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These Bones Live!

> Whether I have succeeded ... in making some of these "dry bones" live again, is up to the reader to decide.
>
> – A. Leo Oppenheim, 1967

The intersection of the field of Assyriology with the history of science is where three distinct but interconnected developments met and continue to interact. The first was the entry of Europe into the Middle East during the nineteenth century and the consequent birth of Assyriology, including the decipherment of Babylonian mathematical astronomical tables; second was the expansion of research on related materials for reconstructing the cuneiform scientific culture; and third was the consequent reassessment of the historiography of science with regard to Middle Eastern antiquity. The first has to do with nineteenth- and twentieth-century politics, which shaped and will continue to shape our knowledge of the ancient Middle East for as long as there is European involvement in the region. The second has to do with the recovery of an entire corpus of historical materials for the history of science in the region of the Middle East. The chronological scope of this source material spans millennia, with deep roots in the second millennium BCE and only disappearing in the first century of our era (CE), at least as far as extant cuneiform scientific texts are concerned. The sources for the intellectual and scholarly activities of the scribes are numerous, and their study is ongoing. The third intersecting point is situated at the place where the long history of the historiography of science meets cuneiform sources. This began to take shape in the eighteenth century when Europeans became aware of Babylonian astronomy as an ancient Oriental science (Swerdlow 1993). It continued in the nineteenth century with the discovery of the cuneiform astronomical tablets

and the decipherment of Babylonian astronomy and was followed by the subsequent and continuing Assyriological study through the twentieth and into the twenty-first centuries of these and other related texts constituting the sciences of the scribes.

As argued in the Introduction, the term science justifiably applies to many of the activities within the epistemological manifold of the learned masters and *eruditi* among the cuneiform scribes. The scientific culture of the scribes, as will be detailed in this chapter, had a particular scope and nature to be differentiated from later, especially Western, scientific cultures. One of the key factors in reconstructing the cuneiform sciences from our present vantage point, however, is that even under the best of circumstances, the excavated remains of Middle Eastern antiquity represent a mere fraction of what once was a historical reality. Things have not substantially changed since A. Leo Oppenheim pessimistically stated:

> The cuneiform texts have given us a strangely distorted picture of more than two thousand years of Mesopotamian civilization. This picture is composed of abundant but very spotty detailed information, and of rough and incomplete outlines of the major political and cultural developments. All this theoretical framework, moreover, is torn to shreds again and again by immense gaps in time and space . . . ever-recurring blackouts of knowledge. (Oppenheim 1977, 11)

The frequency and magnitude of those "blackouts of knowledge" caused Oppenheim to ask, "*Can these bones live?*" (Oppenheim 1967, 56). I propose here that they can and they do.

EUROPE IN THE MIDDLE EAST AND THE DECIPHERMENT OF CUNEIFORM ASTRONOMY

From the beginnings of Europe's rediscovery of Middle Eastern antiquity in the period of British and French colonial interest in the region to the dark days of rampant looting following the American invasion of Iraq in 2003 and the iconoclasm of antiquities by ISIS in 2015 (Tugendhaft 2019, 2020), our formation of knowledge about the history of the region is inseparable from present concerns. The political, mostly predatory, relationship of Western nation-states to the Middle East has always surrounded archaeological research, compounding and complicating its sheer physical difficulty.

European politics has been and still is present in the reclamation and formation of knowledge about the diverse cultures of the Middle East. There has always been more than an abstract interest in the history of the

region because we in the West are the heirs of ancient Middle Eastern cultures, not only of the Hebrew Bible (or what the Jesuits called the Old Testament) but also of the Babylonian, Assyrian, Egyptian, and Sumerian cultures, the oldest continuous literate cultures in human history. The impetus for rediscovery of Assyria and Babylonia in the mid nineteenth century was tied in part to the question of the identity of Judeo-Christian origins, in part to the activity of Jesuit scholars (Winitzer 2025). Recovering the history of the lands of the ancient Middle East, especially the place ancient Greeks called Mesopotamia (Μεσοποταμία),[1] held the potential to ground the Bible in historical reality in a way it could not do by itself. Its rediscovery would represent knowledge of a new antiquity materially relevant to European cultural and historical origins. Because the British and French governments were heavily invested in the region during the mid nineteenth-century partitioning of the Ottoman Empire, local European consuls and vice-consuls, together with officers of the British East India Company, as well as various travelers and businessmen, were on site poised for the study, excavation, and decipherment of cuneiform antiquities and languages.

The outrage felt in the modern West at the ransacking of the National Museum of Iraq in Baghdad and the loss of countless artifacts during April 2003 and beyond testifies to the connection felt to these profound symbols of our common heritage. And yet the cuneiform languages and scripts are alien, as are their modes of expression in subjects otherwise familiar to us, such as law, religion, mathematics, or science. Ancient Babylonia and Assyria, remote yet ancestral, bear an alien character stemming directly from the cuneiform remains themselves, the numerous clay tablets whose script had to be deciphered and whose texts penetrated, a process that is incomplete and ongoing today.

A different picture of an ancestral ancient Middle East was just as readily coopted by Saddam Hussein as he set about restoring the site of Babylon in 1978. The restoration included the creation of Arabic

[1] This ancient Greek term did not denote the territory the term "Mesopotamia" conventionally refers to today, and I prefer not to employ it. The history of the Greek term seems to begin with Arrian in the second century CE, where in the *Anabasis* VII, vii, 3 and the *Indica* 42:3 it is defined as an Alexandrian administrative district carved from the former Achaemenid satrapies of Ebernari and Babylonia (Finkelstein 1962, 73). Because of the predominantly cultural-historical thrust of my discussion, the term "cuneiform world" replaces "Mesopotamia" as a general designation for both the cultural and geographical range from which we have available historical sources written in various cuneiform languages. The cuneiform world represents a somewhat larger geographical realm than that covered by today's conventional use of the term "Mesopotamia."

inscriptions commemorating Saddam in the same formulaic language used by ancient Babylonian kings and the installation of these fabrications in the reconstructed walls of the palace of Nebuchadnezzar (Finkel and Seymour 2009, 213–20). To be sure, Saddam Hussein did not install these inscriptions or put his own image next to that of King Nebuchadnezzar on a coin because he thought Babylonia was the great symbol of Western European antiquity. What modern Iraqi and modern Western attitudes toward ancient Iraq have in common is the idea of a lineal relation between Iraqi antiquity and the present and, therefore, of heightened meaning for us, whoever we are (modern Europeans, Americans, or Iraqis), and for whatever reason.

