Debunking Ancient Jewish Science

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A recently published collection of articles focuses upon a relatively small group of texts dealing mainly with astronomical calculations and omens as well as physiognomic omens, attempting to use these as a basis for reconstructing ancient Jewish science in the Persian and Hellenistic periods. The present review raises questions regarding the aims and methods employed, offering an alternative suggestion for the transfer of technical knowledge from Babylonia to ancient Palestine.

The themes of ancient science (in the broader sense of "*Wissenschaften*") should not be seen simply as precursors to modern physics, astronomy, chemistry, medicine, etc., since ancient scholars had few instruments or technological aids, beyond their powers of observation, memory, calculating, and reasoning. In fact, it would be more accurate to refer to ancient disciplines (see Lloyd 2009) with flexible parameters, to cover areas of knowledge acquisition characterized by the collecting and evaluating of large amounts of seemingly unconnected data in order to establish a more orderly view of the human environment, and to offer rational explanations for events within that environment. Mathematics is arguably the most crucial of any technical discipline, since the ability to formulate abstract mathematical problems and paradigms (rather than simply perform arithmetical calculations) was a prerequisite to the development of "exact sciences" (using Otto Neugebauer's terminology). This seems obvious, but abstract and paradigmatic models were also the basis for another technical discipline—grammar—which appears to have developed concurrently with mathematics.

The early second millennium B.C.E. in Babylonia witnessed the emergence of impressively high-level mathematical thinking, including number theory based on a complex sexagesimal system, which existed side-by-side with a decimal system, and a complete thesaurus of mathematical terminology (see Friberg 2007: 1–11). At roughly the same time, scribal schools were producing analytic grammatical tables of Sumerian-Akkadian verbal forms; mathematical and grammatical texts generated abstract and theoretical examples of geometry or morphology which were both descriptive and prescriptive, and these appeared more than a millennium before Pythagoras and Panini. Although production of new discoveries in both mathematics and grammar later appears to have stagnated, the invention of the zodiac in the fifth century B.C.E. stimulated new models required for highly sophisticated mathematical astronomy, while new theories of grammatical analysis also emerged from the same scribal milieu (see Black 1991).

But other disciplines also developed within Mesopotamian scribal culture, such as lexicography, divination, medicine, magic, alchemy, and astrology, and debates have centered around whether these can be considered as "sciences" or not. The logic of such texts is often loosely associative, usually described as reflecting the fallacy of *post hoc ergo propter hoc*, or false causality. Nevertheless, these disciplines all had similar goals, *to observe phenomena* (*or*

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"signs") *to be able to note diagnostic patterns and predict future events*. Many but not all of these disciplines were recorded in the form of lists, with additional explanatory information or commentaries being provided orally in the curriculum and hence largely lost to modern scholarship. Nevertheless, lengthy compositions were composed and later copied, studied, canonized, and commented upon with complex hermeneutics, which rival other systems of episteme. Moreover, there was an increasing tendency in late periods for such knowledge to become secular rather than religious, since advances in astronomy determined that the celestial universe rotated in a clockwork-like fashion under fixed laws which could be explained without having to posit divine intervention. Alternatively, one could argue that new discoveries even compelled deities to behave according to mathematical rules. This approach profoundly influenced other disciplines, leading to astral medicine and astral magic, while causing traditional systems of divination (e.g., extispicy) to be virtually abandoned.

With the advent of Greek science, the novel genre of philosophy emerged, which not only combined various disciplines but also formulated arguments into lengthy treatises, often following newly conceived systems of logic and rhetoric. This sometimes led to new and remarkable theories to explain the natural environment, which surpassed the obsessive data-crunching of Babylonian scholarship, but early Greek science also lacked technical instruments, and phenomena were usually explained through observation combined with inferences based on analogy. In short, we cannot simply judge ancient disciplines by assessing how much they discovered, but rather by how scholars went about assembling and evaluating the data at their disposal, and whether they perceived their disciplines as ways to explain, predict, and even alter natural events, independent of appeals to divinities.

So what does all this have to do with ancient Jewish sciences of the Second Temple period, the subject of the book under review? Lamentably little. In this volume hardly any of these issues is discussed in detail, with science being understood simply as "a system of exact knowledge of the physical world" (p. 79). This collection of essays takes a limited view of science, based mostly upon the so-called Astronomical Book of First Enoch in its surviving Ethiopic version and some important Aramaic duplicates from the Dead Sea Scrolls (see Drawnel 2011), as well as other fragments of astrology and physiognomic omens from Qumran; these hardly constitute a representative sample of ancient sciences.

