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Conditionals, Inference, and Possibility in Ancient Mesopotamian Science

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Argument

This paper argues that ancient Babylonian signs (omens) reflect a mode of inferential reasoning as a function of their syntactic and logical structure as conditionals. Taking into account the institutional context that produced a systematic written body of omens, the paper is principally interested in the cognitive disposition of such texts. Investigating what constitutes system in these works, formal aspects of the material are examined in terms of the nature of conditionals and the logic of conditional statements. It is argued that conditional statements about ominous phenomena speak as much to a notion of conceivability and possibility as to empirical physical actuality. It is claimed that the epistemological character of the Babylonian compendia of signs cannot be understood without due attention to epistemic possibility and further, that the cuneiform omen texts comprise a different kind of scientific knowledge from that limited to a knowledge of physical phenomena and their laws.

Introduction

> *If* acts as a lever to lift us out of the world of actuality into the realm of imagination.
>
> Konstantin Stanislavskiy

The study of ancient Mesopotamian science is well developed from the standpoint of a reconstruction of its content, methods, and aims (Neugebauer 1975; Swerdlow 1998; Hunger-Pingree 1999). Its situation within a social and political context is less well known, but has been studied to a greater degree than has its nature from a comparative epistemological point of view. Few attempts have been made to comment on philosophical dimensions of cuneiform scientific texts, at least those aspects of such texts that can be related to some issues in the philosophy of science.

This essay focuses on a part of the corpus which is comparatively problematic from a modern classificatory standpoint, namely the omen texts. These present in extensive and formalized lists a corpus of knowledge that in large part seeks to describe what we would call "natural" or "physical" phenomena, though this category is not employed as such in the cuneiform written record. Consequently, no distinctions are made in the ancient sources between natural and other kinds of knowledge, or between physical

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and other phenomena, at least for the purpose of compiling lists of signs and their *significata*. It is at least somewhat clearer in the case of the Greeks, where boundaries between the physical and the metaphysical are known. Still, for Greek antiquity, as Daryn Lehoux put it, "their ideas about what counts as *physical* are going to look a little different from ours, since their physics is so very different" (Lehoux 2007, 37). Given the divinatory character of the Babylonian sources under consideration here, all phenomena of interest to the scribes were subject to the workings of the divine, as, for example, when they say that the moon-god "makes" the eclipse. Whether such divine manipulation of phenomena and events on earth was viewed as "physical" in nature is unknown, if only because no line demarcating the "physical" is drawn in the sources. That prayer, incantation, and magic were accepted as viable means to deal with the impact of divine forces on the physical world further underscores the difficulty in defining boundaries between the physical and metaphysical in ancient Mesopotamia.

The present paper is interested in questions of logic and reasoning within the context of an ancient science whose outlines, interests, and cultural background are different from those of modern western science. The focus here is principally on the ancient study of celestial omens. Cuneiform omen texts were first classified in modern Assyriological scholarship as "scientific" because of their systematic character. Their presentation in lists is clearly related to other lists (lexical lists, sign lists) prepared by cuneiform scribes for purposes of teaching the cuneiform script. The systematic character of these corpora was found in their form and comprehensive nature, that is, in a desire to present everything worthy of knowing and recording and to do so with organizational and logical integrity. A more apt designation of what all these texts have in common might be a "scholastic" or "academic" character.[1] To be sure, Mesopotamian science was the product of an academic scribal culture. That is, the content and form of the cuneiform compilations of omen, magical, astronomical, and medical texts, which we lump together under the rubric "Mesopotamian science," were the result of certain aims of the institutional context within which they were developed, i.e., the scribal school or "institute," whose purpose was to teach and preserve cuneiform learning, although, at the same time, one cannot be sure that social demands fully account for the deeper cognitive disposition of these texts' content and form.

A full exploration of the cognitive disposition of the Babylonian divination texts, i.e., whether the concepts about what phenomena are and how they behave are fundamentally different from those of other cultures and historical periods, cannot be given here. Suffice it to say that by "cognitive" I refer to a way of thinking and to the resulting concepts that shape various beliefs about the world. Interest in the cognitive

[1] Note the functionalist approach of A. L. Oppenheim that the lists do not embody "a quasi-mythological concept as *Ordnungswille*, according to which the scribes who made these lists aimed at 'organizing' the universe around them by listing what they saw of it in word signs written in narrow columns of clay" (Oppenheim 1975, 248).

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in the present paper is limited to how from the treatment of physical phenomena in cuneiform divinatory texts one can say something about a style of thinking, a "cognitive" style, reflected in the use of a particular logical method and form of reasoning.

Science in the context of the cuneiform scribal tradition had to do not only with certain subjects (celestial phenomena, medical phenomena, magical prescriptions, extispicy, and other forms of divination from other kinds of signs) but the particular textual treatment given these subjects bear reflections of how phenomena were seen to relate to one another, and to humankind. Just how rigorous and/or logical the cuneiform scientific corpus as a whole was has never been the subject of any focused discussion, nor is it the intent here to be comprehensive. By limiting discussion to omen texts, and particularly celestial omens, this paper will look at some features of the systematization of omen statements in terms of questions about its inherent logic. Quine and Ullian made the observation that

> Our word "science" comes from a Latin word for knowledge. Much that we know does not count as science, but this is often less due to its subject matter than to its arrangement. For nearly any body of knowledge that is sufficiently organized to exhibit appropriate evidential relationships among its constituent claims has at least some call to be seen as scientific. What makes for science is system, whatever the subject. And what makes for system is the judicious application of logic. Science is thus a fruit of rational investigation . . . at root what is needed for scientific inquiry is just receptivity to data, skill in reasoning, and yearning for truth. (Quine and Ullian [1970] 1978, 3–4)

The following does not intend to rehabilitate omens in terms of modern logic, but rather raises the question of the logic inherent in ancient Mesopotamian collections of what are throughout "if . . . then" statements, i.e., conditionals. The question is this: To what extent do Babylonian omens reflect a mode of inferential reasoning as a function of their syntactic and logical structure as conditionals? Further, in the field of Babylonian omen science, where each statement in the written corpus is unique (of many thousands of omens, no two are alike), the conditional form seems to have offered a useful and adaptable means for creating system. As Dorothy Edgington said, "the conditional . . . is a systematic device: if you understand any conditional, you understand every conditional whose components you understand" (Edgington 1995, 241). The present essay, therefore, explores in a preliminary way a number of aspects of the logical and epistemic nature of the conditional statement in Babylonian science.