Today, the prospect of furthering our knowledge of the ancient Middle East by continued excavation is threatened by the grave consequences of long-standing violent conflict and tensions in the region. The use of ancient sites as defensive military bases by the US military during the Iraq War, the spread of looting (from the 2003 looting of the National Museum of Iraq in Baghdad, the Sumerian site of Tell es-Senkereh/ancient Larsa, to other widespread damage to sites), and the wanton destruction by ISIS of Assyrian antiquities (Tugendhaft 2020) have all had an impact on research.

Less than 200 years after the rediscovery of the ancient empires of Assyria and Babylonia, some of what was reclaimed has already been erased. The loss of so much cultural heritage with its potential to enrich our understanding of the Middle Eastern past is catastrophic, but this loss is secondary to that of so much human life. Nevertheless, in the face of regional tensions and any ongoing potential for the erasure of history, the importance of the legacy of the cuneiform world for human history and the modern humanities should ensure its continuation – not as a mere academic luxury but as a valued necessity.

The ambiguous, that is to say both non-Western and Western, position of the cuneiform world is nowhere better represented than in the history of its science, particularly of the Babylonian celestial sciences. The point of entry at the intersection of Assyriology and the history of science occurred early in the development of Assyriology, when clay tablets found at Babylon and Uruk in southern Iraq became available in the West, mostly through unscientific excavation and acquisition through the antiquities market. These beginnings trace back to the early years of the nineteenth century, when on the strength of the young Englishman's prodigious linguistic abilities in Greek, Latin, Persian, Turkish, Arabic, Hebrew, and Syriac, Claudius James Rich was appointed assistant to the British

consul general in Alexandria. In a few short years, he was moved to Baghdad as resident of the East India Company, and, in the following six years, Rich explored and wrote largely geographical and prearchaeological accounts of the British colonial region of what was once ancient Sumer, Akkad, Assyria, and Babylonia. The year 1811 saw the publication of his popular *Memoir on the Ruins of Babylon*, followed in 1818 by the *Second Memoir on Babylon*, only two years before his death at the age of thirty-three.

Claudius Rich opened the door and ushered in the brilliant and rapid period of decipherment of cuneiform and the identification of the languages of Akkadian and Sumerian during the middle decades of the nineteenth century. By that time, Assyrian royal inscriptions from the walls of palaces were being excavated in Nimrud, Nineveh, and Khorsabad. The famous Akkadian literary epic of Gilgamesh as well as Sumerian texts of many genres, literary and nonliterary, from southern Babylonian sites such as Lagash, Ur, and Uruk, had also come to light and were of interest to some of the original decipherers of cuneiform, such as Henry Creswicke Rawlinson and Edward Hincks.

As compared with the Classical Greek world, the cuneiform world at the time of its discovery offered new and hitherto-unexplored historical territory. Even though well-educated colonial agents of foreign governments may have been versed in the Bible and *The Histories* of Herodotus and could have been able to read Greek, Latin, and possibly Hebrew, as a matter of firsthand documentation, Iraq and its surrounding areas offered new possibilities for assessing the biblical and Classical narratives. Because the lands of the ancient Middle East (Sumer, Akkad, Babylonia, Assyria, Elam, Persia, the kingdom of the Hittites, to limit the list to cuneiform cultures) were previously known to Europeans only through the lens of biblical and Classical writers, the mid nineteenth-century decipherment of the cuneiform script opened a door to these ancient traditions without the filter of the Bible or the Greek historians.

Then toward the end of the nineteenth century, something unforeseen and unexpected came to light among the cuneiform tablets from Babylonia, namely ephemerides of the moon and the five naked-eye Classical planets, Saturn, Jupiter, Mars, Venus, and Mercury, that were not derivative of other ancient forms of astronomy known (Swerdlow 1993, 309–11). The realization of what these tables of cuneiform numbers represented was the result of the collaboration between an Assyriologist, J. N. Strassmaier, and a mathematician and astronomer, Josef Epping. By the turn of the twentieth century, F. X. Kugler in *Die Babylonische*

Mondrechnung (1900) had penetrated the Babylonian lunar theory, exploding any presupposition, widespread at that time, about the inability of so-called Oriental cultures to produce science.

The study of cuneiform astronomical texts began in the 1880s, when Epping and Strassmaier first revealed that the numerical table texts written on cuneiform tablets were lunar and planetary ephemerides (see Figure 1.1) (Epping and Strassmaier 1889). This revelation had a certain gravitas, because the tables analyzed by these pioneer scholars of Babylonian astronomy could be recognized as the oldest mathematical astronomy, the oldest exact science. As Otto Neugebauer pointed out:

> Epping fully realized the significance of his discoveries. The two columns from a lunar ephemeris which he had deciphered, he said, "give us more information about Babylonian science than all the notices from classical antiquity combined" – a fact which cannot be emphasized too often. And he [Epping] foresaw clearly that the new material would become of great importance for ancient chronology, for Assyriology in general, and even for modern astronomy. (Neugebauer 1975, 349 and note 6)

During the very period of the recovery and decipherment of the cuneiform astronomical texts, another scholarly movement was under way that would directly relate to the eventual incorporation of the new field of Babylonian astronomy and astrology into a deeper understanding of the astral sciences of the entire ancient Mediterranean and Middle East. A contemporary of Epping, Strassmaier, and Kugler, the Belgian Classical philologist and historian Franz Cumont, together with Classical philologists Franz Boll and Wilhelm Kroll, was engaged in what would ultimately be the twelve-volume *Catalogus Codicum*

FIGURE 1.1 Babylonian lunar ephemeris, from Otto Neugebauer, *Astronomical Cuneiform Texts* (London: Lund Humphries, 1955), nr. 122 (BM 34580). Photo courtesy of the Trustees of the British Museum.