Philip Alexander's article—first published in 2002 and reprinted here because it sets the stage for the remainder of the contributions (p. 18)—has not been updated, although Alexander himself admits to having changed some of his views (p. 25). Alexander addresses the question of defining ancient science as inferences based on observations of nature, but he qualifies the definition with reference to the dichotomy of the "craftsman" versus the "scientist": both use technology but the scientist tries to explain how it all works. The magician is thus comparable to the craftsman, whose methods are far removed from the rational medicine of Galen the scientist (pp. 27–28). In fact no such dichotomy exists within ancient science, since magic and medicine are each discrete and separate disciplines which follow their own respective (and rational) rules of theory and practice. Moreover, not every scholar who works with scientific data can fully comprehend the algorithms, and it is fair to differentiate between applied and theoretical aspects of the same discipline.

Nevertheless, Alexander's distinction between "craftsman" and "scientist" is never challenged in the volume, since other contributors also draw no lines between astronomy and astrology, or between theoretical astronomy and calendar reckoning. In fact, most of the astronomy discussed by the authors actually refers to calendar reckoning, an aspect of astronomy adapted for practical usage which does not require the full range of theoretical understanding of the movements of celestial bodies. Moreover, the two calendars mentioned in

Jewish sources are relatively easy to calculate, since the 360-day calendar of Enoch was essentially the administrative calendar of 12 months of 30 days each (see Stern 2012: 84), while the 364-day calendar of Jubilees and used in Qumran was simply an idealized solar calendar based on 52 weeks. Other mathematically complicated types of calendar reckoning known from Mesopotamia (e.g., so-called *Kalendartexte*, Goal-Year texts, Almanacs, Normal Star Almanacs, Horoscopes, or Astronomical Diaries; cf. Steele 2007: 142) are not found in Jewish astronomical texts. In effect, if we adopt Alexander's approach, there is no "science" in Jewish sources, but only "crafts."

Let us proceed to specific problems within individual chapters in this volume.

Many of Alexander's comments on the rudimentary nature of Enochic science must now be revised in the light of the publication of Aramaic fragments of Enoch, with a table of calculations regarding visibility of the moon (Drawnel 2011). These same Qumran Aramaic astronomical texts are further taken up in the contribution of James VanderKam, who sees the Aramaic fragments as legitimate representations of science, based on observation and reference to other astronomical works, especially in Akkadian. It is worth noting, however, that neither Alexander nor VanderKam (nor any other author in the volume) ever refers to Second Slavonic Enoch for comparison, but only First Enoch, despite the fact that reliable translations of Second Enoch are available (Andersen 1983 and Badalanova Geller 2010). Why is this so important?

The answer is that all astronomical texts referred to in this volume (including Enoch) are taken out of context. The story of Enoch is essentially a vision of a celestial journey. The common reference to a "first" and "second" book of Enoch is misleading, since these accounts are two versions of the same narrative. Although Qumran provides Aramaic fragments corresponding to First Enoch (best preserved in Ethiopic), this does not rule out Second Enoch as an ancient source with an alternative version of the story, with numerous details in agreement. The point is that Second Enoch describes the sage's journey to either seven or ten heavens and in the course of this journey the text describes the main features of the celestial domain, including relatively non-technical explanations of the movements of the sun and moon, entering and exiting from heavenly "gates," while navigating the constellations of the zodiac; the heavenly gates are mentioned in both First and Second Enoch. The purpose of such descriptions is to provide verisimilitude for Enoch's heavenly journey, with calculations of comings and goings of the sun and the moon over fifty-two weeks as a way of harmonizing calendar reckoning with basic assumptions about lunar and solar movements.

The main purpose of the narrative is to provide information about the whereabouts of sinners and sinless, angels and fallen angels (the so-called Watchers or Awakeners), as moral instructions; the work is not intended as a textbook of astronomy. By ignoring Second Enoch, one easily loses sight of the narrative as a whole, since the plot becomes rather obscured among the five different books thought to comprise the corpus of First Enoch. However, one unique innovation of First Enoch is the inclusion of lengthy astronomical tables (written in words) providing detailed information about lunar visibility. Because of this, Seth Sanders makes an extraordinary suggestion in this volume (p. 89, citing J. Ben Dov) regarding the Qumran astronomical fragments (4Q208–4Q211): "an older, factual description of the layout and cycles of the cosmos appears to have been edited into a story involving Enoch." Aside from the unlikelihood that a story would be created to accommodate a table of arithmetic values, this statement also fails to comprehend the context of the Babylonian astronomical texts, upon which comparisons with Enoch are based.