Formal Attributes of Mesopotamian Scholarly Divination

A large portion of cuneiform scholarship belongs to the extensive tablet series for divination of various kinds. Detailed lists of signs (*ittātu*/GISKIM.MEŠ) with their

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correlated events of a public or private nature make up the corpus of cuneiform scholarly divination. The body of celestial signs corresponds by and large but not exclusively to visible phenomena (physical or optical, i.e., involving or related to light). It may be worth noting that the Sumerian writing of the word GISKIM (Akkadian *ittu*) "sign," is a compound logogram that includes the graphic element IGI "eye," or "to see." But in addition to certain kinds of visible phenomena, signs could be identified in possible, imaginable, or conceivable phenomena as well, i.e., in things not limited to what we consider physical phenomena, though they are clearly grounded in consideration of physical realia. The purpose of the omen compilations appears to be to identify and systematize what, evidently, to the ancients seemed to be the interdependence of elements of their experience, that is, observable events in the environment, with events in social life. The written lists of omen statements, arranged into elaborate paradigms, in the structuralist sense of that term, preserve a Babylonian semiotics whose pre-history is entirely irretrievable. Once formalized in lists, however, the paradigms became traditional and were perpetuated by the faithful copying of the omen lists over the course of many centuries.

Divination series were written, therefore, to preserve a system (of indeterminable antiquity) of associations between signs and their consequences. The signs were compiled according to a variety of subjects, e.g., celestial signs, signs in the exta of sacrificed animals, physiognomic or medical diagnostic signs. The series vary widely in their content but are unified in form. Regardless of their content the lists of signs are formulated as "if . . . then" conditional statements. As D. Sanford says in the introduction to his study of the foundations of reasoning, "we use conditionals to decide what to do. We also use conditionals to decide what to believe, whether or not the belief is immediately relevant to any prospective alternative for action. Much of our inference from evidence is naturally cast in conditional form" (Sanford 1989, 4). "If . . . then" formulations belong to a category of sentences known as indicative conditionals, which express the expectation of something (the consequent or apodosis) on the condition of something else (the antecedent or protasis). Such conditionals seem to have built into them a future state of affairs: "On the condition that (or supposing) P, Q happens, or will happen." P and Q are then related events, P being that which signifies and Q being that which is signified, that is, Q is expected to occur after P.

The question is not whether Mesopotamian omens reflect a conscious interest in the nature of conditionals or in the logic of conditional statements. They do not. The Assyro-Babylonian scribes did not comment on the form of the omens as such, but the fact remains that observational and theoretical interest in physical phenomena resulted in the creation of systematic and highly schematized lists of conditional statements. The question is: what is the real function of the conditional phraseology in this context? In modern scholarship it has been regarded as a function of the use of omens in prognostication, the "if . . . then" being the way a diviner "divined" the future. In this sense the omens served the same purpose Sanford attributes to "our" use of conditionals, i.e., to help human beings decide whether or what action to take in the

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immediate future. This is indeed confirmed by evidence of scribal activity at the Neo-Assyrian court (seventh century B.C.), in which learned scribes advised the Sargonid kings on their official business inside and outside the palace on the basis of celestial omens, as in the following passage:

> And the matter of the planet Jupiter is as follows: If it turns back out of the Breast of Leo, this is ominous. It is written in the Series as follows: "If Jupiter passes Regulus and gets ahead of it, and afterwards Regulus, which it passed and got ahead of, stays within its setting, someone will rise, kill the king, and seize the throne." This aforesaid is the only area which is taken as bad if Jupiter retrogrades there. Wherever else it might turn, it may freely do so, there is not a word about it. (Parpola 1993, 9–10 rev. 12–22)

Apart from the omen lists, other written evidence for the practice of divination is available from letters referring to the observation of omens, reports of the observation of ominous signs, and rituals for averting the evil signaled by some. Such action could include prescriptions for ritual magic, as the scribe in the following example recommends: "Let them find out where the evil (portended by) the eclipse has materialized, and eradicate it. Somebody should go and perform (the rituals) in Nineveh" (Parpola 1993, 40 rev. 2–7; broken passages are not represented in the translation here). As implied in the last passage, the reading of a sign and its interpretation prompted action to be taken to respond in the event the sign was considered dangerous. However, this use of omens does not necessarily mean that the omens themselves offer what we would call "predictions."

The formulation of individual omen statements, "if P, (then) Q," was already employed in the Old Babylonian period (ca. 1800 B.C.), sharing its form with so-called law codes, the casuistic statements of acts and their punitive consequences, "if a man does thus and such, he shall pay" to varying degrees (including, in capital offenses, with his life). The intellectual affinity between Mesopotamian law and divination is as yet under-explored. Raymond Westbrook has commented that the verb *barû*, whose basic meaning is "to see," is also used in the sense of "to establish facts of a case," noting the relation to its use in the context of divination in which the diviner "establishes the true meaning of ominous phenomena" and taking this to mean that the diviner "does justice, since a judgment has two aspects: the verdict or the facts and the orders that may flow from it for punishment, compensation, restitution, etc." (Westbrook 2005, 35, and n. 25). Ann Kessler Guinan has also made mention of the similarity between the conditional formulation of law cases and omens, but judges the similarity "deceptive," because "when we read an individual law, we can understand the connection between the protasis and the apodosis," and "deduce the underlying principles that govern the structure of the text" (Guinan 2002, 19). The relation between protasis and apodosis, or antecedent and consequent, is the working dynamic of Mesopotamian divination, and although to us that connection, at least semantically, is not readily understood, it is subject to certain relational (propositional logical) rules in the same way as are the

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casuistic statements of the cuneiform laws. I contend that the relation of antecedent and consequent in the omens can be understood as a matter of conditional logic, which applies independently of any semantic, causal, or empirical connection there may be (or not be) between the statements P and Q so related.

