory proof in astrological theory or certain aspects of it differs between writers and their respective paradigms. It is noteworthy, however, that in the Hellenistic context the requirement of theoretical proof becomes paramount and the usual claim of thousands of years' worth of observations made in Mesopotamia and Egypt are no longer sufficient to satisfy all authors. It is also evident in the *Anthologiae* that astrology must conform to Greek 'scientific' standards*:* Valens seizes every opportunity to assure the reader that his results are empirically proven and so he upholds the ideal of 'science' in his own right. Despite the Greek obsession with 'ancient oriental knowledge', it was still the claim to empiricism and the use of mathematical method that underpinned the success of astrology among its more critically minded public.

Nevertheless, it is only in Ptolemy that we arrive at the full-blown mechanical theory of physical causality.[1230] Ptolemy's soft determinism, rooted in the idea of hierarchy of causes, coupled with the doctrine of cosmic interrelatedness and the Peripatetic theory of the five elements, results in an

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[1226] Tester 1987: 88.

[1227] *Tetr.* 1.7.

[1228] Also cf. n. 784 above on the system B month-length.

[1229] At least six different systems of terms are known. The one said to be 'Egyptian' (*Tetr.* 1.20) actually differs from the only known Demotic arrangement (from P. CtYBR 1132, the so-called Beinecke table from Roman Tebtunis, published by Depuydt in 1994). However, in both cases Aries, the first sign, is assigned rulers in the Babylonian (benefics v. malefics based) planetary order; after that, the systems diverge.

[1230] The idea is of course known and used to a much smaller extent by other astrologers: cf. Vett. Val. 4.4 & 9.7K/8P.

explanation that the physical qualities (hot, cold, dry, and wet) of the planets and the interaction of these qualities in certain geometry-based relations between the planets exercised direct influence on the earth.[1231] Although stars were thus still the direct causes, the endless number of variables allowed a man to have some control over of his life, using the sky merely as a guide.[1232]

The association of the planets with the four elements – earth, water, air and fire – and hence the four resulting characteristics is of course not Ptolemy's own invention but appears also in Valens' *Anthologiae* and notably in the fragment that mentions Sudines.[1233] Although they are also described by Manilius albeit in very general terms,[1234] they do not become explicitly related to the signs and planets until this relatively late period.

But what else, apart from the philosophical rationale, was 'Hellenistic' in Hellenistic astrology? In my opinion, it is the vast interpretative corpus – not the geometrical doctrines themselves, which we have often seen had Babylonian (or Egyptian) origins, but the readings that were applied to them. A key part in this was played by the zodiacal signs, or more precisely, the characteristics applied to them, which then determined their influence. On the one hand, this sometimes depended on the theory of humours, but on the other, it was acutely entrenched in Greek mythological lore.

The star-myths formed an integral part of the Greek poetry of heavens. The first collection of the star-myths (catasterisms, asterisms) was the Hesiodic *Astronomia*.[1235] Then follow a number of myths from Aratus' *Phaenomena*, (Pseudo-)Eratosthenes' *Katasterismoi* (279-194 BC; surviving epitome from the 1st cent. AD),[1236] Hegesianax's *Phaenomena* (late 3rd/early 2nd cent. BC),[1237] a Hermippus,[1238]

[1231] *Tetr.* 1.2.

[1232] This accords better with the Stoic views (the idea of multiplicity of causes) for which see Sambursky 1959: 54 and Sellars 2006: 104.

[1233] 'Their movement, and whence? On the seventh body lies the Moon, on the sixth the Sun, on the fifth some other of the stars: and from this we can show to you many substances, in order to know the powers: the Sun is warming, the Moon is moistening, Mercury stirs up the winds, Mars makes dry' (see n. 503) Such an idea is not completely unattested in Babylonia. RA 62 52 17-8 gives the following associations: 'Girra: Anu: fire. Primeval: Ea: water. East wind: Enlil: wind.'

[1234] Man. 1.149-70.

[1235] F 288-293 M-W.

[1236] Surviving fragments available in Condos 1997 where they are combined with the equivalent sections of Hyginus.

[1237] SH 465-70 . Lived under Antiochus III (222-187 BC).

[1238] SH 485-90. SH 712 attributed to one of the Ptolemies says: 'Hegesianax and Hermippus and many others put all the stars in the sky and all those celestial phenomena into books...'

additions to Aratus by Germanicus[1239] and Hyginus' extensive *On Astronomy*. But unlike in Aratus, in the last two the constellations are no longer mere astronomical phenomena: they are now identified as the figures that they are supposed to represent. Moreover, to the fifteen catasterism myths in the source text Germanicus adds a further sixteen, notably the twelve for the zodiac,[1240] although Hegesianax had already included some material on them.[1241] The zodiacal constellations were of course derived from Mesopotamia (table 6) and we do not know much about the catasterisms, or even if those existed at all for the 12 zodiacal signs and if they did, how great an influence they had on the native. That catasterisms were not wholly unknown in Mesopotamia is shown by the identification of *Qastum* – 'bow' and 'bow star' – with the goddess Ištar of Elam in the guise of the weapon Marduk used to vanquish Tiamat, installed in the sky and then adopted by Anu as his daughter.[1242] But what we can infer from the meagre predictions accompanying some of the cuneiform horoscopes suggests the interpretation of the native's birth-chart to have depended on a re-evaluation of the traditional EAE omens.[1243]

The Manilian signs, however, were, like those of Germanicus heavily personified: they had their enmities and friendships and although Manilius once expresses the opinion that catasterisms make the signs man-made, he is oblivious to his own criticism when it comes to the zodiacal signs as his interpretations are still very much based on analogy with these same star-myths and the general physical characteristics of the imagined constellations. The latter point weighs more heavily, the imaginary shapes of the signs play an important role.[1244] And though the catasterisms are first and

[1239] To the translation are added some 222 odd lines, a considerable part them about weather phenomena. The source of this information is unknown. Taub (2010: 130) suggests it might be Germanicus' own work, Le Boeuffle (1975: xxv ff.) believes it comes from an unknown poem comparable to that of Manilius. See Toohey 1996: 186 for a comparative plan with Aratus and Cicero's rendering of him. On authorship and date Possanza 2004: 219-35.

[1240] Zodiac in Germ. 531-564; see Possanza 2004: 169-208 for his fixation on aetiological catasterisms.

[1241] SH 470 (Hyg. *Astron.* 2.29). Whereas the later poets associate Aquarius primarily with Ganymede, Hyginus reports that Hegesianax connected it to Deucalion and the Flood.

[1242] *Ee* 5.76-83. Also Astrolable B B1: 14-16 [= KAV 218] and MUL.APIN 1 ii 7.

[1243] See p. 173 above, especially about TCL 6 14. Also Rochberg 1998: 13-4 for the use of stock-phrases from the omen series.

[1244] See Man. 2.150-264, e.g. double signs, signs with amputated limbs, signs that are half-beasts etc. Also consider the description of people born under certain zodiacal and non-zodiacal constellations. The list of professionals born under specific signs (Manilius zodiac signs Book 4, paranatellonta Book 5; e.g. Aries – woolworkers, Taurus – farmers etc., Pleiades have very effeminate offspring; those of the Hare are swift and fast; the Charioteer produces men skilful in horse-riding and the Altar temple dignitaries), is in MacGregor's words (2004: 152) nothing but a simple 'social type-casting, the commonwealth on earth that mirrors the foremost a poetical exercise, they too bear some influence on certain doctrines. For example, the association of Aries with the Ram with the golden fleece that carried Phrixus and Helle underlies Manilius' assignment of the Hellespont to this sign.[1245] Other constellations too are connected with familiar Greek myths, all well attested in the classical Greek literature: the Bull with the story of Europa, Twins with the Dioscuri, Leo with the Nemean Lion and so forth.[1246] An exception to the rule is Pisces, the 'twin gods of Syria'.[1247] The association between this region and fish is a recurring motif,[1248] undoubtedly rooted in the indigenous *apkallu* mythology. Hyginus (64 BC – AD 17) tells us how

> Diognetus Erythraeus says that at one time Venus came with her son Cupid to the Euphrates River in Syria. Suddenly Typhon… appeared in the same place, and Venus and her son leaped into the river and changed themselves forms to fish. In this way they escaped danger. And so the Syrians who live closest to this area abstain from fish...[1249]

If Hyginus' attribution to Diognetus is correct, then the association of Syria, Venus (Ištar) and the fish goes back to at least the time of Alexander the Great.[1250] Eratosthenes took Pisces to be the offspring of the Great Fish (Piscis Austrinus) for whom he relies on Ctesias and his story of Derceto, which is similarly used to account for the sacredness of fishes in Syria.[1251] Manilius also alludes to the same story and thus assigns Euphrates, Tigris and the adjacent areas to the tutelage of Pisces[1252] and explains the untrustworthiness and poisonous tongue of those born under Pisces that 'Cythera… has

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stars.' However, there are parallels to those attributions in Vettius Valens, e.g. Taurus giving birth to labourers and farmers and Gemini to scholars (Vett. Val. 1.2).

[1245] Man. 4.744-48. The association with the same myth also in Germ. 532-5, Ps-Eratosthenes 19, Hyg. *Astron*. 2.20. The last records in addition an Egyptian account for the constellation of Aries, the same applies to Capricorn (2.28).

[1246] Germ. 536-64. For a collection of these myths in Ps.-Eratosthenes and Hyginus see Condos 1997.

[1247] Germ. 563.

[1248] See n. 268.

[1249] Hyg. *Astr.* 2.30, trans. Condos 1997: 161-2.

[1250] Diognetus (*FGrH* 120) was one of the chroniclers of Alexander the Great. Pliny used him as a source for books 6, 12 and 13.

[1251] Ps.-Eratosthenes 38. Also Hyg. *Astron.* 2.41, where Derceto is changed into Isis but the story and its attribution to Syria is the same. Ovid (*Fasti* 2.458-474), on the other hand, records a story how two fish found a large egg in the Euphrates river and rolled it onto dry land; from the egg was born the Dea Syria. Such stories seem to be variations on a theme, making use of a variety of symbols and motifs connected to Syria and its famous goddess. Cf. Lucian, *de dea Syria* 14 and n. 268 above.

[1252] Man. 4.800-6.

implanted in the scaly Fishes the fire of her own passions.'[1253]

4.6 Conclusion

The emergence of Hellenistic astrological tradition is far more complicated than the short treatment here has been able to entangle. But it has shown how astrological material was assimilated to Greek ideological needs and discourse, whilst retaining an identifiably Babylonian origin.

The question of origins is inherently entangled with the question of power relations in the Hellenistic world. The depiction and adoption of astrology in the Western world was conditioned by the fact that it had become a trope in its narrative of the Near East and an emblem of its 'sacred knowledge'. In that sense I should not be surprised if practical astrology as we find it in the Hellenistic period was a distinctly and deliberately 'un-Greek' enterprise. Perhaps the systematic practice of referring to astrologers as 'Chaldeans' is a testimony to the continued foreignness of their art, an art that continually had to be *translated* and did not necessarily or by nature conform to all the norms of Greek 'science' until Ptolemy. This 'fringe' place occupied by astrology in the Greek cultural matrix made any related doctrines readily attributable to pseudepigrapha like the writings of Imhotep-Asclepius, Zoroaster, Abraham, or indeed, the Egyptian pharaoh Nechepsos and the sage Petosiris.

There is little doubt that indigenous populations, especially the Egyptian and the Jewish (lack of evidence limits any claims that could be made about the Babylonian), did make use of this topos and partook in the inherently Greek game of cultural supremacy. Dieleman and Moyer have treated this as part of a general 'what happens when the Other writes back?' question.[1254] The *Astrologumena* of Nechepsos and Petosiris provides a good example. The work is clearly situated in the context of the bilingual literature of an indigenous élite: the narrative itself in which communication between a king and a sage formed a framework for the transmission of astrological knowledge, and a large part of that knowledge was clearly rooted in Egyptian literary tradition;[1255] yet, the work showed at the same time an orientation towards a Greek audience.[1256] So Moyer argues that the Nechepsos

[1253] Man. 4. 579-84.

[1254] Dieleman & Moyer 2010: 429.

[1255] For an overview of Greco-Egyptian literary tradition during the Ptolemaic and Roman periods, which they argue is a direct continuation of earlier Egyptian literature, see Dieleman & Moyer 2010.

[1256] Moyer 2011: 234.

literature also represents ‘a relatively successful cultural strategy of ‘Egyptianization’ – an attempt to integrate a heterogeneous array of ideas and practices (Greek, Mesopotamian, and Egyptian) into an Egyptian scheme of authoritative knowledge.’[1257] It is, then, translation *par excellence.*

However, we need to be more cautious about when exactly these tendencies first appear, and about whether their occurrence in one part of Alexander the Great’s by then dismembered empire means that the same explanatory strategy can automatically be extended to other parts and other periods, with their thoroughly different social situations and cultural-literary traditions. Little can be said with certainty about the situation in Babylonia: the available Babylonian evidence is limited and in any case we cannot here consider all the preserved material due to constraints of time and space. Yet the discussion has at least highlighted the problem and reopened the debate on Berossus’ place in the transmission of Babylonian knowledge to the Hellenistic world.

With the majority of attention paid to Nechepsos and Petosiris and the politically charged context of the early *Astronomica,* the question of when, by whom, and how the technical doctrines of Babylonian astrology were introduced into the Hellenistic Greek cultural space has been left lingering in the background. It is generally accepted that ‘Hellenistic astrology’ ‘appeared’, relatively suddenly, in Egypt around the mid-2nd cent. BC. This approach is certainly attractive, allowing a simplification of the process of ‘translation’ of the core methods and practice of astrology: this way, it can be reduced to one place, one time, and somewhat more tentatively to two (collaborating?) men. The latter is now especially questionable. The contribution of author(s) of the Nechepsos and Petosiris literature in structuring the material available to them into a Hellenistic astrological canon is doubtless immense.[1258] However, their work can hardly be viewed as an invention of ‘Hellenistic astrology’ (by which most authors mean genethialogical horoscopy) but rather as a development from an ‘amalgam of elements drawn from disparate sources.’[1259] What binds this material together is its translation into a Greek intellectual milieu, one quite distinct from both Babylonian and Egyptian contexts.

What we can infer from the Egyptian material is that the adoption of Mesopotamian astral lore to the local repertoire took place in a context highly similar to that in Babylonia: astrology was the domain of the priestly and scholarly élite, largely in the service of the king. Moreover, although the

[1257] Moyer 2011: 234-5.

[1258] Vett. Val. 9.2K/3P: ‘Egyptians, although they had received them in simple form from antiquity, locked them up with complex and interwoven distinctions, and they used sophisticated talk and approaches.’

[1259] Greenbaum & Ross 2010: 153.

Egyptian mythological texts reveal no explicit belief in astrology, the links between stars and certain earthly events had not gone unnoticed. The prediction of Sirius phenomena, for example, which signalled the beginning of the annual inundation of the Nile, continued to form an important part of the Egyptian 'astronomer's' duties well into the Hellenistic period and beyond, as shown by the statue of Harkhebi.[1260]

Yet, the study of testimonies like the one from Harkhebi's statue show that the astral prognostication internalised by the Egyptians by the early Ptolemaic period was an EAE-style general astrology; and moreover, the use of Greek jargon in Egyptian astrological texts indicates that the horoscopic astrology was incorporated into the Egyptian repertoire through Greek interpolation rather than vice versa. Hence we can conclude that any perceived origin of this astrological subfield in Egypt is a deliberately created mirage. Yet the active intellectual change in the fields of astronomy and astrology during the Ptolemaic and Roman periods on the international stage, centred on multi-cultural Alexandria and its unequalled library, inevitably resulted in the incorporation of many and varied ideas into the astrological system. The highway of cross-cultural transmission is in this case not unidirectional.

The study of the *Astronomica* and the *Tetrabiblos* highlights further how the creation of astrological doctrine continued to be a complicated process of assimilation and invention throughout its colourful history. Furthermore, the translation not only took place between cultures and languages but, in the case of the Greco-Roman period, also between genres and paradigms. Over-reliance on the Ptolemaic ideal, as criticised in the introduction, has led to the belief that the methods and the underlying rationale of Hellenistic astrology were distinctively Greek from the very beginning. On this view, whereas in Babylonia the signs were viewed as a warning provided by a deity and there was no sense of astral determinism, the Greco-Roman approach followed from the idea of physical causality. However, we have seen that such a view is too simplistic. We lack, first of all, any definitive knowledge about the views held by Babylonian scribes during the Late Babylonian period and secondly, some aspects of the cosmic religion apparent in the work of Manilius are not so far from what the Babylonians probably believed. This is not to say that there were no significant differences

[1260] For Sirius in Babylonia see Neugebauer 1975: 363-5 and Sachs & Hunger 1988-2001: 1.27. What was predicted was its heliacal rising, heliacal setting, and opposition or apparent acronychal rising. Neugebauer suggests that the pattern of the surviving Sirius schemes was introduced near the very end of the Persian period, i.e. end of the 4th cent. BC, although Sachs and Hunger add that the schematic predictions of Sirius can be traced back to the end of 7th cent. BC.

in their respective world-views: all it implies is that there was sufficient common ground to allow the translation to happen in the first place. Moreover, it is unlikely that the Babylonian system was deliberately reoriented to fit specific Greek philosophical creeds; I believe it was initially only translated to a degree that it would satisfy the general core beliefs of Hellenistic society. Nevertheless, it cannot be denied that the final explanatory-causal rationale of horoscopic astrology as we find it in the surviving astrological texts from the first two centuries AD is distinctively Greek.

Chapter 5: Mathematics

5.1 Introduction

Mathematics can be viewed as 'a method for communicating ideas between people about concepts such as numbers, space, and time.'[1261] Each society creates its own structured system for this kind of communication, taking into account its specific needs, theories, conventions and motivations, as well as the available communication modes (e.g. oral v. written). In a sense, mathematics is thus a set of socially agreed conventions, an act of social construction. Or in D'Ambrosio's words, mathematical systems are 'bodies of knowledge that have been generated in a particular context, with specific motivations, and that have been and are subject to insufficiencies and criticism as well as changes resulting from exposure to other cultures.'[1262] As a result, mathematics is no less immune to the intellectual and cultural environment in which it grows than is astronomy, astrology or any other sphere of life.[1263]

Figure 11: BM 15285 (= RA 19 149)

This is, however, a fairly late understanding. For a substantial period of time, mathematics was, and still is in some quarters, approached as something 'relatively culture-free'.[1264] That mathematical systems are, nevertheless, deeply embedded in their cultural surroundings is well demonstrated by the almost compulsive need of modern commentators to 'translate' ancient mathematical writings into modern algebraic notation and to 'decode' them with the help of contemporary methods.[1265] This tendency applies equally to Babylonian and Greek texts and transcends the understanding of its

1261 Wood 2000:1.

1262 D'Ambrosio 2000: 79.

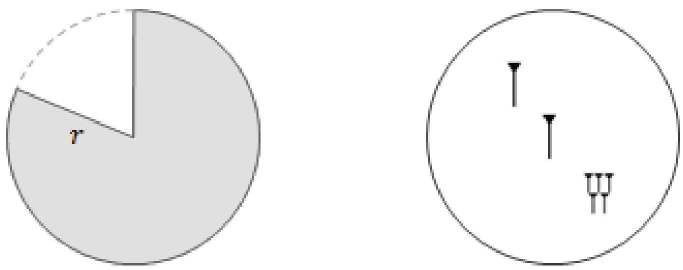
1263 Unguru 1975: 86: it is not detached from its host culture, it is its reflection. See also Bloor 1991 on the sociology of scientific knowledge and n. 9 above for more references.

1264 This is reflected to some degree in Joseph's (1991: 13) note on the relative ineffectiveness of cultural barriers in regard to mathematical knowledge compared to other areas of human knowledge like philosophy and arts. Culture-free mathematics on the whole, however, is a modern Western perspective of contemporary global community and cannot be applied to history (Robson 2002: 106; 2008: xxii).

1265 In Robson's (2000: 95) opinion, translated 'beyond all recognition.'

drawbacks. Consider, for example, Joyce's commentary on Euclid's *Elements*, who explains the propositions in algebraic notation, despite his own admission that 'in doing so the geometric flavour of the propositions is lost.'[1266] The modern notation and phraseology, and the problems that come with them, go back to Heath, whose English translation of the *Treatise on Conic Sections* by Apollonius of Perga is organised in a way that, though making the material comprehensible to his contemporary readers by reformulating, rearranging and even constructing his own algebraic proofs to Apollonius' problems, does not, in Fowler's words, 'give us any idea on how Apollonius presented, or perhaps even conceived, his own material.'[1267]

One must, however, keep in mind that our capacity to translate between symbolic systems is inherently superficial and does not take into account altered mental conceptions. The circle, and the calculation of its area in Babylonia and in modern times, encapsulate this fundamental importance of a cultural setting well (fig. 11). Whereas nowadays a circle is conceptualised as a figure generated by a radius that rotates around a centre, and its area found by multiplying the square of its radius by π (i.e. $A = \pi r^2$), in the OB tradition it was a figure surrounded by a bent line and its area established by dividing the square of the circumference by 4π.[1268]



$$A = r^2\pi \qquad Area = \frac{(circumference)^2}{4\pi}$$

Figure 11: Conceptualisation of circle and its area in modern and Mesopotamian traditions

[1266] Joyce's 1996.

[1267] Fowler 1999b: 150. See e.g. Heath's translations, *Apollonius of Perga: Treatise on Conic Sections* (1896) and *The Works of Archimedes* (1897).

[1268] The diameter and radius are never marked on the surviving diagrams, which usually only record the length of the circumference, its square and the area (Robson 2008: 65-7). The first is recorded because of its role in area calculation, demonstrated e.g. in VAT 7848 no. 4. The traditional Babylonian value π = 3 was probably in general use throughout the Near East (see for instance 2 *Chronicles* 4.2, 1 *Kings* 7.23, and Høyrup 1996b: 14 for Demotic papyri) although more exact approximations were known. For the explanation of cuneiform numerals and their rendering on the diagram see appendix 2.

