



On the Origin of Logical Determinism in Babylonia

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Abstract. In this paper, I show that the idea of logical determinism can be traced back from the Old Babylonian period at least. According to this idea, there are some signs (omens) which can explain the appearance of all events. These omens demonstrate the will of gods and their power realized through natural forces. As a result, each event either necessarily appears or necessarily disappears. This idea can be examined as the first version of eternalism – the philosophical belief that each temporal event (including past and future events) is actual. In divination lists in Akkadian presented as codes we can reconstruct Boolean matrices showing that the Babylonians used some logical-algebraic structures in their reasoning. The idea of logical contingency was introduced within a new mood of thinking presented by the Greek prose – historical as well as philosophical narrations. In the Jewish genre *'aggādōt*, the logical determinism is supposed to be in opposition to the Greek prose.

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1. Introduction: Where Did Logic First Appear?

The ancient Greek logic founded by Aristotle (384–322 B.C.) and Chrysippus (ca. 279–206 B.C.) is considered the first piece of symbolic logic in the world. Nevertheless, recently it was shown that the Talmudic hermeneutics (*middōt*, מִדּוֹת) has many samples of logical inference rules which have nothing similar to the Greek logic, but they are a good way of formal-logical reasoning that can be formalized even mathematically [1–9]. The Judaic hermeneutical (logical) tradition has its roots in the Babylonian legal culture [10–13]. This culture is much older than the ancient Greek logic.

In many fragments in Akkadian especially in trial records and business correspondence dated from the 24th century B.C. to the 6th century B.C., we observe a perfect logical competence of their authors. It is not trivial—in some texts we see really long consequences of correct logical conclusions by applying some logical inference rules step by step including *modus ponens*, see [11–13]. There are no other cultures in the ancient world of that time where something similar can be detected—only some later exceptions such as Aramaic legal texts since the 6th century B.C., Greek philosophical and legal texts since the 5th–4th centuries B.C., some Indian philosophical texts since the 2nd century A.D. and a few others. Furthermore, we can trace back how Greek legal documents containing perfect logical reasoning, also, were a continuation of legal tradition in Aramaic of the Achaemenid Empire and the latter tradition was a continuation of legal tradition of Neo-Babylonians with their origin from the Akkadian culture in turn, see [11–13].

Now that is the question whether a logical handbook can have been written in Akkadian. Here there is possible a great mistake of Westernization of ancient cultures of the Near East – our expectation to find out a Greek philosophical prose in Babylonia before Hellenism. Evidently, it is absolutely excluded. But it is not for the reason that philosophy or logic were not possible there. The true explanation is that in Mesopotamia some literary genres were excluded because of specific ways of thinking. For instance, the genre of historical prose and then of philosophical prose cannot have existed indeed. It is worth noting that this prosaic genre did not exist in the Rabbinic Judaism at the time of the Talmud as well and for the same reason – because of an especial way of Judaic thinking.

In this paper, I am going to compare the following three literary genres from the point of view of logical discourse: the historical prose in the meaning of Herodotus (Sect. 3), histories (Hebrew: *'aggādōt*) in Judaism (Sect. 4), and omens in different dialects of Akkadian (Sect. 5). I am planning to show that all the three genres assume different logical discourses. So, in the historical prose, the following presupposition is implicitly applied by its authors: there exist contingent events and any kind of logical determinism is excluded. In contrast, in the *'aggādōt*, there is supposed a logical determinism as such: each event can be described as an omen or a fulfillment of prophecy. And some events are collected as cautionary tales in these *'aggādōt*. The same idea of logical determinism is detected in the genre of omens in Akkadian. Some rudiments of this genre can be found even in the Bible and the Talmud. In this genre the long lists of divinations are compiled where each singular divination is formulated as the following conditional statement (implication): “if there is an omen p , then an event q appears”.

Thus, the history in the meaning of Herodotus (ca. 484–425 B.C.) was impossible for the early Rabbinical Judaism as well as for the Akkadian culture. The reason is that the existence of contingency was not accepted there. Therefore philosophy and logic cannot be expressed in the form of prosaic works. Hence, a logical handbook in Akkadian is possible, but it needs a new way of reconstructions – it should have been written within a genre unknown

still. In this paper, I show that the ideas of logical determinism (expressed out in Stoicism at first) have their true origin in Mesopotamia in fact. So, the perfect logical competence was not accidental there.

The logical tradition established in Mesopotamia was used for expressing a transparency, inevitability, and necessity of divine and royal power in the human society (logic for legal proceedings) and in the nature (logic of omens). This power was supposed to be eternal. Therefore each divine or royal decision was obligatory forever. Under these conditions, it was assumed that a logical determinism holds true, i.e. each statement about past, actual or future events is either necessarily true or necessarily false. This intuition from modal logic became the first version of *eternalism* – a philosophical belief that all existence in time is equally real.

