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Francesca Rochberg (Berkeley)

Babylonian Astral Science in the Hellenistic World: Reception and Transmission

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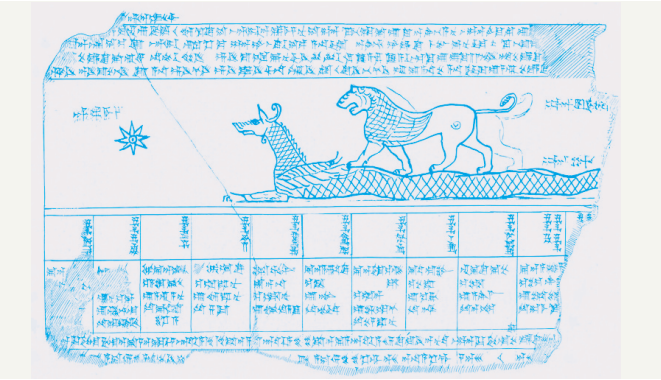
Babylonian Astral Science in the Hellenistic World: Reception and Transmission

Francesca Rochberg (Berkeley)

In his astrological work the *Tetrabiblos*, the astronomer Ptolemy describes the effects of geography on ethnic character, claiming, for example, that due to their specific geographical location „The ...Chaldeans and Orchinians have familiarity with Leo and the sun, so that they are simpler, kindly, addicted to astrology." [*Tetr.* 2.3] Ptolemy was correct in putting the Chaldeans and Orchinians together geographically, as the Chaldeans, or *Kaldayu*, were once West Semitic tribal groups located in the parts of southern and western Babylonia known as *Kaldu*, and the Orchinians, or Urukayu, were the inhabitants of the southern Babylonian city of Uruk. He was also correct in that he was transmitting a tradition from the Babylonians themselves, which, according to a Hellenistic tablet from Uruk [VAT 7847 obv. 11, Weidner 1967, 19; see Fig. 1], associated cities and lands with zodiacal signs, and, in particular, attached the sign Leo to the land of Akkad, another term for the southern part of Mesopotamia.

Fig. 1: VAT 7847, an astrological tablet from Seleucid Uruk in the collections of the Staatliche Museen, Berlin.



Ptolemy's Orchinians, who were „addicted" along with the Chaldeans, also appear in other Greek accounts, such as in Strabo's *Geography*, as well as in an astronomical text from Oxyrhynchus in the second century of our era roughly contemporary with Ptolemy [P.Oxy. 4139:8; see Jones 1999, I 97-99 and II 22-23]. This astronomical papyrus fragment refers to the *Orchenoi*, or Urukeans, in direct connection with a lunar parameter identifiable as a Babylonian period for lunar anomaly preserved on cuneiform tablets from Uruk. The Babylonian, or Chaldean, literati, including those from Uruk were rightly famed for astronomy and astrology, „addicted," as Ptolemy put it, and eventually, in Greco-Roman works, the term Chaldean came to be interchangeable with „astrologer."

Hellenistic Greek writers seeking to claim an authoritative source on astrology or other esoterica often cited generic ancients, such as „Chaldeans," or „Egyptians," and Arnaldo Momigliano once said that, „the mass of writings claiming to be translations from Oriental languages were mainly forgeries by writers in Greek. What circulated in Greek," he continued, „under the names of Zoroaster, Hystaspes, Thoth, and even Abraham was quite simply faked, though no doubt some of the writings contained a modicum of „Oriental" thoughts combined with Greek ideas." [Momigliano 1975, 17]. Within the mass of unreliable and sometimes wholly erroneous attributions to Eastern wise men, however, are legitimate Greek translations of Egyptian temple literature, and especially meaningful evidence ist traceable for the absorption of Babylonian astral scientific tradition in the West following the Macedonian conquest. Indeed, Babylonian sciences seem to be the only part of Mesopotamian scribal culture to have penetrated the Greek world, surviving into Late Antiquity despite the end of cuneiform culture itself.

The story of the Hellenistic transmission of Babylonian

astral sciences has two quite different accounts, the Hellenistic Greco-Roman one, which tells in all its unreliability how Greek and Roman writers saw their astronomical and astrological heritage from the East, and a modern revision, based on cuneiform texts. The modern account itself has two distinct aspects, or perhaps phases. In the first phase, the recovery and exposition of the cuneiform astronomical and astrological texts allowed modern scholars to gauge ancient Greek and Roman claims about the Chaldeans against original sources for the first time. Most dramatic was the discovery of certain numerical parameters already known from much later Greek astronomy. F.X. Kugler first established the ultimate Babylonian origins, for example, of the parameter for the mean synodic month [29;31,50,8,20^{d}] in Ptolemy's *Almagest*. Later, this parameter was identified in Copernicus' *De revolutionibus*, and Otto Neugebauer showed the use of this same value in European calendars deep into the Renaissance, as attested in the 15th century Book of Hours of the Duke of Berry [Neugebauer 1989, 402].