Astrologorum Graecorum (CCAG, see Cumont, Boll, and Kroll 1898–1953).

The collection of the Greek astrological texts would open new possibilities for the study of how astronomy and astrology were interdependent and how the astral sciences functioned within the *oikoumene*, including, of course, the cultural-geographical area of the ancient Middle East (and beyond). In 1911, for example, in the *Sitzungsberichte* of the Heidelberg Academy of Sciences, Boll, together with Semitist and Orientalist Carl Bezold (Bezold and Boll 1911), set out extensive parallels between the then newly available cuneiform celestial omen texts and certain Greek works from the CCAG as well as, for example, the sixth-century CE work of John the Lydian, or "Lydus," on divination, titled *De Ostentis*, "On Signs." This material was proof of an extensive transmission of Babylonian astronomical knowledge, a phenomenon that would occupy many historians of Babylonian astronomy throughout the twentieth century, such as Otto Neugebauer and David Pingree (Misiewicz 2019).

Roughly half a century after the foundation was laid by the Jesuits Epping, Strassmaier, and Kugler for the field of Babylonian astronomy (de Jong 2016), Neugebauer (1955) brought out a critical edition, with transliteration, translation, and commentary of the entire corpus of cuneiform lunar and planetary tables and procedure texts from Babylon and Uruk of the fifth to the first centuries BCE. This work, *Astronomical Cuneiform Texts* (ACT), is still a cornerstone for the field, now supplemented by Ossendrijver 2012 and 2024. In ACT, the two basic calculation methods discovered by Epping, Strassmaier, and Kugler, coined by Neugebauer as Systems A and B, were elucidated. This publication must be seen against another herculean effort to publish astronomical and astrological cuneiform texts in hand copy, for example, Sachs 1955 (with Pinches and Strassmaier = LBAT) and the monumental Sachs–Hunger–Steele 1988–2022 (ADART). In addition to the exposition of Babylonian astronomy in Neugebauer 1975 (HAMA), important analyses of Babylonian lunar theory (Brack-Bernsen 1969, 1980, 1990, 1997, 1999; Britton 1987, 1989, 2002, 2007b, 2009) and planetary theory (Swerdlow 1998) are found in the secondary literature.

The recovered astronomical cuneiform texts would ultimately change the face of the history of astronomy and, by extension, the history of science itself. Neugebauer's three-volume *A History of Ancient Mathematical Astronomy* (1975) placed Babylonian astronomy firmly in line with the tradition of Ptolemy's *Almagest* and all later Western astronomy up to Copernicus. Neugebauer credited to F. X. Kugler (Neugebauer

1975, 305–6) the discernment of Ptolemy's debt to the Babylonians underlying the Hipparchan lunar parameters used in the *Almagest* (IV.2, Toomer 1984, 174–79), specifically from the lunar System B (see Glossary of Astronomical Terminology Cited). The recovery of the bones of Babylonian astronomy made it possible to trace survivals of its parameters and methods not only in Greek but also in Indian and medieval European astronomy.

After Neugebauer, the direct link from Babylon to the West through the transmission of astronomical knowledge[2] to Greece and the Greco-Roman world would come to occupy a central place in assessing the relation of Babylonian knowledge to later science. The impact of the initial decipherment and later explication of cuneiform astronomical texts on the historiography of science of the late nineteenth and early twentieth centuries, therefore, had explosive potential because the most entrenched idea about the history of science of that entire era was the idea that science originated with the Greeks. This potential was a long time in coming, as various arguments were put forward to explain and justify the claim to the Greek invention (critiqued in Rochberg 2004, 14–43) even after Babylonian astronomy was a known quantity, at least to specialists.

One example, from 1954, the year before the appearance of Neugebauer's ACT, is found in Erwin Schrödinger's book *Nature and the Greeks*. In the chapter titled "Return to Antiquity," he quoted Theodor Gomperz, a somewhat older contemporary of Kugler, from his work *Griechische Denker*, first published in 1893 and in its third edition in 1911, still relevant for Schrödinger and his audience in the mid 1950s:

> Nearly our entire intellectual education originates from the Greeks. A thorough knowledge of these origins is the indispensable prerequisite for freeing ourselves from their overwhelming influence. . . . Not only has their [Plato's and Aristotle's] influence been passed on by those who took over from them in ancient and in modern times; our entire thinking, the logical categories in which it moves, the linguistic patterns it uses (being therefore dominated by them) – all this is in no small degree an artefact and is, in the main, the product of the great thinkers of antiquity. (Gomperz, within Schrödinger 1996, 19–20)

The salient point about the Greek invention of science was that it inaugurated a particular kind of thinking – "our entire thinking," as Gomperz said, implying all forms of rational thought. This quality of

[2] By "astronomical knowledge," I refer to all forms of knowledge of the heavens and heavenly phenomena in antiquity, including technical astronomy, astrology, and all related interests in the phenomena.

mind was long and widely regarded as the special possession of the West. The fact that Babylonian astronomical ideas and parameters enabled the development of Greek mathematical astronomy, a historical fact known by 1911 when Gomperz wrote and well known by the mid twentieth century, was still not seen as in any way part of the history of "thought."

Today, the rhetoric of a Greek monopoly on rational scientific thought in antiquity has an essentialist, crude, and artificial ring to it. Thanks to Neugebauer and his Brown University colleagues' attention to sources outside of the Greek corpus, a better way of understanding the complexities of the culture, or the cultures, of astronomical science in the Hellenistic world could be considered. The study of the non-Greek sources for the astronomical sciences – within which I include observational, predictive, and mathematical astronomy, genethlialogical astrology, and celestial divination – in Babylonian, Egyptian, Judean, and Indian texts showed that traditions coexisted and were transmitted, received, adopted, and reformulated. In other words, the "Greek way" of thinking about science was itself, in no small measure, formed by contact and exchange with cuneiform and other cultures that Greek intellectuals encountered through the political and cultural world established after Alexander's conquests.