So, in this paper, I am going to reconstruct modal logical and eternalistic ideas of Babylonians who were the first in introducing the logical determinism as a version of eternalism.

During the Hellenistic period, the following three genres expressing philosophical reflections on logical competence were created independently of each other: (i) ancient Greek philosophical treatises (prose) devoted to logical reasoning (e.g. written by Aristotle and Chrysippus) since the 4th century B.C.; (ii) collections of thematic dialogs in Hebrew or Aramaic taken from the Talmud or from other books such as *Bāraytā'* (בריייתא) since the 1st century B.C., in which some authoritative conversations concerned *middōt* – some logical rules of Judaic hermeneutics for drawing conclusions from the Torah; (iii) philosophical *sūtras* in Sanskrit¹ (collections of thematic aphorisms used to express a school doctrine) composed since the 2nd century A.D., belonging to different schools of Indian tradition (such as Yogācāra and Nyāya schools), and dedicated to *pramāṇa* – sources of correct knowledge. In this paper the emphasis is placed, first of all, on the emergence of ancient Greek prose as a new literary genre, which played an exceptional role in the development of historical and philosophical reflections in Europe.

The philosophical prose in Ancient Greece is one of the most significant manifestations of Greek prose as such. As we will see, philosophy and logic in Semitic cultures cannot have been expressed in the form of prosaic works. Therefore, in order to reconstruct the logical discourse in Akkadian, Aramaic, and Hebrew languages, it is necessary to take into account the circumstances that the prosaic genre in the meaning of Herodotus or Aristotle simply did not exist in the traditional Semitic cultures. But there was a genre of thematic dialogs, which was continued then by the Jerusalem and Babylonian Talmuds.

The aim of the paper is to show that the ideas of logical determinism were originated in Mesopotamia and then they were philosophically reflected in some treatises of the Early Stoa, whose philosophers were inspired by the Babylonian art of divination, as they themselves stated.

¹ Most probably, the first logical works in India have appeared in Gāndhārī – one of the Prakrits.

2. Modal Logical Preliminaries

Let us consider some basic notions of modal logic, which will be used for reconstructing modal logical intuitions in the ancient Greek historical prose (Sect. 3), in the Hebrew and Aramaic *'aggādōt* (Sect. 4), and in the Akkadian codes of omens (Sect. 5). The alphabet of propositional modal logic consists of the following signs:

- propositional letters (atoms): p_0, p_1, \dots ;
- propositional connectives: negation \neg (“not... ”), disjunction \vee (“... or ... ”), conjunction \wedge (“... and ... ”), implication \Rightarrow (“if... , then, ... ”), equivalence \Leftrightarrow (“... if and only if... ”);
- two modal operators: necessity \Box (“... is necessarily”) and possibility \Diamond (“... is possibly”).

A well-formed formula of modal logic is defined as follows:

- each propositional letter is a formula;
- if A is a formula, then $\neg A$ is a formula;
- if A and B are formulas, then $A \vee B, A \wedge B, A \Rightarrow B, A \Leftrightarrow B$ are formulas, as well;
- if A is a formula, then $\Box A$ is a formula, too;
- if A is a formula, then $\Diamond A$ is a formula, too.

Axioms of propositional modal logic are formed from the following statements:

- all propositional axioms such as the rule of excluded middle (*tertium non datur*) $A \vee \neg A$ or the rule of non-contradiction $\neg (A \wedge \neg A)$, etc.;
- all instances of some modal schemata such as $\Box(A \Rightarrow B) \Rightarrow (\Box A \Rightarrow \Box B)$.

The set of axioms is closed under the following two inference rules:

- *modus ponens*: from $A \Rightarrow B$ and A it follows that B ;
- *necessitation rule*: if A is an axiom, then $\Box A$ is an axiom, too.

As we see, the propositional modal logic is an extension of standard propositional logic by adding some modal schemata and the necessitation rule. The most important additional modal schemata are as follows, for more details see [14, 15]:

- (K) $\Box(A \Rightarrow B) \Rightarrow (\Box A \Rightarrow \Box B)$
- (D) $\Box A \Rightarrow \Diamond A$
- (T) $\Box A \Rightarrow A$
- (CD) $\Diamond A \Rightarrow \Box A$
- (=) $A \Rightarrow \Box A$

They are used in different modal logics for expressing either logical contingency or logical determinism – these systems are given in Table 1.

An appropriate semantics for a propositional modal logic is presented by a Kripke model $M = (X, a, R, V)$, where

- X is a set of indices;
- a is a distinguished index;
- R is a binary relation on the indices;

TABLE 1. Modal logics for logical contingency and logical determinism

<i>Modal logic Axioms</i>		
Basic modal logic	K	Propositional axioms together with (K)
Modal logic for expressing logical contingency	D	Propositional axioms together with (K) and (D)
	T	Propositional axioms together with (K) and (T)
Modal logic for expressing logical determinism	CD	Propositional axioms together with (K) and (CD)
	K=	Propositional axioms together with (K) and (=)

- V is a function assigning a valuation $V(x)$ to each index x and a truth-value $V(x)(A)$ to each index x and atom A .