This chapter will, therefore, first take a closer look at how the 'home repertoire', i.e. our own mathematical tradition, with its notation and conceptions, and the 'cultural grid', which is constituted by our preconceived ideas about ancient cultures, have influenced the reception and study of Greek and Mesopotamian mathematical traditions within modern scholarly discourse. Although the ahistoricity of the pioneering scholars and the 'translation-dependence' of their successors has become almost an obligatory topic in every modern study written on the subject,[1269] it is reiterated here as it serves to illustrate the point of 'cultural translation' in general, highlighting the dangers of conducting any kind of investigation of other cultures (especially their sciences) without realising one's own cultural affiliations and adopting a solid socio-historical approach.

We will then examine how the insights gained by this analysis can be applied to the study of the relationship between ancient mathematical traditions. This study proceeds from the belief that there is no one 'Greek mathematics' or 'Babylonian mathematics',[1270] but that a large number[1271] of more or less concurrent streams of tradition coexisted in different social contexts, were practised by different sets of people, and often served very different aims. Yet, when they came into contact they were capable of interaction and mutual stimulus. Section 5.3 aims to highlight a number of slightly divergent traditions that existed within Mesopotamia in the hands of various social groups during its 3500-year history. Some we can reconstruct with relative certainty; the existence of others can barely be comprehended behind the thick veil of time. The same applies to Greek and Hellenistic mathematics. Although we are used to thinking of Greek mathematics as Euclidean-style geometry, a continuous (extra-Euclidean, as Burkert calls it) arithmetical tradition existed contemporaneously with it,[1272] not to mention the more practical techniques and riddles used by the surveyors and

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1269 See for example Szabó 1978: 15-24, Netz 2004a: 1-8, and especially Høyrup 1991.

1270 In regard to the latter, due to large majority of the evidence dating to OB period, a term 'Babylonian' mathematics has been applied to the entire topic; referring to a period rather than an area. However, the use of 'Babylonian' as an overarching term is ambiguous at best and persists primarily through convention: it describes a tradition that started long before the OB era when it had little or nothing to with Babylon; the tradition then evolved over thousands of years across a number of states and empires; in fact, very few mathematical tablets from the OB period have been found in Babylon proper, and the information used to reconstruct OB mathematical practices comes from a wide variety of Mesopotamian cities. The source material for the study of post-OB mathematics, although it continues the same tradition, derives from Assyrian as well as Babylonian sites. I have therefore chosen to use a more general term, 'Mesopotamian' mathematics, instead. Robson (2008: xxii-xxiii) observes the same problem but prefers 'ancient Iraq'.

1271 Even the simple differentiation between 'pure' (scholarly, formal) mathematics, 'supported by an epistemology whose practice is restricted to professionals with specialities' (D'Ambrosio 2000: 85) and 'practical' (popular) mathematics cannot suffice in this context.

1272 Burkert 1972: 431.

merchants.

In order to make any insightful statement about how Greek mathematical traditions were influenced by their Babylonian counterparts (indeed *if* they were, and to what extent), all these various streams and systems need to be examined; comparing just OB or LB material with axiomatic mathematics will remain as fruitless as it has ever been. What must be aimed for is a bigger picture, one that takes into account all different traditions and cultural strata and applies a solid methodological reading to the available material. Naturally, this limits the amount of detail that I have been able to incorporate into the present study.[1273]

The choice has fallen on rather general case studies of four different fields of Greek mathematical discourse. These aim to determine how (if, etc.) these different streams underwent changes when they came, in numerous different occasions, into contact with Mesopotamian material. However, it is also assumed that unlike the topics considered in the last two chapters, mathematics never formed a significant part of the 'Chaldean cultural grid' and that the contacts between the two traditions were somewhat less direct than has been argued for astronomy and astrology. I have presumed that we cannot talk of a single even loosely determinable 'translation' event. Hence, the focus turns to establishing the effects of these differences. In other words, what happens if the 'cultural grid' does not support, or at least encourage, the adoption of certain knowledge? To what extent will the forces active on mathematical material as a result differ from the system of 'cultural translation' observed in the last two chapters? Does the fact that scientific knowledge is not in itself associated with a certain locality influence its incorporation into the 'home repertoire'? Will it be freed from certain preconceptions and patterns of 'translation' or does the supposed lack of prestige of such material hinder its transmission?[1274]

5.2 Modern 'Translation' of Ancient Mathematical Texts

The investigation of ancient mathematical material and its influence on Greek culture has been, in a

[1273] The study is further hindered by the uneven preservation of the source material. Whereas little of Greek 'lay' traditions remain, not much is known of the Mesopotamian 'pure' (as much as it can be called 'pure') mathematics of the post-OB period. Out of the several thousand 'mathematical' tablets unearthed by excavations in various centres of the ancient Mesopotamian civilization, the majority date to OB period; somewhat lesser amount comes from the Seleucid era.

[1274] Although see p. 248 below on geometry belonging to the 'Egyptian cultural grid', which could have facilitated its inclusion in an equal degree.

vein similar to the study of all non-European sciences and indeed, as we have already established, in cultures more generally, severely distorted by a Eurocentric viewpoint.[1275] It has predominantly concentrated on the decoding and assessment of the techniques and on the part these played in the lead-up to modern science.[1276] The nature of these trends is grounded in the fact that a considerable part of the research into Near Eastern mathematics has been conducted by mathematicians or historians of mathematics who, as Robson complains, have 'little feel for the culture which produced the mathematics or the archaeology which recovered the artefacts, and no technical training in the languages or scripts in which the mathematics was written.'[1277] At the same time, Assyriologists have shown little interest in the subject, 'seeing it as overly complex and marginal to mainstream concerns within the intellectual and socio-economic history of ancient Iraq.'[1278]

Detailed study of the cuneiform mathematical tablets started with Otto Neugebauer in late 1920s. The joint efforts of Neugebauer, Thureau-Dangin, Vogel and Gandzt soon led to the emergence of a coherent approach to the history of Mesopotamian mathematics. The 'cultural grid' that developed as a result and conditioned all subsequent forays into this field for the next half a century, relied on their assumption that Mesopotamian mathematics was algebraic (i.e. numerical) in nature.[1279] The

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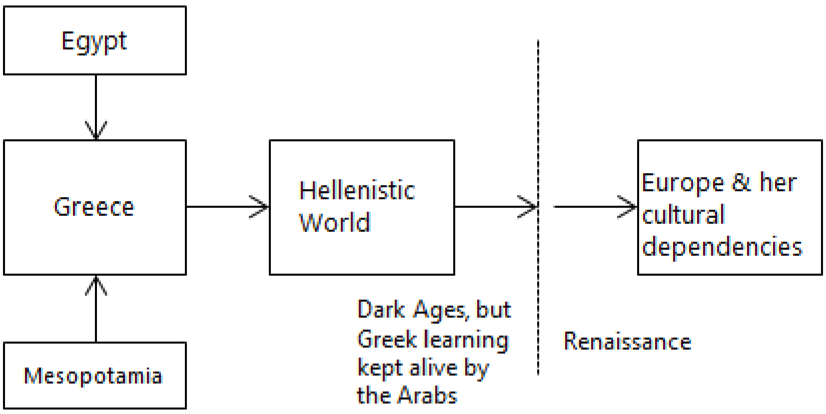
[1275] Robson 2008: 1-2 sums up these views: 'Seen as the first flowering of 'proper' mathematics, it [i.e. mathematics of ancient Iraq] has been hailed as the cradle from which classical Greek mathematics, and therefore the Western tradition, grew.' Joseph's (1991: 9) model of a modified Eurocentric trajectory illustrates this point well:



[1276] For the latest overview of the historiography of ancient mathematics see Imhausen 2010.

[1277] Robson 2000: 95.

[1278] Robson 2008: xxi.

[1279] Høyrup 1991: 8 & 2002: 1-3. Robson (2008: 7) points out that because Neugebauer had stopped working on Babylonian mathematics in late 1940s and the further output from other cuneiformists was very little, successive historians of mathematics were allowed to treat the corpus as complete.

fact that this ‘grid’ was based on *an interpretation* cannot be stressed enough. First, there was, and still is, the question of transliteration and translation of the cuneiform texts, which makes extensive use of sumerograms with polyvalent logographic meanings, that must often be extracted from the given or potential solution process.[1280] These logograms were interpreted by Thureau-Dangin in the style of the rhetorical algebra of the Middle Ages and Neugebauer suggested that they might have at least partly functioned as non-verbal representation of symbolic algebra.[1281] The ambiguity surrounding the role of Sumerograms in Akkadian mathematical thought and terminology sustained their widespread translation into modern code.[1282] What ensued was a separation of philology and mathematics; a widening gap between the mathematical contents of the texts and their historical context. The resulting readings completely eradicated the sense of their socio-historical otherness and hence, the following period was defined by ‘unreflecting characterisation by means of modern mathematical concepts to interpretation in terms of these.’[1283]

In short, Mesopotamian mathematics was - for a long time considered successfully - ‘translated’ into modern idiom. However, from a historiographical viewpoint this caused problems: the drawbacks created by the ‘translation’, pointed out in the introduction in regard to Greek mathematics, apply with equal force here. Høyrup has summarised the consequences as follows:

> Since the secondary literature was more prone than the (generally cautiously formulated) text editions to subscribe to modernizing readings of the texts and would neglect all references to terminology and its development, it was soon conventional wisdom that ‘Babylonian mathematics’ could be treated as *one thing* from Old Babylonian through Seleucid times; that Babylonian mathematics could be adequately described in terms of symbolic algebra and other recent mathematical techniques; and finally that Greek ‘geometric algebra’ was *really* a geometricized algebra derived from the Babylonian prototype.[1284]

[1280] See Høyrup 2002: 4-7 for examples.

[1281] Høyrup 2002: 7-8.

[1282] Neugebauer (e.g. 1952: 42) occasionally argued that such a ‘logograph to modern symbol’ transmission was useful.

[1283] Høyrup 1991: 14.

[1284] Høyrup 1991: 19-27, author’s italics. See for example Neugebauer 1952: 29, who argued that little change, but for the one in notation, language and the introduction of ‘zero’, can be observed from OB to Seleucid texts.

A few examples serve to demonstrate his point. Texts were indeed modernised to an extent that the small number of illustrations that were present in the cuneiform originals, usually non-right-angled triangles (fig. 12), were as if by default turned into right-angled triangles in Neugebauer's commentary.[1285] Though this makes them more 'correct' from the mathematical vantage point, it visibly neglects the peculiarities of Babylonian thought and depiction.

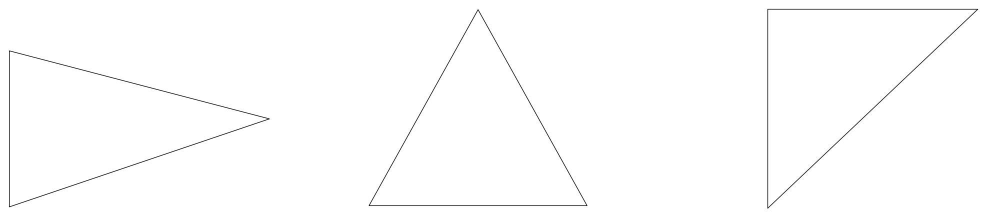


Figure 12: archetypal triangles as they appear in (1) cuneiform tablets, (2) modern imagination and (3) modern mathematical commentaries

A more consequential example is the treatment of Plimpton 322, one of the most famous ancient mathematical texts at hand, that is held to contain the so-called 'pythagorean triples'.[1286] It has been almost unequivocally presented in a modern form – in modern numerals and decimal notation, with errors eradicated, and the headings of columns either omitted or replaced with currently used symbols for the variables, which they are supposed to represent.[1287] Yet, this apparent convenience has led to major errors in interpretation. As the table has been removed from and presented adrift from its mathematico-historical setting, it has consequently been analysed from a modern platform as a kind of self-contained 'detective story'.[1288] This has often resulted in interpretations that carry most value in the eyes of the contemporary mathematicians – e.g. theories that Plimpton 322 is either a form of proto-trigonometric table or a generation of functions.[1289] However, when analysed in its historical context in conjunction with other mathematical documents from the same era, it becomes clear that, although both mathematically valid, neither of these explanations is very

[1285] See e.g. in Neugebauer & Sachs 1945: 48-9. Robson 2002: 105-6 has drawn attention to the culture-dependent image of a perfect triangle.

[1286] See p. 267 below.

[1287] Robson 2001: 169.

[1288] E.g. Buck 1980 (whose article, named 'Sherlock Holmes in Babylon', has inspired Robson's 'Neither Sherlock Holmes nor Babylon' (2001) and despite the refutation offered by the latter also, Anderson et al. *Sherlock Holmes in Babylon and Other Tales of Mathematical History* (2004)).

[1289] Robson 2002: 107-8.

plausible. Robson has more recently suggested that Plimpton 322 is actually a list of reciprocal pairs with appropriate parameters for common word problems, which was compiled as an aid for scribal teachers.[1290]

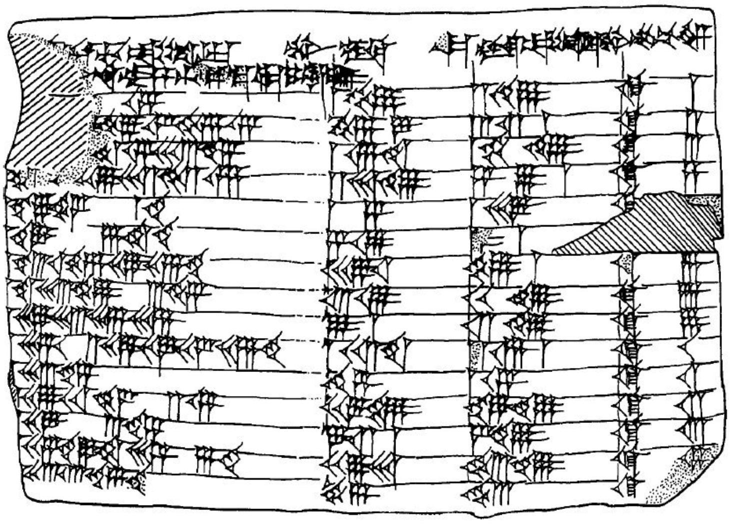



Figure 13: Plimpton 322

Furthermore, Robson comments that the narrow focus on Plimpton 322, YBC 7298 (evidence for the theorem of Pythagoras) and IM 55357 (properties of similar triangles),

> led OB mathematics to be viewed through the lens of early Greek mathematics, whose received image was at that point no less partial: Heath and his contemporaries had created the narrative in which the so-called crisis of incommensurability had led to the rejection of arithmetic in favour of formal Euclidean-style axioms and deductive proofs. Just as one strand of ancient Greek mathematics had become privileged over the rest, a generation later OB mathematics was cherry-picked for resemblances to that tradition.[1291]

So, the reception and study of both Greek and Mesopotamian mathematical material was very much dependent on contemporary 'cultural grids', which dictated what these respective traditions must have been like and what it was for any field or idea to be 'Greek' or 'Mesopotamian' more generally.

These tendencies, enhanced by Eurocentric and diffusionist theories of origin and mutual dependence of various mathematical traditions that tended to ignore historical circumstances and

[1290] Robson 2001, 2002; 2008: 110-15.

[1291] Robson 2008: 272.

cancel out technical differences,[1292] finally evoked strong criticism. In 1974 Unguru raised serious claims against the 'geometric algebra'[1293] approach to ancient Greek mathematics in the History of Science conference in Tokyo. He argued that the historiographical position embodied in the term was 'offensive, naïve and historically untenable', that the use of modern methods in the reading of ancient mathematics was 'the safest way' to misunderstand its character, and that the indiscriminate application of modern manipulative techniques of algebraic symbols to it will hinder the understanding of inherent differences built in the mathematics of bygone eras.'[1294] More to the point, he renounced the view of Greek geometry as a form of algebra altogether.[1295] The reason behind this traditional, but distorting approach, can again be attributed to the fact that history of mathematics was written primarily by mathematicians who sought to reveal the modern ideas and procedures in antique works and to translate the ancient texts into a language understandable to the modern reader.[1296] Although attempts to refutate Unguru's criticisms followed swiftly[1297] and the term 'geometric algebra' still persists in use today, it is now approached with more caution and Unguru's observations have finally been taken into account in more recent works on both Babylonian and Greek mathematics.

Hence, it was only from the 1970s onwards, that the split between humanist scholarship and the study of mathematics began to fade; the latter was reintegrated into the general pattern of the study of cultures and into the broader context of Mesopotamian society.[1298] In addition, the seventies also saw an increased interest in the development of the very early mathematical traditions.[1299] The new approach stopped viewing Mesopotamian mathematics as '*a step on the ladder leading to,* and

[1292] Like Van der Waerden 1983 in his Indo-European origin theory. Although this was published almost a decade after Unguru's criticism, it was strongly dependent on Seidenberg (1962; 1978).

[1293] Coined by Tannery (1882, published in 1912) and Zeuthen (1886), reinforced in popular use by Heath (1908 etc.) and advocated for by Van der Waerden (1954); indicating the interpretative approach to the propositions in Euclid's *Elements* that are believed to be of Pythagorean origin. The accuracy of the term was first questioned by Szabo (1978).

[1294] Unguru 1975.

[1295] In his view (Unguru 1975: 77) 'geometrical algebra' is not only a logical but also a historical impossibility.

[1296] Unguru 1975: 68-9.

[1297] Van der Waerden 1976, Freudenthal 1977, Weil 1978. To which Unguru replied in 1979 and again with Rowe in 1981 & 1982.

[1298] Høyrup 1991: 26-7.

[1299] Especially in the works of Powell (e.g. 1971, 1972, 1976), Schmandt-Besserat (e.g. 1978, 1979), and Friberg (1978, 1979).

hence from the *perspective of* modern mathematics' to analysing it more from the side of 'multi-dimensional anthropology' and in historical development.[1300]

Nevertheless, the questions on the nature and definition of the Mesopotamian mathematical tradition remained and the old interpretation of it being essentially algebraic, with geometry playing only a 'rather insignificant' role, was still generally accepted until the 1990s.[1301] But it has become increasingly clear since then that in its notation, Mesopotamian mathematics was actually essentially geometric.[1302] Høyrup was one of the first to argue that the geometric entities involved were not abstract, as Neugebauer, but concrete measurable line segments and areas; and that the techniques laid on the geometrical foundation were applied to non-geometrical quantities, not vice versa.[1303] Friberg, therefore, applied the term metric algebra – denoting a blend of geometry, metrology, and linear or quadratic equations - to the resulting system.[1304] The methods entailed can be in all cases reduced to 'what in Greek geometry would be seen as application of an area with square excess or

[1300] Høyrup 1991: 36-7, author's italics.

[1301] As in Neugebauer 1952: 42-3, who insisted that 'It is substantially incorrect if one denies the use of a 'general formula' to Babylonian algebra. The sequence of closely related problems and the general rules running parallel with the numerical solutions form de facto an instrument closely approaching a purely algebraic operation, of course, the fact remains that the step to a consciously algebraic notation was never used.'

[1302] Babylonian mathematical notation and its modern equivalent symbols, after Joseph 1990: 108.

Modern symbol	Geometric term	Babylonian quantity
x	length	*ush*
y	breadth	*sag*
x^2	square	*lagab*
z	height	*sukud*
xy	area	*asha*
xyz	volume	*sahar*

However, Høyrup (2002: 33, referring to Viète's *In Artem Analyticen Isagoge,* ed. Hofmann 1970: 1) maintained that OB mathematics can indeed be approached as a form of algebra, but algebra in the Viètean sense, which holds that: 'Central to every calculation technique that somehow can be characterized as 'algebraic' is the *analytical approach*, that is, 'the assumption of what is searched for as if it were given, and then from the consequences of this to arrive at the truly given'.

[1303] Høyrup 1992: 606; 2002: 34. Contrast Neugebauer (1952: 43-5) who found that ''geometry' is only one among many subjects of practical life to which the arithmetical procedures may be applied.'

[1304] Friberg 2007: vi.

deficiency.'[1305] How this works will be shown later.

Høyrup's theory was fully elaborated in *Lengths, Widths, Surfaces*, published in 2002, a book that completely reassessed the numerico-algebraic interpretation of OB mathematics using the principles of 'structural analysis' and 'close reading', putting more emphasis on the connotations that words and logograms have in specific mathematical contexts.[1306] This is something that, as has been pointed out above, the commentators working only on modern translations were inherently unable to do. To overcome this limitation, Høyrup, and Friberg in his footsteps, adopted a 'conformal translation' approach, disregarding in their translations the use of idiomatic English and to a lesser extent modern symbolic algebra.[1307] The result is a so-called *alienating* translation that, by keeping the rendering as close to the original as possible, maintains the intellectual distance between the ancient text and the modern reader, as opposed to the *domesticating* translation aimed at by the earlier interpreters.[1308] In that way the translation becomes less culturally conditioned and allows the reader without detailed knowledge of the Akkadian language nevertheless to work closely with the original text.[1309]

Another important benchmark was achieved with the publication of Robson's *Mathematics in Ancient Iraq: A Social History* in 2008, which as its name suggests, aimed to situate Iraqi mathematical culture in its social and intellectual context. Robson advocated for the constructivist historical view that tries to understand why 'societies and individuals *choose* to describe and understand a particular mathematical idea or technique on particular way as opposed to any other' and how 'the social and material world in which they lived affect their mathematical ideas and praxis.'[1310] She therefore used the ethno-mathematical approach - as developed by D'Ambrosio and

[1305] Høyrup 2002: 96.

[1306] For an introduction to structural analysis and close reading see Høyrup 2002: 14-15.

[1307] Høyrup 2002 (esp. 40-42 for an explanation), Friberg 2007.

[1308] Netz's (2004b) recent translation of the works of Archimedes takes the same course: he states his aim as removing 'all barriers having to do with the foreign language itself, leaving all other barriers intact.'

[1309] Robson (2008: 7) has highlighted the ground-breaking nature of Høyrup's early work, saying that his article 'Algebra and Naïve Geometry' (1990) signalled 'a paradigm shift away from the history of Mesopotamian mathematics as the study of calculational techniques and their 'domestication' into modern symbolic algebra. Høyrup's work was in effect a discourse analysis of Mesopotamian mathematics: a close scrutiny of the actual Akkadian words used, and their relationship to each other. In this way he completely revolutionised our understanding of ancient 'algebra', showing it to be based on a very concrete conception of number as measured line and area.'

[1310] Robson 2008: xxii.