Even though early twentieth-century historiographies of science were fraught with prejudice against "Orientals" and "primitives" (i.e., non-Greek ancient peoples), the original cuneiform astronomical texts made it clear that Greek astronomy did not spring as Athena full grown from the head of Zeus, but itself owed a sizable debt to Babylon. The claims about Chaldean astronomy found in Greco-Roman sources such as Geminus, Ptolemy, Pliny, Diodorus, and others could finally be assessed against cuneiform texts, and a basis for comparison was thus established. Once one took account of the units (sexagesimal numbers, the 360-degree circle, the cubit, and the finger), observations (e.g., lunar eclipse observations given in Ptolemy's *Alm.* IV.6, Toomer 1984, 191–92), parameters (one of the famous Babylonian parameters is the length of the mean synodic lunar month as 29;31,50,8,20 days in the lunar System B), and period relations (the 19-year lunisolar cycle also known as the Metonic cycle in which 19 sidereal years = 235 lunar synodic months; the Saros cycle to predict eclipses for which 38 eclipse possibilities = 223 synodic months) adopted from Babylonia by Greek, Greco-Egyptian, and Greco-Roman astronomers and astrologers, it became clear how extensive the Babylonian contribution to Hellenistic astronomical science in fact was.

Where Babylon had influenced Greece, a greater relevance or legitimacy could be attributed to the Babylonian tradition by virtue of its making

the advances of Greek science possible. This was of a piece with other aspects of cuneiform culture, its urbanism, law codes, and well-developed military capacities, which were viewed as continuous with and contributing to the construct of "Western Civilization." Thus, the Fertile Crescent came to represent the "Cradle of Civilization," where civilization is synonymous with that of the West. Speaking from a broad historiographical standpoint rather than specifically about science, Marc van de Mieroop observed that "the predilection to see the Ancient Near East primarily as a precursor of the Judeo-Christian and Graeco-Roman legacy tacitly presents the European cultural development as the superior one in the world and measures the relevance of other traditions only in relationship to it" (van de Mieroop 1997, 288). Similarly, insofar as cuneiform science anticipated Greek developments, it took its place in the history of science.

The increasing evidence of the importance of Babylonian astronomical sciences to the Greeks, Romans, Judeans, and Indians spearheaded a major effort to trace the transmission of Babylonian knowledge to these other cultures. The work to trace Babylonian number-notation style, parameters, methods, and schemata to other cultures began in 1911 (Bezold-Boll 1911), was expanded and deepened by David Pingree (Pingree 1997), and continues to this day (Brown et al. 2018; Misiewicz 2018). Not only is van de Mieroop's observation, therefore, a critique of historiographical teleology because it can result in assessing earlier traditions as less developed and less sophisticated and therefore lesser in all respects than what comes later, it is also an invitation to take the cuneiform sources on their own terms. Although science was not part of van de Mieroop's remit, the question about teleological historiography was clearly fraught for historians of science.

ṭupšarrūtu and its scientific culture

The second of the elements at the intersection of Assyriology with the history of science is that of our developing study of the cuneiform scientific culture itself. Taken as a totality, the sciences of the cuneiform world of ca. 2000 BCE to ca. 100 CE, including divination, astronomy, astrology, magic, and medicine, have enormous significance for the historiography of science. Their significance is due to the unique combination of what we can identify as points of contact with conventional ways of recognizing science as well as presenting a radical otherness in other respects.

The sciences in question comprise the knowledge corpora and associated practices of *ṭupšarrūtu*, the term for the component scribal scholarly

disciplines that organized knowledge of the phenomenal world and the practices that depended upon that organization. Textual evidence for *ṭupšarrūtu* is extant from the Neo-Assyrian period (seventh century BCE) from such sites as Nineveh (Kuyunjik), Assur (Qalʿat Sharqāṭ), Kalhu (Nimrud), and Huzirina (Sultantepe) to the Neo-Babylonian and Seleucid periods (fifth to second centuries BCE) from sites such as Babylon and Uruk (Robson 2019, 52–53). Arguably, even earlier texts from Old Babylonian periods (including Hittite texts) belong to this tradition, but the term *ṭupšarrūtu* itself is a designation found only in first-millennium Akkadian sources.

Morphologically an abstract Akkadian noun from the professional designation "scribe" (DUB.SAR = *ṭupšarru*), *ṭupšarrūtu* is defined (CAD, s.v. meaning 2) as "scribal learning, scholarship." The forms of scribal scholarship encompassed by the term *ṭupšarrūtu* produced a distinct textual and intellectual culture. Moreover, in *ṭupšarrūtu* we see the marks not only of a textual and intellectual culture but also of a scientific culture.[3]

In addition to the rubric *ṭupšarrūtu* "scribal knowledge" for this literature and its traditions, there were other Akkadian terms such as *nēmequ* "skill" or "technical knowledge," as well as other less well-attested terms for knowledge, scholarship, and expertise in skills, crafts, and artisanry (*ummânūtu*, *mudûtu*, *lē'ûtu*). The term *nēmequ*, from a root meaning "to be able," connotes knowledge associated with the production of various material technologies (Escobar 2017, 17, 19–20, and throughout).

Expertise and knowledge (*nēmequ* and *ṭupšarrūtu*) were closely connected, but these terms could refer in some cases to different textual domains. In other cases, the terms seem to be mutually inclusive. At the height of the Assyrian empire, for example, a prism inscription describes how King Assurbanipal was educated in the "house of succession" (*bīt ridûti*):

> I, Ashurbanipal, learned inside it [the bīt ridûti] the expertise (nēmequ) of the god Nabû, the entire corpus of scribal scholarship (kullat ṭupšarrūti). I probed every kind of knowledge of every kind of scribal master in existence.[4]

It is clear from this passage that *nēmequ* connoted skill and mastery of technique, in addition to knowledge of "the entire corpus of scribal

[3] The relationship between *ṭupšarrūtu* as cuneiform knowledge and our term "science" is discussed in Rochberg 2016a, 9–10, 34–35, 61–102; Robson 2019.