The distinguished index a is to show an actual time. The relation R is to be said a possibility since a . Let us take x from X such that aRx . Then aRx shows a possibility since a at an index x .

A true valuation of formulas at an index x in a model M is defined as follows:

- (1) for atomic A , A is true at x in M Iff $V(x)(A) = T$, where T means truth;
- (2) $\neg A$ is true at x in M Iff A is not true at x in M ;
- (3) $A \vee B$ is true at x in M Iff A is true at x in M or B is true at x in M ;
- (4) $A \wedge B$ is true at x in M Iff A is true at x in M and B is true at x in M ;
- (5) $A \Rightarrow B$ is true at x in M Iff if A is true at x in M , then B is true at x in M ;
- (6) $A \Leftrightarrow B$ is true at x in M Iff A is true at x in M if and only if B is true at x in M ;
- (7) $\Box A$ is true at x in M Iff for all y with xRy , A is true at y in M ;
- (8) $\Diamond A$ is true at x in M Iff for some y with xRy , A is true at y in M .

A formula A is valid if A is true in all models, and A is satisfiable if A is true in some model.

Different modal logics are sound and complete in different Kripke models with different properties of the relation R , see Table 2.

Let us assume that R is serial and $\Box A$ holds true at a in M . It means that for all y with aRy , A is true at y in M , but the seriality of R gives some x such that aRx . Hence, it guarantees that (D) is true in all Kripke models with the serial R . Suppose now that R is reflexive and $\Box A$ holds true at a in

TABLE 2. Properties of R in different Kripke models

	<i>Modal logic Properties of R</i>	
Basic modal logic	K	R can be any relation
Modal logic for expressing logical contingency	D	R is serial: there exist y such that xRy
	T	R is reflexive: xRx
Modal logic for expressing logical determinism	CD	R is unique: $(zRx \wedge zRy) \Rightarrow x = y$
	K=	R is bisimilar: $xRy \Rightarrow x = y$

M . Then for all y with aRy , A is true at y in M , but due to the reflexivity of R we have aRa . From this it follows that (T) is true in all Kripke models with the reflexive R . We can check that if R is reflexive, then R is serial, but not vice versa. Then **T** contains all the theorems of **D**, but not vice versa.

Let R be unique and $\diamond A$ holds true at a in M . Then for some y with aRy , A is true at y in M , but the uniqueness of R shows that aRy for all y . So, (CD) is true in all Kripke models with the unique R . Let R be bisimilar and A holds true at a in M . Then from aRy we infer $a = y$, therefore A is true at y in M for all y . Thus, (=) is true in all Kripke models with the bisimilar R . Let us note that if R is bisimilar, then R is unique, but not vice versa. Then **K=** contains all the theorems of **CD**, but not vice versa.

3. History as Literary Genre in Ancient Greece for Expressing Contingency

For the first time, the historical narrative (prose) as a new literary genre had arisen during the early classical period in Ancient Greece. Hecataeus of Miletus (Ἑκαταῖς ὁ Μιλήσιος; ca. from 550 B.C to 476 B.C.) is regarded as a founder of this genre. He had written the following two works survived only in short fragments: the *Survey of the Earth* or *Periodos gēs* (Περίοδος γῆς) and the *Genealogies* (Γενεαλογίαι), also cited as the *History* (Ἱστορία) or *Hērōlogia* (Ἡρωολογία). The *Periodos gēs* had been divided into two sections: the first called the *Europe* (Εὐρώπη) and devoted to the geography and customs of the western part of the Achaemenid Empire and the second called the *Asia* (Ἀσία) and containing the data on the regions and the nations in the eastern part of the Achaemenid Empire. The book *Genealogies* was the first attempt to classify the mythical era genealogically.

The new genre was continued in the *Histories* (Ἱστορίαι) consisting of IX books, which were survived till now and were written in the Ionic dialect of classical Greek by Herodotus Halicarnassus (Ἡρόδοτος Ἀλικαρνασσεύς; ca. from 484 B.C. to 425 B.C.). Mainly, this work was devoted to the Greco-Persian

wars. Factually, the books of Herodotus became a sample of historical prose for all the succeeding generations. Some significant features of this literary genre are as follows: (i) a prosaic consideration of some important facts about different geographical locations with mentioning the practice and customs of their communities; (ii) a prosaic description of different events as results of human actions caused by a conflict of interests; (iii) a consideration of different opinions on the conflict of interest that was behind the event. Hence, in the historical prose established in Ancient Greece there were introduced two types of facts which should have been examined necessarily: (a) geographical facts including the general data on some regions and nations and (b) historical facts including a description of conflicts of interest causing appropriate events.