Some omens were not introduced with the word *šumma* "if," but merely stated as two conjoined statements "P:Q," with the implication that P, the antecedent clause was associated with or indicated Q, the consequent. The practice of writing *šumma* in Old Babylonian omens is by and large effected by writing BE-*ma* [to be read *šum*$_4$-*ma*] "if," but later, in the Neo-Assyrian period, by writing DIŠ, meaning "entry" after the fashion of many (not all) third millennium Sumerian lexical lists and a few later such lists wherein the entries in these lists are preceded by a single vertical wedge, meaning "item" or "entry." The translation of omens written with DIŠ can in fact be "P:Q," without "if." The *Chicago Assyrian Dictionary* (1992, 276) s.v. *šumma* explains that the logogram DIŠ, when introducing omens written with DIŠ alone, is "unlikely to have the reading *šumma*," since it sometimes happens that omens which are introduced by DIŠ can also be preceded by the word "if," written either *šum-ma* or BE-*ma*. With or without DIŠ the logical relationship between P and Q remains the same. P functions as the antecedent clause in which an ominous sign is posited, supposed, or given. We can therefore translate "if P," "on the condition that P," or "given that P."

The grammar of conditionals in Akkadian does not dictate that the posited event P should be expressed with the verb in the preterite, but in omen texts it normally is. The preterite verbs of the protases are in many editions of omen texts translated into English with the simple present, "if P happens." This is a matter of interpretation, that is of our interpretation of the way the ancients understood the relation between antecedent and consequent (protasis and apodosis) and how they used the omens. The idea is that whenever a sign should occur, meaning sometime in the future, Q is what one expects. Hence our translation of these verbs in the present tense with present-future aspect: "If, or on the condition that, P should ever occur . . . " The consequent is translated as following upon the event in the antecedent in the manner of a prediction. It is expressed as a subsequent occurrence with its verb in the present-future aspect: DIŠ MUL SAG.ME.GAR *ana* UL Á.MUŠEN *itehhi* "If (or, "given," or, "on the condition that") Jupiter approaches the Eagle Constellation (Aquila)" *miqittim būlim išakkan murṣānu ina mati ibašši zunnu arhi* 1.KAM *ul izannun* "there will be (meaning 'there is as a result') disease of the cattle herds, sickness in the land (and) no rain for one month."

What strikes us as peculiar in relating P and Q in this way is that the relationship between the events P and Q bear (to us) no physical or causal connection. Whether the ancients thought that Q occurred because P occurred is never addressed in cuneiform sources, neither indicated in the evidence of the omens themselves nor in ancillary texts such as reports and letters to the king about ominous signs. To us the idea that this kind of (false) causality would apply to the omen texts is extremely discomfiting as it lays the entire system open to the charge of *post hoc ergo propter hoc* fallacious reasoning. But

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one would like to have a surer grasp of a Babylonian theory of causality, be it somehow physical or divine, for such a charge to make sense within the ancient context. While no appeal is made to physical reasons or forces to explain the connection between P and Q, a generalized acceptance of a divine causality in the world of phenomena does appear to be the case, though we have no conception of how that causality was understood to work. What can be established from the internal evidence of the omen texts is a strong paranomastic relation between antecedent and consequent clauses, suggesting that the relation between P and Q need not be physical, causal, or even divinely produced for P to indicate Q.[2] The point is, conditional statements need not be causal statements, though they certainly can be when P precedes Q. Moreover, the fact that "if . . . then" statements are commonly used for making causal statements does not mean that all conditionals make causal statements. What the omens do make are implications, in the logical sense, that is, "if P then Q" can be taken to mean "P implies Q," and this relation does not have to do either with causality or prediction.

The last formal attribute relevant to the discussion of the conditional statements in omen tablets is the organizational character, which can be described in terms of the structures of paradigm and syntagm, two basic dimensions of the analysis of textual form going back to Jakobson and Saussure (de Saussure 1974 and Jakobson 1971).[3] On the syntagmatic level, the horizontal axis so to speak, are the elements that come together to constitute the sign, such as "If [Jupiter] in the middle watch has a *ṣirhu* toward the North" (Reiner-Pingree 2005, 124–125 r.1'). The syntagmatic relation of the elements of a given antecedent is constructed by combination. But the antecedents are also structured on the vertical axis such that elements of the syntagm can be replaced forming a new combination of elements, as the lines following the one just quoted demonstrate (only the antecedents are given here, and breaks in the tablet are not indicated):

If Jupiter in the middle watch has a *ṣirhu* toward the North
If Jupiter in the morning watch has a *ṣirhu* toward the North
If Jupiter in the evening watch has a *ṣirhu* toward the South
If Jupiter in the middle watch has a *ṣirhu* toward the South
If Jupiter in the morning watch has a *ṣirhu* toward the South

[2] For example, from the extispicy series (*bārûtu*): "If the coils of the intestine look like the face of Huwawa (written logographically ^{d}HUM.HUM): it is the omen of the usurper king (Akkadian *hammê*) who ruled all the lands." Antecedent and consequent are related by a word play based on the phonetic echo of HUM.HUM in *hamma'u* (see Clay 1917, vol. 4 Text No. 13 rev. 65).

[3] I use these terms in a strictly formal sense without subscribing to the overall program of structuralism's or post-structuralism's claims to the relation of culture and meaning, words and things, and in awareness of the critiques of structuralism offered, for example, by Slater and Pavel. None of this is relevant for my adoption of the terms and the ideas of paradigm and syntagm in Babylonian omen texts. Note that N. Veldhuis articulated this same idea, without invoking the terminology of the structuralists, but nonetheless described omens and lexical lists as both having "a horizontal and a vertical reading. The vertical reading [the paradigm] uncovers the system behind the individual items" (see also Veldhuis 1999, 114).