Ascher and until then only applied to anthropological examination of non-literate cultures - and recognised the crucial point that

> whether one's philosophical stance is that mathematics is created or discovered, it is nevertheless demonstrable that ways in which mathematics is conceptualised, described, and discussed are culturally bounded... Thus we should expect to find commonalities between mathematics and other modes of discourse within a single culture, and we can use those points of comparison in two ways. First, we can seek the subject matter of Mesopotamian mathematics in the natural and built environments of Mesopotamia, albeit in a more nuanced manner than simply describing it as a 'reflection of everyday life'. Second, we can then analyse the detailed and formal discourse of ancient mathematics to help illuminate the conceptualisation of related documents and artefacts.[1311]

5.3 The 'Source Text' – Mesopotamian Mathematics and its Development

Robson's meticulous analysis revealed that not even OB, not to mention Mesopotamian mathematical tradition as a whole, was a 'homogeneous mass of undifferentiable, anonymous writings that it is often presented as.'[1312] The following pages give an overview of the development of these slightly different mathematical systems over successive historical periods, first analysing the relationship between mathematics and the current socio-economic and political circumstances, and, not least important, showing how mathematics came to be applied to the cultic-religious area of life. A closer look into these matters lays the foundation for comparing the Mesopotamian mathematical material with the respective Greek traditions.

The earliest written evidence for mathematical practices comes from late 4th millennium BC Uruk. These early tablets display sophisticated methods of balance accounting and are concerned with practical administration of the city-state economies.[1313] Mesopotamian mathematics, with its terminology, subject matter, methodology and conceptualisation remained grounded in the service

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[1311] Robson 2008: 45.

[1312] Robson 2008: 97.

[1313] These are clerical accounts, primarily recording summations of different categories of goods, raw materials and grain harvests. Høyrup (1992: 604) points out, though, that it is difficult to distinguish between administrative records and school texts for this early period. For the distinguishing features in general see Robson 2008: 63-4.

of this numerate bureaucracy until at least the mid-3rd millennium BC. But from then on, the texts show an increasing interest in the pedagogical value of the properties of numbers[1314] and so the previously utilitarian mathematical system evolved beyond bureaucratic needs. Texts found from Šupurrak and Ebla, for instance, deal with problems that are unlikely to be encountered in the context of daily administration.[1315] This development appears to have been continuous: the Early Dynastic materials systematically work through the relationship between length and area and, by the Sargonic times, five types of problem-texts are attested.[1316]

A different kind of headway was made over the succeeding Ur III era. The mathematical stagnation and repression, brought about by the totalitarian regime that Høyrup postulated for this period[1317] does not hold in Robson's view, who argues that the situation was quite the opposite and Ur III was instead characterised by 'cognitive innovation hitherto paralleled only by the first commitment of numbers to writing in late fourth-millennium Uruk.'[1318] More specifically, early Ur III saw the increasing utilisation of the sexagesimal place value system (SPVS from now on; see appendix 2 for how it works) which from then on started to replace the different number bases used according to the counted goods and materials.[1319] According to Friberg, the earliest firmly dated example for SPVS is YBC 1793, from c. 2200-2100 BC.[1320] Moreover, Ur III-style work rates and standards formed the basis of later constants.[1321]

The latter were systematised when mathematics made unprecedented progress during the ensuing OB period, between 1900-1600 BC. As elementary scribal training underwent a revolution, mathematics came to play an important role in the schools that 'developed a curriculum which

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1314 Robson 2008: 44, 51.

1315 Høyrup 1992: 604.

1316 Robson 2008: 44, 56. These include (a) finding the short side of the rectangle when a long side and area are given; (b) finding an area of a square when its side is given; and (c-e) finding the area of a quadrilateral field, sometimes with derived agricultural data or the volume of a rectangular prism. Note that although all these are marked as pedagogical exercises, they are nevertheless still constructed to reflect administrative needs.

1317 E.g. Høyrup 1992: 604.

1318 Robson 2008: 54-84.

1319 Converting between different metrological systems had formed the focal point of mathematical exercises from the late 4th millennium BC onwards (Robson 2000: 102-3; 2008: 15, 77, 292).

1320 Friberg 2005a: 1.

1321 Robson 2008: 75.

stressed virtuosity beyond what was practically necessary'.[1322] A few thousand surviving mathematical tablets testify to a complex mathematical culture, which concerned itself with theoretical problems far removed from the practical needs of Mesopotamian everyday life.[1323] Nevertheless, Robson points out that even the most abstract problems continued to be dressed up with 'practical' scenarios,[1324] affirming the 'applied' base of mathematical discourse.

The mathematical tablets dating to this and succeeding periods can be divided into two main categories: (1) the so-called (a) 'problem texts' - many of which are compilations loosely reminiscent of modern textbooks (often with explicitly pedagogical structure, moving from simple exercises to increasingly more complex problems; e.g. 'anthology texts', 'theme texts', 'catalogue texts, and 'series texts';[1325] see fig. 1[1326]) - or (b) 'school/procedure texts', providing a step by step solution to set exercises, which usually entail finding the measure of certain lines or areas when other parameters are given.[1327] And (2) 'table texts' which can in turn be allocated into three separate groups according to their nature and subject matter: (a) mathematical tables that encompass multiplication, reciprocals, squares, cubes, square roots, cube roots, root n of $n^3 + n^2$, and the successive powers of a number;[1328] (b) tabulated conversions of metrological values into sexagesimal multiples; and (c) technical tables of *igi.gub* – i.e. 'fixed factors' or 'constant coefficients' - to be used in practical computation. The first two were used as aids for calculation; the third formed the nexus between mathematical computation and administrative and engineering reality.[1329]

After the OB period mathematical texts become exceedingly rare. From about a thousand tablets published in the Digital Corpus of Cuneiform Mathematical Texts (DCCMT), only one dates to the MA

[1322] Høyrup 1992: 604.

[1323] Høyrup 1992: 603; Robson 2000: 94-5.

[1324] Robson 2008: 89.

[1325] See Høyrup 2002: 8-10 for a longer discussion on the subtleties of the division. Altogether a few hundred tablets, containing between themselves about one throusand problems (as estimated by Robson 2000: 107; according to Neugebauer (1952: 41-2) a single tablet can provide more than 200 problems).

[1326] An OB clay tablet, c. 1750 BC, probably from Larsa, Southern Iraq, recording geometrical diagrams and accompanying problems (e.g. 'the side of the square is 60 rods (c. 360 m). [Inside it are] 4 triangles, 16 barges, 5 concave squares. What are their areas?' – trans. by Robson 1999: 217).

[1327] For the standard format and structure of the problem texts see Høyrup 2002: 32-9 or Robson 2008: 90. Robson (2008: 8) estimates a number of school texts in the body of published evidence at c. 80%.

[1328] For examples of tables containing squares, cubes and their roots see Neugebauer & Sachs 1945: 33-5; MLC 2078 for successive powers of 2.

[1329] Høyrup 1992: 604-5. For more information see appendix 2.

and 17 to the MB era. The NA and NB periods are slightly better represented with 6 and 44 respectively.[1330] This sudden and distinct decrease in primary evidence could of course be explained by the haphazard survival and discovery of archaeological material (brought about by the shift from the virtually indestructible but uncomfortable clay tablets to perishable writing materials like parchment and papyrus),[1331] coupled with a significant quantity of unpublished tablets from the period in question. But it could also reflect the change in social order after the Kassite conquest and the alleged loss of scribal schools and their ideology.[1332] It is believed that from then on such education continued to be provided primarily by the 'scribal families' rather than special institutions; and although mathematics remained part of the curriculum, it appears to have lost the autonomy it had previously enjoyed as a subject.[1333] Nevertheless, despite the almost complete lack of evidence from the first half of the 1st millennium BC, the techniques perfected during the OB heyday clearly remained in use over the next millennium.[1334] Two word-problems from the NB period show a remarkable continuity with the older pedagogical exercises, only with distinct differences in metrology, spelling conventions and technical terminology.[1335] Similarly, Babylonian culture persisted through the Persian and Hellenistic periods. Temples of Marduk in Babylon and the sky god Anu in Uruk remained the bastions of Babylonian religion, literacy, and civilisation and all known mathematical activity is associated with them.[1336] Anu-aba-utēr's compilation of word problems

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[1330] DCCMT is accessible at http://oracc.museum.upenn.edu/dccmt/corpus and contains transliterations and translations of around a thousand cuneiform mathematical tablets. For the transliterations of Nippur tablets in the collection of the Istanbul Archaeological Museum see Proust 2007. The numbers given above must be compared against the 813 tablets from the three centuries of the OB rule. Only a small number of post-OB texts were available to Neugebauer and his contemporaries, see e.g. Neugebauer & Sachs 1945: 38, 169-45.

[1331] Evidence for the increasing use of perishable writing materials includes the 'Sack of Musasir' stone relief from Fort Sargon that shows two scribes, one with a tablet and a stylus and the other with a parchment or papyrus (see Albenda 1986: pl. 133). There are other similar examples, which usually depict a scribe holding a parchment or papyrus next to another with a hinged wooden re-usable writing board. An ivory writing board has been found in or near a Neo-Assyrian house in Assur. See Robson 2008, sections 3.4 and 5.4, and especially 140-5 for more information; for the increasing use of Aramean scribes who would have used such boards rather than tablets also Beaulieu 2006b: 188.

[1332] Høyrup 2002: 315. Only four mathematical tablets are known from the Kassite period. However, see Robson 2008: 153 for the scribal-school argument.

[1333] Høyrup 1992: 604.

[1334] E.g. a 9th cent. AD mensuration text by Abū Bakr shows an astonishing degree of similarity with the OB texts, not only in substance and methods but also in the rhetorical and grammatical structure (Høyrup 1992: 607).

[1335] BM 47431 and BM 78822. Robson 2008: 186.

[1336] Robson 2005: 12.

which forms part of the Sîn-lēqi-unninni family archive from Seleucid Uruk and is the latest dated cuneiform mathematical tablet known, includes many problems that are very similar to the OB ones. Essentially, it is a mixture of old cut-and-paste (discussed below) procedures and new innovative methods.[1337] Furthermore, Robson argues that the evidence we currently have points to a conceptual shift between the 5th cent. BC and the Hellenistic period, which saw a move away from a highly metrological mathematics to a considerably more demetrologised system, in which 'cubits and minas are given rather trivial passing mention, but essentially numbers have become separated from the objects and sets they quantify for the first time in cuneiform culture.'[1338]

Although Late Babylonian/Seleucid mathematics is better represented in the archaeological record,[1339] it is clear that as calculation continued to be written mainly on perishable materials, we do not know exactly which heights Mesopotamian mathematics achieved during this phase of its development. Some directions it took can, however, be observed. First of all, the 1st millennium BC did see great progress in astronomy. Although mathematics and astronomy were linked in several ways, there is reason to believe that the former was not completely subordinated to the service of the latter. Mathematical tablets from the houses of Uruk's scholarly families show predominant concern for reciprocals, and lengths and areas, both of which play no role in astronomical calculation methods.[1340]

Nonetheless, strong ties had formed between mathematics, astrology, and religion. Robson explains that

> from the mid-seventh century onwards, Assyrian scholars like Nabû-zuqup-kēna and the anonymous Babylonian compilers of eclipse records and astronomical diaries had begun to think in terms of *divine quantification.* They understood that the god's management of time and space was deeply mathematised. Apparently random events of great ominous significance were observed, quantified, and recorded in the hope that numerical patterns could be detected amongst them… Thus in later Babylonia mathematics become a priestly

[1337] Robson 2008: 244. For the use of more innovative methods, including repeated factorisation see *ibid* 237, 267, 280-1.

[1338] Robson 2008: 260-1.

[1339] A considerable number of the tablets is archaeologically grounded and provides a much better socio-cultural insight than the context-lacking OB material. E.g., a coherent corpus of mathematical tablets was found in the house of the Šangû-Ninurta family from 5th cent. BC Uruk. See Robson 2008: 227-40.

[1340] Robson 2008: 227, 237, 261.

concern,[1341] and even when it was not immediately practical it was the expression of deeply mathematised nature of the universe as the gods created it; even the gods themselves were associated with particular numbers.[1342]

So, this Nabû-zuqup-kēna, an Assyrian court scholar in Kahlu who copied *Enuma Anu Enlil* from Babylonian originals between 718 and 701 BC, also either copied or compiled *Inam ğišḫur ankia,* a work that speculates on the various aspects of 'the plans of heaven and earth' and uses numerical manipulation to do so.[1343] Moreover, a whole genre of compositions is concerned with the dimensions of great cultic temples and sanctuaries, Esangila for instance,[1344] and some astrological omen texts dating to the early-1st millennium BC were even written cryptographically in numbers.[1345]

That mathematics had become a domain of the privileged priestly classes is shown by the aforequoted passage by king Aššurbanipal, which locates arithmetical ability – multiplication and division – amongst the most esoteric and specialised scholarly specialisms.[1346] All this has more than just passing importance as the tendency to resort to this sort of number mysticism has been connected to the teachings of Pythagoras (below) in Greece.[1347] Number mysticism itself was of course much older. In Gilgameš dangerous spaces and times of transition were always associated with sexagesimally irregular numbers 7, 11 and 13 – a mathematical preoccupation that extends as far back as the Early Dynastic Period. Tools and measurements used to overcome these difficulties, on the other hand, were counted in whole round numbers, which conform to mathematically simple shapes.[1348]

Returning for a moment to Aššurbanipal, Assyrian mathematical tradition also warrants attention, especially as it serves to further show the local 'home repertoire' influenced transmission of

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[1341] See section 5.5 for how this is relevant.

[1342] Robson 2008: 268. A LB metrological tablet W 23273 assigns numbers to gods as follows: [1] Anu, [2] Ellil, [3] Ea, [4] Sin, [5] Marduk (?), [6] Enki (?), [7] the Seven gods, 8 the Igigi gods, 9 the Anuna gods, 10 Bel, 20 Šamaš, 30 Sin, 40 Ea, 50 Ellil. K 170 + Rm 520 provides an alternative set: [60] Anu, [50] Ellil, [40] Ea, [30] Sîn, [20] Šamaš, [6] Adad, [10] Bēl Marduk, [15] Ištar, [50] Ninurta, [11] Nergal, Šakkan, [10] Gibil, Nusku.

[1343] Robson 2008: 148. Also see p. 103 & 169 above.

[1344] See n. 462.

[1345] Høyrup 1992: 607.

[1346] See p. 80-1.

[1347] Cf. Neugebauer 1963: 528-9.

[1348] Robson 2008: 181.

mathematical traditions even within the Mesopotamia itself. Twenty tablets, mostly standard OB-style elementary lists and calculations, have been found in Old-Assyrian Mari, Kaneš and Assur. The Middle-Assyrian period has yielded only one purely mathematical tablet: a complete series of multiplication tables ending with a table of squares, again based on an OB original but dating to c. 1178-1076 BC and found in the Neo-Assyrian context in the temple of Aššur, together with about 60 other MA tablets and at least 300 NA ones many of which are also copies of Babylonian works. The same tendency to duplicate Babylonian, whether OB or Kassite, material has been observed on Neo-Assyrian mathematical tablets, found in Assur, Nineveh and Huzirīna (modern Sultantepe in southern Turkey).[1349]

However, despite this evident dependence on Babylonian mathematical knowledge (perhaps due to its higher status) Assyrian tradition retained a certain degree of distinction. Those practising calculation in Aššur and Kaneš had no crises of notation or base like Babylonians, who were used to switching between several metrological systems; neither did they try to replicate Babylonian formal education. Assyrian literacy and numeracy were practical, needed only to administer economic transactions: any education was thus purely grounded in the immediate needs of trainee merchants.[1350] Perhaps most noteworthy, however, is the fact that Assyrians held on, at least in notes and ephemera, though not in official documentation, to their local decimal number system.[1351] In addition, Robson observes that 'the calculations attest to a lively local culture of riddles quite divorced from the ideologies of scribal self-identity: neither ants nor birds were the objects of bureaucratic management regimes.'[1352] How these riddles might be as important a glue as the surviving cuneiform tablets will shortly be discussed.

5.4 Babylonian Influence on Greek Mathematical Traditions

That OB mathematical traditions had spread outside Babylonia proper is shown not only by the tablets found in Assyria but also in Kabnak in Elam, Ugarit in northern Syria and Hazor in Canaan.[1353]

[1349] Robson 2008: 127-8, 144-5.

[1350] Robson 2008: 133-6.

[1351] Robson 2008: 149.

[1352] Robson 2008: 149.

[1353] Robson 2008: 154-5, 266-7. Excavations in the latter have yielded tablets which contents link directly to the OB tradition, i.e.they were written on the material that is identical to the letter sent by the local ruler to

The traces of Mesopotamian influence, however, disappear soon after the fall of the OB Empire and Robson has concluded that Babylonian mathematical problems were not popular in the wider Middle East from the late-2nd millennium BC onwards, perhaps due to their slight relevance to local counting systems, metrologies, or political ideologies.[1354] In the light of such claims the question how they could have influenced Greek mathematical discourse rises to the forefront. This has been a matter of serious debate and divergent opinions for nearly a century.[1355]

Greeks themselves have often been depicted as adamant that their mathematical tradition was imported from abroad. But on a closer look, their explanations were never anything more than mere guesses. Herodotus states clearly 'δοκέει δέ μοι' that the origins of geometry lay in Egypt where the annual flooding of the Nile prompted the need for accurate land measurement. But the same passage also attributes the introduction of the 'sun-dial and the gnomon and the twelve divisions of the day' to the Babylonians with much clearer certainty: πόλον[1356] μὲν γὰρ καὶ γνώμονα καὶ τὰ δυώδεκα μέρεα τῆς ἡμέρης παρὰ Βαβυλωνίων ἔμαθον οἱ Ἕλληνες.[1357] The alleged Egyptian origin of geometry was then reinforced by Aristotle (with the alteration that he credited it to the leisured priestly class), by his pupil Eudemus, and later on by Hero, Diodorus Siculus, Strabo, Iamblichus and Proclus.[1358]

So, unlike in astronomy and astrology, Chaldeans were never explicitly credited for any mathematical theories. Nevertheless, their more or less direct influence on Greek mathematical traditions can be gathered from the surviving evidence. This is nowhere as pronounced as with astronomy and astrology, but it nevertheless offers interesting avenues for the study of cultural translation: the lack

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Akhenaten in Amarna.

[1354] Robson 2008: 181, 267.

[1355] Some more or less direct derivation was proposed by Kugler in 1911 but his arguments were somewhat circular, trying to explain with the help of Pythagorean number symbolism why numbers 15 and 150 were substituted for words 'right' and 'left' in certain cuneiform texts (e.g. on a Neo-Babylonian tablet from a private collection, published in Biggs 1974, lines 11-12). The continuity of mathematical methods from Sumer to the Hellenistic period and Greece was suggested by Schuster in 1930 and had become an accepted fact by the end of the decade, despite the serious questions posed by the evidence itself (Høyrup 1991: 8-9). The latest treatment of this topic is Friberg 2007.

[1356] The LSJ explains πόλος as a *pivot,* an axis of the celestial sphere, pole of this axis, orbit of a star; but a concave sun-dial in the passage in question, on which the shadow was cast by the gnomon.

[1357] Hdt. 2.109.

[1358] *Metaph.* 981b10-25; Eudemos F 133 (*In Eucl.* 64.17f); Heron *Geom.* c.2, Diod. Sic. 1.69.5, 1.81.1; Strabo 17.3 (also saying that 'accounting and arithmetic originated with the Phoenicians, because of their commerce', which must be a rationalisation); Procl. *in Euc.* 64-5 (in Morrow 1970: 51-2).

of references could be explained by the fact that mathematics does not form part of the Greek 'Chaldean repertoire', but, as seen, that of the Egyptian instead. Moreover, the transmission routes for mathematics must have been sufficiently different from those of astral siciences. How this affected the adoption of originally Babylonian mathematical practices into the Greek 'home repertoire' will form the focus of the following four small case studies.

5.4.1 The Sub-Scientific Calculation Puzzles

What is generally viewed as Greek or Hellenistic mathematics is the 'pure', i.e. non-utilitarian, tradition, characterised by the presentation of areas of mathematical knowledge as theories. Of course, there is a strong bias in the preservation of mathematical works that could explain the tendency to see only this side of the science, although as Høyrup concludes:

> The lens of the late schoolmen can be seen to have been somewhat distorting; but it certainly did not change the total picture, not *a fortiori* produce an illusion. Greek and Hellenistic mathematics, *in its culturally and quantitatively dominating form, was* theoretical and concerned with abstract entities…[1359]

However, we shall start this investigation not with this 'pure' form of mathematics but with one that was *not* culturally and quantitatively dominating, one Høyrup has termed 'sub-scientific knowledge'. By his definition this is an organised body of knowledge that is in the likeness of a scientific discipline but is really the domain of a practical craft.[1360] In essence, these 'sub-scientific' methods are not the techniques used by OB scribal students, NA and NB priestly classes or the Greek mathematician-philosophers (although some cross-influence can be assumed) but rather the problems and their solutions encountered by practical specialists like merchants and surveyors. Their traditions existed before, and side by side with, classical Greek geometry and concerned 'arithmetical and geometrical problems with numerical solutions, similar to the problems we find in Egyptian, Babylonian, and Chinese collections.'[1361] We may surmise that the Egyptian 'ropestretchers' (*harpedonaptai*) whom Democritus boasts he has surpassed 'in making lines into figures and proving their properties' were

[1359] Høyrup 1990: 3, author's italics.

[1360] Høyrup 1990: 7-8.

[1361] Van der Waerden 1983: 157.

the carriers of one such stream of tradition.[1362] And in all likelihood the Roman practitioners as well, to whom Cicero alluded to when he says that 'with the Greeks geometry was regarded with the utmost respect, and consequently none was held in greater honour than mathematicians, but we Romans have restricted this art to the practical purposes of measuring and reckoning,' can be counted among them.[1363]

Høyrup explains that

> like Babylonian scribal mathematics, sub-scientific mathematics in general possesses a 'pure', i.e. non-utilitarian level, which can be regarded as its 'cultural superstructure'... The utilitarian basis of a body of sub-scientific mathematical knowledge is thus determined by problems, and its characteristic methods and conceptual tools have been developed with the aim of coping with these problems. To this extent, the basic structure of sub-scientific mathematics is similar to the central principle of theoretical mathematics of Greek type. '[1364]

But the 'pure' level of sub-scientific mathematics is not based on the problems themselves, rather on the stock of methods that it masters. The problems are selected according to the ability to solve them and they serve two types of interests: teaching and the formation of professional identity and pride.[1365] But even OB mathematics, with its rationale to display professional virtuosity, served in effect the same ends.[1366] Our knowledge, however, is limited. Robson has argued that even the fact that we know so much of OB mathematics is paradoxical, for 'the wealth of written evidence is an artefact of fundamentally oral, memorised transmission of knowledge and values: OB school tablets were essentially ephemera, created to aid and demonstrate recall, destined almost immediately for the recycling bin.'[1367] Hence it is not surprising that once the scribal schools had disappeared, the records became even scantier. Høyrup speculates that this happened because 'unlike its scribal predecessor traditions… practical computation and its carriers had stopped being culturally productive.'[1368] The same also applies to Greece, where the puzzles belonging to the realm of

[1362] Clem. *Strom.* 1.15.69.