Perhaps the most widely known result of Assyriological scholarship in the early part of the 20th century was that ancient Mesopotamia came to be known as the cradle of (Western) civilization, the site of the origins of urbanism, literacy, and statecraft. Somewhat less well publicized was the realization that Babylonia was the site of the foundation and origin of Western astronomy. This realization was based on the discovery both of a long tradition of empirical celestial observation in the city of Babylon from roughly the eighth to the first centuries B.C.E., and the development of a fully theorized and predictive mathematical astronomy, emerging in roughly the 6th century and continuing through the Hellenistic period. Despite holding such a position at the Creation (of the West), Babylonian astronomy in its early reception into the history of science was viewed as a kind of scientific miracle within an otherwise non-scientific primitive belief system consisting of divination and astrology. This narrative was based on the tendency to unify when it comes to science (i.e., it is about nature not culture), and to leave other aspects of intellectual culture from the Cradle to take up a more „indigenous" character.

Still, there were scholars in the early 20th century, such as Carl Bezold and Franz Boll, who explored then recently edited cuneiform astrological texts for parallels in Hellenistic Greek. David Pingree later expanded the investigation of the transmission of ancient Near Eastern astral sciences to include astrological and omen literature not only in Greek and Latin, but in Aramaic, Hebrew, Syriac, Arabic, Persian, Demotic, and Sanskrit as well. [Pingree 1998, 125-137] Despite these efforts, and those of, for example, the scholars associated with the Warburg Institute, to promote the study of astrology as an important dimension of art and science in the West, the interdependent nature of these disciplines in the cuneiform material was not emphasized until relatively recently. This latter phase in the modern account of the legacy of ancient Mesopotamian science to the Greek and Greco-Roman worlds is based upon an expanded conception of science in antiquity, one that no longer sees science in decontextualized bodies of knowledge or as a process of the discovery of the truths of nature, but rather in the cultural practice of inquiry and as an engagement of specific historical communities with the physical world as they saw it. This conception draws the distinction between astronomy and astrology in a different way from that which sees the former as science and the latter as non-science, focusing instead, for example, on the nature of their predictive goals as a criterion of difference.

The basis of the Babylonian astral science tradition that later came to be of significance for Greek scientific writers of the Hellenistic period can be said to begin with the Assyro-Babylonian scribes of the 7th century B.C.E. and their later counterparts, scribal professionals of the late Babylonian temples of Babylon and Uruk. These scribal professionals concerned themselves to a great extent with detailed lists of signs with their correlated events of public or private nature. The body of celestial signs corresponded by and large, but not exclusively, to visible phenomena in the heavens, i.e., of the moon, sun, planets, and stars. Both groups styled themselves keepers of this tradition of astral science, which.in extant texts dealing with lunar and solar eclipse omens is traceable to the late second millennium. The scribes, however, imagined the celestial divination tradition to

have come up through the ages, from the god of wisdom Ea himself and the antediluvian sages, who passed the tradition of celestial and other divination along to future generations of scribes. Within this ancient scholarly community, and over many centuries, arose such developments as predictive astronomy and genethlialogy, or birth astrology, but always in dynamic relation to the existing tradition of celestial omens known as *Enūma Anu Enlil*. Even the Hellenistic Babylonian scribes who produced astronomical texts viewed themselves and their work as part of this divinatory textual tradition, as shown in this colophon from an ephemeris for lunar eclipses, written in 191 B.C.E.

On eclipses of the moon.
Tablet of Anu-bēl-šunu, lamentation priest of Anu, son of Nidintu-Anu, descendant of Sin-lēqi-unninni of Uruk. Hand of Anu-[aba-utêr, his son, scri]be of ***Enūma Anu Enlil*** *of Uruk. Uruk, month I, year 12[1?] Antiochus III (The Great) [and Antiochus, his son, were kings].*
Whoever reveres Anu and Antu [will not remove it (the tablet) in an act of thievery.]
Computational table. Wisdom of the highest order (lit: of Anu-rank), exclusive knowledge conc[erning heaven and earth], a secret of the scribal masters. An expert may show (it) to an[other expert].
A non-expert may not [see it. It is a restriction] of
Anu, Enlil [and Ea, the great gods]. [Hunger, 1968, No. 98]