Almost all of the authors in the volume refer to key Babylonian texts such as MUL.APIN and *Enūma Anu Enlil* Tablet 14, although less known is a Babylonian mystical text known as

i.NAM.giš.hur.an.ki.a. Each of these texts has its own narrative, into which lunar tables have been incorporated. MUL.APIN is a scholastic astronomical-astrological text dating from c. 1000 B.C.E., which divides the heavens into three paths of rotating heavenly bodies and provides a system of intercalation based on an ideal 360-day year (Hunger and Pingree 1989). With the use of a gnomon, measurements are given for the relative lengths of days and nights throughout the year. While thought to be a source text for Enoch, MUL.APIN never mentions heavenly "gates" (which are only known from Akkadian non-astronomical literary texts; see Heimpel 1986); moreover, the system of intercalation in MUL.APIN was already long passé by the time Enoch was composed, since it had been replaced by the more accurate nineteen-year lunar cycle reckoning. In any case, MUL.APIN does not represent technical mathematical astronomy typical of the Persian and Hellenistic periods in Babylonia.

Enūma Anu Enlil Tablet 14 (EAE; Al-Rawi and George 1991/1992) is another favorite candidate for the source of Enochic astronomy, since it consists of four different tables of lunar visibility. The first fourteen tablets of *Enūma Anu Enlil*, however, form a sub-series consisting of omens based upon the first visibility of lunar crescents at the beginning of each month; only the final tablet contains tables of lunar visibility and is likely to have been an appendix of technical data. The context is astrological and the astronomical data is secondary. It should be pointed out that the system of calculation of divisions of lunar visibility in EAE 14 is not identical to the table in First Enoch, although the basic idea of numerical divisions is similar (as pointed out by VanderKam, p. 63). In fact, EAE 14 divides lunar visibility into 1/15 segments in a base-60 (sexagesimal) system while First Enoch employs 1/14 segments in a base-7 system, showing fundamental differences in the algorithms.

The third text mentioned above, i.NAM.giš.hur.an.ki.a (Livingstone 1986: 24–27), is a mystical text about the dimensions of the granaries of the main temple in Nippur, but since this information somehow concerned the moon god Sîn, the text included a table of lunar visibility on the first and fifteenth days of each calendar month; the colophon describes the tablet as a "mathematical tablet," but the context is clearly more general and difficult to comprehend. There is no justification for assuming that in any of these texts the astronomical information was anything but secondary, but this is in fact the very characteristic of all of these works which makes them comparable to Enoch. The astronomical and calendrical data is provided within a framework of omens or religious texts, and this is the firmest basis for comparisons to Enoch.

In fact, the question of "religion" versus "science" is often raised throughout this volume, without ever confronting the question head-on. Contributors refer to the zodiac in ancient Jewish sources, but without fully considering the religious or scientific ramifications. The zodiac was designed as an astronomical instrument, as an accurate way of charting celestial movements in a map-like form, but at the same time combined with a notion of celestial influences over human affairs, possibly based upon the astute observation that the moon phases affect tides and river levels. After its invention, new genres of astral magic and astral medicine appear, including complex theories of melothesia in which zodiac signs influenced the health of various parts of the human body. Although the gods nominally appear within zodiac representations, the system of predictions tended towards being secular, in the sense that zodiac or planetary influences directly determined human fates rather than personal (and even arbitrary) decisions of divinities. Nevertheless, the zodiac became a popular decoration of Roman-period synagogues in ancient Palestine, with Helios depicted as the sun, and for this reason was probably acceptable to the author(s) of Enoch.