[1363] *Tusc.* 1.2.

[1364] Høyrup 1990: 8.

[1365] Høyrup 1990: 9-12; 1996: 5-6.

[1366] Høyrup 1992: 606.

[1367] Robson 2008: 124.

[1368] Høyrup 1990: 1-5.

practitioners of calculation, a group different from the élite Greek intellectuals, must have been common. This lack of information, however, makes it difficult to tell whether, and if so to what extent, they were 'derived from the theoretical mathematics of the age, indigenously but autonomously developed, or borrowed from older neighbouring cultures.'[1369]

In terms of transmission, what must be present in order to postulate the interdependence of two traditions, are the so-called 'index fossils', i.e. features that remain unchanged over time and space.[1370] These are, however, very hard to track in case of simple applied arithmetic, elementary geometrical constructions, simple area calculations and wrong approximate formulae. Such shared techniques, as they can potentially all stem from similar practical problems, do not prove the existence of connections between different mathematical cultures. However, this cannot be said for certain peculiar expressions and weird geometrical approximations that can be observed in the 'recreational' problems used at the sub-scientific level. And these testify to the existence of 'a number of enduring diffusion patterns.'[1371]

On the basis of the comparison between cuneiform tablets and post-classical Greek texts, some Mesopotamian influence on Greek utilitarian mathematics can be quite securely assumed. Remnants of this lay tradition survive in the works of Hero and Diophantus (discussed in more detailed below), as well as in the *Greek Anthology* and other late compilations.[1372] One of the more reliable index fossils is the occurrence of composite fractions in the West. Høyrup has observed that their use in Greek riddles must stem from a Semitic-speaking area (we have previously seen Assyrian riddles).[1373] OB and Egyptian sources allow us to assume that these were expressed in a particular way, e.g. one third of one fourth, instead of the more usual one twelfth.[1374] No classical source employs this method of expression but they do turn up again in *Problems to Sharpen the Young*[1375] and the *Greek*

[1369] Høyrup 1990: 6.

[1370] Robson 2008: 274.

[1371] Høyrup 1990: 13-4. One of them is the 'Silk Road community' within which the 'recreational mathematical puzzles appear to have migrated as 'camp fire riddles' for professional traders.' For the inclusion of the 'Silk Road material' in the classical world see *ibid.,* 15-16.

[1372] See also Netz 2004a: 97-120, 137-144 on Archimedes and the multiplication of areas by lines.

[1373] Høyrup 1990: 25.

[1374] E.g. YBC 4652 no.20 ('...one third of one thirteenth I multiplied by 21…').

[1375] A Medieval Latin collection of recreational mathematical problems, attributed to Alcuin of York and dated to the second half of the 8th century, contains 56 problems. See Hadley and Singmaster 1992 for an English trans. Problems involving combined fractions are nos 2, 3, 4, 40.

Anthology (where they are used in a curious set of specific problems: with the Mediterranean extensions of the Silk Road,[1376] the legal partition of heritages,[1377] the hours of the day,[1378] and in one special case, dealing with an unfortunate banquet held in Hellenistic Syria[1379]). The definite pattern is made more outstanding by the fact that problems which refer to Greek mythology, history or other similar topics make use of Greek or Egyptian fractions instead. All this implies that the origins of these problems should be sought for in the Near East and that they demonstrate the survival of an autonomous sub-scientific tradition.[1380]

Moreover, Høyrup has argued that the 'four sides and the area' problem must have been in common circulation among practical geometers since pre-OB period.[1381] OB text BM 13901 (= RA 33 29) no. 23 shows how this would have been solved. The problem is a slightly more advanced version of the 'one side and the area' problem ($y^2 + y = a$, explained below in ch. 5.4.3), only in this case, the four sides are attached to the sides of the original square ($y^2 + 4y = a$). Moreover, the choice of 10 as a standard side of regular polygons in OB, Heronic, and Arabic mathematical literature dealing with this problem must be more than a coincidence, as 10 is otherwise not used as a preferred length for a side (especially in Mesopotamia where 30 is the favoured regular quantity), and is thus an 'indubitable and very direct reference' to the Near Eastern tradition.[1382]

We may agree with Høyrup's conclusion that 'a whole fund of sub-scientific mathematics, connect to the transcontinental trade routes and including superstratum of 'recreational', non-utilitarian

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1376 *Greek Anthology* 14.121 ('…thence to the precipitous Pyrenees is one eight and the twelfth part of one-tenth…'); 14.129 ('Voyager, between Cretan Ram's Head and Sicilian Pelorus are six thousand stades, and twice two-fifths of the distance we have traversed remains till the Sicilian strait…'). Trans. Paton 1918.

1377 *Greek Anthology* 14.128 ('Poor tearful I have this fifth part of the seven-elevenths of my brother's share…'); 14.143 ('To me he gave twice two-thirds of his share, on our mother he bestowed two-eighths of my share…').

1378 *Greek Anthology* 14.139 ('Four times three-fifths of the distance he has traversed remain until he sinks to the western sea'); 14.140 ('the night still wanted till morning twice two-sixths and twice one-seventh of what was past'); 14.141 ('Tell me the transits of the fixed stars and planets when my wife gave birth to a child yesterday. It was day, and till the sun set in the western sea it wanted six times two-sevenths of the time since dawn') – this is of special interest for its astrological nature but so is 14.124 that uses simpler non-complied fractions; 14.142 ('Arise, work-women, it is past dawn; a fifth part of three-eighths of what remains is gone by').

1379 *Greek Anthology* 14.137 ('A fifth of the fifth part of those who perished were from Athens…').

1380 Høyrup 1990: 24, 26. Or different traditions, for there are some variations in the *Anthologia* and the *Propositiones.*

1381 Høyrup 1996a.

1382 Høyrup 1996a: 5; 1996b: 27-8.

problems, was diffused throughout Greco-Roman society though at the 'culturally subliminal' level.[1383] And that at that level,

> … the Classical world was traversed by a multitude of sub-scientific networks, more or less merged with each other. We may also conclude that some of these technologies and networks were important for what went on at the culturally conscious level. Just as in the case of literature, the hidden undercurrents of non-literate and often oral culture provided an important part of the water and the nutrients which made literate scientific culture flourish.[1384]

We can, therefore, infer that the transmission of originally Babylonian mathematical knowledge to Greece moved, at least partly (see alternative suggestions below), through rather indirect routes. It is thus difficult to make any significant conclusion about the cultural translation of this material *per se.* However, an analysis on how this material was incorporated into Greek deductive mathematical tradition will allow insights into the role of 'home repertoire' and 'repertoire-making'.

5.4.2 Emergence of Deductive Mathematics

In theory, every mathematical development inevitably lies on some kind of sub-scientific soil. But the way this initial spark was moulded into a particularly Greek style of deductive mathematics has raised considerable debate. The standard account holds that early Greek mathematics started as arithmetised geometry but after the discovery of incommensurability, and the *Grundlagekrisis* this induced, it came to be reformulated in a non-numerical way.[1385] Although whether incommensurability had the effect many presume had been questioned before,[1386] this view came to be most heavily criticised in the works of Fowler,[1387] in whose opinion it was rather the problem of the dimension of squares that gave an initial impetus to the development of axiomatic mathematics; a natural process that

[1383] Høyrup 1990: 21.

[1384] Høyrup 1990: 42.

[1385] E.g. Neugebauer 1952: 143; 1963: 530 (the $\sqrt{2}$ problem led to the emergence of a logical geometric system that 'severed all relations with the ultimately Mesopotamian origins of mathematical knowledge').

[1386] Burkert 1972: 462 has pointed out that no *Grundlagekrisis* is actually attested in the sources.

[1387] Fowler 1999a: 359-69. In his view, its discovery was 'no more than an incidental event in the early development of mathematics.'

starts with a problem that already has a very characteristic Greek flavour; it pursues its exploration using an algorithmic procedure that leads to the appearance of a compelling pattern, followed by the realisation of the need for a proof (this distinction between true judgement and proof being the topic of Plato's *Theaetetus*); it then moves on to the discovery of one such method of proof and some of its many consequences; then on to its limitations, and the discovery of extensions of all of this: better techniques for resolving this problem, and further problems, some eventually soluble, others not; and then, finally, the disappearance of the original motivating problem.[1388]

Plato's philosophical interest triggered remarkable advances in Greek mathematics as a deductive science[1389] and it has also been argued that Plato was somehow behind the tradition that Pythagoras was responsible for the introduction of mathematical sciences from Egypt to Greece.[1390] This view was promoted by Neoplatonists and Neopythagoreans[1391] but its origins definitely date back much earlier, with Hecateus of Abdera, Anticlides, Hermesianax of Colophon and Callimachus (all post-Plato), all connecting Pythagoras to the introduction or development of geometry/arithmetic/geometrical astronomy in some way or another.[1392] The latter however, makes

[1388] Fowler 1999a: 373-4.

[1389] Plato's importance for the advancement of mathematical science was stated already by Proclus (in Morrow 1970: 4).

[1390] Heath (1931: 3-4) was convinced that the Pythagoreans had at least roughly developed and covered Books 1, 2, 4 and 6 (and perhaps 3) of the *Elements*. Generally, the entirety of Book 2 and sections of Book 1 from Proposition 42 onwards were held to be of Pythagorean origin and essentially concerned with 'the transformation of areas into equivalent areas of different shape or compositions by means of 'application' and use of the theorem of 1.47 [i.e. the theorem of Pythagoras]' (Heath 1921: 152-3; Van der Waerden 1983: 81). However, that Pythagoras or his school were responsible for the initial development of deductive mathematics was called into question as early as 1907 by Junge, Vogt and then Sachs. See Burkert 1972: 8, 404, also 1-14 for the development of modern thought on Pythagoreanism. The topic is indeed a complex one, and Burkert concludes that 'the material seems to fall into the pattern each inquirer is looking for. The historian of science rediscovers Pythagoras the scientist; the religiously minded show us Pythagoras the mystic… Pythagoreanism is thus reduced to an impalpable will-o-wisp, which existed everywhere and nowhere.' Yet, 'minimalism that eliminates every aspect of tradition which seems in any respect questionable cannot help giving a false picture' either. See 208-17 for convincing arguments that little deductive mathematics can be attributed to Pythagoras or the early Pythagoreans. Also Neugebauer 1952: 142 and Robson 2008: 285.

[1391] The three biographies of Pythagoras by Diogenes Laertius, Pophyry, and Iamblichus - each one 'more marvellous than its predecessor' (Kahn 2001: 5). See Burkert 1972: 406-7.

[1392] Burkert 1972: 407, whereas the passage usually attributed to Eudemus via Proclus (*in Euc.* 419-20): 'These things, says Eudemus, are ancient and are the discoveries of the Muse of the Pythagoreans, I mean the application of areas, their exceeding and their falling-short. It was from the Pythagoreans that later geometers took the names, which they again transferred to the so-called conic lines...') must be taken from Iamblichus (409-11). Burkert (1972: 452) points out that the 'application of the area' solution was not used by Hippocrates, a mockery of the alleged Egypt-Pythagoras episode, clearly alluding to the fact that the career of geometry had begun before Pythagoras' time and thus Pythagoras could by no means have been the one to introduce it into Greece.[1393] Early geometry must have begun to take form at least by the time of Thales (c. 624-c. 547 BC); geometrical concepts can be comprehended behind the works of Anaximander (c. 610-c. 546 BC) and Hecataeus (c. 550-c. 476 BC); and the 6th cent. BC Ionic technical writings on astronomy and time-reckoning (above) must have used the concept of circles and angles.[1394] In sum, by the time Pythagoras (c. 570-c. 497 BC) reached adulthood, technological and geometrical thinking was already at its prime.[1395]

The development of Greek mathematics cannot, therefore, be considered in isolation from the advances and interests of current natural philosophy, as discussed before.[1396] Its success was aided by the practice of debate throughout the Greek world.[1397] Development of axiomatic science was a longer process that probably began in the 5th cent. BC. Lloyd notes that strict deductive proofs occurred in philosophy before they did in mathematics and the Eleatics (e.g. Parmenides) provided 'the first clear statement of the key thesis that serves as the epistemological basis for any abstract inquiry such as mathematics, namely the insistence on the use of reason (as opposed to the senses) as the criterion.'[1398] This increased emphasis on reason and proof with it meant that the naïve cut-and-paste procedures were no longer enough, they now had to be backed up with solid evidence. In addition, we can also observe a search for the 'incontestable principles of some kind as the foundation of mathematics' although there is some 'indeterminacy in the conception of these foundations'.[1399]

One cannot deny that the end result, the Euclidean-style geometry, was something radically new; even in the light of advances made in reinterpreting both Mesopotamian and Greek material, Heath

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who used the method of 'inclination' or 'verging' instead. The Pythagoreans to whom Eudemus refers to may well belong to the post-Hippocrates period. These did indeed make a significant contribution to the development of Greek geometry (1972: 465).

[1393] Burkert 1972: 420.

[1394] Burkert 1972: 416-9.

[1395] Burkert 1972: 419.

[1396] See p. 135.

[1397] Lloyd 1970: 8-15.

[1398] Lloyd 1970: 110.

[1399] Lloyd 1979: 114, 117-8 for how Euclid's primary principles relate to disputes current in the Greek society.

was still right in stating that 'the Greeks in fact laid down the first principle in the shape of the indemonstrable axioms or postulates to be assumed, framed the definitions, fixed the terminology and invented the method of *ab initio.*' [1400] Although when and by whom exactly axiomatic mathematics was coined still cannot be determined with full certainty and the debate will surely carry on for years to come, some concepts and methods can be connected with those familiar from the cuneiform sources.

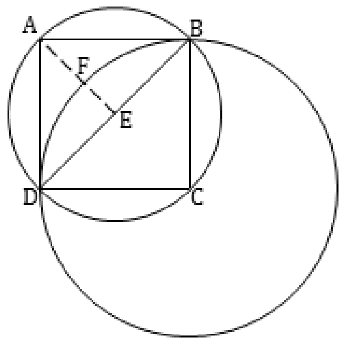
Proclus tells us that the first to have compiled *Elements* was Hippocrates of Chios in the 5th century BC.[1401] Not very much is known of this work. As he learned mathematics in Athens, it is not surprising to find him primarily occupied with the then popular challenges of squaring a circle and duplicating a cube.[1402] This led him to a discovery of the theorem for calculating the areas of lunes.[1403] Arguably, much of its contents (e.g. geometrical solutions to quadratic equations) must have overlapped with or been directly included into the first two books of Euclid's *Elements,* the earliest of its kind (c. 300

[1400] Heath 1931: 1.

[1401] Procl. *in Euc.* 66 (in Morrow 1970: 54).

[1402] The first was proved impossible by Lindemann in 1882; for the second he postulated that a cube can be doubled if two mean proportionals can be determined between a number and its double.

[1403] A lune (Gr. *meniskos* 'little moon') is a crescent-shaped figure, bounded by the arcs of two unequal circles. Our knowledge of them comes from Eudemus (almost verbatim via Simp. *In Ph.,* Heath's translation in the *History of Greek Mathematics* 1, 182-202). In short, the proposition proves (see the figure) that the area of $\text{lune AF} = \Delta\,\text{ABD}$ using the following method: let the line segment between AB and AD be called a and that between BD b. These segments are similar to each other.



From Pythagorean theorem we get that $\frac{a^2}{b^2} = \frac{b^2}{2*b^2} = \frac{1}{2}$, i.e. $b^2 = 2a^2$. If S_a and S_b are the circle segments on a and b, the area of the lune is L and the area of the triangle is S_Δ , then $L + S_b = S_\Delta + 2S_a$ and $S_b = 2S_a$. Hence, the area of the lune is equal to the area of the triangle (i.e. the half square). A slightly different proof is given by Alexander (see Friberg 2007: 309-11). For similar problems with trapezoids, see Friberg 2007: 312-5. A connected text in the cuneiform corpus is a Late Babylonian W 23291-x §1 (probably borrowed from an OB source). The text deals with an expansion of the 'heart', i.e. the middle part of the accompanying figure, and makes use of the constants given in TMS 3 (see Friberg 2007: 316-20 for their construction, and 321-6 on how they apply to the given exercise).

BC) to survive in full.

It is clear that Euclid also made substantial use of other earlier mathematicians, including Pythagoreans, Theaetetus of Athens, and Eudoxus of Cnidos; in that sense his work can be viewed as a compendium of current Greek mathematical knowledge, summarised and arranged in a systematic order in 13 books.[1404] Their headings give a convenient overview of the key areas of contemporary mathematical investigation:

1. Fundamentals of plane geometry involving straight-lines	
2. Fundamentals of geometric algebra	
3. Fundamentals of plane geometry involving circles	
4. Construction of rectilinear figures in and around circles	Planimetry
5. Proportion	
6. Similar figures	
7. Elementary number theory	
8. Continued proportion	Arithmetic
9. Application of number theory	
10. Incommensurable magnitudes	
11. Elementary stereometry	
12. Proportional stereometry	Stereometry
13. The platonic solids	

Each book is structured around definitions, propositions (postulates) and common notions (axioms). In short, *Elements* aims at providing theoretical proofs for the theorems it presents without resorting to empirical proof by means of measurement.[1405]

Modern commentators looking for evidence of 'east-west communication' have always taken a great interest in the second book. Even Neugebauer suspected that the contents of its 'geometrical algebra' utilised the results of Mesopotamian tradition, although he was unable to prove it.[1406] The advances

[1404] Folkerts s.v. 'Euclides', BNP.

[1405] Fitzpatrick 2008: 4.

[1406] Neugebauer 1952: 141.

made in the investigation of the latter field have, however, yielded evidence that verify his suspicions.

The first four propositions of *El.* 2 offers are very simple, essentially postulating that the whole is always equal to the segments it contains. Algebraically read, they can be seen as proving most types of rectangular-linear, quadratic-linear, or quadratic metric algebra problems.[1407] Stripped of their 'critical dress', they can be easily reduced into the underlying 'naïve' procedures that one finds in the Babylonian corpus.[1408] Thus Friberg argues that *Elements* 2 can be divided into three parts with relations to the nine basic equations or systems of equations used in OB algebra.[1409] That propositions 4-8 and 9-14 are related to the same basic quadratic or rectangular-linear systems of equations, although presented in a different way, has led him to suggest that a lost Greek forerunner of the book, containing only propositions 1-8, must have been written in the style of a Babylonian text on the same subject. This Babylonian text was likely to have given solutions to concrete metric algebra problems, and not lettered diagrams and abstract propositions like Euclid.[1410]

No such Mesopotamian text exists *per se*. There are, however catalogue texts or theme text with relevant problems and solutions. For instance, BM 80209 (= CT 44 39), provides a template for a systematically arranged 'catalogue' of metric algebra problems: it contains a collection of problems, each set solvable with a progressively more complicated quadratic equation or system of equations,[1411] but none concerned with the type of problems involved in Euclid's propositions.[1412] A more relevant text is TMS 5, which gives a list of problems for squares. None of the problems is accompanied by a solution process or even an answer but Friberg has drawn parallels between the basic quadratic equations needed to solve some of them and those provided by the *Elements*.[1413] Solution procedures are, however, given on tablet BM 13901 (= RA 33 29).

[1407] Friberg 2007: 6-26.

[1408] Høyrup 1999: 406.

[1409] Friberg 2007: 24. A: (1)-3: related to the basic quadratic equations; B: 4-8 and C: 9-14: both related to the quadratic or rectangular-linear systems of equations.

[1410] Friberg 2007: 24, cf. Robson 2008: 290, who states that it 'seems highly unlikely that a proto-Euclidean *Elements* will turn up amongst the hundreds of Neo-Babylonian tablets still to be deciphered.'

[1411] See Friberg 1981 and 2007: 27-9. The equations are: 1 (Obv. 1-2). $x = a^2$; 2 (Obv. 3). $x^2 = 2a^2$; 3 (Obv. 4). $x =$ dikšum(a); 4 (Obv. 5-8). $5u^2 = A$; 5 (Obv. 9-Rev. 5): $5u^2+cu = A$ and $5u^2-cu = B$; 6 (Rev. 6-9). $5u^2+5v^2 = A$, $v-u = 10$; 7 (Rev. 10-13). $5u^2+30u+u = A$.

[1412] Problem type 7, however, has a parallel in Heron's *Geometrica* (4.445) but is apparently very unusual in a Greek context (Friberg 1981: 64).

[1413] Friberg 2007: 34.

The first problem on this tablet utilises an idea which appears to underlie a number of different solutions, the principles of which are demonstrated in *El.* 2.[1414] The problem states 'the field and my equalside I heaped, 45',[1415] i.e. $y^2 + y = 0;45.$[1416] The solution to finding the side s is entirely geometrical, as opposed to Neugebauer's and Thureau-Dangin's initial conviction that it is algebraic,[1417] and based on the reading of y not as the square's side but as an area $(1 * y = y)$ of a rectangle that is attached to the square (Cf. *El.* 2 proposition 3).[1418] This rectangle, with a combined area 45 is then converted into a square. The resulting figure is parallel to the one illustrating Euclid's proposition 4, which states that 'if a straight line is cut at random, the square of the whole equals the squares of the segments plus twice the rectangle contained by the squares.'[1419] I.e.

$$\text{if } x = y + z, \text{ then } x^2 = y^2 + z^2 + 2yz$$

which in geometrical terms is expressed by the following diagram:

[1414] *El.* 3, 4, 7; for the special relevance of 6 see Høyrup 2002: 96-9.

[1415] Trans. Friberg 2007: 36.

[1416] $45 * 60^n$. The given answer is only correct if $n = -1$. In decimal system 45 would then be $\frac{3}{4}$. Again, see app. 2 for my notation of sexagesimal numbers.