[4] Prism F i 24–26, http://oracc.museum.upenn.edu/rinap/rinap5/pager.

scholarship." We learn from this same passage that the knowledge in which the crown prince Assurbanipal was educated included equitation ("how to shoot a bow, ride a horse [and] chariot, [and] take hold of [their] reins," lines 27–28) and the art of warfare. The skill of writing itself was called the "*nēmequ* of Nabû (the patron deity of writing)." Thus, *nēmequ* has particular connotations that the word "wisdom" in later Western contexts does not have. The clarification and definition of *nēmequ* and how it relates to our word "wisdom" is an important complement to the recent redefinition of science that takes into account categories and criteria at stake in original sources.[5]

In the colophons to scholarly texts stored in Assurbanipal's palace during the seventh century BCE, the tablets comprising the various fields of *ṭupšarrūtu* were described as *nisiq ṭupšarrūti* "the highest level of scribal scholarship," *nēmeq Nabû* "the wisdom/skill of Nabû, patron deity of writing," and *tikip sattakki* "the cuneiform signs." As an account for why the texts belonging to *ṭupšarrūtu* and *nēmequ* held the highest rank, the masters (*ummânū*) of the fields of *ṭupšarrūtu* took their lineage from seven mythological antediluvian sages of the underground sweet waters where the god of wisdom and patron deity of the master scholars, Ea, had his abode. In this way, the uppermost echelon of scribes who wrote scholarly texts, including astronomical ephemerides, identified themselves with a tradition of knowledge they claimed was handed down to them from the remotest antiquity before the Flood. This tradition has been characterized as a "mythology of scribal succession" (Lenzi 2008, 109, 115, 119, and throughout) and is a significant element of how scholarship and knowledge were defined in cuneiform culture.

Learning fell under the patronage of the gods, expressed as *nēmeq Nabû* "wisdom/skill of Nabû" and *nēmeq Ea* "wisdom/skill of Ea," which is said of a scholarly tablet, and the scribe who wrote it was called "one who understood the entirety (*kullatu*) of *ṭupšarrūtu*" (Hunger 1968,

[5] Peter Harrison (2006, 51) traces "the gradual dissociation of wisdom from both theology and the natural sciences" over the course of the centuries from the early Christian fathers through the early modern rejection of Aquinas's views on knowledge, theology, science, and wisdom. According to him, patristic views opposed heavenly wisdom (about God) and earthly wisdom (about Classical science), a split that later came together when Aquinas counted the earthly wisdom of science as a path to the heavenly wisdom of theology. The medieval state of affairs is relevant to the present context of cuneiform science if only as a reminder that wisdom and science have been at times opposed, at times united, but after the cuneiform tradition, this relationship has always been gauged in terms of a relationship or opposition between natural and divine forms of wisdom. There was no separation along those lines for Babylonian scribes.

nos. 330:5, 331:6; both Assurbanipal palace colophons). Divine patronage of learning is seen in every corner of the texts comprised by *ṭupšarrūtu*. Judging by these expressions, throughout the Neo-Assyrian period divine patronage was mostly identified with Ea, the patron of wisdom and magic, but also the god Nabû, patron of writing, with his goddess Tašmētu (Robson 2019, 53–85). Rituals for the diviner (Starr 1983) who inspected the entrails (*bārû*) appealed directly to the divine patrons of divination, Šamaš and Adad, who were said to communicate their decisions by writing on the liver, sometimes called "the tablet of the gods" (Lambert 1998, 148–49: 8, 14, 16). Writing divinatory texts in cuneiform on tablets was by this metaphor elevated to divine status.

In the Seleucid period, the idea of divine wisdom and knowledge is also attested in Late Babylonian astronomical ephemerides. The contents of these tablets are sometimes described in colophons (Hunger 1968, no. 98; also in Neugebauer [1955] 1983, 18 as Colophon U), much as in the Neo-Assyrian colophons, as *nēmeq anūti* ("the wisdom/expertise of Anuship"). As *anūtu* is the abstract form of the divine name Anu, the divine head of the pantheon and god of the heavens, *nēmeq anūti* is the highest order of wisdom and knowledge/skill. *Nēmeq anūti* was also held to be a secret of the great gods, and the possession of the *ummânu*, the absolute scribal master of *ṭupšarrūtu*. On the upper edge of ephemerides from Late Babylonian Uruk, the sky god and his goddess, Anu and Antu, were regularly invoked (Bēl and Bēltīja in the texts from Babylon), also in a horoscope text (Rochberg 1998, text 14), with the formula *ina amat Anu/ Bēl u Antu/ Bēltīja lišlim*: "By the command of Anu and Antu (or Bēl/ Bēltīja), may it go well/remain intact." Whereas some of the astronomical literature, such as the astronomical observation texts now known as Diaries (in antiquity as the "regular watch," see ADART), does not appear to belong to this category of divine knowledge, both the exclusivity of access to divine knowledge and no doubt as well the highly technical nature of the bulk of astronomical texts made those texts fit to be seen only by the "knowledgeable" scribe (called *mudû*, Rochberg 2016a, 62).

For insights into the epistemic interests and methods of *ṭupšarrūtu*, the lists of text incipits in catalogues provide a bird's-eye view of the scholarly genres for which such catalogues remain (Frahm 2011a). Our grasp of the contents and structure of many individual compositions and compendia of cuneiform scribal scholarship owes much to the preservation of text catalogues that list the incipits of such works. Old Babylonian text catalogues may have originated as inventories of the holdings of particular collections (Delnero 2010) or as an ordering system for use in a scribal

school curriculum (Tinney 2011). Features of the organization of those early literary catalogues carry over into the first-millennium scholarly inventories of *ṭupšarrūtu*, in particular of omen texts, seen in the sequences of thematically grouped texts, the use of subscripts to identify the type of text catalogued, and the variable inclusion of different text types within a single catalogue. First-millennium (Neo-Assyrian and Neo-Babylonian) catalogues are aimed either at a particular genre of texts, such as incantations, or at tablets within a discrete compendium, such as the celestial omen series *Enūma Anu Enlil*.