On the basis of this and other evidence to be suggested here, I want to stress that in ancient Mesopotamia as well as in the Hellenistic West, though in different ways, astronomy was part of a broad intellectual culture in which celestial divination, astrology, and even astral theology (for lack of a better term) not only coexisted but were interlocked. The importance of celestial phenomena in Near Eastern and Greco-Roman antiquity and the centrality of the astral sciences to the development of what we now call „scientific inquiry" is a matter of much more than the computation of planetary or lunar appearances alone. As James Evans and Len Berggren said in the preface to their edition of the Hellenistic treatise on astronomy, the *Introduction to the Phenomena* of Geminus, astronomy had „vital links to nearly every other aspect of the culture," that it „had links to ancient religion, for the planets were widely held to be divine, and the celestial phenomena commanded the attention of the poets, who from the time of Hesiod had sung of the celestial signs and of the revolving year." [Evans and Berggren 2006, 92 -100 and 227-230] More recently, Reviel Netz, with respect to such works as Eratosthenes' *Hermes* and Aratus' poetic version of Eudoxus' *Phaenomena*, has commented on „the special role for the skies" in Hellenistic science, that „these after all serve, at the same time, as depository for mythical references, and as literal, scientific objects." [Netz, 2009, 181]

The phenomena had similar multivalence in Babylonian science, that is, they were objects of empirical investigation and mathematical analysis and they were signs, objects of interpretation that came of a belief in a mode of communication with the divine through such signs. In both cases celestial phenomena were scientific objects.

During the Neo-Assyrian period (7th century B.C.E.), celestial divination was a scholarly profession of great distinction, the ranks of the diviner scholars being filled to a considerable extent by members of elite literate families, such as that of the venerable Nabu-zuqup-kena who worked in the court of Sargon II at Nimrud. In the service of the royal courts of Esarhaddon and Assurbanipal such scholars that had attained mastery of the repertoire of celestial omens interpreted ominous astronomical phenomena for the benefit of those kings. Most of the omens from *Enuma Anu Enlil* portend events of consequence, usually catastrophic, for the king, his country, its economy, and its enemies. For example:

If an eclipse occurs on the 14th day of Abu, and it begins in the south and clears in the east; it begins in the evening watch, variant, in the morning watch, and ends and clears up. You observe his (the moongod's) eclipse and bear in mind the south(wind). The decision (of the gods) is given for the king of Eshnunna: There will be an uprising of the Ummanmanda, variant, my army. Battle will rage. One man will kill another man in battle. [EAE 21 § V.1, Rochberg, 1988, 239]

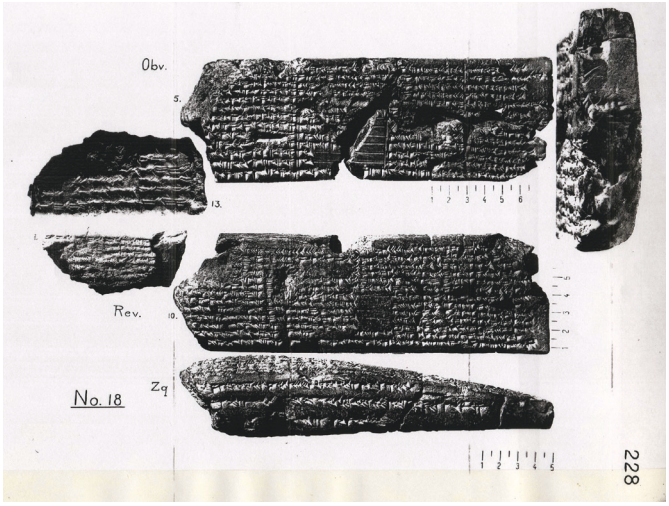
Enuma Anu Enlil comprised an extensive repertory, numbering 70 tablets and many thousands of omens.

The use of this repertory is well-attested in a correspondence between the scholars and the Neo-Assyrian monarchs, complete with urgings by the scribes for the kings „not to worry" because the required rituals against bad portents would be performed.
Sometime in the fifth century, after the Persian conquest, the priestly literati came to be supported within the institutions of the major temples rather than at court. There a new sort of heavenly prognostication, not for kings but for individuals, was developed in the form of genethlialogy, or birth astrology, producing horoscopes in which the situation of the heavens at the moment of birth would be read more or less as an omen. For example:

Year 92 [(S.E.) [=220 B.C.E.], Antiochus (III) was king. Tašrītu 30, night of the 1[2th(?), first part of night, the moon was] below „the rear star of the head of the Hired Man [= α Arietis]. The moon passed 1/2 cubit to the east [of α Arietis]. [...] the child was born, in [his] hour, [the moon was in Aries(?),] the sun was in Scorpius, Jupiter [was in Aries], Venus and Saturn (were) i[n Sagittarius], Mercury and Mars [which had set were not visible.]." And so on. Very occasionally, omen style predictions will be included in these horoscopes, such as „The place of Mercury: The brave one will be first in rank, he will be more important than his brothers; he will take over his father's house." [Rochberg, 1998, No. 10 r. 1-3]

In order to give the positions of all the planets, that is the five naked eye planets plus the sun and moon, genethlialogical astrology, unlike celestial divination, was dependent upon predictive astronomical methods and it is in the period in which horoscopic astrology appears that a number of such methods were developed. According to dated tablets from 308 B.C.E. to 43 C.E., tabulated dates and positions of lunar and planetary phenomena, such as lists of new and full moons, solar and lunar eclipses, and planetary appearances, are extant from the Hellenistic cities of Babylon and Uruk. The latest of these tables is datable to the year 43 of the Common Era, but other non-tabular, so-called non-mathematical astronomical texts were also produced into the first century of our era, the latest dated text being from 75 C.E. Eyewitness testimony to the existence of the Babylonian astronomers at this time comes from the Elder Pliny [*HN* 6.123; 7.193], who claims to have seen them in Babylon in the „Temple of Jupiter-Bēl" and how the city had crumbled in ruins around it. Much later, Pausanias in the 2nd century of our era echoes the report on the existence of the temple of Bēl in the midst of a deserted city.