Let us consider a fragment VI, 137.1–VI, 137.4 of this narrative from the *Histories* to show features mentioned above. In this fragment [16], Herodotus described how Miltiades, son of Cimon (Μιλτιάδης; ca. 550–489 B.C.), took possession of Lemnos, the island in the northern part of the Aegean Sea, and then he ceded it to the Athenians. It is a historical fact. An appropriate conflict of interest consisted in that “the Pelasgians were driven out of Attica by the Athenians” (Πελασγοὶ ἐπέιτε ἐκ τῆς Ἀττικῆς ὑπὸ Ἀθηναίων ἐξεβλήθησαν) and “the Athenians gave to the Pelasgians Lemnos as a dwelling-place in reward for the wall that had once been built around the acropolis” (ἐπέιτε γὰρ ἰδεῖν τοὺς Ἀθηναίους τὴν χώραν, τὴν σφίσι αὐτοῖσι ὑπὸ τὸν Ὑμησὸν εὐοῦσαν ἔδοσαν Πελασγοῖσι οἰκῆσαι μισθὸν τοῦ τείχεος τοῦ περὶ τὴν ἀκρόπολιν κοτῆ ἐληλαμένου), see *Ibid.* Then the Athenians decided to take Lemnos back. There are two opinions about this conflict that “the act of the Athenians was just or unjust” (εἶτε ὧν δὴ δικάως εἶτε ἀδίκως), see *Ibid.* “Hecataeus the son of Hegesandrus declared in his history that the act was unjust” (Ἐκαταῖος μὲν ὁ Ἠγησάνδρου ἐφησε ἐν τοῖσι λόγοισι λέγων ἀδίκως), because Lemnos was in the possession of the Pelasgians at the time of war, see *Ibid.* Nevertheless, Herodotus declared that the Athenians themselves say that their reason for expelling the Pelasgians from the island was just and he considered their reason, see *Ibid.*

Aristotle (Ἀριστοτέλης; 384–322 B.C.) was one of the first philosophers who defined the features of the genre of historical prose. He emphasized in his *Poetics* (Ποιητικὴ) 1451b [17] that “the writings of Herodotus could be put into verse and yet would still be a kind of history” (εἶη γὰρ ἂν τὰ Ἡροδότου εἰς μέτρα τεθῆναι καὶ οὐδὲν ἤττον ἂν εἶη ἱστορία). Hence, a prosaic narration is not its main feature. But the real difference from poetry consists in that the author in the historical genre “tells us what happened” and the author in poetry “what might happen” (ἀλλὰ τούτῳ διαφέρει, τῷ τὸν μὲν τὰ γενόμενα λέγειν, τὸν δὲ οἷα ἂν γένοιτο), see *Ibid.* As a consequence, “poetry is something more philosophical and serious than history” (διὸ καὶ φιλοσοφώτερον καὶ σπουδαιότερον ποίησις ἱστορίας ἐστίν), because “poetry tends to give something general” (καθόλου), namely one plot with a continuous action, while “history gives particular opinions” (ἕκαστον λέγει) about many plots with many different actions, see *Ibid.* Aristotle explained this difference as follows. Poetry describes something general, because it assumes that “a certain type of

man will do or say either probably or necessarily” (ἔστιν δὲ καθόλου μὲν, τῷ ποίῳ τὰ ποῖα ἄττα συμβαίνει λέγειν ἢ πράττειν κατὰ τὸ εἰκὸς ἢ τὸ ἀναγκαῖον), i.e. there is only one plot, where all events are connected among themselves by chance (τὸ εἰκὸς) or by a causal relationship (τὸ ἀναγκαῖον), see *Ibid.*

In tragedies one plot should be around a man “who is not pre-eminently virtuous and just, and yet it is through no badness or villainy of his own that he falls into the fortune, but rather through some flaw in him, he being one of those who are in high station and good fortune, like Oedipus and Thyestes” (ὁ μῆτε ἀρετῆ διαφέρων καὶ δικαιοσύνη μῆτε διὰ κακίαν καὶ μοχθηρίαν μεταβάλλων εἰς τὴν δυστυχίαν ἀλλὰ δι’ ἀμαρτίαν τινά, τῶν ἐν μεγάλῃ δόξῃ ὄντων καὶ εὐτυχία, οἷον Οἰδίπους καὶ Θυέστης), *Poethics* 1453a9-1453a11 [17]. Thus, in tragedies the plot should be devoted to the passing of a common man from good fortune to misfortune (ἐξ εὐτυχίας εἰς δυστυχίαν). In histories we cannot have a general plot at all.

To sum up, according to Aristotle, the historical events cannot be collected within one plot. It means that for the historical events there are no connections by chance (τὸ εἰκὸς) or by a causal relationship (τὸ ἀναγκαῖον), see Aristotle’s *Poethics* 1451b. So, Aristotle treated historical events as something contingent. Let R show a possibility since a . Then, in accordance with Aristotle, for necessary events, R is serial: there exist y such that aRy , see Table 2; and for contingent events, R is not unique – it is false that $(zRx \wedge zRy) \Rightarrow x = y$.