On the other hand, it is unlikely that the soberly religious Qumran sectarians (the Yahad) would have approved of the zodiac, its imagery, or its mantic usages. Jonathan Ben Dov's idea (pp. 138–44) that the Yahad simply incorporated mantic texts originating within Baby-

lonian astrology and physiognomy as part of its ideology seems wide of the mark, since such texts appear to be far too secular or at very least pagan in origin, nor is it convincing that a sect with such stringent views would adopt such an obviously foreign technology. Ben Dov defends his position by suggesting (p. 136) that the Qumran sect was unaware of the foreign influences behind their own astral science, which they cloaked within a religious framework of patriarchal narratives. This assumption undermines the very notion of "science" in Qumran as a tool for studying the human environment, but casts the Yahad as having a naive and religion-based ideology which was isolated from other centers of learning and epistemes. A Hebrew physiognomic scroll from Qumran shows that such omens were domesticated by Jewish scholars, but Ben Dov assumes that these particular omens in Hebrew were not based upon similar Greek or Babylonian models (pp. 143–44). Nevertheless, there is little reason for thinking of these physiognomic omens (or other science-scrolls) as home-grown sectarian compositions originating in Qumran, rather than being brought there from outside.

This leads us to the important question of *Wissenstransfer* posed in this volume by Mladen Popović, who attempts to reconstruct how Jewish scholars would have learned Babylonian science (pp. 162–65). To seek an adequate explanation for knowledge transmission, Popović resorts to Social Network Analysis (pp. 168ff.), concentrating on the "social context of the transmission of astronomical knowledge" (p. 169), based on a "community of elites," which included foreign scribes with non-Babylonian and non-Assyrian names (pp. 170–74). Aramaic is perceived as the vehicle of transmission, employed by *sēpiru*-scribes who wrote on leather (rather than cuneiform tablets) as part of the temple and palace administration (p. 175). Finally, Popović draws upon isolated examples of "Chaldean" scholars known to the Greek world (pp. 180–82), combined with Berossus and Graeco-Babyloniaca tablets (containing both cuneiform writing and Greek transliterations), as examples of direct transmission of Babylonian learning to the Greek world, and by analogy and inference, to Jewish scholarship.

Taking into account Popović's own caveats about these assumptions, there are many points which require response. First, there is no plain evidence for any Jewish scholars actively participating in Neo-Assyrian or Neo-Babylonian scribal schools (just as there is no evidence for *sēpiru*-training within these schools), which might have allowed us to assume that "alien wisdom" could have been brought back to Judea in the Persian period. The fact that Jews spoke Aramaic is insufficient to assume that they were familiar with Aramaic science. Second, there is no evidence from Babylonia of any major Aramaic libraries which would have competed with the very large cuneiform libraries and archives attached to temples, palaces, and even private homes; there was apparently no ancient Aramaic library of significance in Babylon in this period, comparable to the library of Alexandria, but if such an institution had existed, we would probably have heard about it.

Nevertheless, there is indirect evidence that a certain amount of cuneiform scientific literature was being translated into Aramaic, if one assumes that Berossus, a Babylonian high priest and astrologer, wrote his works in Aramaic (rather than in Greek, *pace* Popović, p. 187). The fact that Berossus's *Babyloniaca* is only preserved in Greek is hardly proof that he wrote in this language, as we know from numerous other works of apocrypha and pseudepigrapha. Parallels are often drawn with the Egyptian priest Manetho, who wrote in Greek at about the same time as Berossus, but Egypt was rapidly hellenized after the founding of Alexandria. It is very unlikely that so soon after Alexander's incursion into Babylon, a high priest would compose works in Greek for a Babylonian constituency of predominantly Aramaic speakers; it is not certain that Akkadian was still being spoken at that time, but Greek was certainly not particularly current. The evidence for Berossus himself having moved to Cos to found a school of Babylonian astronomy is flimsy at best, although it may

reflect the fact that many Aramaic (or Chaldean) works were being translated into Greek in Alexandria (and perhaps Cos and Pergamon), and these works were later disseminated to the West (see Geller 2014).

In fact, it is important to consider the *Wissenstransfer* role of Alexandria, from where we know of an Akkadian astronomical text appearing in Greek. However, such transmissions usually appear to be a one-way street, from East to West. Not only is there a lack of awareness of Greek science (e.g., Plato, Aristotle) in Babylonian sources before Byzantium, the LXX is the best example that knowledge did not travel in the other direction, since no trace of the Bible in Greek can be found in Mesopotamia in Late Antiquity; it is most unlikely that Babylonian Jews knew or used Greek, in contrast to their brethren in Greco-Roman Palestine. This affects Popović's point (pp. 183ff.) about knowledge transmission to the Jewish world, since it would seem much more plausible for Qumran texts from the Second Temple period to have been aware of Greek rather than Babylonian science; Greek texts have been found in Qumran, Akkadian ones have not. This remains a conundrum for Popović.