Fig. 2: Table of new and full moons for S.E. 263/49-48 B.C.E. and designated „*tersētu* of Naburimannu", published in O. Neugebauer, *Astronomical Cuneiform Texts* (1955), No. 18.



Before Alexander entered Babylon, there is little convincing evidence to point to for Greek awareness of Babylonian astral science. After that date, however, Hellenistic Greek writers gave explicit priority in the astronomical sciences to both Babylonia and Egypt in a vague sort of way. Aristotle said the Egyptians and Babylonians „made observations from a very great number of years" and had provided „many reliable data for belief about each of the planets." [*Caelo* 291b34 – 292a9] In his *Bibliotheca Historica* [Bk 2. 31.9] Diodorus of Sicily in the 1st century B.C.E. assigned a value to this „great number of years," saying „as to the number of years which, according to their statements, the order of the Chaldeans has spent on the study of the bodies of the universe, a man can scarcely believe them; for they reckon that, down to Alexander's crossing over into Asia, it has been four hundred and seventy-three thousand years since they began in early times to make their observations of the stars." Roughly a century later, Pliny, in his *Natural History*, invoked Epigenes as an

authority on the antiquity of Babylonian astronomical observations, saying they went back 720,000 years. [*NH.* 7. 193] He (Pliny) also claimed that Critodemus, a name associated with Greek horoscopes of the 1st and 2nd centuries of our era, had direct access to Babylonian sources. In Book 7 of the *Natural History* he mistakenly placed him in the 3rd century B.C.E. on the assumption that he was a student of Berossus, the supposed Babylonian priest and author of the *History of Babylonia* in Greek for Antiochus I. Pliny's claim was that Critodemus agreed with Berossus that Babylonian astronomical observations went back 490,000 years. It is not the inaccuracy or the exaggerated nature of the figures that needs comment. It is that the Greeks found the idea of keeping many centuries of records of celestial observations to be new and important. As is clear from the dearth of dated observations of astronomical phenomena in Greek texts before the 2nd century B.C.E., Greek astronomy prior to contact with Babylonian science was not equipped with an empirical foundation of dated lunar and planetary observations. The material if however obliquely referred to in these Greek attributions to the Babylonians was no doubt the archive of nightly lunar and planetary positions compiled in Babylon from 746 B.C.E. until the mid-first century B.C.E. which we now called the astronomical diaries. The following is from a diary dated in the year 331 B.C.E., the year Alexander the Great defeated Darius III and entered Babylon:

Night of the 20th, last part of the night, the moon was [nn cubi]ts below The Rear Twin Star (β Geminorum), the moon being 2/3 cubit back to the west. The 21st, equinox; I did not watch. Ni[ght of the 22nd, last part of the night,] [the moon was] 6 cubits [below] The Head of the Lion (ε Leonis), the moon having passed 1/2 cubit behind Regulus (α Leonis). Night of the 24th, clouds were in the sky. [Sachs-Hunger1988, Vol.I , 177, No.-330]

The same diary goes on to report Darius III's defeat at Gaugamela as follows:

That month (Month VI), on the 11th, panic occurred in the camp before the king [...the Hanaeans (meaning here Macedonians)] encamped opposite the king. On the 24th, in the morning, the king of the world (that is, Alexander) [erected his] standard [....] they fought against each other, and inflicted a heavy defeat on the troops of the king (Darius); the king's troops deserted him and fled to their cities [... to the l]and of the Gutians.