A sea battle became a quite often mentioned historical event at the time of Aristotle. For instance, Thucydides (Θουκυδίδης; ca. from 460 B.C. to 400 B.C.), the Athenian historian and general, wrote the *Histories* (Ἱστορίαι) devoted to the Peloponnesian war, where we find out many descriptions of sea battles such as the following narration: “Meanwhile Leon and Diomedon with the Athenian fleet from Lesbos issuing from the OeLacedaenussae, the isles off Chios, and from their forts of Sidussa and Pteleum in the Erythraeid, and from Lesbos, carried on the war against the Chians from the ships, having on board heavy infantry from the rolls pressed to serve as marines” (καὶ Λέων καὶ Διομέδων ἔχοντες τὰς ἐκ Λέσβου Ἀθηναίων ναῦς, ἔκ τε Οἰνουσσῶν τῶν πρὸ Χίου νήσων καὶ ἐκ Σιδούσσης καὶ ἐκ Πτελεοῦ, ἃ ἐν τῇ Ἐρυθραίᾳ εἶχον τεῖχη, καὶ ἐκ τῆς Λέσβου ὀρμώμενοι τὸν πρὸς τοὺς Χίους πόλεμον ἀπὸ τῶν νεῶν ἐποιοῦντο· εἶχον δ’ ἐπιβάτας τῶν ὀπλιτῶν ἐκ καταλόγου ἀναγκαστούς), *Histories* VIII, 24.2 [18]. Also, sea battles are often mentioned even in comedies – e.g. in the *Frogs* (Βάτραχοι) written by Aristophanes (Ἀριστοφάνης; ca. from 446 B.C. to 386 B.C.): “If there were a sea battle, and then they had bottles of vinegar, they could squirt them in the eyes of enemies” (εἰ ναυμαχοῖεν καὶ ἔχοντες ὀξείδας ραίνουεν ἐς τὰ βλέφαρα τῶν ἐναντιῶν), *Frogs* 1440 (tr. by Matthew Dillon).

In the book *On Interpretation* (Περὶ ερμηνείας), Aristotle defined a modal logic for the first time – a formal logic with alethic modalities for any proposition p : possibility (“It is possible that p ”, formally: $\Diamond p$) and necessity (“It is necessary that p ”, formally: $\Box p$) – see the previous section. He considered some modal propositions as always true statements which are axioms

of the present-day's modal logic **T** in fact, see Tables 1, 2. In this system **T**, there are assumed contingent events – the events p which possibly appear and possibly disappear (“It is possible that p and it is possible that not p simultaneously”). And a sea battle is the Aristotelian classical example of such an event p : “A sea battle must either take place tomorrow or not, but it is not necessary that it should take place tomorrow, neither it is necessary that it should not take place, yet it is necessary that it either should or should not take place tomorrow” (Δὲ οἷον ἀνάγκη μὲν ἔσσεσθαι ναυμαχίαν αὔριον ἢ μὴ ἔσσεσθαι, οὐ μὲντοι γενέσθαι αὔριον ναυμαχίαν ἀναγκαῖον οὐδὲ μὴ γενέσθαι γενέσθαι μὲντοι ἢ μὴ γενέσθαι ἀναγκαῖον) Aristotle's *On Interpretation* IX, 19a. Hence, by Aristotle, we can state: “Either a sea battle appears tomorrow or it does not appear tomorrow” (either p or not p), because it is a logical law of excluded middle. But we cannot state modally: “Either it is necessary that a sea battle appears tomorrow or it is necessary that it does not appear tomorrow” (either $\Box p$ or $\Box \text{not } p$). The negation of the statement “either $\Box p$ or $\Box \text{not } p$ ” is represented by the statement “ $\Diamond p$ and $\Diamond \text{not } p$ ”. The statement “either $\Box p$ or $\Box \text{not } p$ ” tells us about a logical determinism that everything necessarily appears or necessarily disappears. Its negation “ $\Diamond p$ and $\Diamond \text{not } p$ ” tells us about a logical contingency that there exists something that possibly appears and possibly disappears. And historical events such as a sea battle belong to the class of this contingency (i.e. we have the negation that R is unique).

Thus, poetry is “more philosophical and serious than history” (διὸ καὶ φιλοσοφώτερον καὶ σπουδαιότερον ποίησις ἱστορίας ἐστίν), see Aristotle's *Poetics* 1451b, because history concerns contingent events such as sea battles and these events cannot be collected as one plot. In this way we can draw a conclusion that, according to Aristotle, history is a literary genre where some contingent events presenting the past of some people are examined. It means that the historical narrative could arise only due to the assumption that there exist contingent events which cannot be collected through a causal relationship, but they can be just mentioned and then described in detail.