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> If Jupiter in the evening watch has a *ṣirhu* toward the West
> If Jupiter in the middle watch has a *ṣirhu* toward the West
> If Jupiter in the morning watch has a *ṣirhu* toward the West
> If Jupiter in the evening watch has a *ṣirhu* toward the East
> If Jupiter in the middle watch has a *ṣirhu* toward the East
> If Jupiter in the morning watch has a *ṣirhu* toward the East.
> (Reiner-Pingree 2005, 124–125 r.1'–11')

On the plane of the paradigm, new elements are introduced by substitution. A given paradigm will be expanded until it reaches a stopping point when the elements of that paradigm are exhausted. In the example given, nothing further can be added to the pattern of middle, morning, evening watch combined with the four directions.[4] The consequence of this structural method is that some "phenomena" will emerge within the paradigm that are purely imaginative constructions not possible in the actual world.

Conditionals and Inference Making in Cuneiform Omen Texts

Dorothy Edgington introduces her article "On Conditionals" with the following statement:

> The ability to think conditional thoughts is a basic part of our mental equipment. A view of the world would be an idle, ineffectual affair without them. There's not much point in recognising that there's a predator in your path unless you also realise that if you don't change direction pretty quickly you will be eaten. Happily we handle ifs with ease. Naturally, we sometimes misjudge them, and sometimes don't know what to think. But we know what it would take to be in a position to think or say that B if A, what would count for or against such judgements, how they affect what we should do and what else we should think. (Edgington 1995, 235)

This is an encouraging assessment if we are interested in defending a claim against the idea of a difference in cognition between the ancients and ourselves. But there is serious comparative work to do in this regard, and while, as Edgington believes, conditional thought is "basic," the theory of the conditional statement is not. Furthermore, her own question "are there irreducibly different kinds of 'ifs'?" seems to me to require some careful analysis on our part with respect to Mesopotamian "ifs" before we issue any general statements about the cognitive in Mesopotamian omen texts.

We are not accustomed to approaching Babylonian omen texts from the point of view of what their form might suggest about their meaning and purpose because we tend to (or want to) view the omens as having, or being based on, an empirical

[4] It isn't clear why no entry for a *ṣirhu* in the evening watch to the North is given. If it occurred in the break preceding line 1', it would be out of order. We expect it between lines 2' and 3'.

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connection. The following example will suffice: If/on the condition that Jupiter leaps in the middle of the (constellation) Fish and stands: no rain for one month (Reiner-Pingree 2005, 43 r.1', without marking break). On the standard view, this statement means that whenever the phenomenon is observed (the leaping and standing of Jupiter in the middle of the Fish), a conclusion (or prediction) is drawn (no rain for a month) on the basis of that observation. This interpretation presupposes an empirical foundation for the association of P and Q, namely, that at some time in the past it was observed that following the leaping and standing of Jupiter in the middle of the Fish constellation there was no rain for a month. Whether or not this was the case is not ascertainable from the omen text itself. Neither is there direct evidence outside the omen lists that this was ever the method by which some omens might have been generated, tempting as it is to presume so. The idea of an original empirical connection between sign and signified remains entirely speculative and is also occasionally shattered by the "impossible" phenomena which cannot have been observed at any time, as well as by the paranomastic relations clearly attested in the texts (see note 2).

Perhaps a better approach would be to bracket altogether the problem of supposed empirical underpinnings of omens. If some signs were related to events without an empirical connection, which is certainly the case for the "impossible" phenomena, then perhaps whatever related the antecedent to the consequent in those instances held in other cases as well. Our presumption of an original empirical connection may be motivated by our difficulty in seeing as in any way logical conditional statements where there is no causal or empirical connection between antecedent and consequent. But the logic and the truth-functionality of conditionals (for details, see below) is not dependent upon the meaning of its component statements. R. J. Farrell commented,

> students of truth-functional logic frequently regard material implication [that P implies Q] to be patently absurd. Most of us who teach elementary logic have encountered intelligent students who frustratedly exclaimed something to the effect that: Any logic which pronounces true a sentence such as, "If the moon is a green cheese, John F. Kennedy was the 35th President of the United States," is illogical. (Farrell 1979, 383)

Even if the antecedent is not patent nonsense, as in the moon being a green cheese, the relation of antecedent to consequent, if unconnected by physical, causal, or experiential association (such as "If the moon is a satellite of Earth, John F. Kennedy was the 35th President of the United States"), still seems bizarre to us. Just as in these two deliberately bizarre conditionals, it is difficult to assess the nature of a Babylonian omen as a conditional statement when taken in isolation. Although the ancient omens were not constructed for the purpose of illustrating material implication in a conscious exploration of the logic of conditional statements, from a formal point of view they may functionally be viewed as a series of implications (P implies Q).

Seen in the context of the written list it is easier to see the difficulty of the question about a physical connection between antecedent and consequent particularly given the

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schematic (or paradigmatic) nature of the development of the list. The following is a section from omens for the planet Jupiter from the series *Enūma Anu Enlil* (Reiner-Pingree 2005, BPO 4 Group G K.8097:4'-19'; tablet number is unknown). Square brackets indicate breaks in the clay tablet:

> If ditto (= Jupiter) passes to the front of the Goat (= Lyra): [In Akkad . . .]
> If ditto passes to the rear of the Goat: [In Elam . . .]
> If ditto passes to the right of the Goat: in [Amurru . . .]
> If ditto passes to the left of the Goat: in S[ubartu . . .]
> If ditto passes to the navel of the Goat: in Guti [. . .]
> If ditto passes to the sting of the Goat: in all the lands [. . .]
> If ditto passes to the throat of the Goat: Enlil and [. . .] there will be confusion, a flood will sweep away the land, rain in the sky, flood in the spring will come, ditto: in that month, variant: in that year, Adad will beat down the crop of the land, there will be an eclipse of the Moon and the Sun, the king's land will revolt against him.
> If ditto passes to the in-between area of the Goat: *rapādu*-disease will [seize] the land.
> If ditto passes to the rear of the Goat: scarcity of barley and [straw?]
> If ditto comes close to the Goat: scarcity of barley and straw and. . . .
> If ditto comes near to the Goat: the mind of the land will change, [. . .]
> If ditto leans against the Goat: Nergal will [. . .] the cattle.
> If ditto stands with the Goat: Gula will cause shivers.