[1417] See Høyrup 2002: 11-4.

[1418] The term *mitḫartum* meaning 'a confrontation of equals', *viz.* the square configuration parametrized by its side, as recognised by Høyrup (2002: 13) not 'side' as both Thureau-Dangin and Neugebauer interpreted it (though with some caution). Van der Waerden (1983: 72) too followed the same traditional reading, arguing in the same vein that 'Babylonians do not hesitate to add an area to a line segment… for the Babylonians the length, width, are etc. were mainly considered as *numbers*, which can be added and multiplied without any restriction.'

[1419] Trans. Joyce 1996.

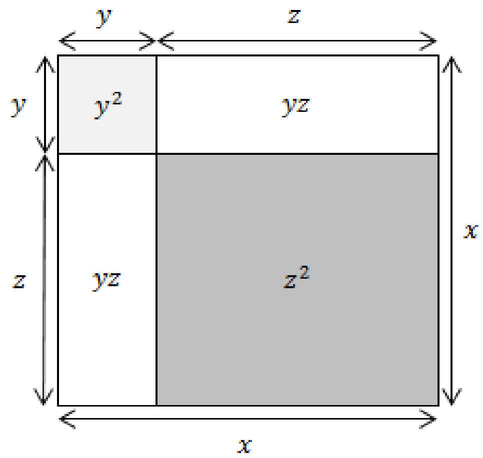


Figure 14: $x^2 = y^2 + z^2 + 2yz$

The solution process of BM 13901 no.1 is best explained visually. The problem is set up as:

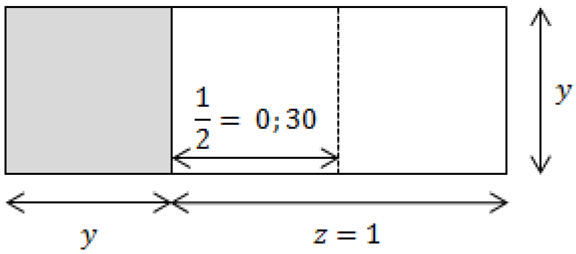


Figure 15: $y^2 + y = 0;45$

The value for y^2 is found by (1) reimagining the problem on the lines of figure 8:

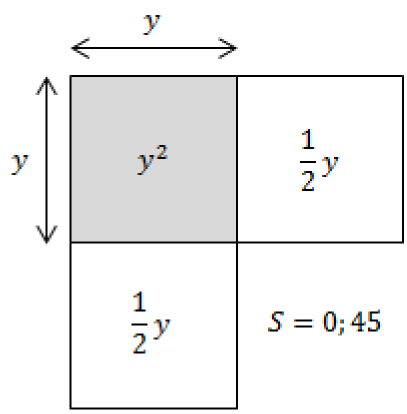


Figure 16: Step 1 of the solution process

(2) calculating the size of the square segment that makes the newly formed large square

complete (i.e. squaring 0;30, that is half of the side of the segment 1, which gave us $1y$):

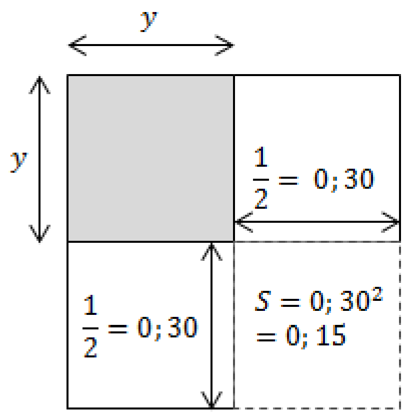


Figure 17: Step 2

(3) adding the result to 0;45, which gives us that the total area of the large square is 1.

(4) finding the side of this square: $\sqrt{1} = 1$.

(5) and finally, subtracting from this result known side 0;30: $y = 1 - 0;30 = 0;30$. A quick check shows that $\frac{1}{4} + \frac{1}{2}$ is indeed $\frac{3}{4}$, or 0;45.

This algorithm, based on the 'square expansion rule' known to and utilised by the Mesopotamian scholars at least from the Sargoid period onwards,[1420] was applied to geometric as well as non-geometric problems. YBC 6967 puts it into a parallel computational use; only, this time the exercise is disguised as one of finding reciprocals, an *igûm-igibûm* problem. The student is told that one reciprocal exceeds the other by 7. As it is a given that their product is 60, the problem can again be envisaged as a rectangle with unknown parameters x and y. Whereas a modern student would see it as a system of equations $\begin{cases} x - y = 7 \\ xy = 60 \end{cases}$ and tackle it by substituting x for $y + 7$ and then solving the resulting quadratic equation $y^2 + 7y - 60 = 0$ by $y = \frac{-7 \pm \sqrt{7^2 + 4*60}}{2}$, the Babylonian student followed the geometry-based algorithm described above,[1421] breaking it down into tiny steps instead.

[1420] See Friberg 2007: 38-42.

[1421] The terminology used in this text differs somewhat from the one used in BM 13901 (see Høyrup 2002: 57) but the term *šutakūlum* (or *šutākulum*), 'to make hold/eat each other', which, although its interpretation remains open, is generally associated with geometric problems, whereas *našûm,* which would be more often used for simple multiplication, appears in both (see Høyrup 2002: 5-7, 13 & 23-7 for these terms).

The solution follows an identical pattern to the one just described above: 7 is divided into two equal parts, the rectangle is transformed into a square, its area and sides are found and the reciprocals calculated by adding 3;30 to one side and subtracting it from the other. The same problem, only in geometric form and one side exceeding the other by 10, is recorded on MS 5112.11[1422] and again in LB text W 23291 (§1e).[1423]

Directly related to these problems is the method of the 'application of areas',[1424] fundamental to Greek geometry[1425] and exemplified in *El.* 6.28 and 6.29. The accompanying diagrams are essentially the same as those for *El.* 2.5 and 2.6 but involve parallelograms instead of squares and rectangles; and the proofs used in the former are just generalisations of single steps in the proofs of the latter.

Other problems on BM 13901 differ in detail and the exact algorithm used (e.g. one based on 'the square contraction rule'), but are drawing on ultimately similar principles that we find postulated in the 'geometric algebra' of Euclid.[1426] The concordance between BM 13901 no.8 and no.9 and *El.* 2.9 and 2.10 has been pointed out by van der Waerden.[1427] Furthermore, OB parallels for *Elements* 2 part C can be found in TMS 1, MS 3049, CT 09 08 (esp. nos 21, 22), and RA 32 04 (no. 9) (for circles and chords), and VAT 7351 (for trapezoids).[1428]

However, it is not only book 2 that is riddled with Mesopotamian influences. The rest of the possible links and parallels, as argued by Friberg, are summarised in the following table. The degree to which influence on specific cases can be postulated varies. For instance, the proof offered for the Pythagoras' Theorem in *El.* 1.47 can be argued to be fundamentally Greek because it utilises the Greek conception of quantified angle, something that the Babylonian geometers appear to have lacked.[1429]

[1422] See Friberg 2007: 41.

[1423] The latter gives the student the seed measure, which must be converted into a surface measure by multiplying it with the right constant. §1d also works on the same solution principle.

[1424] I.e. an application of a given area (of a triangle or any rectilinear figure) to a limited straight line with possible defect or excess.

[1425] Heath 1921: 150.

[1426] *El.* 2.8 (see Friberg 2007: 14-5 could be used for the solution of BM 13901 #8, #9, #11 although see Høyrup 2002: 66-70 for alternative drawings.

[1427] Van der Waerden 1983: 85-6.

[1428] Friberg 2007: 42-50.

[1429] Høyrup 1999: 406.

Elements	Theme	Related tablets	Reference in Friberg 2007
1.43-44, *Data* 57-61, 84-85	Application of areas	YBC 4709	211-234
1.47	Proof of the Pythagorean theorem $a^2 + b^2 = c^2$	TMS 5 TMS 3	73-81
Book 4	Figures within figures	BM 15285 (= RA 19 149, see fig. 11) (TMS 3) TMS 21 MS 1938/2, 2985, 3050 & 3051 YBC 7359	123-140
10.28 (lemma 1) & 10.29	Generation of Pythagorean triples	Plimpton 322 MS 3971 §3, 4 AO 6484 §7	83-94
10.32 (lemma) & 10.33	Subdivision of right triangles	IM 55357	95-100
10.33, 10.54, 10.57	Quadratic rectangular systems of equations	BM 13901 #12 MS 5112 §2 IM 67118 MS 3971 §2	116-122
Book 12	Pyramids and cones	TMS 14 BM 96954+102366+SÉ 93	171-202, 207-210
Book 13	regular polygons and polyhedrons	TMS 3 IM 51979 MS 3049§5 and 3876	141-188
***On Divisions* (lost)**	Division of areas	Str. 364, 367 TMS 18, 23 MLC 1950 VAT 7621, 7531, 8512 YBC 4608, 4675, 4696 MAH 16055 IM 31248, 43996, 58045 Ist.Si. 269 Ash. 1922.168 MS 3908 Erm. 15073, 15189 AO 17264	235-308

Table 13: Possible paralleles between the Elements *and Mesopotamian material*

That the Mesopotamian 'cut and paste' methods carried on beyond the OB period is clear from W 23291.[1430] Friberg argues that several features of the LB/Seleucid texts, such as the use of OB units of measurements, suggest that these were written in direct imitation of OB models.[1431] Correspondingly,

> when *Elements* II, or more likely a lost Greek forerunner to *Elements* II was written in imitation of some oriental archetype, it was only the last link in an extremely long chain of theme texts with metric algebra problems. The heated debate over the question whether some of the propositions in *Elements* II were Greek *geometric reformulations* of Babylonian *algebra* can now be laid to rest. In reality, *Elements* II appears instead to have been a direct *translation* into non-metric and non-numerical 'geometric algebra' of key results from Babylonian *metric algebra.* It is noteworthy that, in spite of this translation, Greek geometric algebra still relied on *the same geometric models* as Babylonian metric algebra.[1432]

5.4.3 Pythagoras and the Number Theory

Burkert's highly convincing view that little or no deductive mathematics can be attributed to Pythagoras or his immediate disciples has often been utilised, perhaps too vigorously, by scholars like Fowler and Robson.[1433] Pythagorean cosmology was inherently related to arithmetic and number theory,[1434] and in Lloyd's opinion some of their inquires in this area,

> were connected with, and stimulated by, a brand of number mysticism – the belief that numbers in some way hold the key not just to what we recognise as quantitative relationships but also to qualitative ones, including morality.[1435]

Both the general association itself as well as details of the emerging theory can be shown to have used and developed Babylonian formulas.[1436]

[1430] Friberg 2007: 50-68.

[1431] Friberg 2007: 70.

[1432] Friberg 2007: 71, author's italics.

[1433] Fowler 1999: 357-8, 362.

[1434] See Burkert 1972: 15-83, esp. 37-8, 427-47. E.g. Arist. *Metaph.* 985b 23 ff, 1080b 16 ff, *Cael.* 300 a 16.

[1435] Lloyd 1979: 228.

[1436] West has speculated that, even before that, the dimensions of Anaximander's cosmos may betray a Babylonian element and the thought that the numerical speculation game was carried over to Anaximander is

The Pythagoreans took a cataloguing approach to the numbers, finding a classification scheme in the arithmetic that they believed symbolised the world and the society within it. Bloor has summarised this world view in the following words:

> Its order and hierarchy captured for them both the unity of the cosmos and our aspirations and role in it. The various types of number 'stood for' properties like Justice, Harmony, and God… It was a way of making intellectual contact with the essence and potencies which underlay the order of things.[1437]

In other words, specific numbers were associated with discoverable meanings and exalted to almost divine status. For example, Philolaus' work on astronomy presents an unusual scheme of heavenly bodies, which includes a so-called counter-earth, allegedly solely for the purpose of bringing the number of spheres up to 10,[1438] demonstrating an almost superstitious fixation on significant numbers such as 10 and 7.

This sort of number mysticism appears also to have been current in Mesopotamia. The well attested use of numbers to designate gods has already been mentioned above.[1439] The number ten, for example, also attracted a degree of special attention in the cuneiform tradition. The polyvalent sign representing it was used for words like 'high', 'strong', 'man, master', 'totality' and in conjunction with *dingir* to designate various gods.[1440]

Moreover, Parpola has proposed a reading of the Mesopotamian symbol of divine order, the 'sacred

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compelling indeed. In his own words (1971: 91-2): 'Commentators speak in general terms of the sacred significance of the numbers three and nine that play such an evident role in his system. But there may be something more to it. If the stars' wheels are nine times the size of the earth, the moon's wheel 18, and the sun's 27, the outer *ouranos* will be 36, whether diameters or circumference are being compared.' There is also the possible connection to the 36 stars of the astrolabes. However, Burkert (1972: 309-10) points out that the prominence of number 9 is a point of contact with Hesiod. Nevertheless, it is clearly a game of symmetry that shines so brightly through Anaximander's speculation. Naturally, with the majority of his postulates lost to us, it is difficult to determine the true extent and due provenance of the oriental influence in Anaximander's philosophy. Other possible connection points are possible: compare for example his world map surrounded by a circular ocean with the peculiar map on BM 92687 and with Sargon Geography texts (VAT 8006 and BM 64382+82955), which apart from geographical information include some anthropological observations, like comments on strange diets and funerary practices (lines 52-9).

[1437] Bloor 1991: 120.

[1438] Arist. *Metaph.* 986a8ff. See Lloyd 1970: 28-9 for a description and explanation. Also see p. 128.

[1439] For designations see n. 1342.

[1440] Kugler 1911: 9.

tree' or the 'tree of life', invested with an esoteric lore which centred on number mysticism. The tree has remarkable parallels in the Jewish Kabbala and the Sefirotic Tree of Life both in symbolic content and appearance. Parpola believes the Jewish system to have been modelled on an older Mesopotamian tradition[1441] and armed with that assumption, has attempted a hypothetical reconstruction of its numerical values by replacing the Sefirot gods with the Mesopotamian counterparts and the numbers associated with those gods in the cuneiform literature.[1442]

His suggested Pillar of Equilibrium indeed displays a nice symmetry, each level yielding 30, the sum total of which, when added to the total of the individual numbers, gives 360, the number of days in the Assyrian cultic year and the circumference of the universe expressed in degrees.[1443] Whether or not this proves the correctness of the proposed model that Parpola hopes for, he makes a compelling case for the mathematically perceived cosmos.[1444]

Number mysticism itself is of course an age-old phenomenon.[1445] Hence, claiming that the Pythagorean idea originated wholly in Babylonia would put undue strain on the argument. Even the 3-4-5 symbolism is attested in early Greek folk customs.[1446] But it is possible, and even likely, that Pythagoras and his disciples applied scientific formulas, originating from Babylonia, to a previously existing belief system and took these ideas to another level. For instance, it is unlikely that Pythagoras introduced the famous theorem later named after him into Greece[1447] (although Burkert does not deny that he could have had some genuine contact with the Orient[1448]), but fully

[1441] Kugler 1911: 9.

[1442] Taken from Röllig, s.v. 'Göttenzahlen' in *RLA*.

[1443] Parpola 1993: 188. For the importance of 360 see ch. 3.2.

[1444] Parpola (1993) has tried to give further strength to his case by offering numerical readings of the *Enuma eliš* (tablet 1), the Gilgameš epic and the Etana myth – altogether perhaps a bit too strenuous an effort but some points, for instance Anu generating Ea in his likeness, which with great likelihood refers to the fact that both 1 and 60, the respective numbers of the two gods, are written with the same sign in cuneiform (Parpola (1993: 190-1) takes this to mean that 'the composer of the epic conceived the birth of the gods as a mathematical process') and the erading of the Etana with its flight to heaven as an allegory of spiritual awakening and a mystical ascent of the soul (using some numerical knowledge?) are interesting possibilities.

[1445] See Burkert 1972: 468-77 for examples in other cultures.

[1446] Burkert 1972: 474-5.

[1447] Pythagoras as the discoverer of the theorem in Apollodorus *FGrH* 1097 F 1.

[1448] Burkert 1972: 112, although he does not define what that could have been (the Babylonian episode as presented cannot be true, at least in the form that we have it, as it is chronologically impossible and was probably modelled after the story of Democydes). Kahn (2001: 5-6) offers a convenient summary of the relevant claims made by late antique authors: 'He first studied geometry and astronomy with Anaximander, comprehensible that it served some cryptic meaning in Pythagorean number mysticism. This default Pythagorean triple[1449] can, for example, be interpreted as 3 for male, 4 for female and 5 for marriage.

Van der Waerden[1450] has postulated a common origin for the calculation of related triples[1451] but this remains problematic to say the least.[1452] Interestingly, however, a formula for the calculation of some special cases is ascribed to Pythagoras by Proclus[1453] and Plato uses another one,[1454] whereas there are no relevant formulas in the works of Euclid, Archimedes or Apollonius perhaps because the triples are of no value for practical mathematics. They do, however, appear to have been used again by Diophantus (below). Van der Waerden has also argued that the 'Bloom of Thymarides' is another link in a once continuous chain of traditions from Babylonian texts through Pythagor(e)a(n)s to Diophantus.[1455]

Furthermore, an important part of Pythagorean number and musical theory was constituted by the arithmetic, geometric and harmonic means. The first and last provide an increasingly closer approximation of the square root. The latter can be expressed by the sequence of arithmetic means (a_n)

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then hieroglyphic symbolism with the priests of Egypt and the science of dreams with Hebrew masters. He studied also with the Arabs, with the Chaldeans of Babylon, and finally with Zoroaster, who taught him the ritual of purification and the nature of things.' Although the late date of the sources plays an important part in the counter-arguments; the formation of such an image begins much earlier. Pythagoras' association with the priests of Egypt is mentioned by Isocrates and hinted at by Herodotus. The 5th and 4th cent. BC mentions are generally ironical in tone and paint of picture of Pythagoras as 'a fabulous sage and religious teacher, who was perhaps also a charlatan' (Kahn 2001: 12-3, see also n. 720 above).

1449 See glossary.

1450 Van der Waerden 1983: 10. Throughout his book *Geometry and Algebra in Ancient Civilization* van der Waerden (inspired by Seidenberg 1962) argues for the common Indo-European origin of ancient mathematical traditions (Greece, Babylonia, India, China). Regardless of his explanation, the similarities he points out between Greek and Babylonian mathematics help build towards a cumulative argument.

1451 I.e. integers a, b and c satisfying the condition $a^2 + b^2 = c^2$. Primitive triples have no common factor. These can be easily found with the formula $(c - b)(c + b) = a^2$ or if $a = xy$ then $c + b = x^2 \rightarrow c = \frac{x^2+y^2}{2}$ and $c - b = y^2 \rightarrow b = \frac{x^2-y^2}{2}$, although other formulas exist as well.

1452 Not least because his reconstruction of the Babylonian method of finding triples is based on the restoration of three allegedly missing columns of Plimpton 322 as those containing $a, \frac{b}{a} = m$ and $\frac{c}{a} = n$. If this is correct, then the triples would have been found by the formula $1 + m^2 = n^2$, $b = am$, $c = an$.

1453 $a = x, b = \frac{x^1-1}{2}, c = \frac{x^2+1}{2}$.

1454 $a = 2x, b = x^2 - 1, c = x^2 + 1$.

1455 Van der Waerden 1983: 162.

$$a_{n+1} = \frac{a_n^2 + c}{2a_n} \ (n = 2, 3, \dots)$$

and the sequence of harmonic means (h_n)

$$h_{n+1} = \frac{c}{a_{n+1}} = \frac{2a_n c}{a_n^2 + c} \ (n = 2, 3, \dots)$$

The Babylonian method is mathematically equivalent to the one described here and in Heron's *Metrica* 1.8,[1456] although the one that Fowler and Robson describe is *computationally* more tedious.[1457] Iamblichus even says that the most perfect proportion 12 : 9 = 8 : 6 was introduced from Babylon.[1458] This then could be another case when a rule discovered in Babylonia was transposed into Greek number speculation.[1459]

Another parallel within Babylonian and Pythagorean arithmetical traditions is what the Neopythagorean Nicomachus of Gerasa (AD c. 60-120) calls the ἀριθμοί παραμηκεπίπεδοι.[1460] These are volumes of rectangular parallelepipeds, expressible by $n^2(n \pm 1)$. There are cuneiform tables of these numbers, used to solve cubic equations in the form of $n^2(n \pm 1) = a$.[1461]

All in all, some Pythagorean mathematical interest cannot be denied be it mystical or practical. Neugebauer argues that:

> It seems to me characteristic, however, that Archytas of Tarentum could make the statement that not geometry but arithmetic alone could provide satisfactory proofs. If this was the opinion of preceding mathematician of the generation just preceding the birth of the axiomatic method, then it is rather obvious that early Greek mathematics cannot have been very different from the Heronic Diophantine type.[1462]

There was a Pythagorean mathematical tradition, and the fact that it was not axiomatic and did not

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[1456] See appendix 2.

[1457] Fowler & Robson 1998: 376.

[1458] *In Nic.* 118.23f.

[1459] Burkert 1972: 441-2.

[1460] Becker 1938: 181.

[1461] E.g. MCT 1.76, Van der Waerden 1976: 202.

[1462] Neugebauer 1952: 142.

form a direct basis of the development of what we call the classical Greek mathematics, does not devalue its legitimacy in any way in the current context. It is clear that this proofless kind of arithmetic lasted long after Plato and made some use of methods derived from Mesopotamia, 'translating' them according to its own needs.[1463] These needs appear to have been cosmological and if Parpola is right about the existence of a numeric-esoteric lore in Assyria and Babylonia, the translation might not have been too difficult to do.

5.4.4 Merging Traditions

Many of the streams of mathematical traditions current in the Greek-speaking world of Hellenistic Egypt and linked in one way or another to Mesopotamia, were merged together in the works of Heron and Diophantus.[1464] Although both follow the classical Euclidean way in many respects, they occasionally show knowledge of alternative 'algebraic' tricks.[1465] Their debt to Mesopotamian methods is one of the least contested aspects of the entire debate.[1466] Heron, for instance, records the procedure Babylonians used for calculating square roots (explained in Appendix 2 and just referred to in connection with the Pythagoreans), and consequently, it is still sometimes referred to as 'Heron's method'.[1467]

Diophantus is a curious figure in Greek mathematics who stands out for his formal, algebraic treatment of quantities, something quite distinct from the Euclidean geometric approach, but whose 'theoretical' algebraic knowledge is nearly impossible to grasp.[1468] Hankel observed in 1874 when next to nothing was known of the equivalent Mesopotamian tradition that 'wären seine Schriften

[1463] Burkert 1972: 433.