In the main, *ṭupšarrūtu* consisted of a wide variety of multitablet omen compendia. The omens compiled in these formalized text series (e.g., the series *Enūma Anu Enlil* comprised seventy tablets) were based on the observation not only of the details of human experience but also of terrestrial and celestial phenomena. Intrusions of one into the other may be found for all seven of the major compilations (as outlined in Rochberg 2004, 54):

- *Enūma Anu Enlil* ("When Anu and Enlil," the celestial omen series)
- *Šumma ālu* ("If a city," the terrestrial omen series)
- *Sakikkû* (omens devoted to symptoms of an illness, both prognostic and diagnostic)
- *Alamdimmû* ("If the form," the series for physiognomy and morphoscopy, with its poorly attested subseries *Nigdimdimmû* "If the appearance" and *Kataduggû* "If the utterance")[6]
- *Šumma izbu* ("If an anomalous birth," the series for omens from malformed fetuses and other irregularities of births)
- *Ziqīqu* (the series for dream omens)
- *Iqqur īpuš* ("He tore down, he rebuilt," the series for the propitiousness of dates for undertaking various activities or for someone born on certain dates)

These series compiled omens from so-called unprovoked signs, things that happen independently of the diviner's actions to "provoke" them. The omens resulting from the diviner's provocations were the consequence of actions that appealed to the gods, Šamaš and Adad, for an answer, providing them with a medium of communication, such as the

[6] An important discussion of the relations and connections among the series *Sakikkû*, *Alamdimmû*, *Nigdimdimmû*, *Kataduggû*, *Šumma sinništu* ("If a woman"), *Šumma liptu* ("If a spot [on the body]"), and even *Šumma ālu* is Schmidtchen 2018 and 2019, and for cuneiform physiognomic texts in general, Johnson and Stavru 2019.

sacrificed sheep, dropping oil into water, releasing smoke from a censer, or sprinkling flour. Of the provoked omens, extispicy (inspection of the entrails) had an extensive series for omens from the inspection of various entrails, such as the liver, gall bladder, intestines, and lung. The provoked omens came under the heading *barûtu*, meaning inspection by extispicy. Accordingly, the *bārû* ("diviner," literally "the one who makes an inspection") was the diviner specializing in provoked omens from the exta, oil, and smoke.

It is fortunate that the celestial omen series *Enūma Anu Enlil* is the subject of two extant catalogues, one from seventh-century Assur and the other from second-century Uruk (dated 26 Šabaṭu year 117 SE = 24/25 February 194 BCE). The Uruk catalogue gives the incipits for *Enūma Anu Enlil* Tablets 1–26. The Assur catalogue (excerpts given on pp. 46–7) contains incipits for *Enūma Anu Enlil* Tablets 39–59 and twenty-nine single-column *ahû* tablets (IM.GÍD.DA.MEŠ BAR.MEŠ), meaning tablets with noncanonical content. Following the list of incipits for the celestial divination series are incipits for the terrestrial divination series *Šumma ālu* Tablets 1–22 and 30–62. Whatever else might have been a part of this list is unknown due to the broken lines at the end of the catalogue (rev. col. iv). The 400-year gap between the catalogues means that they display a number of superficial differences, but overall their function was the same.

The combination of the celestial with the terrestrial may be an important factor to take into account in analyzing the Assur catalogue, as it could reflect upon its purpose and how the scribes classified the materials of *ṭupšarrūtu*. The combination of other disparate scholarly series together in a single catalogue (such as the combination of diagnostic omens from the series SA.GIG, and physiognomic omens from the series *alamdimmû*, Finkel 1988) could shed some light on the practice in general and whether the Assur catalogue of *Enūma Anu Enlil* and *Šumma ālu* (and perhaps a third or more series) is unusual or not.[7]

In order to better convey the essence of the material described in this chapter, some lines from the Assur catalogue are given here (for details see the full edition, Rochberg 2018b). For comparison, a number of examples of omens from the tablets whose titles are entered in the catalogue are given as well. The importance of this material here is both in the content of

[7] The pairing of the celestial with the terrestrial is known from the Diviner's Manual (Oppenheim 1974), but the incipits of celestial and terrestrial omens given in the Diviner's Manual do not come from *Enūma Anu Enlil* or *Šumma ālu* and so remain an exceptional case.

the series catalogued and in the manner of description of the various phenomena.

Assur Catalogue obverse col. i

1′ [If Adad thun]ders [in the east.] Tablet 39.
2′ [If Adad t]hunders [in the middle of the Pleiades.] Tablet 40.
. . .
4′ [If an earthquake shak]es [in Nisannu.] Tablet 42.
5′ [If in Nisannu the south wind blo]ws. Tablet 43.
6′ [If the Wagon Star (is visible) for an ecl]ipse. Tablet 44.
7′ [If the Field is vis]ible [in Nisannu.] Tablet 45.
8′ [If the Field (γ Pegasi) and the Stars/Bri]stle (Pleiades) are visible. Tablet 46.
9′ [If the Stars/Bristle re]ach [the Yoke (Boötes).] Tablet 47.
. . .

obverse col. ii

1′ – 2′ [If (Jupiter)] approaches the [place] where the sun becomes visible and stands.
3′–4′ If on the 12th day of Nisannu the moon is early and becomes dark in the evening; his features are like sulphur fire.
5′ Total of 29 Tablets, alternative one-column tablets.

6′ Tablet of incipits of (the series) If a city is situated on high ground. Series not (completed?). . . .

7′ If a city is situated on high ground. [Tablet 1]
8′ If in the observation hole of the city gate.
9′ If a brick mold (or) blade of a spade.
10′ If during the destruction of his house.
11′ If the foundation of his house was laid on the 16th day.
18′ If [white] lichen [appears in] the house [of a man.]
. . .
19′ If fungus [appears] in the city square.
20′ If holes open up in houses and cities.
21′ If water is spilled at the door of a man's house.
22′ If a man thinks every day about making his grave.
. . .
25′ If a goat-like demon is seen in a man's house.
26′ If a flash of light is seen in a man's house.

27′ If a dead man like a living one is seen in a man's house.
28′–29′ [If] on the first day [in the month Nisannu] a man, before he even puts his foot (out of bed) [onto the ground] sees a snake.