The purpose of the omen list seems to be to provide a series of cases that serve as a basis for knowing what happens if P, or, put another way, what is indicated or implied by P. Although the omen lists provide only the series of "If P then Q" statements, the use of the omen texts as reference works seems to be well indicated by other sources for the practice of divination (the letters and reports from the scholars in Hunger 1992 and Parpola 1993). If ever P is observed, we presume, the omen statement in which P is mentioned permits the association to Q.

In effect, Q can be inferred from P in a manner that, at least from a formal standpoint, follows the logic of indicative conditionals as follows: "If P then Q. P: Therefore Q." This is the most common rule of inference, known as *modus ponens* ("the mode that affirms"). The *modus ponens* formulation will appear completely familiar to anyone with an acquaintance with Babylonian omen and other divinatory cuneiform texts. Logically speaking, two premises are brought into relation. The first is simply the conditional statement "if P then Q," where the logical relation is one of implication, that is, $P \rightarrow Q$ ("P implies Q"). The meaning of the conditional is then "if P implies Q." The second is the truth of P (when it is observed), from which, by the inferential rule of conditional logic, it is concluded that Q.[5] From a formal point of view, therefore, the

[5] Historically speaking, the logic of *modus ponens* was first situated in the context of the Greek philosophical tradition of the Old Stoa. Of the early Stoic authors, e.g. Zeno, Cleanthes, and Chrysippus, virtually nothing is left. As discussed amongst their critics in later centuries, however, they seem to have developed a consistent

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written body of omens can be construed as a list of conditional statements that offer inferences from established premises.[6]

Apart from any empirical considerations of omen taking, or questions about the physical reality of the signs, the logical relationships between the signs and what they signify stem from the syntax of their conditional formulation. As Edgington pointed out, conditional thinking is a basic cognitive function and the logic of conditionals is tied to conditional statements. On this formal level of analysis, the cognitive nature of the Babylonian divinatory science can be said to be characterized by inferential reasoning. Although the omen lists provide only a series of "If P then Q" statements, the use of the omen texts as reference works seems to be implied by other sources for the practice of divination (the letters and reports from the scholars). From these texts it follows that when P is observed, the omen list is consulted. On the basis of the entry in the list in which P is found, a correlation to Q, i.e., the meaning of P, can be inferred. This reading of the omens, as just suggested, can also be expressed as $P \rightarrow Q$ ("P implies Q"), removing temporal, causal, empirical, or otherwise physical elements from their relation.[7] On this view, the omens are not what we would understand as predictions.

logic of propositions and inference schemes. Stoic logic was influenced by the Socratic school of Megara, associated with the names of Diodorus Cronus and Philo. As Mates stated, "the so–called 'first undemonstrated' inference-schema of the Stoics ran as follows: If the first, then the second. The first. Therefore, the second. As a concrete example of this type of inference, they were accustomed to give: If it is day, then it is light. It is day. Therefore, it is light." Mates distinguished the Stoic propositional logic from Aristotelian class logic, by showing that the Stoics substituted sentences for the ordinal numbers rather than another variable (such as a term, e.g., man or animal or mortal). Mates further points out that whereas Aristotle gave his syllogisms nearly always in the form of conditionals ("If animal belongs to all ravens and substance to all animals, then substance belongs to all ravens"), those in his school expressed them as rules (see Mates 1953, 1–10, for a concise overview of the sources; also Long and Sedley 1987, 31–38, on Stoic logic and semantics; see also Long and Sedley 1987, 2, on the more tightly systematic as well as the more specialized character of the post-Aristotelian philosophical systems of the third century and later). I am grateful to Prof. Heinrich von Staden for drawing my attention to this reference.

[6] That the inferential character of Assyro-Babylonian divination appears to coincide with what was known as the "first undemonstrated" inference scheme of Stoic logic seems on the face of it interesting, but not evidently interdependent. At least no textual (or other) evidence exists to link the two. Cuneiform omen texts continued to be copied throughout the Hellenistic period (fourth to first centuries B.C.) as exemplars from the late Babylonian collections stemming from Babylon, Uruk, and possibly Sippar attest. The fact of their contemporaneity with the activities of the Stoic philosophers in Athens and Alexandria of the third century B.C. and later means nothing in and of itself. However, it must be at least mentioned that this was a period of significant transmission of science from Babylonia to the Greeks, as evidenced by the appearance of Babylonian astronomical methods in Greek astronomy later in the Hellenistic Greek astronomical papyri, but also possibly by the time of Hipparchus in the second century B.C., according to Ptolemy's *Almagest*. Already Euclid's *Phaenomena*, ca. 300 B.C., which is the earliest extant Greek treatise to take up the question of the rising times of the zodiacal signs and the corresponding values for length of daylight, indicates a knowledge of Babylonian astronomy (see Berggren and Thomas 1996, 2).

[7] A similar reading has been given by Velduis 1998, 83, where he says that the relation between P and Q is indeterminate.

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The relation established between P and Q is based on or determined by a paradigmatic structure, which becomes ossified by tradition and is subsequently taken as authoritative. And though the relation between the signs and physical existence, much less observational reality, is not a requirement for a phenomenon to function as a sign, at least not to be included in the written list of ominous signs, we must allow that on the formal level, those antecedents which are obvious constructions of the imagination did function as signs. The consequents associated with them are still inferences to Q given P. This feature of the omen texts challenges our understanding of the connection between antecedent and consequent, particularly if we are looking for some kind of physical dependence (such as an empirical connection) of the consequent upon the antecedent; for how can we understand the establishment of a meaningful dependence on something that does not exist?