[1464] An analysis of the parallels can be found in Friberg 2007: 327-65 - they will not be reiterated here.

[1465] Høyrup 1996b: 20.

[1466] Neugebauer (1952: 140 & 1963: 529-30) considered Heron's methods to have been a Hellenic form of a general oriental tradition. Diophantus' debt to Mesopotamian methods has been similarly well observed (e.g. Van der Waerden 1983: 99, Høyrup 1990: 36-7, Joseph 1990: 111, Fowler 1999a: 9, 359, Folkerts s.v. 'Heron' in *BNP*; cf. Schappacher (2005: 8) who finds that the Babylonian influence is 'often conjectured' and the suggestion that Diophantus might have been a Hellenised Babylonian is outright absurd), although it has at times been subject to unhistorical treatments by scholars unfamiliar with its predecessors (e.g., Bashmakova 1974; see Schappacher 2005: 27-8 and Friberg 2007: 327 for criticism).

[1467] A similar method is also recorded in the Indian *Sulbasutras,* probably dating to sometime between 800 and 500 BC (Joseph 1990: 106).

[1468] This due to the disparity between the general formulation of problems and certain restrictive conditions, rare general comments, and the particularity of the given solutions (Schappacher 2005: 16).

nicht in griechisher Sprache geschrieben, Niemand würde auf den Gedanken kommen, dass sie aus griechischer Cultur entsprossen wären...'[1469]

Of the originally 13 books of Diophantus' *Arithmetica*, dealing with the solutions of determinate and indeterminate equations, 6 have survived in Greek, and 4 in Arabic, translation.[1470] The problems follow a semi-systematic structure and are solved by a wide variety of methods (often complemented by 'surprising tricks') tailored for their individual needs.[1471] For all (including indeterminate) problems, only one solution (out of a possibly infinite number) is offered and this is always a positive rational number. These last two points bring to mind Høyrup's remark that in sub-scientific level, problems were generated from available solution processes.[1472]

Additionally, except for the inclusion of *diorisms,*[1473] both the contents and the structure of book one are reminiscent of OB mathematical theme texts and metric algebra problems.[1474] Diophantus used the same method to solve linear equations with two unknowns as did the Babylonians and that, as has been shown, was essentially the same as used by Euclid. Friberg thinks that Diophantus probably got his inspiration from some humble collection of originally Babylonian mathematical problems, perhaps inscribed on a number of Egyptian demotic or Greek-Egyptian papyrus rolls.[1475] One such is *P. Cairo,*[1476] a hieratic mathematical recombination text from the 3rd cent. BC. Many problems have Babylonian parallels, e.g. nos 36 and 37 are quite obviously related to BM 85194 (= CT 09 08) nos 12 and 17.[1477]

[1469] Hankel 1874: 157.

[1470] An Arabic translation was made around the 870s by Qusṭā ibn Lūqā, a Greek Christian working in the court of Bagdad. A 1198 copy of books 4 to 7 was found in the Astan Quds Library in Meshed around 1971. These were translated into English by Sesiano in 1982 and into French by Rashed two years later. The default edition of the Greek copies is Tannery 1893-5. A somewhat condensed English translation with extensive commentary was made in 1885 by Heath and a French one in 1926 by Ver Eecke.

[1471] Folkerts in *BNP* s.v. 'Diophantus [4]'.

[1472] See p. 250.

[1473] I.e. necessary conditions, e.g. $2b - a^2$ is square; problem 3.9 lists as many as eight such conditions. Altogether about 15% of the currently known 300 problems contain diorisms (Schappacher 2005: 17).

[1474] Friberg 2007: 328-9, compare with BM 80209 on page 29 and TMS 5 on page 32. But cf. Folkerts in *BNP* s.v. 'Diophantus [4]' about these problems being common currency in the Greek world at least since Archimedes.

[1475] Friberg 2007: 328.

[1476] JE 89127-30, 89137-43 verso; published in Parker 1972.

[1477] 'The wording of the problems and the method of solution are similar, and so are the drawings. In all cases the object of investigation is a segment of a circle, and one of the main tools is the Theorem of Pythagoras. The

Moreover, Michigan Papyrus 620, a fragment that contains parts of three mathematical problems, makes use of the same symbol *S* for the ἄλογος ἀριθμός, 'the untold number', as Diophantus (this earned him the honorary nickname 'father of algebra'). Robbins has dated it on paleographic grounds to early second century AD but leaves room for an earlier date. It has been taken to predate Diophantus and thus to prove that his method of reducing algebraic problems to equations with only one unknown quantity was not original.[1478] The problems in the papyrus and the algebraic approach adopted to solve them are similar to some of those in Diophantus' first book, although not so scientifically generalised as in the *Arithmetica*. Robbins has suggested that it was probably a sort of schoolbook, thinking that from it and other similar papyri Diophantus 'derived ideas which served as a basis for his mathematical methods'.[1479] Or perhaps Høyrup's oral transmission of sub-scientific tradition explains their inclusion. Part of Diophantus' material (1.16-19, 22-5) certainly derives from recreational mathematics, which already in Plato's time had given rise to theoretical treatments (e.g. the 'Thymarides' flower' discussed above). The question of transmission will presently be considered in more detail.

With the works of Heron and Diophantus parts of sub-scientific mathematical tradition came full circle – from OB recorded developments of utilitarian calculation to oral reckoning to inclusion in the written scientific system once again. But what remains in between is Greek theoretical mathematics. And one should not underestimate its importance for these works or be tricked into thinking that Diophantus only records what he finds in a certain utilitarian tradition. Schappacher has pointed out that the problems that Diophantus sets out to solve, a lot of which involve cubes and higher powers up to x^9, 'are not easy to solve today for, say, a good first year university student of

circumference of the circle is always assumed to be 3 times the diameter. The fractions used in the Cairo papyrus are all finite sexagesimal fractions, converted into sums of common fractions' (Van der Waerden 1983: 177-9). Other similarities have been meticulously pointed out in Friberg 2005b: 105-37. For other papyri and their relationship to cuneiform texts see Friberg 2005b: 25-268.

1478 Van der Waerden 1983: 108-9. Although it is, according to Schappacher (2005: 5), 3rd cent. AD but it remains unclear on what this is based. The precise dates of Diophantus are unknown: for an overview of the issues, see Schappacher 2005: 3-6. Knorr (1993: 180-8) has argued that a work called *Preliminaries to the Geometric Elements* (and the now lost *Preliminaries to the Arithmetic Elements*), usually attributed to Heron and included in the few extant collections of his works, was actually written by Diophantus. Hence Knorr moves back his date by a generation, from the generally accepted 2nd half of the 3rd cent. AD to the 1st half, but points out that, as Diophantus' dedicatee Dionysius cannot be identified with any certaintly, Diophantus could have lived much earlier, possibly even earlier than Heron, whose current 1st cent. AD date is not beyond reasonable doubt either. In this case P. Mich. 620 could post-date Diophantus.

1479 Robbins 1929: 329.

mathematics.'[1480] If Knorr is right about his authorship of the *Preliminaries* then it means that Diophantus actively engaged with (probably even taught) Euclidean geometry. Writing both on arithmetic and geometry shows that he saw his own *Arithmetica* and Euclid's *Elements* as counterparts within the same mathematical curriculum, 'an expanded core of basic mathematical doctrine'.[1481]

5.5 Knowledge Dissemination and Assimilation

The question of possible transmission routes has been vaguely touched upon in the preceding discussion but deserves more attention. We have already referred to Neugebauer an opinion that the transmission of mathematical knowledge would not have been an insurmountable issue as 'ancient pre-Greek mathematics is easy to understand since it concerns only the elementary facts of arithmetic, geometry, and algebra. This material must have been accessible in countless elementary treatises at all periods and in all areas of the Near East.'[1482]

Another possible avenue is of course Høyrup's 'sub-scientific' streams, most likely in connection with trade. He suggests that the geometrical solution to second degree problems did not actually originate in the scribal school but was taken over from an earlier non-scholarly tradition ('carried, we may surmise, by surveyors and other practical geometers'), where it served recreational problems aimed to demonstrate the practitioner's virtuosity.[1483] These were essentially riddles about the square and its sides (described above). Høyrup concludes that

> There is no doubt that the Greek geometers encountered the Pythagorean rule when they started their investigation of what the Near Eastern practical surveyors knew (to some extent this knowledge had been brought to Egypt by Assyrian and Persian administrators…) The Greek geometers did not restrict themselves to adoption and digestion; one of their primary aims became to understand *why* and *under which conditions* the 'metric geometry; of the surveyors worked – a process of quasi-Kantian 'critique' whose results are summarised in

[1480] Schappacher 2005: 10, 19.

[1481] Knorr 1993: 188.

[1482] Neugebauer 1963: 534.

[1483] Høyrup 1990: 31-2.

Elements II.1-10.[1484]

Democritus' boast 'no one surpasses me in constructing lines with proofs, not even the so-called ropestretchers (*harpedonaptai*) of the Egyptians' is worth recollection here.[1485] In that context, there is a possibility that Egypt indeed played a central role in the transmission of geometry to Greece, much as Herodotus speculated. That later material bearing close resemblance to Mesopotamian methods comes from Alexandria is another indication that the Nile Valley occupied a key position in the spread of sub-scientific mathematics.

Indeed, almost all kinds of survival of this perfected material can also be attributed to the sub-scientific tradition.[1486] The Seleucid texts that deal with the second-degree 'algebra' testify that it definitely circulated through the non-scholarly environment. Moreover, the problems in question crop up again in *Liber Mensurationum*[1487] and the Geneva papyrus.[1488] Neugebauer held that these more or less basic discoveries had become a common mathematical currency all over the ancient Near East.[1489]

Another possibility is that 'ancient mathematics, whether Babylonian or Greek, was maintained and transmitted across centuries by tiny communities of experts, each clinging to life in a niche socio-intellectual ecology.'[1490] That would call for some direct contact between Neo- and Late Babylonian

[1484] Høyrup 1999: 405.

[1485] See n. 1362.

[1486] Høyrup 1990: 35.

[1487] The *Liber Mensurationum* was written by Abū Bakr in Arabic around AD 800 and translated into Latin by Gerard of Cremona shortly after 1150 (Høyrup 1996b: 3).

[1488] Høyrup 1990: 35-6.

[1489] Neugebauer 1963: 529-30.

[1490] Robson 2008: 288. However, how tiny his community was must be questioned. Netz's (1997: 6-9) catalogue of Greek mathematicians includes 144 individuals but this must reflect just a fraction of people involved in the study (see Netz 2002: 203). And the same situation cannot be imposed on and substantiated for all periods of Greek history. It is clear that mathematics was, from the middle of the 5th cent. BC onwards, at the centre of intellectual interest. By the end of the century branches of it were included in the Sophists' curriculum of higher education and mathematicians like Archytas, Eudoxus, Theaetetus, Meton and Hippias (or more legendary figures like Thales and Pythagoras) were of very high social standing (see Netz 2002: 200) and capable of communicating their work to potentially wide circles. There is every reason to believe that for the first few centuries of their development, Greek mathematical traditions (and I emphasise their plurality) remained more or less in the public eye, their appeal decreasing in conjunction with methods becoming increasingly complex. This supposition is supported by the number of known mathematicians rapidly rising until the mid-4th cent. BC and then entering gradual decline, clearly becoming a minority interest from the 2nd cent. BC onwards (see Netz 1997: 10, figure 1). That in its Alexandrian phase it carried little popular appeal is scholars and Greek philosophers. The scholarly families of Seleucid Uruk, discussed on numerous occasions above, whose libraries have yielded mathematical tablets, were at least partially Hellenised and had favourable relations with the Seleucid kings. A number of Akkadian-Greek double names are known from Seleucid Babylonia[1491] and it has been speculated that mathematician Zenodorus[1492] might be the carrier of another such name.[1493] Although the name 'Zenodorus' makes his origin from the region of Syria and Palestine conceivable, it is equally plausible that he came from an influential Lamptrai family from Attica, among whom the name was hereditary.[1494] In any case, Zenodorus leads us to Philonides, who served in the Seleucid court.[1495] Interested in mathematics, he was also in contact with Apollonius of Perge, Eudemus and Dionysodorus.[1496] Philonides came from a respected family in Laodicea-on-Sea in Syria and was an honorary Athenian citizen and an ardent Epicurean. He could have been a direct link between educated circles of Babylonia and the mathematicians-astronomers of Greece during the 2nd cent. BC. It is not beyond comprehension that as a courtier, he would have had access to relevant Aramaic or cuneiform material.

For example, from a storeroom in the Reš temple at Uruk the excavators recovered the clay seals of long-perished papyrus rolls, bearing brief descriptions in Greek. In another were nearly 140 cuneiform tablets dated to 322-166 BC, including hymns, rituals, horoscopes, collections of omens, and astronomical works, as well as significant number of legal documents. Several of these scholarly

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indicated by almost non-existent papyrological evidence (Netz 2002: 204).

[1491] E.g. In Uruk Anu-uballit=Nikarchos and another Anu-uballit=Kephalon (see Doty 1988: 95-108). A Greek ostracon BRM 4 58 from Babylon mentions a Marduk-erība=Heliodoros/Uballissu-Bēl, a father of Erotios and Aristeas=Ardi-Bēlit. There is also a double-named slave, one Philonides=Bēlit-nūri, attested in P.Lond.Zen. 2052. For more examples of Akkadian-Greek double names see Boiy 2004: 289-90 and 2005, for the latest treatment on the issue Pearce 2010.

[1492] Zenodorus is also referred to as an astronomer in Diocles' *On Burning Mirrors* and in a catalogue in MS. Vat. Gr. 381 (Toomer 1972: 190-2).

[1493] Other mathematicians for whom non-Greek descent has been suggested include Dositheus (3rd cent. BC, Jewish, see Dowden's comm. To *BNJ* 54), Basilides of Tyre (3rd cent. BC) and possibly Zenodorus (early 2nd cent. BC).

[1494] Toomer (1972: 180-6, 189) points out that this is the only area of the Greek-speaking world where the name Zenodorus can be considered common. The name was mostly used by Semites, often as an alternative Hellenised variant of their Aramaic name (perhaps corresponding to Zabdibōl, 'gift of Bōl', or 'Zabdilah, 'gift of god'). Toomer 1972: 189.

[1495] See Gera 1999 on his influential position at court.

[1496] Toomer 1972: 179.

tablets belonged to Anu-aba-uter of the Sin-leqi-unninni family.[1497]

5.6 Conclusions

For lack of a better metaphor, the history of mathematics can be imagined as a river landscape with a multitude of tributaries, streams, trickles, occasional floods, subversions and large delta with intertwining branches and man-made canals.[1498] This simile would serve more to the point if we could imagine a few interrelated river networks flowing through different lands, the water fertilising its margins but being equally affected by the soil itself. In this image, the Greek-style deductive axiomatic mathematics forms no more than a branch of one river and the same applies to OB scribal-school mathematics or the NB mathematical astronomy. The general stream would only be formed by the joint knowledge of the Mediterranean basin and the Near East, to which not only Babylonia or Greece but also everyone else over a period of several thousand years made a contribution. An important aspect of this imaginary river is the fact that its different streams can meet and mingle, splitting into new waterways in the process and carrying water from faraway regions to new territories. Ptolemaic astronomy and the mathematics of Hero and Diophantus are a good example of how traditions of Greek geometry and what had originally been Babylonian calculators' arithmetical methods could be mixed into a new powerful blend.

Yet, the debate has almost inclusively been centred on these three topics. Fowler has claimed that Mesopotamian influence on Greek mathematics was an 'invention' of modern scholarship, based on little more than indirect evidence, 'mainly by comparing some Babylonian procedures with those of some Euclidean propositions.'[1499] Robson has endorsed this, and they argue that Early Greek mathematics was ignorant of its OB predecessor and indifferent to its contemporary LB tradition.[1500] They must indeed be correct in thinking that OB mathematics could not have influenced Greek discourse directly – but to say that there was no influence at all, no matter how indirect the contact, risks being a severe oversimplification.

[1497] Robson 2008: 257-8.

[1498] Høyrup (1996b: 30) used the delta simile, with 'a multitude of independent streams now running together, now splitting apart', to describe the mathematical traditions of later antiquity. Also see D'Ambrosio 2000 for how it has been and can be applied to non-Western mathematics.

[1499] Fowler 1999b: 151-2.

[1500] Robson 2005: 6.

Several arguments commonly used to refute the influence theory must be revised here. First comes our criticism of the way both Greek and Mesopotamian mathematics are studied, especially the 'translation' of allegedly incompatible systems into modern algebra. Secondly, there are fundamental differences in the internal features of the compared traditions - OB is inherently metric, LB increasingly arithmetic, and classical Greek geometric, heavily deductive and axiomatic.[1501] Indeed, from quite early on there is a fundamental difference between the Greek need to prove and the Babylonian aim to compute.[1502] However, if we see this as a symptom of cultural conditions and values, and put more emphasis on the underlying methods both sets of mathematicians made use of, new avenues of research can be pursued that provide some interesting results.

So far, however, the fact that all three come from very different social contexts and were practiced by small communities of experts has been seen as working against the possible interaction. In Netz's view, Greek mathematicians were an inward looking group and few in numbers, *ad hoc* networks of amateurish autodidacts.

> If a city had only a single mathematician, his mathematics would die with him, and would have to be reimported from elsewhere to be born again. Such rebirths must have happened again and again. Continuities were the exception in Greek mathematics.[1503]

The OB scribal-school mathematical tradition too had allegedly met its end around 1600 BC and the 'stream of tradition', usually postulated for Babylonian mathematics, was in Robson's opinion

> more like trickles, liable to dry up at any moment. It is hardly surprising that the mathematicians of Classical antiquity should have been entirely ignorant of the achievements of OB mathematics (as indeed were their LB successors), over a thousand miles away and a millennium before. Equally, the dwindling, isolated, conservative community of numerate astronomer-priests in Hellenistic Babylonia had little in common with the patrician leisured mathematicians of the contemporary Mediterranean.'[1504]

[1501] E.g. Robson (2005: 10): 'we are dealing with two, perhaps three, very different mathematical cultures, even if we dismiss matters of language, script, media, and numeration as surface presentation. So in internal evidence alone we can dismiss OB mathematics as the putative arithmetical precursor to early Greek mathematics, simply because it was not particularly arithmetical.'

[1502] Friberg 2007: 4.

[1503] Netz 2002: 215.

[1504] Robson 2005: 12-14.

Nevertheless, it is clear that some methods developed in the OB scribal schools survived for millennia, although their exact formats, and the structural system that supported them, probably crumbled together with the society in which they were embedded. Their survival must be considered in the light of the way this material translated in response to changed needs, in this case the theory of reciprocity with the sub-scientific stratum of mathematics. This is a theory according to which non-utilitarian features of practical mathematics can give an impetus for the development of scribal mathematics and the theoretical advances made in it could be incorporated into the popular tradition in return. This tendency must have been rather common in OB times, when scribal mathematical education with its non-practical exercises had an applied base and was still ultimately in the service of administrative needs, especially surveying.[1505] Furthermore, the 'minuscule expert communities' argument only applies to certain periods of time and the most sophisticated levels of mathematical culture.[1506] And even between these inherently different communities some mutual interaction could easily have taken place during the Seleucid era (Ch. 5.4.4).

Last but not least is the Greeks' alleged indifference to or even disdain for the Eastern cultures.[1507] As previous chapters have shown, such claims are largely unsubstantiated and Robson falls into the same trap that she has accused others of, namely, cramming over half a century of Greek history and views into one oversimplified statement. The example of Berossus (whose work 'seems to have sunk like a lead balloon'[1508]) is late, overused, and incorrect, and that despite whether Geller is right about the *Babyloniaca* being a translation from Aramaic or not.[1509]

Whether the ultimate origins of Greek mathematics can and should be sought in Mesopotamia is not the main issue here. The issue is to recognise how mathematical knowledge stemming from this area and encountered either there, in Egypt, or anywhere else around the Mediterranean, was translated

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[1505] In early periods mathematics was closely associated with law and just governance. Consider the following passage from *Enki and the World Order* (ETCSL 1.1.3, 412-7) for the importance of surveying: 'My illustrious sister, holy Nisaba is to receive the 1-rod reed. The lapis lazuli rope is to hang from her arm, she is to proclaim all the great divine powers. She is to fix boundaries and mark borders. She is to be the scribe of the Land. The god's eating and drinking are to be in her hands.' The powers of literacy and mensuration are also attributed to Ninlin, Nin-sumun, Inanna and her Akkadian counterpart Ištar, among others (Robson 2008: 118-21, 175-6, 266).

[1506] See n. 1490.

[1507] E.g. Fowler 1999a: 372-3, Robson 2005: 14; following Kuhrt 1995.

[1508] Robson 2005: 14.

[1509] See p. 202-3.

into something fundamentally new in the hands of the Greeks. It seems safe to conclude that the incorporation of this material into the Greek 'home repertoire' was relatively more successful than was the case with equivalent astral traditions, in which case we have observed a more or less conscious level of deliberate alienation. Perhaps the fact that Mesopotamian mathematics was never explicitly associated with this 'superior' cultural stratum, accounts for the much freer handling of the inherited material.

Based on the realisation that OB and LB 'mathematicians understood quadratic equations in terms of the dimensions and areas of rectangles and other *measurable geometric magnitudes',* Friberg has recently put forward a theory that the Greek approach is 'of the same nature as closely related results in Old and Late Babylonian metric algebra, and that therefore the assumption that the Greeks had to use a geometric reformulation of an originally purely *algebraic* theory of quadratic equations... must be false.'[1510] Still, the differences should not be downplayed. Mesopotamian mathematics started out as a *technology,* and despite developing along non-utilitarian lines, in form, it always remained 'applied'. Its 'pure' contents never developed into the 'theoretical' science we see in the Greek sources.

What can be concluded about post-OB mathematics, based on the meagre sources we have, is its reliance on the religious and divinatory spheres. Already from the mid-3rd millennium BC onwards, the 'sacred numbers' were associated with the gods; but the religious-mystical role of the numbers grew after mathematics had lost its autonomous status. For the development of some parts of Greek mathematics, however, this seems to have been the starting point and not the end result. The mathematical nature of the Pythagorean cosmos was either inspired by, or in its own right inspired, the development of distinctly Pythagorean arithmetic, one that apparently made use of the Babylonian methods of calculation.