The appearance of historical prose in Ancient Greece caused also the appearance of philosophical prose as an additional literary genre – it became a new genre of meta-narration where all possible kinds of narration including prose and poetry can be analyzed theoretically within the three disciplines: dialectics (our reasoning), physics (natural forces), and ethics (our customs and characters). While in history there are possible different opinions explaining conflicts of interest, in philosophy there are possible different opinions in meta-narration. So, these opinions can be collected, as well, and Diogenes Laërtius (Διογένης Λαέρτιος; ca. from 180 A.D. to 240 A.D.) wrote the *Lives and Opinions of Eminent Philosophers* (Βίοι καὶ γνώμαι τῶν ἐν φιλοσοφίᾳ εὐδοκμησάντων) where there are considered biographies and views of the most prominent Greek philosophers.

4. 'Aggādāh as Literary Genre in Judaism for Expressing Logical Determinism

At first glance, 'aggādāh (אגדה) including non-legalistic exegetical texts recorded in the Talmud and Midraš (hence, compiled over the period of late antiquity – from the 3rd to 5th centuries A.D.) and containing different histories (first of all, cautionary tales) can be treated as a historical prose, too, close to the historical narrative founded by Hecataeus of Miletus. To show some really significant differences from the Greek history, let us consider just one story taken from the 'Eyn Ya'aqov (עין יעקב) – a big compilation of different 'aggādōt (Hebrew: "histories") from the Talmud and Midraš edited and issued by Ya'aqov ben Šlomoh 'ibn Ḥabib (יעקב בן שלמה אבן חביב) (ca. from 1460 to 1516 A.D.), the rabbi born at Zamora, Spain.

This 'aggādīc story ('Eyn Ya'aqov, Gittin V, 5), we are going to explore, describes the destruction of the Second Temple – the most tragic historical event for the Jews just before their exile from Israel. But in this story there is neither an important geographical information nor a consideration of the conflict of interest causing the Judaic war against Rome – the things needed in the Greek history surely. Instead of that we read a tale about the following woman – "Martha, the daughter of Beithus, who came from one of the richest families in Jerusalem" (מרתא בת בייתוס עהירתא זירושלים), see *Ibid.* During the siege of Jerusalem by the Roman army, she was hungry and sent a messenger to buy a "fine flour" (סמידא). But it was sold out and he came back without the fine flour. Then she said to him to bring a "usual flour" (חירותא), but it was sold, too. After that she sent him to buy a "dark flour" (גושקרא), but it was sold, also. At the end, she asked him to bring a "barley flour" (קמחא), and again it happened that this was sold out. She put her shoes on and said she herself would try to find something to eat. Nevertheless, "while walking in the street dirt infected her foot and it caused her death" (אי משכחנא מידי למיכל איתיב לה פרתא בכרעה ומתה), see *Ibid.* It is the end of the story.

In this tale, there occur the following six events with Martha: (i) the fruitless attempt to buy the most expensive flour (סמידא) by the messenger for her; (ii) the unsuccessful attempt to buy the expensive, but quite cheaper flour (חירותא) for her; (iii) the failed attempt to buy the cheaper flour (גושקרא); (iv) at the end, the fruitless attempt to buy the cheapest flour (קמחא); (v) the decision of the lady to buy herself something to eat; (vi) the death of the lady because of the dirt on her foot. We observe a cascade of worsening events from the easy misfortune of (i) to the scariest misfortune of (vi). So, the plot of this story embodies the growth of misfortunes from the light to the worst.

According to the 'aggādāh ('Eyn Ya'aqov, Gittin V, 5), there were two eyewitnesses of the described misfortunes of the lady: Rabban Yoḥanan ben Zakk'ai (רבן יוחנן בן זכאי; the 1st century A.D.) and Rabbi Zadoq (רבי זדוק; the 1st century A.D.). Both of them defined this event as a clear omen for the prompt destruction of Jerusalem and the Second Temple. In the meanwhile, Rabban Yoḥanan ben Zakk'ai applied to her the following passage from the

Torah (*Deuteronomy* 28:56), see *Ibid*, to tell the inhabitants of Jerusalem about fulfilling a prophecy right now: “And she who is most tender and dainty among you, so tender and dainty that she would never venture to set a foot on the ground, shall begrudge the husband of her bosom, and her son and her daughter”. When Rabbi Zadoq saw how before the death Martha “took all the gold and silver and threw it in the streets, saying: “What do I need this for?”” (ניחא נפשה אפיקתא לכל דהבא וכספא שדיתיה בשוקא אמרה האי למאי), he applied the following passage from the Prophet (*Ezekiel* 7:19), see *Ibid*, to warn all the inhabitants of Jerusalem about the prompt destruction: “They shall throw their silver into the streets, and their gold shall be treated as something unclean. Their silver and gold shall not avail to save them in the day of the Lord’s wrath – to satisfy their hunger or to fill their stomachs. Because they made them stumble into guilt”.