The astronomical diaries are a remarkable source of contemporary dated astronomical observations of the moon and planets with respect to so and so many cubits distance from a series of ecliptical reference stars, such as in the statement that the moon was 6 cubits below ε Leonis in the example just quoted. One can hardly blame the Greeks for their astonishment and awe at the duration of the Babylonian tradition of celestial observation. Extant diaries do span nearly 800 years and were no doubt the source of some of the observations utilized by Ptolemy in the *Almagest*. Those of Mercury in *Almagest* IX 7, for example, are dated „according to the Chaldeans," i.e., in the Seleucid Era, a Babylonian astronomical dating convention, and they too make use of the cubit as well as the ecliptical norming stars known in accordance with the practice of the diaries.
Of the more specific references to Chaldeans are those mentioned by Strabo, who flourished from the mid-first century B.C.E. to some time in the first century C.E. In his *Geography* several Babylonian astronomers [*mathematikoi*] are mentioned by name: Sudines, Kidenas and Naburianus. For the authenticity of Sudines, alleged to have been in the court of King Attalus I (Attalos Soter) of Pergamon, no cuneiform evidence is extant. Evidence that a Sudines wrote on the properties of stones comes from Pliny's *Natural History*, where he claims that this Sudines knew of the provenance of onyx, rock-crystal and amber and commented on the color of pearls and „astroite" or the „star stone." Further mention of Sudines is found in the *Natural History* as a „Chaldean astrologer." Consistent with this designation is a late papyrus fragment (3rd century C.E.), purportedly summarizing a commentary on the *Timaeus* by the Stoic Posidonius (2nd or 1st century B.C.E.). Here the influences of the five planets, sun and moon are enumerated in terms of Aristotelian qualities (warm, moist, dry) and further indications are given for the planets Saturn, Jupiter, Mars, and Venus as the „destroyers" of men and women, young and old. The planet Venus as the destroyer of women is given

„according to Sudines." Ca. 160 C.E., the astrologer Vettius Valens lists parameters for the length of the year according to Greek and Babylonian astronomy. There Sudines is associated with a somewhat arbitrary sounding year length of 365 + 1/4 + 1/3 + 1/5 days. Valens adds that he used Sudines (and Kidenas and Apollonius) to compute lunar eclipses and that he normed the equinoxes and solstices at 8° of their signs. Aries 8° is in fact a legitimate Babylonian norming point for the vernal equinox in a zodiac in which degrees are counted within sidereally fixed zodiacal signs beginning with Aries (or „The Hired Man" in the Babylonian zodiac). The norm 8° Aries as the vernal point underlies many Hellenistic astrological texts and continued in use throughout late antiquity.

The name Kidin(nu) appears in the colophons of two cuneiform ephemeris tables, where they are designated as „tersētu of Kidin(nu)," tersētu being the term for the cuneiform tables of dates and positions of the moon and planets. Each of these computed tables mentioning Kidinnu concerns new and full moons, in one case for the years 104-102 B.C.E. Valens said he used „Hipparchus for the sun, Sudines and Kidinnu and Apollonius for the moon," though he makes no specifications about the methods associated with these names. Kidenas is also mentioned by Pliny when he gives values for the maximum elongations of the inner planets from the sun. He says his authorities for these values are Timaeus for Venus (46°) and Kidenas and Sosigenes for Mercury (22°), but what such attributions really mean is impossible to determine.

The third Babylonian named by Strabo, Naburianus, has been interpreted as the Greek version of the Babylonian name Nabû-rimannu that appears in broken context in the colophon of an astronomical tablet from Babylon. The colophon designates this tablet too as a *terṣetu* or „computed table," and like the tables of Kidinnu contains dates and positions of new and full moons, though later in date, for the years 49-48 B.C.E., putting it among the youngest of extant cuneiform lunar ephemerides (see Fig. 2).

The specific contents and methods of calculation of these Babylonian astronomical tables were also known to Greek astronomers by at least the first century B.C.E. and by the first century of our era were in use, as Alexander Jones [1997 and 1999] has shown, in the Greek papyri from Oxyrhynchus in Roman Egypt. Greek knowledge of the methods and concepts inherent in the Babylonian astronomical tables is also attested in chapter 18 of Geminus' *Introduction to the Phenomena*, where he discusses lunisolar period relations. This work can be dated to the first century B.C.E., contemporary, therefore, with some of our extant cuneiform ephemerides. In chapter 18.9 Geminus gives the precise value of the mean [daily] motion of the Moon „found by the Chaldeans" (13;10,35°). And although he does not identify the other lunar parameters mentioned in this chapter as such, they too are parameters of a typically Babylonian zigzag function for the progress of the moon in degrees per day (=column F of System B lunar theory in O.Neugebauer's terminology). In this same chapter Geminus discusses a lunar cycle used in the prediction of eclipses called the *exeligmos*, or „revolution." The period governs the return of the occurrence of eclipses to a particular time. Geminus' value for the period [669 synodic months = 717 anomalistic months = 19,756 days] is consistent with Babylonian period relations and his entire discussion of the *exeligmos* is in line with Babylonian lunar theory.