Netz has pointed out that from Greek mathematical writings, ethnicity cannot be inferred and so this could potentially 'make mathematics an ideal arena for cross-ethnical achievement.'[1511] Even though we cannot talk about mathematicians of different races working together in a university-like environment (apart perhaps from in Alexandria?), cultural boundaries were nevertheless crossed and the 'streams' united, sometimes with surprising results.

[1510] Friberg 2007: 1-2, Høyrup 2002; cf. previously held opinions that Mesopotamian mathematics was algebraic in nature.

[1511] Netz 2002: 199.

Conclusion

We have observed how the views propounded to explain both the nature of the Greek discourse on the 'barbarians' and the latter's influence on Greek culture, and science more specifically, are either too Hellenocentric, overestimating the importance of the political motivation behind these phenomena, or alternatively, over-emphasising the underlying foreign prototypes of specific literary and technical elements, without paying enough attention to the changes that these clearly underwent. It has not been sufficiently acknowledged that these changes are not random but result from a complicated process that is governed by a number of general principles. This process is best described as a type of 'translation', as it renders the elements of one culture intelligible to another by explaining them in the recipient's own terms and concepts. Around this understanding has been built a new methodological framework, one that is founded on semiotic theory, but makes use of ideas developed within a number of different disciplines in order to analyse the way foreign 'signs' or 'texts' are read and their signification reinterpreted in a new milieu. For the convenience of analysis these have been labelled 'source' and 'target texts' in their respective contexts. However, further analysis proceeds from Even-Zohar's insistence that:

> An adequate study of transfer in the context of repertoire making cannot stop at comparing transferred items with their sources, nor at analysing their nature and the processes of adaption they enter in a target system. What needs to be studied is the complex network of relations between the state of the home system, the nature of the transference activity (e.g. whether it is the 'permanent flow' type, or the 'deliberately engaged' type), and the relations between the power and the market, with a special attention to the activity of the makers of repertoire who are at the same time agents of transfer.[1512]

Due attention has been paid, therefore, towards pinpointing the various forces and influences the transfer agents as interpreters are subject to. Of greatest importance are (1) their inherent dependence on the 'cultural grid', which determines the expectations one would have about a given society and its features, and (2) the 'home repertoire', i.e. the terms and concepts available to a person to explain any phenomena.

The way Greek 'cultural grid' of 'Chaldea' was shaped and utilised was examined in the second

[1512] Even-Zohar 1997: 362.

chapter. Although our evidence is limited, it is clear that the view of Chaldea influenced, and was at the same time influenced in return, by the more general view of the 'Eastern barbarians'. It is similarly evident that such grids were relatively static: although subject to change, they can show surprising disregard for actual evidence, being more likely to interpret it in a way as to make it fit into the grid, rather than tweaking the grid to make it cohere with the reality. Case studies of the individual elements of the Greek 'Chaldean imaginaire' – the semi-mythical rulers, the Hanging Gardens, the stories of prostitution - have shown how the new material from or on Babylonia was rationalised into a manifestly Greek framework. Even after Alexander's conquest, which profoundly changed Greek access routes to Near Eastern cultures, most of the old assumptions remained intact and, moreover, accommodated the introduction of Babylonian scholarly material into Greek intellectual discourse. Greeks had for a considerable time perceived Egyptian and Chaldean traditions as older and, therefore, more prestigious. When Greeks became the prominent power in the Near East, the 'sacred knowledge' of the priests served as a currency for cultural supremacy, which in turn could have ensured a limited political influence.

The way this knowledge was translated into Greek syntax has been demonstrated by chapters three to five, on the examples of astronomy, astrology and mathematics. Special focus was put on establishing the differences between the various home contexts and 'repertoires' within which the scientific traditions were situated. A few fundamental differences between the two cultures were highlighted. First of all, in the Babylonian milieu more or less all three were grounded in and inspired by the local religion, which relied heavily on number mysticism[1513] and saw in the movement of the stars messages from the gods; the traditional Greek religion, on the other hand, presented no equivalent beliefs. Moreover, the Sin-leqi-unninnis and all other people associated with astronomical, astrological and mathematical learning in Mesopotamia, belonged to the educated priestly circles – they were mostly *kalû* priests and to a lesser extent *āšipu* priest[1514] - that had formed a separate social class in the Near East from the very beginning of its civilization. The role of priests in Greek society, however, was profoundly different. Burkert has even observed that 'Greek religion might almost be called a religion without priests: there is no priestly caste as a closed group with fixed tradition, education, initiation, and hierarchy… Priesthood is not a general status, but service of one

1513 Although as Neugebauer (1963: 528) points out, the mathematical corpus itself displays little to no signs of it.

1514 See table 2.

specific god in one particular sanctuary.'[1515] The character of a priest/priestess in Greece could be more likened to that of a caretaker or overseer: they were appointed to a part-time and honorary office, not, usually, born into it for life; with certain exceptions, anyone could have become a priest.[1516] On the one hand, the distinctly different functioning of priesthood in the Eastern cultures startled and excited Greeks, and their long literary, educational and religious traditions as well as their extraordinary social standing naturally created awe among a society that lacked many equivalent practices.[1517] Rochberg summarises the result:

> Seen in broader context the transmission of quantitative astronomy came as part of a complex set of ideas, including the divine nature of the heavenly bodies or the idea that reciprocity between a heaven and earth manifested in celestial signs. From a cultural point of view, Babylonian astral sciences and their surrounding ideas and world system, including Babylonian mathematical astronomy, astrology and astral theological thought, came to be of acute interest within a Hellenistic intellectual and religious culture with its multiplicity of ideas about the cosmos, especially the heavenly regions, its luminaries, and their relation to the divine. In this cultural climate the astral sciences of ancient Mesopotamia not only penetrated the linguistic and cultural boundaries of Hellenism, but found fertile grounds for their acceptance.[1518]

On the other hand, the outlined differences set limitations on the ways these ideas could be incorporated into the Greek 'home repertoire'. The potential solutions to obstacles are best described by Jones' observation that 'one modifies a borrowed tool, either so that it can do a slightly different job, or because it does not fit one's grip.'[1519] The Greeks opted for a mixed reaction. The esoteric Babylonian knowledge was 'translated' into the Greek mysteries, philosophy or science, or a curious mix of the three: Oriental influences on the cosmic speculations of Orphism can hardly be doubted[1520] and, as we have seen, the same can be argued for Pythagoreanism.[1521] Somewhat later

[1515] Burkert 1987: 95.

[1516] Burkert 1987: 95-99. Occasionally priestess- and priesthoods can be reserved for one family, e.g. the Eteoboutadai in Athens. Delphi is an exception to prevailing customs.

[1517] E.g. Hdt. 1.132, who expresses astonishment on the indispensable role the magi played in Persian religion, and 2.142 on priestly functions being a long-standing family affair in Egypt.

[1518] Rochberg 2010: 10.

[1519] Jones 1996: 140.

[1520] Burkert 1987: 296.

we can observe the way Babylonian discoveries were applied to Greek time-reckoning practices. It is, however, only much later that Greek cosmological speculation had evolved to a state where it could make full use of the much superior Babylonian astronomical schemes, and centuries more until it was ready to make Chaldean astrological learning its own. This step by step adoption of Babylonian learning is also indicative of the fact that the transmission process was and is not only dependent on the needs of the recipient and the prestige of the donor culture, but also limited by the former's level of technical competence.

Furthermore, the Greek spherical world-view was very different from that of the Babylonians. The latter's technical schemes had to be accordingly altered to fit this fundamental assumption. However, in many cases 'the outward sign is not necessarily changed, but it is given a new inward meaning that makes it fit into its new intellectual setting.'[1522] Examples are provided, for instance, by the rendering of the Babylonian daylight scheme into the Greek system of *climata*, or the use made of the originally Babylonian measurements, not least the degrees of arc.

It is interesting to note that in many cases the knowledge of this origin was purposfully retained but this only seems to apply to the fields associated with Chaldea in the 'cultural grid'. The difference is most evident if we compare the treatment of Babylonian astrological and mathematical doctrines within the respective Greek traditions. The first remained, as if deliberately, 'un-Greek' for a considerable period of time after its initial introduction and 'translation' into the Greek-speaking world. It was perceived as the very model of 'barbarian wisdom', intriguing and attractive, but at the same time inherently alien to 'rational' Greeks. It is only during the first two centuries AD that the astrological system underwent a secondary 'translation' that finally allowed it to move closer to the Greek scientific theory and become part of the local 'repertoire'. Mathematics, on the other hand, was never explicitly associated with Chaldea, even when we can detect a relatively clear Babylonian influence behind Greek doctrines. The 'translation' of ideas that must have stemmed originally from Babylonia into a distinctly Greek mathematical discourse was so complete, that in many cases the extent of the debt can only be comprehended in the vaguest of terms.

This happens to be most true in these areas of Greek mathematics and astronomy and astrology as

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[1521] Ch. 5.4.3. Burkert (1987: 299) has expressed a realisation that 'an Ionian of the sixth century should assimilate elements of Babylonian mathematics, Iranian religion, and even Indian metempsychosis doctrine is intrinsically possible.'

[1522] Jones 1996: 140.

well, that the modern mind has come to identify as the principal Greek paradigm: those of Euclid, Hipparchus and Ptolemy respectively. The drawbacks of this limited approach have been duly pointed out throughout the thesis. It has been shown how by only looking at theories that our 'cultural grid' dictates are 'Greek' (or 'Babylonian'), modern analysis has limited its ability to form an objective understanding of the relationship between Greek and foreign traditions. The fact that all systems of knowledge are in perpetual flux and the Greco-Roman intellectual culture in particular is characterised by its multiplicity of views, has been given credence here as much as possible.

However, this naïve attempt to give a rounded view of the Greek sciences, without giving preference to one approach over the others, has compromised the technical aptitude of this study. At times, it is superficial at best. There are numerous areas which could benefit from further work, starting from supplementing the methodological approach itself with additional insights into knowledge diffusion offered, for example, by Social Network Analysis theory, which, as Popović has pointed out, 'may help to conceptualize specific conditions for the transmission of astronomical and astrological knowledge.'[1523] The case studies too need much deeper analysis, one that incorporates the details that, either due to time and space restraints or those posed by my own linguistic or technical lack of competence, have not found consideration here. In addition, this thesis lacks any textual study. It has paid no attention to how the languages themselves interact, including the (in)compatibility of terminologies.[1524] Nevertheless, it does serve its initial purpose of providing a more balanced explanation for the distanced travelled by Babylonian ideas as they underwent significant changes to allow their entry to the Greco-Roman world. It contests both the simple attribution of the 'target text' to the creation of 'barbarian discourse' and the variations between the 'source' and 'target texts' as an invention or misunderstanding on the part of the Greeks; rather, it seeks to clarify these phenomena as resulting from a complex process of 'translation'.

[1523] Popović, forthcoming. Popović himself uses it as 'a heuristic tool to ask certain socio-cultural questions'. Murray's suggestion (2001: 25) that accurate (though not necessarily truthful) transmission is more likely if a tradition is not public property, but rather forms the esoteric knowledge of a special group, in which case it is potentially more continuous and more cohesive, is also worth consideration.

[1524] Such a study is lacking altogether. Very preliminary notes of Greek astronomical and astrological vocabularies can be found in Lloyd 1987: 207-8 and a more general discussion of the Greek language of science in 172-214. If ever such a study is attempted, Riley's lists of Greek arithmetical and astronomical terms (downloadable from http://www.csus.edu/indiv/r/rileymt/) could provide a good starting point.

Appendix 1: Mesopotamian Chronology

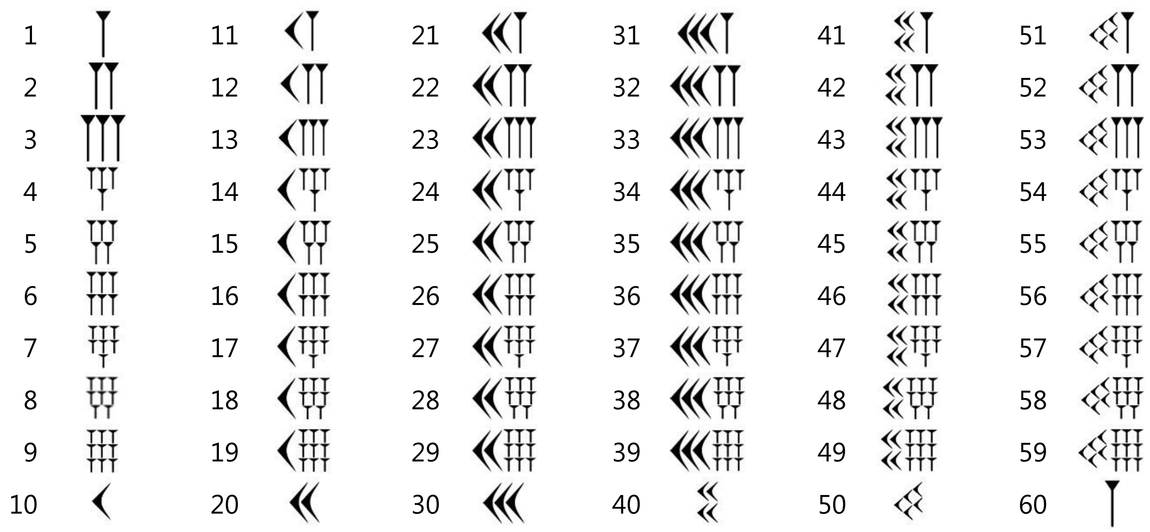
	Assyria	**Babylonia**
ca. 2000-1600 BC	Old Assyrian Period **(OA)**	Old Babylonian Period **(OB)**
ca. 1600-1000 BC	Middle Assyrian Period **(MA)**	Middle Babylonian (Kassite) Period **(MB)**
Neo-Assyrian Empire **(NA)**	Aššur-dan II (934-912 BC)	
	Adad-Nirari II (911-891BC)	
	Tukulti-Ninurta II (890-884 BC)	
	Aššurnasirpal II (883-859 BC)	
	Šalmaneser III (858-824 BC	
	Šamši-Adad V (823-811 BC)	
	Adad-nirari III (810-783 BC)	
	Šalmaneser IV (782-773 BC)	
	Aššur-dan III (772-755 BC)	
	Aššur-nirari V (754-745 BC)	
	Tiglath-pileser III (744-727 BC)	Nabu-nasir (Nabonassar) (747-734 BC)
		Nabu-nadin-zeri (733-732 BC)
		Nabu-šuma-ukin II (732 BC)
		Nabu-mukin-zeri (731-729 BC)
	T-P III ruling Babylonia as Pul (Poros) from 729 BC	
	Šalmaneser V (726-722 BC)	
	Sargon II (721-705 BC)	Marduk-apla-iddina II (Merodach-Baladan) (721-710 BC)
	Sargon proclaimed king of Babylonia in 710 BC	
	Sennacherib (704-681 BC)	

		Marduk-zākir-šumi II (703 BC)
		Marduk-apla-iddina II (703 BC)
		Bēl-ibni (703-700 BC)
		Aššur-nādin-šumi (son of Sennacherib) (700-694 BC)
		Nergal- ušēzib (694 BC)
	Babylonia recaptured by Sennacherib in 694 BC	
	Esarhaddon (680-669 BC)	
	Aššurbanipal (668-631 BC)	Šamaš-šum-ukin (668-648 BC)
		Kandalanu (647-627 BC)
	Aššur-etel-ilani (631-627 BC)	Nabu-apal-uṣur (Nabopolassar) (626-605 BC)
	Sin-šari-iškun (627-612 BC)	
	Aššur-uballit II (611-609 BC)	
	Fall of Nineveh in 612 BC, Harran in 609 BC	
	Nabu-kudurri-uṣur (Nebuchadnezzar) (604-562 BC)	
	Amil-Marduk (Evil-Merodach) (562-560 BC)	
Neo-Babylonian (Chaldean) Empire **(NB)**	Nergal-šar-uṣur (Neriglissar) (560-556 BC)	
	Labašši-Marduk (Labosoarchod) (556 BC)	
	Nabu-naid (Nabonidus) (556-539 BC)	
539-331 BC	Achaemenid (Persian) Period	
312 BC - AD 64	Seleucid (Hellenistic) Period	

Appendix 2: An Overview of the Sexagesimal Place-Value System and the Standard Problems and Methods of Mesopotamian Mathematics

The following gives a short overview of the Mesopotamian numerical system (SPVS) and very basic features of their mathematical methods. This list is by no means comprehensive but focuses on the more characteristic ones directly relevant to the discussion above.[1525] The peculiarities of Akkadian terms used for mathematical operations are discussed in Høyrup (2002) and there is no need to reiterate his findings here.[1526]

The Babylonian numerical scheme is a mixture of decimal unit notation and a sexagesimal place-value system. The unit is symbolised by a simple wedge, which could be repeated up to nine times, whereas 𒌋 stands for 10. For all subsequent numbers up to 59 as many tens and as many single units as necessary are added together.



From 60 onwards, numbers are expressed by a position-system, much like the Arabic numbers we use today (e.g. 123, where '1' denotes hundreds, '2' tens and '3' units). Number 2,898,635, for example, is expressed as:

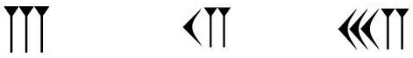
[1525] For a good and concise overview of metrology see Høyrup 2002: 17-8, for more comprehensive tables Neugebauer 1952: 4-7; most easily accessible is Robson's 'Overview of metrological systems' on the DCCMT homepage.

[1526] Høyrup 2002: 19-32, also 43-9 for a glossary of Akkadian terms and logograms with translations.

$(13 * 60^3)$ $(25 * 60^2)$ $(10 * 60)$ (35)

$2{,}808{,}000 +$ $90{,}000 +$ $600 +$ 35 $= 2{,}898{,}635$

One of the clear advantages of the system (and we shall see many more) lies in the fact that fractions can be expressed in exactly the same manner:



(3) $(12/60)$ $(32/60^2)$

$3 +$ $0.2 +$ 0.01 $= 3.21$

Problems may occur when trying to determine the position values. I.e. 3.21 is expressed the same way as 192.6 $(3\text{x}60 + 12 + 36/60)$ or $11{,}556$ $(3\text{x}60^2 + 12\text{x}60 + 36)$, among others. Hence the readings are heavily context-dependent. In addition, an empty position only became noted during the LB period, the first attestation coming from a tablet of squares and inverse squares of integers and half-integers from a library in Kiš.[1527] Where sexagesimal numbers are expressed in the text, they are parted by commas, the fractions are separated from the integers by a semicolon, and the zeroes are marked where necessary.

Until then the SPVS was just a calculation device, a purely positional system, initially used to ease the movement between different metrologies. Hence, Robson argues that 'these deficiencies were not the outcome of an unfortunate failure to grasp the concept of zero, but rather because neither zero nor sexagesimal places were necessary within the body of calculations.'[1528]

In terms of mathematical possibilities that SVPS offered let us take division as an example. Instead of doing it as we would today, Babylonians multiplied the dividend by the reciprocal of the divisor. Hence, the choice of numbers in multiplication tables was related to reciprocals, i.e. numbers that when multiplied are equal to any power of 60.[1529] Reciprocals were used for division (explained below) and recorded in relevant tables, e.g. Old Babylonian tablet BM 80150 (= CT 44 42), which

[1527] Robson 2008: 198.

[1528] Robson 2008: 16. The multi-value system had interesting advantages. An excellent example of its sometimes beneficial ambiguity is the rebuilding of Babylon: when Sennacherib destroyed the city in 689 BC it was supposed to remain in ruins for the next 70 years. However, as Esarhaddon insisted on earlier rebuilding, 70 (1 10) was manipulated into reading 11 (Robson 2008: 148-9).

[1529] Until Ur III the product was always 60, from OB onwards it was generalised to 1 (60^0) or any other power of 60 (Robson 2008: 86-7).

when translated reads: ‘Sixty: its 2/3 is 40, its half is 30, the inverse of 2 is 30, the inverse of 3 is 20…’. Reproduced here is a standard table of reciprocals[1530] in modern transliteration for the convenience of future calculations:

2	30	16	3; 45	45	1; 20
3	20	18	3; 20	48	1; 15
4	15	20	3	50	1; 12
5	12	24	2; 30	54	1; 6, 40
6	10	25	2; 24	1	1
8	7; 30	27	2; 13, 20	1; 4	56; 15
9	6; 40	30	2	1; 12	50
10	6	32	1; 52, 30	1; 15	48
12	5	36	1; 40	1; 20	45
15	4	40	1; 30	1; 21	44; 26, 40

Only the numbers contained in second columns, apart from the usual integers up to 10, were given in multiplication tables.[1531] Hence, they were compiled so that they could also be used for division. There are also tables which provide complete sequence of consecutive numbers, both regular and irregular. These become more detailed and accurate over time. For instance OB tables usually give three or four places for irregulars, this increases up to 17 by the Seleucid period.[1532]

When a reciprocal has been found and multiplied by the dividend, the sexagesimal place in the received number is shifted by one power of sixty and the figure thus produced is the answer to the original division. E.g. taking 44 divided by 4, we first find that the reciprocal of 4 is 15 (i.e. $\frac{60}{4} = 15$). Shifted by one power it is $\frac{15}{60} = 0.25$. $44 * 0.25$ is 11, the right answer to the division. One can calculate that $44 * 15 = 660$ and change the position of the numerals. With a simple mental move

[1530] Reproduction of Neugebauer 1945: 11. There are tables for non-standard complex reciprocals (which often show a high degree of accuracy, e.g. YBC 4704 gives reciprocals 6; 3, 12, 24, 9, 21 = 9; 54, 42, 9, 37, 9, 15, 32, 10, 54, 17, 25, 48, 58, 16, 17, 46, 40; see also MM 86. 11.409, CBS 29.16.21; for the creation of some of them see Neugebauer & Sachs 1945: 14-16; Høyrup (2002: 30) supposes their preparation to have been a mathematical exercise in itself) and tables which include irregulars, i.e. although some standard tables simply remark ‘7 does not divide’ or ‘11 does not divide’ (both have recurrent sexagesimal values as reciprocals), others give approximations (e.g. YBC 10529).