To sum up, the story of Martha was examined by rabbis, on the one hand, as an omen for the demolition of the Second Temple and, on the other hand, as a fulfilment of the old prophecies.

It is worth noting that each misfortune from (i) to (v) was a personal omen (warning) for Martha to stop her actions. Nevertheless, she ignored these evident signs and continued to go to her own end. Why did she deserve the terrible end of (vi)? There is a good *'aggādic* explanation (*'Eyn Ya'aqov*, *Yevamot* VI, 1) for this historical fact, also: Yehošu'a ben Gamla (יהושע בן גמלא), the Jewish high priest in about 64–65 A.D., betrothed the widow Martha, the daughter of Boethus, and was appointed by the King as high priest, to whom a widow is always prohibited, he nevertheless married her (דף ס"א) מתני' מעשה ביהושע בן גמלא שקידש למרתא בת בייתוס ומינהו המלך להיות כהן גדול וכנסה וכו'). So, at the beginning she committed a great sin to become the wife of the high priest being a widow, then she ignored personal omens and, therefore, she deserved to become an omen for everybody in Jerusalem that the city is doomed.

Let us come up with a conclusion how far the *'aggādōt* (“histories”) in Judaism differ from the *ιστορίαι* (“histories”) in Ancient Greece. First of all, contingent events as such are impossible in the Judaic narrations (thinking) – each event can be examined as both an omen and fulfilling a prophecy simultaneously. As a consequence, any compilation of historical facts as contingent events cannot be accepted in Judaism at all. Contingent events exist only in the mind of unjust people. In reality, any event is an omen for us and a result of prophecy coming from some old sages. In other words, the relation R is always unique or bisimilar, see Table 2. In the meantime, the bisimilarity of R means that all events are actual: if aRy , then $a = y$. For each event a there are at least two witnesses (such as Rabban Yoḥanan ben Zakk'ai and Rabbi Zadoq) who can consider a as a result of past prophecy and as a new omen for a next prophecy. It is a kind of eternalism – all historical events are actual and connected among themselves by a unique or bisimilar R .

Notice that Flavius Josephus (Φλάβιος Ἰώσηπος; ca. 37–100 A.D.) wrote the *Antiquities of the Jews* (*Antiquitates Judaicae*; Ἰουδαϊκὴ ἀρχαιολογία) in the way of Greek chronics, but in general this way of history with many contingent events was pushed back by the rabbis. The sacral history of the Jewish

nation cannot be treated as a history written by Herodotus Halicarnassus and other Greek authors. For the same reason, the *Septuagint* (*Interpretatio Septuaginta Seniorum*; Ἡ μετάφρασις τῶν Ἑβδομήκοντα), the Greek translation of the Hebrew Bible in the 3rd century B.C., was considered by the rabbis as a profanation of the sacral *'aggādōt* and their wrong interpretations. So, the tenth day of the Hebrew month of Ṭevet (ῥבז) is celebrated as a fasting day marking the beginning of the siege of Jerusalem by Nebuchadnezzar II of Babylonia (^dNabû-kudurri-uṣur; נְבוּכַדְרֶצְצַדְרִי־וֹשֻׁר, ca. from 605 B.C. to 562 B.C.). And the same day of the Jewish calendar marks the completion of the *Septuagint* to show that the idea of this translation was wrong from its beginning.

Thus, a history in the meaning of Herodotus was impossible in Judaism. The *'aggādōt* cannot become the *ἱστορία* forever. The Judaic thinking categorically avoids the intuition of the modal logic **T** which assumes the existence of contingent events p such that “ $\diamond p$ and $\diamond \text{not } p$ ”. The story of Martha as a tale about the destruction of the Second Temple demonstrates that in Judaism the intuition of logical determinism is widely accepted – each event p is logically determined to be an omen or a prophecy fulfillment: “either $\Box p$ or $\Box \text{not } p$ ”, which is an axiom of logics **CD** and **K=**, see Tables 1, 2.

5. Omens as Literary Genre in Akkadian for Expressing Logical Determinism and the Religious Roots of Stoic Modal Logic

As we know, Aristotle in his *On Interpretation* (Περὶ ἐρμηνείας) introduced some modal statements as axioms which correspond to the present-day logic **T**. In this logic there are possible contingent events p such that “ $\diamond p$ and $\diamond \text{not } p$ ”. The intuition of this logic was shared by a lot of Greek philosophers with one exception – the Stoics who supported the idea of logical determinism and completely avoided any contingency. This intuition of the Stoics was fulfilled recently in the modal logic **K=** where there is logical determinism and contingent events are impossible in principle, see [15].