As we know from Hypsicles' *Anaphorikos*, the treatise on the rising times of the zodiacal signs, Geminus' *Introduction*, Ptolemy's *Almagest*, and the Oxyrhynchus papyri, details of Babylonian units, parameters, and methods appear in Greek astronomical works by the second century B.C.E. and continue until late antiquity. The Babylonian cubit (KÙŠ= *ammatu*) continued to be used for measuring distances in the heavens between, e.g., fixed stars and the meridian, or between planets and nearby ecliptical stars, and its subdivision the finger or digit (ŠU.SI= *ubānu*), was used in measuring eclipse magnitudes. Another fundamental reference tool of Greek astronomy adopted from Babylonia was the zodiac, which today we associate exclusively with astrology (see Fig. 3). The ancient zodiac, however, began as a mathematical standard for calculating positions of celestial bodies. The treatises of Autolycus and Euclid (ca. 300 B.C.E.) already assume the zodiac, and a reference in Pliny's *Natural History* claims that a certain

„Cleostratus" was responsible for introducing the concept to the Greeks around 500 B.C.E. Firm evidence, however, of a 360° zodiac in Greece comes only in the 2nd century with Hypsicles and Hipparchus, that is to say, after contact with Babylonian mathematical astronomy.

Fig. 3: Zodiac of 12 30-degree signs through which sun appears to travel in 1 year.

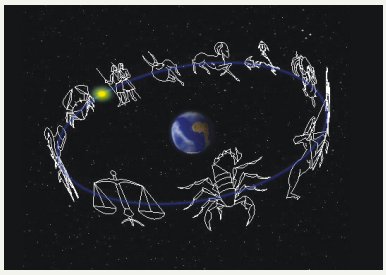
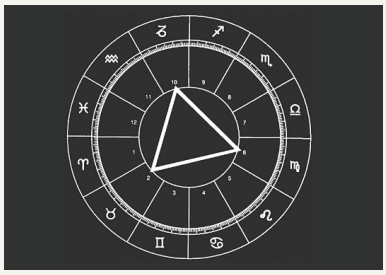
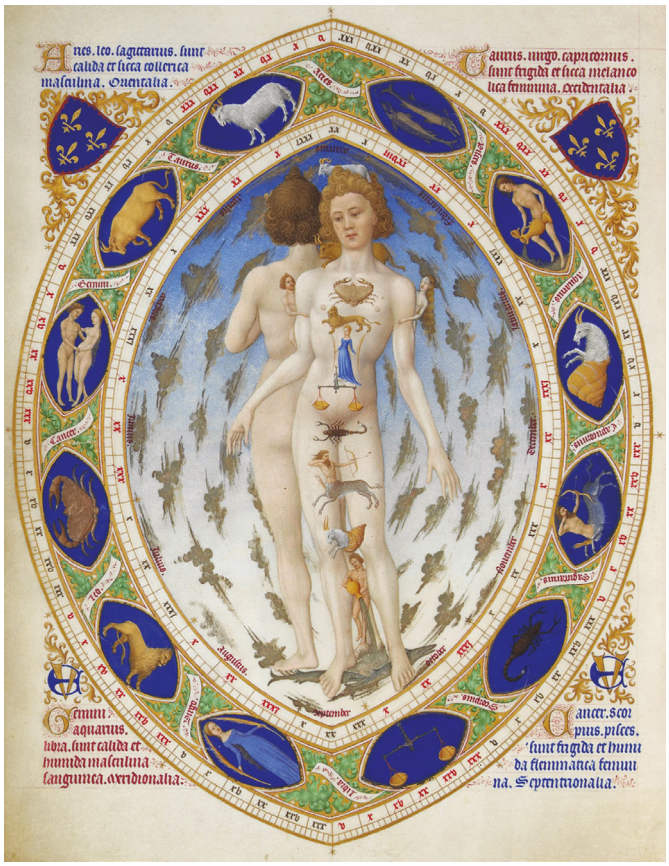


Fig. 4: Astrological aspect: Trine aspect between two planets which are 120 degrees apart.



Just as the history of Western astronomy is traceable in cuneiform astronomical texts, the seeds of Western astrology are also clearly identifiable in the cuneiform celestial omens and horoscopes, beginning with the very idea of prognostication by heavenly phenomena and including more concrete borrowings such as planetary aspect (especially the trine aspect that relates three planetary bodies found in zodiacal signs 120° apart; see Fig. 4). The *dodekatemoria* or the 1/12ths of zodiacal signs, the hypsomata or exaltations of the planets where they have their greatest astrological influence, and the association of planets and parts of the body in the style of the *melothesia* (see Fig. 5) are other clear borrowings from the cuneiform tradition.

Fig. 5: Illumination of the melothesia (zodiacal man) from the Book of Hours of the Duke of Berry