This excerpt from the Assur catalogue of incipits from two of the principal omen series, celestial and terrestrial, offers a glimpse of the kinds of phenomena identified by the scribes as ominous. Although this particular selection seems to deal with observable things (with the exception of the incipit concerning the sighting of a goat-like demon), the omen texts themselves contain many statements in which a phenomenon that is said hypothetically to be "seen" is by our lights not possible to see. Observable and unobservable, material and immaterial, physical and nonphysical things alike are identified as celestial or terrestrial phenomena (Rochberg 2009a, 16–20, 2010b). We must resolve this divergence from the physical phenomena we define as objects of scientific inquiry by investigating the aims and the conceptual frameworks of this and other corpora of cuneiform knowledge.

Apart from the vast collection and systematization of omens and their different series, *ṭupšarrūtu* also encompassed the sciences of astronomy and medicine. What we call astronomy consisted of a number of well-defined genres of such texts devoted to astronomical observation, schematization, and nonmathematical and mathematical prediction (Hunger and Pingree 1999 provides a survey), including horoscopes (Rochberg 1998). What we call medicine consisted of a number of interrelated and interdependent forms of the science of healing, namely, *āšipūtu* (knowledge and practice of conjuration against evil, and incantation and prayer literature) and *asûtu* (medical practice and knowledge of medicines, as in Geller 2010; Schwemer 2019, 39–41).

The *āšipu* was expert in techniques of appealing to the gods to heal the sick, such as incantations and rituals for ridding the patient of whatever consequences he would suffer from bad omens (*namburbû*), especially those responsible for illness. This expert did not simply come in after diagnosis to heal through ritual and incantation but was a master of the medical diagnostic omen series *Sakikkû* and the physiognomic series *Alamdimmû*. Together, these omen compendia combined knowledge of symptoms, diagnostics, prognoses (of recovery or death) in the case of certain symptoms, and all the anatomical regularities and irregularities of the human body.

The *āšipu*'s colleague, the *asû*, specialized in the practice of administering medicine in the form of drugs, the many preparations made from a wealth of *materia medica*, as well as the use of bandages. Just as those of

the omen series *Enūma Anu Enlil* and *Šumma ālu*, the texts of *asûtu* were catalogued in what is now called the Assur Medical Catalogue (Steinert 2018, 11, 13–14, 172–84, and [with S. V. Panayotov, M. J. Geller, E. Schmidtchen, J. C. Johnson] 203–91 [for the edition of the text]; Panayotov in Steinert 2018, 89–120). As Geller and Steinert showed (Geller 2010, 9; Steinert 2018, 187–92), there was considerable overlap between the two kinds of medical practice, while they were nonetheless internally classified under two rubrics (*āšipûtu* and *asûtu*). Thus, the separation of the two into medicine (*asûtu*) and magic (*āšipūtu*) as though these distinctions parallel our own separation of medicine from "alternative medicine" makes for a false dichotomy and a misclassification of the evidence.

A list of texts in the corpus of *āšipūtu* "the art of the incantation expert" covers the text series and subjects to be mastered by the *āšipu*, a priest whose duties included the conjuration of demons for the purpose of healing the sick and also diagnoses of illness. The text in question (KAR 44, Geller 2018, 292–312) opens with "The incipits (i.e., titles) of exorcism compositions, established for study and reading (lit. 'viewing'), named in their entirety" (Geller 2018, 297) and is then followed by a number of omen texts also belonging to the *āšipu*'s repertoire, namely, *Sakikkû*, *Alamdimmû*, *Nigdimdimmû*, and *Kataduggû*. Further incantations, purification rituals, prayers, and spells are also listed, as well as "predictions from stars, birds, oxen, and flocks, oracles (based) on stones (or) flour, on incense, (and) on a god, in their totality, 'explanatory stone lists,' 'explanatory plant lists,' the 'tablet of stones,' the 'tablet of drugs,' 'strings' and 'pendants'" (Geller 2018, 299–300).

Celestial and terrestrial omens together with knowledge of medicinal plants, amuletic stones, and incantations and apotropaic rituals, together with omens from inspection of the liver and exta of the sacrificed lamb, as well as mathematics and astronomy all belonged to *ṭupšarrūtu*. Nearly this entire range of subjects was claimed as the extensive learning of King Assurbanipal, as follows:

> Marduk, the sage of the gods, gave me wide understanding and broad perceptions as a gift. Nabû, the scribe of the universe, bestowed on me the acquisition of all his wisdom as a present. Ninurta and Nergal gave me physical fitness, manhood and unparalleled strength. I learnt the lore of the wise sage Adapa, the hidden secret, *the whole of the scribal craft* (*kullat ṭupšarrūtu*). I can discern celestial and terrestrial portents and deliberate in the assembly of the experts. I am able to discuss the series "If the liver is a mirror image of the sky" with capable scholars. I can solve convoluted reciprocals and calculations that do not come out evenly. I

have read cunningly written text in Sumerian, dark Akkadian, the interpretation of which is difficult. (K 2694 + 3050, from Livingstone 2007, 100, lines 10–18; my emphasis)

The totality of scholarly fields and the many phenomena and areas of interest pertaining to the sciences of *ṭupšarrūtu* make very clear that a historiography of science reducing the aims and characteristics of science to those that stem from a modern sensibility about science, that is, one aimed at discovering and representing the physical workings of nature, will not suffice. Some of the premodern sciences, such as Ptolemaic and Copernican astronomy, medieval natural magic, alchemy (as well as metaphysics), and Renaissance astrology have already played a role in a reappraisal of the scientific revolution (Lindberg and Westman 1990). The more remote and distant sciences of *ṭupšarrūtu* present another and somewhat different opportunity for a reassessment of the meaning of science in historical as well as cultural contexts.