[1531] Neugebauer 1952: 30-1. See MKT I 34f and Neugebauer & Sachs 1945: 20-3 for lists of single multiplication tables and MKT I 44-59 and Neugebauer & Sachs 1945: 25-33 for combined tables.

[1532] Neugebauer 1952: 34. Longer numbers are recorded. Ossendrijver (forthcoming) has decoded fragmented tablets which recorded numbers equivalent to 9^n and $9^{11}*12^n$, when $n \leq 39$.

(10x60+60) becomes (10+1)[1533]

Multiplication tablets were used to make the process quicker. This relatively easy system allowed for admirable accuracy when taking square roots. The algorithm used for this was later attributed to Archytas (428-365 BC) and Heron of Alexandria (c. 100 AD). In modern terms it can be expressed as:

$$R' = (R + \frac{N}{R})/2$$

This is, in essence, a simple formula to take the average, in which R is an approximation of the square root and N is the square. An example will serve well to make this clearer. Let us look for a square root of 6 and take 2 as an approximation.

We first find an answer to $6/2$:

times → (180 → 3)

Then we add to it the original approximation (2) and get (5).

We take the average by dividing it with 2:

times → (150 → 2.5)

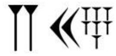
Hence, we find that 2.5 is closer to the real value of √6 than the first approximation 2. But a simple check will make it clear that the square of 2.5 is actually 6.25. In order to find an even closer approximation we have to repeat the same algorithm:

The reciprocal of 2.5 is 24, so:

(6) times (24) → (144 → 2.4)

(2.5) plus (2.4) → (4.9)

[1533] In modern terms: $\frac{44}{1} : \frac{60}{15} = \frac{44*15}{60} = \frac{660}{60}$ = 11. It is based on the fact that reciprocals will always give one power of sixty: i.e. 2.0*30=60^2=3,600, 2*30=60 and 2*0; 30=60^0=1.

 times  → 

(4.9) (30) (147 → 2.45)

Check: $2.45^2 = 6.0025$. This is much closer to 6 than 2.5^2. Repeating the procedure one more time would provide an even closer answer. That considerable precision was achieved can be seen from the famous tablet YBC 7289 (figure 2), which gives an approximate value for $\sqrt{2}$=≈ 1.41424297as $1\ 24\ 21\ 10$ and shows evidence for the Babylonian knowledge of what we are used to calling Pythagoras' theorem.[1534] Knowledge of the $a^2 + b^2 = c^2$ principle is well attested for all periods of Mesopotamian history. A Seleucid text provides a nice example:

> [A triangle. $1, 0$ is the length, 45 the width. $1, 0$ tim]es 1,0 is $1, 0, 0$. 45 times 45 is $33, 45$. Add together, and (the result is) $1, 33, 45$. What should I multiply by what so that (the result) [would be $1, 33, 45$? 1,]15 times $1, 15$. (It is) the hypotenuse.[1535]

The focal point of Mesopotamian scribal mathematics was the general procedure, not its numerical result.[1536] The ones that have, or are alleged to have, bearing on Greek methods will be discussed below in more detail. Here it suffices to give an idea of the extent of Mesopotamian mathematical capabilities.

Linear and quadratic equations with one or several unknowns posed few problems to trained scribes. Equations of greater orders were solved by simplification and substitution. See for example BM 13901 no.12 - 'the surfaces of my two confrontations I have accumulated: $21{,}40$. My confrontations I have made hold: 10' - which is formally a problem of the fourth degree[1537] but is not solved as such.[1538] When transforming such initially complex questions into simple problems, OB students would make use of stock of customary tricks but no standard formulas.[1539]

[1534] Although the given problem was solved by multiplying the constant $\sqrt{2}$ with the side of the triangle rather than following the formula we are used to (see e.g. Robson 2008: 110).

[1535] VAT 7848 no.2. Trans. Neugebauer & Sachs 1945: 141. In modern terms: $\sqrt{60^2 + 45^2} = \sqrt{5625} = 15$

[1536] Neugebauer 1952: 42.

[1537] $\begin{cases} x^2 + y^2 = 21\ 40 \\ \quad xy = 10 \end{cases} \rightarrow x^4 - 21\ 40x^2 + 100 = 0$

[1538] See Høyrup 2002: 71-3.

[1539] Høyrup 1992: 605.

For the calculation of areas and volumes precise or approximate formulas were devised.[1540] A large group of problem texts is concerned with the latter. It includes the so-called ki-lá (or 'excavation') problems, irrigation problems and 'brick' problems. The first are dealing with the volumes of prisms and truncated square pyramids, giving certain parameters and the expenditure of labour and telling the student to find others. The problems are of different levels of complexity, some assuming only the knowledge of the basic relations, others the use of quadratic equations.[1541] Irrigation problems are much the same but deal with the size of the canals.[1542] These prismatic and cylindrical volumes were probably derived from a 'naïve'[1543] consideration of proportionality.[1544] The last category is concerned with finding the areas, volumes and/or the equivalents of the volumes in terms of capacity.[1545]

[1540] A Seleucid text VAT 7848 no.3 demonstrates the finding of the area of an equilateral trapezoid when its measurements are known. This was done by first calculating the height using Pythagoras' Theorem and then following a formula for the area of a trapezoid – half of the sum of its bases times the height, or $S = \frac{a_1 + a_2}{2} * H$ in modern code. More complex problems involving trapezoids can be found, for example the partition of their areas into equal parts in YBC 4675 and YBC 9852. Similar problems were solved for triangles. For instance, MLC 1950, YBC 4608 no.5 and YBC 8633 are concerned with the division of triangles into triangles and trapezoids and the finding of resulting parameters. Høyrup (1992: 605) has observed that such partition of areas is a very specifically Babylonian type of geometric problem.

[1541] E.g. YBC 5037 which lists 44 problems, YBC 4662 and 4663 with the former giving solutions to some the problems presented on the latter.

[1542] E.g. YBC 4666, YBC 7164.

[1543] I.e. that the method and result can be immediately 'seen' to be correct; no theoretical proof necessary.

[1544] Høyrup 1992: 605.

[1545] E.g. YBC 4607. Coefficients can be used for the last task, see Neugebauer & Sacks 1945: 96-8.

Appendix 3: Chronography

	SOURCE A[1546]						
SIGN	HIPPARCHUS & 'ANCIENTS'[1547]	VALENS	DOROTHEUS[1548]	PAUL OF ALEXANDRIA[1549]	MANILIUS	PTOLEMY[1550]	HERM. TRIS.
Aries	Babylonia Thrace Armenia Arabia Egypt Persia, Cappadocia, Mesopotamia, Syria, the Persian Gulf	Babylonia Elam Persia The vale of Syria Armenia Thrace, Sicily, Cappadocia and Susa, the Red Sea and Rhypara Egypt and the Persian Ocean	Babylon Arabia	Persia	Hellespont Propontis Syria Persia Egypt	Britain (Transalpine) Gaul Germany Bastarnia (Coele Syria Palestine Idumaea Judea)	Ocean Vatricani Lydia
Taurus	Media Scythia Armenia Cyprus	Media Babylonia The right side of Scythia Cyprus Arabia Persia and the Caucasian mountains Sarmatia Ethiopia Carthage Armenia, India, Germany	Media Arabia Egypt	Babylonia	Scythia Asia Arabia	Parthia Media Persia (Cyclades, Cyprus, shores of Asia Minor)	Media Amazonians Babylonia (=Semiramiden)
Gemini	Boeotia Thrace Galatia Pontus Cilicia Phoenicia India	India and contiguous places and Celtica Sicily, Galatia, Thrace, and Boeotia Egypt, Libya, the Roman region, Arabia, Syria	Cappadocia Perrhabia Phoenicia	Cappadocia	Black Sea	Hyrcania Armenia Matiana (Cyrenaica Marmarica Lower Egypt)	Troas Persia Parthia
Cancer	Bactria Scythia, Hyrcania, Hellespont, Libyan sea, Britain, isle of Thule Armenia, Cappadocia, Rhodes, Cos, Cyclades Asia Minor Lydia	Bactria Zacynthus, Hyrcania Ethiopia, Schine The Sea of Azov and the nations dwelling around it, the Red Sea, the Hyrcanian Sea, the Hellespont, the Libyan Sea, Britannica, and the isle of Thoule Armenia, Cappadocia, Rhodes, Cos Troglodytia, Ionia, Hellespont	Thrace Ethiopia	Armenia	Ethiopia India	Numidia Carthage Africa (Bithynia Phrygia Colchica)	Syria Assyria Ethiopia
Leo	Propontis Greece Macedonia	Celtica and contiguous places Bithynia Macedonia and the contiguous places Propontis Galatia Celtica Thrace Phoenicia, the Adriatic, Libya	Greece Phrygia Pontus	Asia	Phrygia Bithynia Cappadocia Armenia Macedonia	Italy Apulia (Cisalpine) Gaul Sicily (Phoenicia Chaldea Orchenia)	India Two unknown lands

1546 Both Hipparchus et al. and Valens associate every location with a particular part of the sign's 'body'; I have not included the specific parts - they can be viewed at http://www.auxmaillesgodefroy.com/zodiac_geography. Regions grouped under the same part are separated by commas.

1547 Hipparchus is given with 'the ancients' (318.26 - οἱ παλαιοί, 147.114 - οἱ ἀρχαιότεροι), but after Taurus reference to Hipparchus is dropped. A problem appears in Sagitarrius (152.150-1), where Hipparchus and the ancients seem to differ somewhat.

1548 Hephaestio always says 'the Egyptians and Dorotheus' and sometimes just 'the ancients' (*archaioi*), indicating that Dorotheus too depended on an earlier source. There are a few discrepancies between Dorotheus as listed here (based on the translation of his books) and Dorotheus and the Egyptians as given by Hephaestio.

1549 The list combines one he gives in the section on geographical astrology with the remarks he makes elsewhere in the text. The list is very similar to the list of countries in *Acts* 2:9-11. See Metzger 1970 for discussion.

1550 According to Metzger 1970: 127 Ptolemy depends heavily on Eratosthenes and the system of the parallel *klimata*. The lands within each quadrant are assigned to a zodiacal trigon (i.e. three signs). Furthermore, lands situated at the inner angle of a quadrant have an affinity with the trigon ruling the quadrant diametrically opposite.

		Phrygia, Syria Pisinous					
Virgo	Ionia Rhodes, Peloponnese Arcadia, Cyrene Doria Sicily Persia		Rhodes Cyclades Peloponnese	Greece and Ionia	Rhodes Caria Doria Ionia Arcadia	Mesopotamia Bablyonia Assyria (Hellas Achaia Crete)	Arabia Armenia Elephantine
Libra	Rome and adjacent areas Arabia, Egypt, Ethiopia, Carthage Libya, Cyrene Sparta Smyrna, Libya Tyre Isle of Thakon Arabia Cilicia Sinope		Cyrene Italy	Libya and Cyrene	Italy	Bactriana Casperia Serica (Thebais Oasis Troglodytica)	Egypt Trachonitis Libya
Scorpio	Italy Icaria Rome, Baternia		Sicily	Italy	Carthage Libya Cyrenaica Sardinia Mediter. Isles	Metagonitis Mauretania Gaetulia (Syria Commagene Cappadocia)	Palestine, Phoenicia Cilicia Cappadocia, Galatia, Phrygia
Sagittarius	Crete, Sicily Italy Iberia Cyprus, Erythrian Sea Thyrennic Sea Caspian Sea Euphrates Mesopotamia, Carthage, Libyan sea Adriatic sea and adjacent areas Syria Atlantic ocean Triballi Bactria Egypt and adjacent areas		Gaul Crete	Cilicia and Crete	Crete Sicily	Tyrrhenian Celtica Spain (Arabia Felix)	Achaea, Pamphilia Sea of Nikere Africa
Capricorn	Aegean Sea and nations dwelling around it and Corinth The Great Sea Iberia Cyllenia and Thyrrenia Thyrrenic Sea Egypt, Syria, Caria	The Aegean Sea and the nations dwelling around it and Corinth Sicyon The Great Sea Iberia The Tyrrhenic Sea Egypt, Syria	Cimmeria	Syria	Spain Gaul Germany	India Ariana Gedrosia (Macedonia Thracia Illyria)	Mauretania Pannonia Galatia
Aquarius	Syria Euphrates and Tigris R. Tanais (Don)	Lower Egypt and Nubia region? Syria Euphrates and Tigris, Egypt and libya and contiguous rivers of Egypt and the R. Indus R. Tanais and the remaining rivers from the Hyperboreans flowing to the southwest	Egypt Mesopotamia[1551]	Egypt	Phoenicia Cilicia Lower Egypt	Sauromatica Oxiana Sogdiana (Arabia Azania Middle Ethiopia)	Syria Germany Sarmatia
Pisces	Euphrates and Tigris Syria, the Red Sea, India Persia Arabian Sea, R. Borysthenes (Dniepr) Thrace Asia, Sardinia	Far East? Euphrates and Tigris, Syria, Red Sea, the Indian Sea, Persia and contiguous places The Arabian Sea and the R. Borysthenes Thrace Asia and Sardinia	The Red Sea Indian Ocean	The Red Sea and India	Chaldea Mesopotamia Parthia Indian Ocean	Phazania Nasamonitis Garamantica (Lydia Cilicia Pamphylia)	Britannia Dacia Chaukilikaonia Etruria Italy Campagna

[1551] Not in Dorotheus, from Hephaestio of Thebes (156.184; 157.200).

Glossary

Administrative calendar – one of the calendars used in Mesopotamia, an ideal 360 day year divided into months of 30 days. Used only for making calculations, centralised bookkeeping, simplifying the administation of large scale projects. Further evolved into *schematic calendar*.

Anomaly – the distance of the moon from the earth.

Antiscia & contra-antiscia – relationships between the zodiacal signs determined by the parallele lines drawn within the circle of the zodiac. Shadows, or mirror images of planets or degrees, which are the same distance from the reference line (solstice points).

Aphelion – the point in which earth is the greatest distance from the sun (cf. *perihelion*).

Apogee – the point where moon is furthest from the earth and moves most rapidly (cf. *perigee*).

Ascendant – zodiacal sign or degree of the ecliptic rising above the Eastern horizon at a specific time and place (e.g. on birth). It can also be defined as a point of intersection of ecliptic with the Eastern horizon of a given location.

Celestial Circles

> **Arctic and antarctic circles** – mark the boundaries, on the *celestial sphere*, between the ever-visible and the ever-invisible stars in the northern and southern hemispheres respectively.
>
> **Celestial equator** – bisects the *celestial sphere*.
>
> **Northern and southern tropic circles** – mark the northernmost and southernmost points of sunrise and sunset on the horizon.

Celestial Sphere – an astronomical model of the cosmos as seen from the earth surrounding the observer, envisaged as an outer sphere. Astronomical objects are represented as points on its surface. The sphere appears to revolve at a uniform rate on a tilted *polar axis*.

Chorography – a sub-discipline of astrology, studying the influences of the stars on the regions of the world and their inhabitants as generic groups.

Conjunctions – moments when two or more heavenly bodies appear to occupy the same longitudinal position in the sky when viewed from the earth.

Cultic (civil) calendar – one of the calendars used both in Mesopotamia and Greece, the year being divided into lunar months of 29 or 30 days. Defined by the solar year and by lunar phases: the first day of a new month begins at sunset when the new crescent becomes visible for the first time aftern *conjunction* with the sun, either 29 or 30 days (irregularly) after the last first visibility. It required regular intercalation to keep the solar and lunar years in line.

Decan – in astrology 1/3 of a zodiac sign, i.e. a 10° section. Originating from the Egyptian *decans*.

Decans – 36 small Egyptian constellations, used as a guide to the solar year. These groups of stars would appear in sequence, a new one rising heliacally after every 10 days. In use from the late 3rd mill. BC.

Depression – a degree of the ecliptic where a planet is at its weakest, the antithesis of *exaltation* and thus located diametrically opposite.

Descendant – zodiac sign or its degree setting on the Western horizon at a given time and location, directly opposite the ascendant.

Diorism – a necessary condition in a mathematical exercise.

Dodecatemories – small division of zodiacal signs, usually 1/12 of 30° as the name indicates but the exact interpretation varies between individual astrologers.

Ecliptic – the annual path of the sun projected onto the *celestial sphere*, running through the twelve signs of the *zodiac*.

Epact – the difference between solar and lunar year.

Equinox

> **Autumnal equinox** – the point at which the ecliptic crosses the equator, with the sun going South.
>
> **Vernal equinox** – the point at which the ecliptic crosses the equator again, with the sun going North.

Exaltation – the point in the zodiac circle where a planet is most potent, cf. *depression*.

Exeligmos – tripled value of the *Saros cycle*, which allows us to estimate when an eclipse will occur at the same place at a similar time again.

Gnomon – a sundial-like apparatus used to determine solstices and equinoxes. A stick marked with measurements and placed vertically in a horizontal plane so that it throws a shadow, which will be at its minimum at noon, the shortest minimum at the summer solstice and the longest minimum at the winter solstice.

Heliacal rising – rising of the stars/planets on the eastern horizon just before dawn. Stars rise heliacally at annual intervals.

Horoscopus – see *ascendant.*

Hypogeion – an unobservable zodiacal sign or degree of the ecliptic that is directly opposite the *midheaven* at a specific time and location.

Imum Caeli – see *hypogeion.*

Intercalation – the insertion of an extra unit (e.g., a lunar month, a day) into a calendrical cycle, to bring the calendar year into alignment with the solar year.

Latitude of the Moon – the distance of the moon north or south of the ecliptic, max. 5° 8' either way.

Lunar year – a period of 12 lunar *months* of 29 or 30 days, i.e. slightly more than 354 days.

Medium Caeli – see *midheaven.*

Metonic cycle – an *intercalation* cycle based on the realisation that there is an almost integer number of lunar months in 19 solar years and, therefore, 7 intercalary months must be added over these 19 years to keep the months in their seasonal places.

Midheaven – zodiacal sign or its degree that occupies the highest place of the ecliptic in the observable sky at a given time and location, at 90° angle from the *ascendant* and the *descendant* and opposite the *hypogeion.*

Months

> **Anomalistic month –** a period between two moments when the moon is closest to the earth, 27.55 days.

Sidereal month – the period it takes for the moon to travel around the earth with the reference to a star. The average length of the sidereal month is 27.32166 days but it may vary up to 7 hours.

Synodic month – the time between two consecutive *conjunctions*. Because of the passage of the sun along the *ecliptic*, the synodic month is about two days longer than the *sidereal month*, with an average mean value of 29.53059 days, but this may vary as much as 13 hours. The variation is caused by the changing speed of the moon as it moves closer to and further from the earth along its elliptical orbit, and the same happens to the earth moving around the sun.

Obliquity – the angle of the *ecliptic* in reference to the *celestial equator*.

Octaeteris – 8 year *intercalation* cycle of 99 months (3 intercalary) or 2922 days, devised in the late 6^{th} or early 5^{th} century BC and used in Athens before the introduction of the *Metonic cycle*. Not attested in Babylonia.

Opposition – an astrological aspect. Planets are said to be in opposition when they are directly opposite one another on the ecliptic, i.e. 180° apart in the birth chart.

Parapēgma – almanacs, originally in the form of inscriptions, later on papyri, that recorded/predicted key astronomical and meteorological events of the year. The inscription format included holes for a peg that would be moved each day of the year.

Perigee – the point of at which the moon is nearest to the earth and in which the moon moves most slowly (cf. *apogee*).

Perihelion – the point in which the earth is closest to the sun (cf. *aphelion*).

Periods –

Latitudinal – planet's period of alternating northward and southward motion within the zodiacal belt.

Longitudinal – a period of planet's revolution around the zodiacal belt.

Synodic – periods of a planet's motion along the zodiac relative to the sun.

Places – 12 divisions of 30° that have astrological meaning, visualised as a fixed wheel that rotates through the zodiacal signs, usually starting from the *ascendant*. Each division governs several related aspects of life. Equivalent to the mundane houses of modern astrology.

Planetary houses – zodiacal signs as assigned to planets that 'rule' over it. In other words, each planet is 'at home' in two specific signs where its influence is increased, apart from the luminaries that have one house each.

Polar axis – an imaginary line connecting the two poles, around which earth revolves. It is tilted in relation to the celestial equator.

Pythagorean triples – sets of three integer numbers (a, b, c) satisfying the equation $a^2 + b^2 = c^2$ (i.e. Pythagoras' theorem). The most well-known triple is 3, 4 and 5.

Quartile – an astrological aspect, formed of three groups of four signs 90° apart.

Saros cycle – a cycle of 223 *synodic* months, which determines *inter alia* the return of the sun and the moon relative to a lunar node, and thus specifies a period after which lunar eclipses of the same character may recur (though they may not be observable at the same location every time).

Schematic calendar – Mesopotamian year consisting of 12 months of 30 days, thus 360 days altogethe, and without intercalations. The implied correspondence of 1 circuit = 360 units was extended to the actual day and later to circuit and circle. Used in astronomical texts (e.g., in MUL.APIN).

Sextile – an astrological aspect, formed of two groups of six signs 60° apart, with the line connecting the signs forming a hexagon.

Square – see *quartile.*

Solar Year – a passage of time controlled by a passage of the sun along the ecliptic.

> **Sidereal Year –** a period (365 days, 6 hours, 9 minutes and 9 seconds) it takes the sun to complete its passage along the ecliptic from one star back to the same star, i.e. the time that it takes the earth to make one revolution around the Sun. *Note that the word 'year', unless otherwise specified, always refers to the sidereal year.

Tropical Year – a period (365 days, 5 hours, 48 minutes, 46 seconds) of two successive crossings of the sun at the vernal equinox. The 20 minute difference from the sidereal year is brought about by the precession of the equinoxes.

Synodic - belonging to the relation between the planet or moon and the sun (e.g. eclipses, first visibilities, conjunctions, opposition, stationary points).

Terms – small division of the zodiac circle, normally each sign has five terms of unequal length.

Trine – an astrological aspect, four groups of three signs 120° apart. So the signs form a triangle.

***Ziqpu*-Stars** – Akkadian term for a series of stars that culminate in sequence in the night sky.

Zodiac – a circle of twelve 30° divisions referred to as zodiacal signs that are centered upon the ecliptic and get their names from the constellations through which the sun, moon and planets appear to travel in their course.

Watch – 1/3 of the night in Mesopotamia.

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