The rich and detailed nature of the transmission of Babylonian astral sciences to the Greeks must, however, be seen against some fundamental differences between the Babylonian and the Greek world systems. For example, the *horoscopus*, or rising point of the ecliptic at the moment of birth, as it is known from Greek and later European horoscopy was not a feature of cuneiform „horoscopes." Nor was the conceptual basis for the *horoscopus*, i.e., the sphere and the continuously moving great circle of the ecliptic, at home in Babylonian astronomy. The physical theory by which Ptolemy [*Tetr.* I.2 and 24] explained stellar influence in terms of planetary rays, or the power of the aether that is „dispersed through and permeates the whole region about the earth" is equally absent from Mesopotamia. Physical influence from the stars may be implied in the Babylonian magical corpus when potions and medicaments must be left out overnight before use, but stellar irradiation of substances does not find its way into cele-

stial divination, nor is it the same as the Greek physical theory of astrological influence for the principal reason that the physical substance of the aether is absent from Babylonian physics. Indeed, celestial divination in ancient Mesopotamia seems to have functioned without benefit of a physical theory, its causality being tied to the agency and manifestation of divine will, and not the action of celestial matter upon the mundane. By the 2nd century, the elements of Babylonian astral sciences of interest to the Greeks, that is, the Babylonian quantitative methods and astronomical concepts as well as various astrological traditions, including omens, horoscopes, astral magic and zodialogical medicine, were all integrated within various world systems fundamentally different in conception from that which we can roughly reconstruct for the Babylonians themselves.

The evidence for a fundamental difference between Mesopotamia and Greece in their respective conceptions about how astrology works, and also how astronomical theory fits into a physical world picture, suggests that the ancient history of the astral sciences is as much about culture as it is about nature. A more general such claim was already long ago made by Thomas Kuhn [Kuhn 2002, 218-219] in the context of an argument *against* the notion of the uniformity of nature. In one of the earliest challenges to scientific universality, Kuhn did not see that natural phenomena were „the same for all cultures" and remained unconvinced by the argument that because nature stands apart from human culture, existing independently from our actions and our knowing, that its phenomena are necessarily or categorically unaffected by culture. He suggested that not only are concepts („of the natural or social world") „the possession of communities (cultures or subcultures)," but social concepts as well as concepts of the natural world „shape the world to which they are applied." By way of example, he remarked that „the heavens of the Greeks were irreducibly different from ours." And so were they irreducibly different from those of the Babylonians. One cannot generalize about „physical reality" within remote historical frameworks, or view historical developments against a universal background of nature.

As far as a Babylonian conception of nature is concerned, physical phenomena did not occupy a realm apart from the divine, despite the obvious fact that heavenly phenomena could be observed, analyzed, and predicted *qua* phenomena. But Greek and Roman attitudes, despite Protagoras and Lucretius, and despite a different sort of engagement with the notion of nature as well as the notion of the divine, did not challenge the existence of gods (or the divine) while engaging in scientific inquiry. And seemingly contradictory ideas about the relation of the heavens to the divine obtained even within a given system. For example, regarding the Mesopotamian cosmos, the idea of the world presupposed a notion of the divine, but seemed to permit such contradictions as divinities removed from the physical world in a kind of transcendent relation to the visible or material plane and/or as active forces within visible physical phenomena in a relation more akin to immanence.

The ambiguity inherent in the Mesopotamian sources may well be reflected in the account of Chaldean astrology by Diodorus, who in the first century B.C.E. wrote about the „Chaldeans" in his universal history [Bk. 2.30-31]. Diodorus did not report wholly accurately on what he called „Barbarian" history and culture, but each of the two possible relations between god and heavenly body are reported in this work. He says that the Chaldeans considered the planets instrumental in predicting the future. He says the planets, whom he refers to as „Interpreters", „by virtue of following each its own course, point out future events, thus interpreting to mankind the design of the gods. For sometimes by their risings, sometimes by their settings, and again by their colour, the Chaldeans say, they give signs of coming events to such as are willing to observe them closely." By this account, the gods are separate from heavenly bodies, which appear by divine design as signs of future events. On the other hand, however, Diodorus describes the thirty stars (or „decans," an Egyptian doctrine erroneously attributed to the Babylonian astrological system) „as 'counselling gods'," and that „twelve of these gods, they say, hold chief authority, and to each of these the Chaldeans assign a month and one of the signs of the zodiac, as they are called." Here Diodorus' attribution of the divine „decans" to the Babylonians evokes correctly the Babylonian idea that celestial phenomena made manifest the attributes and the agency

of certain remote deities while also being considered sometimes to be deities themselves.

These kinds of metaphysical considerations, about the heavenly phenomena and the divine, are as important a part of science in the Hellenistic period as are the computed tables of the moon and planets. The transmission and reception of Babylonian astral scientific tradition in the Greek world is not, to my mind, a question of whether Hipparchus went to Babylon and learned mathematical astronomy (though connections between Babylonian astronomers and Hipparchus might be traced in cuneiform texts, according to D. Rawlins 1985, cf. Toomer 1988), but of a multifaceted cultural matrix which allowed for the various parts of these interrelated sciences to be understood and significant in the West. 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. Book 10 of Plato's *Laws* already expressed the belief that heavenly bodies are propelled by a soul whose nature is wise, true and good and that this is the divine in nature which affects all things, including humankind. Aristotle [*Met.* 12, 8.19], also interested in the idea of the divinity of the heavens, remarked that „there is a very ancient tradition in the form of a myth, that the stars are gods and that the divine embraces the whole of nature." We do not know, of course, whether Aristotle was referring to ancient Babylonia, but the connection between the heavens and the divine goes back to the very beginnings of cuneiform texts, where cult offerings found in Level IV of Uruk, that is, where writing was first found, are made to Venus as both Inana-húd (UD) „Inana of the morning," that is the morning star, and Inana-sig „Inana of the evening," or the evening star.