Whether it is best to speak of *ṭupšarrūtu* as the reflection of an intellectual culture (Stevens 2019), a textual culture, or a scientific culture seems to me a function of the questions one poses. In my view, it encompassed all three. The corpora of *ṭupšarrūtu* constituted an intellectual culture by virtue of being the product of an educated elite. The high status of this elite community of scribes, regardless of whether they were court appointees in the palaces of Assyrian kings or specialized priests and experts employed by the Babylonian temple during the Neo-Babylonian and Seleucid periods, remained consistent over time. As a textual culture, *ṭupšarrūtu* shared some features with medieval textual cultures, such as are discussed in Wallis and Wisnovsky (2016). The amalgam of traditions from the entire Greco-Roman realm, including the Arabic tradition of learning and science, ultimately inherited some of the traditions of cuneiform cultures in the fields of astronomy, medicine, and divination, in short the scientific fields from the second century BCE. That the Hellenistic/Greco-Roman intellectual culture included those scientific cultures from the East has long been known, even in antiquity. Furthermore, the unity of *ṭupšarrūtu* is also suggested by the relationship its series had to secret knowledge (discussed in Rochberg 2004, 214–17 and Lenzi 2008, 143).[8] Finally, if we define science in terms of the practices and

[8] Alan Lenzi said, "Late second and early first millennium sources on secrecy and scribalism use a word familiar to this study to describe the scribal craft: *nişirtu*. The excursus to chapter one of this study [Lenzi 2008] noted the semantic proximity of *nişirtu* and *pirištu* based on a synonym list (Aa = nâqu II/4 52–53). Interestingly, the very next word in this list is *ṭupšarrūtu*, 'the scribal craft.' This list, it seems, sets the three terms into a close semantic

methods of inquiry into and the resulting systems of knowledge of what a particular community imagines and perceives as its phenomenal world, *ṭupšarrūtu* is the instantiation of science in the cuneiform world.

Most importantly, how the cuneiform scribes defined and understood the phenomena, the objects of their inquiry, is the crux of how they understood their world. How the objects of the scribes' inquiry were understood, then, is a central question for both historical epistemologies *and* ontologies. The kind of knowledge encompassed by science and the relation it has to its world underscores the integrated nature of epistemologies and the ontologies supporting them, regardless of cultural or historical context. This aspect, of ontology and worldmaking, is reserved for Part II of this book.

Finally for this chapter, the following section takes up the third intersection point of Assyriology and the history of science in very broad outlines. Chapter 2 develops this historiographical context further.

HISTORIOGRAPHY AND CUNEIFORM SCIENCE

The third point of intersection of the field of Assyriology with the history of science was made possible by a new direction in the historiography of science associated with Kuhn in the 1960s (Oliveira 2012; Daston 2016) but presaged earlier, especially by Koyré in the 1950s (Pisano, Agassi, and Drozdova 2018). This development, in bringing matters of social and other contextual factors to bear on the study of science in history, would ultimately open new possibilities for a different approach to cuneiform science within a broader methodological scope. This postpositivist history of science had a decisive impact on my own approach to cuneiform knowledge in relation to science.

The sociology of scientific knowledge that emerged in the 1960s and 1970s, by grounding science in its social and historical contexts, provided an argument for the historicity of epistemic categories and a consequent pluralism applied to standards of scientific knowledge. The alternative to the so-called internal history of science as the story of progress and cumulative knowledge detached from history and social factors was a so-called external historiography, in which the social dimension of science and its practice took center stage. Eventually, however, it would be recognized that, strictly speaking, there is no division between internal

relationship. If there is evidence for attaching secrecy to the scribal craft in general, this text, originating in the 12th century, is the first glimpse of it."

and external histories of science once the nature of science as a cultural phenomenon is fully acknowledged.

Although contextualism for science in history was not entirely new, Kuhn's *Structure of Scientific Revolutions* ([1962] 1996) was the book that galvanized the history and philosophy of science around the historical, cultural, and social dimensions of scientific knowledge, standards, and norms. In the opening chapter, titled "Introduction: A Role for History," Kuhn stated his aim as "a sketch of the quite different concept of science that can emerge from the historical record of the research activity itself. Even from history, however, that new concept will not be forthcoming if historical data continue to be sought and scrutinized mainly to answer questions posed by the unhistorical stereotype drawn from science texts" (Kuhn [1962] 1996, 1). Kuhn's approach had a complex development, outlined in detail by Oliveira (2012). Oliveira's tracing of the new historiography of science looks at change from inside as well as out. Regarding the endogenous shift in the historiography of science, he (Oliveira 2012, 116) quoted the following passage from Kuhn's *Structure*:

> Gradually, and often without entirely realizing they are doing so, historians of science have begun to ask new sorts of questions and to trace different, and often less than cumulative, developmental lines for the sciences. Rather than seeking the permanent contributions of an older science to our present vantage, they attempt to display the historical integrity of that science in its own time. (Kuhn [1962] 1996, 3)

This statement points to the problem for the historiography of science of a- or unhistorical questions. That is, the very questions raised by historians of science should have a connection to the cultural and historical contexts of their sources, otherwise little progress is made in understanding. Without such a revised historiography of science and the questions it can productively pose, and sometimes even answer, the nature of the cuneiform sciences could never be realized in a fuller sense than that which remained focused only on its mathematical or strictly empirical aspects.

In the famous and oft-quoted postscript to *Structure*, Kuhn again underscored the perspectival nature of his historiography of science, saying, "Scientific knowledge, like language, is intrinsically the common property of a group or else nothing at all. To understand it we shall need to know the special characteristics of the groups that create and use it" (Kuhn [1962] 1996, 210). The common property of the cuneiform *eruditi*

was in its essence encompassed by the parameters of *ṭupšarrūtu*. The group that stewarded this long and multifaceted tradition was that of the scribes and scholars discussed in this chapter. The scribes' craft (*ṭupšarrūtu*), its objects of inquiry, its knowledge domains and methodologies are the stuff of cuneiform science in its intellectual and textual culture.

The sociology of science and of scientific knowledge has not gone unrecognized in recent Assyriological scholarship. Since the later twentieth century, in addition to the continuation and expansion of textual analysis of astronomical tablets, research has indeed focused on contextual questions of social and intellectual dimensions (Rochberg-Halton 1991, Rochberg 1992, 1993, 2004, 2009a and 2009b, 2016a, and 2021; Ossendrijver 2011a and 2011b; 2021a and 2012b; Haubold, Steele, and Stevens 2019; Bowen and Rochberg 2020, subtitled "The Science in Its Contexts") not only concerning astronomical and astrological sources, but other areas of *ṭupšarrūtu* as well, such as medical, magical, and divinatory works. These works can provide a springboard for new research that raises useful questions for the ontological underpinnings of the epistemic culture of *ṭupšarrūtu*.