Possibility and Impossibility

As Gendler and Hawthorne explained in the context of the conceivable and the possible,

> our faculty of perception reveals to us what is actual. And there is a widely accepted explanation of why this is so: our perceptual mechanisms are sensitive to features of the actual world, which impinge on them causally to produce systematic patterns of stimulus and response. Likewise, it seems, our faculty of conception reveals to us what is possible. But here there is no widely accepted explanation of why and to what extent this is so. (Gendler and Hawthorne 2004, 3)

In reference to the omen texts, as pointed out above, ominous phenomena as entries in the lists do not carry observational weight, i.e., do not represent actual events. Even in the cases where some potential relation to physical reality exists, the omens in the lists are not observations. They are hypothetical statements representing a conditional belief that Q if P. Gendler and Hawthorne's indication that we are not on firm, or at least established, ground when it comes to accounting for the relation between the conceivable and the possible raises interesting questions that pertain to the ominous signs included in the cuneiform lists. Some ominous phenomena seem to have no actual properties in the world, yet in terms of their function as signs, and the fact that all ominous signs are correlated with consequents, it would seem that such actuality was at stake.

How certain an Assyro-Babylonian diviner would have been that Q would occur on the condition that P is a judgment we might make on the basis of our knowledge of the practice of scholarly divination. Rituals to ward off the consequences of observed signs were ordered with enough regularity in the correspondence to the Neo-Assyrian kings that we can surmise a high degree of belief in Q given P. But provided we refer

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only to the omen statements in the lists, any consideration of the empirical is irrelevant for an analysis of how P and Q are related. The modality of the statements P and Q that make up each omen allows us, for the sake of an analysis of the internal logic of the omen statements, to treat the antecedent and consequent of an omen statement as the conjunction of two propositions. The statements P and Q can be said to function like propositions in the sense that they do not represent actual empirically established events, but rather something more like beliefs or some other "propositional attitude."

The epistemic character, particularly of the signs themselves, is further complicated for us because some of them are imaginative constructions. On the criterion of empirical veridicality, therefore, such constructed or imagined phenomena are "impossible." If the omen lists constitute a body of knowledge, we ask ourselves, what would it mean to "know" such phenomena? Despite the fact that the omens as listed in the texts are not tied to observations, the signs by and large refer to phenomena with real properties. Occasionally, however, due to the completion of paradigmatic substitutions, such as the three watches, the four directions, or the five colors, some signs do not refer, but stand in the text as "mere" constructions. Examples of such "impossible" phenomena are the appearance of the sun at midnight or the lunar eclipse shadow that travels from west to east across the lunar disk. From our point of view, the criterion of empirical veridicality would have ruled out the inclusion of these phenomena. But they are included because they fulfill paradigmatic schemes and belong to the structure and logic of the omen lists. This presents a puzzle to our way of thinking because if we know that P cannot occur we wonder what purpose statements beginning "If P . . . " serve. If we know, for example, that Venus can never be seen at the zenith, a statement beginning "If Venus is seen at the zenith" seems pointless and wrong.

It may seem facile, but for purposes of analysis it might be more useful to speak of possibility rather than impossibility. To say certain phenomena in the omen lists are "impossible" or "absurd" because they do not occur and cannot be observed is our judgment and occurs nowhere in the ancient sources. That is to say, our definition of impossible (not in accordance with real properties) is not expressed in the texts. It seems more consistent with the overall makeup of the omen lists that recording a phenomenon as an entry in a codified omen list is evidence that it was regarded as epistemically possible. That is, the list of statements (P) constitute data, or knowledge, on the basis of which the diviner makes judgments and draws conclusions about what will happen. The use of the terms possible and impossible are, among other things, relative to one's accepted knowledge of how and what things are. Gendler and Hawthorne put it this way: "One might offer a *permissive* account of epistemic possibility, according to which P is epistemically possible for S just in case S does not know that not-P, or in a *strict* account, according to which P is epistemically possible for S just in case P is consistent (metaphysically compossible) with all that S knows" (Gendler and Hawthorne 2004, 3). There are as well intermediate definitions between the permissive and the strict accounts, where, for example, "P is epistemically possible for S just in case S's evidence does not warrant S's believing not-P; or P is epistemically

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possible for S just in case S could not reasonably be expected to ascertain not-P on the basis of what S knows" (ibid., 3 n. 4). This approach opens up the field for discussion of the epistemic character of the non-occurring phenomena that appear in the omen lists.

Taking the permissive account first, we might conclude that phenomena such as Venus appearing in the zenith or the sun appearing at midnight are conceived of within the omen list as possibilities because the scribes did not know that such phenomena cannot occur. The elaboration of the antecedents in the omen lists by means of paradigmatic substitutions, such as the three watches, the four directions, or the regions of the sky, produces such possibilities, extending known phenomena to possible phenomena. The paradigm then serves as a guide for the conception of possibilities. An Old Babylonian text (BM 97210) has the following lines:

> ^{d}*Utu ina bararti* IGI.DU$_8$ *šahluqti maš nīši* "If the sun appears in the evening watch: destruction of the herds of the people."
> ^{d}*Utu ina qablīti* IGI.DU$_8$ *bartum ana šarri* "If the sun appears in the middle watch: revolt against the king."
> ^{d}*Utu ina šaturri* IGI.DU$_8$ *ina ali šuātu šarru šanumma ibašši* "If the sun appears in the morning watch: in that city there will be another king."

Another example of possibilities conceived in omen texts that have no physical properties are the eclipses that occur on days of the month when eclipses are not possible. The pressure of the paradigm produces lists of eclipse omens on days when they will never occur. The Babylonians' perspicacity in matters of periodicity is attested in the early ability to predict eclipses (Steele 2000) and so we hesitate to say that the scribes were unaware of the impossibility of a solar eclipse, say, on the tenth day of the month, or a lunar eclipse on the twentieth. In fact, the high degree of the scribes' understanding of the behavior of phenomena suggests that such phenomena as had never been observed were included not because they were thought to be usual or likely occurrences, but because they stood at the extreme negative end of possibility, that is to say the extremely unlikely. How such phenomena were thought to "fit into" a (metaphysical) conception of the world is interesting to contemplate. Perhaps, as Stephen Yablo pointed out, there is a meaningful difference between conceptual and metaphysical possibility.[8]

On the strict account, P is epistemically possible for someone if it is consistent with everything that person knows. In such cases, epistemic possibility then corresponds to metaphysical compossibility. If there were such a metaphysics in ancient Mesopotamia that permitted the compossibility of all sorts of non-occurring phenomena, the divination corpus in effect constitutes one. There are in fact other texts to support

[8] Where he distinguishes counterfactual worlds that are metaphysically possible from *counteractual* worlds that are conceptually possible, see Stephen Yablo, "Coulda, Woulda, Shoulda," in Gendler- Hawthorne 2004, 445 and 448.