The divine nature of heaven came to be a basic understanding in the Greco-Roman world. Cicero [*Nat. D.* 2.61.153] said that „contemplating the heavenly bodies the mind arrives at a knowledge of the gods," and that from this knowledge, „arises piety, with its comrades justice and the rest of the virtues." Why the contemplation of the heavenly bodies was thought to confer the virtues of piety and happiness is much later explained by Ptolemy [*Alm.* 1.1] in the introductory section of his treatise on mathematical astronomy. There he placed the celestial bodies with the eternal and unchanging, hence divine, part of the universe, and claimed that „from the constancy, order, symmetry and calm which are associated with the divine, it [that is, astronomy] makes its followers lovers of this divine beauty, accustoming them and reforming their natures, as it were, to a similar spiritual state."

In the Christian context the cosmos was regarded as proof of the existence of the divine creator, though the notion of the divine cosmos, and certainly the veneration of the stars or the cosmos itself, was explicitly condemned. But behind this condemnation lies a Hellenistic tradition, from which Babylonian influence cannot be removed, that is, of the personification of the heavenly bodies as deities with powers of thought, feeling, judgment, and knowledge. In conscious opposition to what he says of „Chaldean opinion," meaning the opinion of astrologers, Philo [*Migr. Abr.* 32,182] stated that God „cannot be contained," that is, by „this visible universe, " and he enjoined humanity to „come down therefore from heaven" because knowledge of the divine is not to be sought in „every detail respecting the movements of the sun, and of the circuits of the moon, and of the glorious rhythmical dances of the other constellations," but in our own mind (that is „nous"). This is not to imply that Philo himself, or the other Middle Platonists of the turn of the Common Era, knew anything of the Babylonian astral scientific tradition directly, much less of its technical astronomy. But as members of the literate Alexandrian culture they were no doubt aware of its existence. Even had Babylonian astronomy not still been current in the first century of our era, Hellenistic astral sciences and philosophy were already indelibly marked by Babylonian ideas and methods.

The question of Babylonian influence has always been approached via specific references to the Chaldeans found in Greco-Roman authors. As already mentioned, such references are available from most of the Hellenistic period, that is, from the first century B.C.E. to the 3rd century of our era. There are too many to make

mention of here. One finds Chaldeans in Vitruvius (1st century B.C.E.) in connection with Berossus, in Theon of Smyrna (1st-2nd century C.E.) in connection with „saving the phenomena," or Sextus Empiricus (2nd or 3rd century C.E.) in connection with astrology. Some of these Chaldeans, as said before, are simply astrologers, and may not have much to do with specific Babylonian tradition. Not generally mentioned, however, is the Hellenistic interest in signs. Already Aratus in his poetic star catalogue, as Netz points out, „sets up the poem from its very beginning, in the most general terms of signs," with Zeus being the one who established these heavenly signs. Even more so is the focus on signs evident among the Stoics, whose theory of signs in the context of conditional statements about future events is discussed at length by Cicero in his treatise *De Fato* [1.1]. A two thousand year long tradition of such conditional statements about future events in the form of Babylonian omen texts stands in the background of this treatise and was well-known to him, according to a statement in his *De Divinatione* [1.1, cf. 19]. Because of his engagement with other thinkers, especially Stoics such as Diogenes of Babylon and Chrysippus, whose works are not otherwise preserved, Cicero's treatises on divination bear greater attention for the purpose of understanding the impact of this Babylonian preoccupation upon Greco-Roman philosophy of science. Indeed, the Hellenistic discourse on divination, the Greco-Roman portion, was contemporary with the late, i.e., 3rd century and later, continuation of Babylonian divination, especially astrology. And it is well to remember, as Netz said, that „Hellenistic philosophy of science was organized around the problem of 'inference from signs'." [Netz, 2009, 186]

To conclude, the transmission of Babylonian astronomical quantitative methods and parameters were instrumental and formative for Western astronomy and astrology, and the modern recovery of this material was instrumental if not revolutionary for the history of the ancient astral sciences. But the story of the transmission and reception of Babylonian astral science in the Hellenistic world is not limited to the imprint of astronomical concepts and methods on later astronomy. Seen in a 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 a reciprocity between 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 own 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 Mespotamia not only penetrated the linguistic and cultural boundaries of Hellenism, but found fertile grounds for their acceptance.

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For further reading, see Francesca Rochberg, *In the Path of the Moon: Babylonian Celestial Divination and Its Legacy,* Studies in Ancient Magic and Divination 6 (Leiden and Boston: Brill, 2010).