New data has emerged for the existence of precisely this kind of technical knowledge transfer from Babylonia to Palestine, in the form of a unique Cairo Genizah lunar-omen text (Bohak and Geller 2013), which closely parallels 4Q318, the Qumran "brontologion" referred to many times in the present volume (see p. 159). The remarkable feature of the Genizah text is its textual affinities with other lunar omens apart from those in 4Q318, i.e., in Akkadian dating from the Persian period and in Demotic (probably translated from Aramaic), as well as its close parallels with the Mandaic *Book of the Zodiac* and Syriac *Book of Medicines*. Byzantine manuscripts of similar content are often thought to attest to an original Greek *Vorlage* for 4Q318, but the Greek texts attribute their data to original Egyptian and Babylonian sources. The precise parallels allow us, perhaps for the first time, to trace a route of transmission of a single astrological text from Mesopotamia to Palestine to Egypt and must have broader implications for *Wissenstransfer*.

However, there is still the problem of secret knowledge, raised by Ben Dov in this volume (p. 133), and further taken up by Annette Yoshiko Reed (p. 235). The phenomenon of technical knowledge being kept within a prescribed circle of initiated scholars is well known. Babylonian colophons often explicitly state that the information on the tablet is only to be revealed to the "knowledgeable" (*mūdû*) and not to be revealed to the "uninitiated" (*la mūdû*), just as the Hippocratic Oath was actually intended to restrict Hippocratic medicine to the circle of his followers and adherents. The kind of information for limited access is not mystical, as supposed by Yoshiko Reed when trying to relate these secrecy clauses to Rabbinic *maaseh bereshit* speculation. On the contrary, the restricted cuneiform texts consisted of straightforward scholastic compositions which are often meant to be understood as read, as opposed to highly esoteric mystical texts which can only be understood through hermeneutics (cf. Livingstone 1986). The question is how would Jewish scholars have been granted access to such knowledge without being insiders and integrated into Babylonian scholarship? One possible answer is that such secrecy clauses over time were only used to distinguish between professionals and laymen, in the absence of any diplomas in antiquity or designations of professional qualifications. When required, practical technical information (on calendar reckoning, medicine, divination, etc.) could cross borders and linguistic boundaries, since it represented a useful commodity which could be traded and exchanged.

In the light of the above arguments, we can begin to try to reconstruct a possible scenario in which Babylonian science (probably in a form translated from Akkadian to Aramaic) could have been brought to Palestine in the Persian period. First, why an astronomical table

of lunar visibility was incorporated into a literary composition such as Enoch is impossible to assess without knowing more about the authorship of this work, and without ruling out the possibility that some part of this narrative may have originated in Babylonia; clearly the astronomical table of First Enoch was inspired by Babylonian astronomy.

As for Qumran texts, however, a different answer can be proposed. The kind of technical literature found in Dead Sea Scroll fragments—such as physiognomic omens, lunar eclipse omens, or omens based upon thunder—would hardly be comprehensible to a non-specialist, in the same way that an advanced physics textbook would not be of general interest today. Interpreting omen texts required professional expertise associated with a center of learning, usually within a palace or temple school, since the science of divination was utilized by the elite or ruling classes and omen predictions applied to king and country, not to private citizens. The only context which one might consider as plausible for such texts in ancient Judea would have been the relatively brief period of Hasmonean rule, roughly a century of political independence during which Jannaeus eventually managed to crown himself as king, mint his own coins, and maintain his own army. These are precisely the circumstances in which professional expertise might have been required, and during which time scientific texts could have been introduced through Seleucid Babylonian scholarship, translated into Aramaic. These scraps of scientific divination found in Dead Sea Scrolls might simply be remnants of texts from a Jerusalem archive deposited in Qumran, having little or nothing to do with the Qumran sectarians.

There is always a tendency with volumes generated within a research group or workshop for the results to be somewhat self-referential. In this particular case the bulk of the discussion is based almost exclusively on secondary literature (except for five lines of physiognomic omens on p. 143), and the contributors most often cite each other's works, with one author citing his own publications no less than twenty times. It is time to broaden the discourse. While the contributors have made a brave attempt at reconstructing Jewish science based upon a limited range of sources, and many provocative questions have been raised in the course of their inquiries, the subject matter is important and merits further study. It would be useful to expand the field of inquiry to include other disciplines, as well as some Rabbinic texts, to get a more balanced view of ancient Jewish science.

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