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the idea that the Babylonian scribes held a metaphysics allowing for the possibility of all sorts of freak occurrences. These are the texts that deal in obvious prodigies, phenomena that transgress rules of order either in "nature" or society (Guinan 2002). But perhaps this is where we step into the realm of the conceivable, or the conceptually possible, as differentiated from the possible, or at least the metaphysically possible. However, it is clear from the texts that refer to prodigious events such as a bearded woman being seen in the city or stars falling from the sky, that the same logic applies to prodigies as to omens constructed from regularly occurring events. The ominous nature of an event did not seem to correlate with its degree of regularity, conceptual or metaphysical possibility, though the severity of their consequents perhaps did. The prodigies discussed by Guinan all presaged the extremely grievous condition of the fall of the state.

The conception of possibility and impossibility, in addition to being relative to the things one knows through observation and experience, is also relative to one's understanding of the reasons for the variation in the things observed, e.g., why it is that certain celestial bodies appear at the horizon but not on the zenith, or why a lunar eclipse occurs at the middle not the beginning of a month. Only when one has such understanding of the reasons for a particular range in variation of certain phenomena can one begin to speak of possible versus impossible phenomena. On the face of it, however, the omen texts can be read in terms of a position that does not rule out certain variations whose particular character is grounded in the paradigms. What is taken into account, therefore, is not actual properties of the phenomenon, but rather paradigmatic "possibilities" (conceptual possibilities). The paradigms do not permit just any phenomenon, but only those whose variations belong within the fairly tightly reasoned parameters of each paradigm (right-left, four directions, three watches, etc.). The "possibilities" are not limitless. They are only possible on the basis of the assumptions given in the paradigmatic structure of the list. All phenomena given as antecedents in omen texts are epistemically possible by virtue of being consistent with the structural rules of the list. By this reasoning, we err in classifying as "impossible" phenomena in the omen texts that do not conflict with but rather satisfy and effect paradigmatic structure and for which some causality or justification must apply at some level.

In describing the convention for introducing omens with the sign DIŠ, a comparison was previously made to the Sumerian lexical lists. But there is further relation to lexical lists that should be made explicit here. Niek Veldhuis explained in reference to the archaic lexical lists from Uruk, that "it has often been observed that these archaic lists contain much that seems utterly irrelevant and that may not be explained by the purely utilitarian reason of teaching a new generation of scribes how to compose an administrative record" (Veldhuis <http://cuneiform.ucla.edu/dcclt/intro/lexical_intro.html>). He notes that very few of the professions in the list Lu A ever appear in contemporary administrative texts. He has challenged the notion that the lexical lists reflect some ordering cosmological sensibility, the old idea that somehow the Sumerians were cognitively disposed to order the world through list-making. The

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lists clearly provide more than what is needed if we are to use actual administrative records as a guide. In response Veldhuis says, "the direct relevance of the lists for the practice of writing is, indeed, low because these are manuals that cover every possibility, including the unlikely and the very unlikely ones. The archaic lists betray the problem of creating a new bureaucratic system that is capable of recording every transaction that is possible or even imaginable within the bureaucratic context. Therefore, the scribes who created these lists went out of their way to invent signs for birds and fish and professional titles that some future scribe once upon a time might need to write down" (ibid.). The idea of inventing items for a list because at some time there would be a need for such an item suggests the very opposite of a conception of "impossible" phenomena. Indeed, the phenomena or items in the list seem to have been thought of not only as conceivable but possible. They are epistemically possible not because they are consistent with actual physical properties in the world (our epistemological category) but because they are consistent with the conceptual rules of the list (their epistemological category).

In the context of physical science, in which physical laws allow or disallow certain phenomena to occur, to posit a non-occurring or "impossible" phenomenon seems to indicate a lack of knowledge of the laws involved. The eclipse omen in which the shadow makes its transit from right to left (or west to east) could be taken to demonstrate such a lack of understanding. That is, a failure to know that such a thing cannot occur. The character of omen lists, however, shows the importance of a different kind of knowledge. The paradigmatic treatment of the ominous phenomena creates room for expansions into the realm not of the empirical but the conceivable. The conceivable (or conceptually possible) does not always map neatly onto the actual, and the meaning of "possible" does not necessarily refer solely to physical actuality.

Earlier the question was raised what purpose statements beginning "If P . . . " serve if we know that P cannot occur. It may seem as though the impossibility of P renders the entire omen statement senseless, but a closer consideration of the logical structure of indicative conditionals puts the ancient omen statements containing conceptually, if not metaphysically, possible phenomena in a different light.

Truth-functionality of Conditionals in Babylonian Omens

As discussed in a previous section, the validity of inferences such as are allowed by conditional statements is syntactic not semantic: That the antecedent P proves not to occur (= is false), as in the sun appearing at midnight, is not damaging to the validity of the statement "if P, Q" to which it belongs. Inferential reasoning is one of the fundamental ways in which we describe a method for knowledge. But an inference makes no promise as to truth or falsity, correctness or incorrectness. It must only follow from a pre-existing statement or premise, but true premises are a necessary element in valid inferential reasoning. Other ingredients are sometimes thought to be

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necessary for valid inferences to be made, for example, a causal relationship between the evidence and the conclusion or hypothesis drawn from it, such as my conclusion from the evidence of the darkened face of the moon that the earth's shadow has crossed it, or that the moon has approached very near to the ecliptic and is at opposition to the sun which is also very near a node. I could also conclude or hypothesize on seeing the darkened moon that the evil *Sibitti* (seven demons) were whirling 'round him in heaven. Any of these relationships could be defined as causal. Alternatively, I could see the darkened face of the moon and decide that the king was in danger because I believed a temporal connection applied between lunar eclipses and bad luck for kings. Or thirdly, I could determine that lunar eclipses signified a range of events because a traditional code existed for making such interpretations of the sign "lunar eclipse," and any such interpretation or conclusion had an inferential relationship to the evidence, that is, the sign.

From a logical standpoint, the truth-functionality of such conditionals entails that the statement "If P then Q" is independent of all such relations just mentioned, i.e., temporal, causal, empirical, or traditional. As Michael Woods has said, "One thing that gives rise to doubts about the truth-functionality of conditional statements is that it seems so easy to construct sentences which have no natural use but which would have to be counted as expressing truths if conditionals are understood truth-functionally" (Woods 1997, 3). We (mistakenly) see the omens as presenting nonsensical relationships between antecedent and consequent because of their counter-intuitive yet truth-functionally legitimate nature as conditionals. Woods cited as an example of a bizarre conditional "If Rome is the capital of Greece, there are no snakes in Ireland" (ibid.). Yet, from a truth-functional point of view, a Babylonian example, such as "If Jupiter leaps in the (constellation) Fish, there is no rain for a month" can serve just as well. Each example exhibits a bizarre juxtaposition, but, in terms of the truth-functionality of conditionals, such juxtapositions are as true as other statements that seem more intuitively "reasonable."

A conditional statement of the kind "If P then Q" (as material implication $P \rightarrow Q$) is simply true in every case but when P is true and Q is false.[9] From this it is clear that no matter the truth or falsity of the individual statements, antecedent or consequent, it is their relation that determines the truth or falsity of the conditional. If we are to consider as a criterion for truth whether a phenomenon can actually occur or not, it is clear that even such "false" phenomena can be enjoined in true conditionals, provided the consequent's truth-functional value is true. P can be "false" in some sense, such as

[9] Truth-functionality can be schematized as follows:

P	Q	$P \rightarrow Q$
T	T	T
T	F	F
F	T	T
F	F	T

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in the guise of a non-occurring phenomenon, and the statement "If P then Q" can still be true by virtue of conditional logic.

The seeming incompatibility of the possible and impossible phenomena can be reconciled by further formal analysis of the genre. As already briefly indicated, the organization of the omen tablets can be described in terms of the structures of paradigm and syntagm. On the syntagmatic level are the elements that come together to constitute the sign, such as [Jupiter] leaps in the middle of the Fish to the right and stands (Reiner-Pingree 2005, 43: rev. 2'). The syntagmatic relation of the elements of a given protasis is constructed by combination. But both antecedents (and consequents) are also structured on the vertical axis such that elements of the syntagm can be replaced forming a new combination of elements. On the vertical plane of the paradigm, new elements are introduced by substitution, as illustrated by the series of Jupiter omens cited above. The mechanisms by which paradigmatic structure is created in omen texts are not unique to the genre of omen texts, but can be seen in lexical texts, as in the following extract:

[amar] calf
amar [ga] milk calf
amar ga [nag(-a] calf that drinks milk
amar ga gu_7-[a] calf that "eats" milk
amar ga sub-a calf that suckles milk
amar sah_4 playful calf
amar lirum strong calf
amar ban_3-da wild calf
amar mu-3 three years old calf
amar mu-2 two years old calf
amar mu-1 one year old calf
amar babbar white calf
amar $kukku_5$ black calf
amar su_4-a red calf
amar sig_7-sig_7 yellow calf
amar gun_3-a speckled calf (Old Babylonian Nippur Ura 3: 222–237, see Veldhuis <http://cdl.museum.upenn.edu.dcclt> for composite text, and note that this extract does not contain the initial DIŠ before each entry).

What the omen lists share in common with the lexical lists is an internal constructed nature and a certain resultant detachment of some of their content from external realia. These scholastic texts share a systematic and logical treatment of words and phenomena, and, seemingly, a point of view on what constitutes knowledge.

Conclusion

This essay has focused on formal considerations of Babylonian omen texts as a representative of one part of ancient Mesopotamian science. An attempt was made

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to put the predictive and empirical elements of the texts into a new frame of analysis. In the case of the former, the predictive element, it was suggested that prediction is not necessarily to be seen as inherent in the omens themselves. That the collections of omen statements were used for prognostication goes without saying, but this is a different claim from that which sees the consequents of the conditional omen statements as predictions. Instead, on a formal analysis, the omens appear to have a greater affinity with statements of material implication ($P \rightarrow Q$), and in fact, first-order logical statements of the form "P implies Q" are the equivalent of the conditional statement "If P then Q." Omens collected in the many tablets of the various divination series represent artificially constructed statements, products of the scholastic traditions of the cuneiform scribes. As such they do not represent a collection of "things said," about which one might expect less rigorous relations to apply between antecedent and consequent. The present argument has offered material implication as a possible way to view the logic of the omen statements. It has been used as a heuristic, without laying claim to a Babylonian awareness of this logic. Neither has it been put forward that the omens constitute precursors to such exercises in logic, the *modus ponens* inference scheme being first consciously defined by Stoic philosophers of the fourth and third centuries B.C.

The empirical element of Babylonian divination can also be seen to have a subsidiary function. Obviously a significant part of the divinatory enterprise, observed phenomena are not, however, the exclusive purview of Babylonian omens. Far from being nonsensical or irrelevant to the enterprise of Babylonian divination, the unobserved, that is, the phenomena in the realm of the conceivable and the possible, are fully integrated within the system of the omens. The validity of the omen statements has been seen to be unaffected by the inclusion of unobserved or unobservable phenomena.

What implications are to be drawn from establishing in Babylonian omens the reflection of a mode of inferential reasoning as a function of their syntactic and logical structure as conditionals? Most significantly, it makes it no longer possible to explain on cognitive grounds why divination has had a troubled relationship to science, resting as it does on certain (metaphysical) assumptions about relations between phenomena in the world that do not depend upon the physical and causal connections we ourselves would make. It appears that such a difference in assumptions about the phenomenal world are unrelated to cognition, or more precisely, cognitive style, being a function rather of culture. The scientific, that is, logical and systematic, character of ancient Mesopotamian divination appears to be one important consequence of the use of the conditional as its form and mode of expression.

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