According to the Stoics, “nothing happens without a cause” (*nihil enim fieri sine causa potest*), see the *On Divination* (*De Divinatione*) II, 61 written by Marcus Tullius Cicero (106–43 B.C.). As a result, each individual proposition (ἄξιόματα) p (even about future) is necessarily true or it is necessarily false: “either $\Box p$ or $\Box \text{not } p$ ”. For example, a sea battle tomorrow appears necessarily or it does not appear necessarily. Hence, the world is subordinated by necessity (ἀνάγκη) and fate (εἰμαρμένη). That divine force is called also by them destiny (πεπρωμένη), pneuma (πνεῦμα), cause (αἰτία), reason (λόγος), Zeus, will (βούλησις) of Zeus. Due to the fate, each event has its cause and then it is fully determined.

Let us assume that p is a cause for q . Then p determines q : “if p , then q ”, and p explains q : “ q because of p ”. On the other hand, q can be regarded as a sign for p : “if there is a sign q , then an event p takes place”. Some examples of reasoning based on signs which are provided by the Stoics: “If this one has milk in her breasts, she is pregnant”, “If sweat flows through the surface, then there are imperceptible pores”, “If this one has a scar, he has had a wound”,

see the *Outlines of Pyrrhonism* (Πυρρόωνειοι ὑποτυπώσεις) II, 106 and the *Against the Grammarians* (*Adversus Mathematicos*) VIII, 252; VIII, 254-255 written by Sextus Empiricus (Σέξτος Ἐμπειρικός; ca. 160–210 A.D.).

In accordance with the Stoics, implications (conditional statements) by appealing to signs such as “if there is a sign q , then an event p takes place” are used in divinations: “if there is an omen q , then an event p occurs”. So, according to the Stoics, omens are not causes of events, but they are their signs, while events might be real causes of omens sometimes.

So, for the Stoics, any proposition is either necessarily true or necessarily false only because an event described by an appropriate proposition always has a natural cause. This claim is used for proving the existence of fate by *modus tollens*:

Si est motus sine causa, non omnis enuntiatio, quod ἀξίωμα dialectici appellant, aut vera aut falsa erit; causas enim efficientis quod non habebit, id nec verum nec falsum erit; omnis autem enuntiatio aut vera aut falsa est; motus ergo sine causa nullus est. Quod si ita est, omnia, quae fiunt, causis fiunt antegressis; id si ita est, fato omnia fiunt; efficitur igitur fato fieri, quaecumque fiant (Cicero, *De Fato* X, 20–21).

If uncaused motion exists, it will not be the case that every proposition (termed by the logicians an *axioma*) is either true or false, for a thing not possessing efficient causes will be neither true nor false; but every proposition is either true or false; therefore uncaused motion does not exist. Precedent causes for all things means fate and causal determinism. It is better to give up the truth/falsity of propositions. If this is so, all things that take place take place by precedent causes; if this is so, all take place by fate; it therefore follows that all things that take place take place by fate (tr. by H. Rackham).

In the formal notation: If p (“uncaused motion”), then not q (“not the case that every proposition is either true or false”); q ; thus, not p . Then there is fate. And according to fate, each actual event occurs necessarily:

Quia futura vera, inquit, non possunt esse ea, quae causas, cur futura sint, non habent; habeant igitur causas necesse est ea, quae vera sunt; ita, cum evenerint, fato evenerint (Cicero, *De Fato* XI, 26).

The reason is, says he, that future things that have not got causes of *why* they will be in the future cannot be true; therefore those that are true must necessarily have causes; accordingly when they have occurred they will have occurred by fate (tr. by H. Rackham).

Even the gods have no foreknowledge of events without knowing sufficient causes:

Ita ne praeterita quidem ea, quorum nulla signa tamquam vestigia extarent, Apollini nota esse censebat; quo minus futura! causis enim efficientibus quamque rem cognitis posse denique sciri, quid futurum esset. Ergo nec de Oedipode potuisse Apollinem praedicere nullis in rerum natura causis praepositis, cur ab eo patrem interfici necesse esset, nec quicquam eius modi (Cicero, *De Fato* XIV, 32–33).

Therefore Carneades held the view that Apollo had no knowledge even of these past events which had left behind them no trace of their passage – how much less had he knowledge of future events, for only by knowing the efficient causes of all things was it possible to know the future; therefore it was impossible for Apollo to foretell the fate of Oedipus when there were no causes fore-ordained in the nature of things making it necessary for him to murder his father, nor could he foretell anything of the sort (tr. by H. Rackham).

The Stoics, including his father, Zeno of Citium (Ζήνων ὁ Κιτιεύς; ca. 334 – 262 B.C.) who founded the Stoic teaching on divinations, and his prominent pupil, Cleanthes (Κλεάνθης; ca. 330–230 B.C.) who described this teaching in detail, all them defended nearly every sort of divination (*sed cum Stoici omnia fere illa defenderent, quod et Zeno in suis commentariis quasi semina quaedam sparsisset et ea Cleanthes paulo uberiora fecisset, accessit acerrimo vir ingenio*), see Cicero's *De Divinatione* I, 6. After that Chrysippus “discussed the whole theory of divination in two books” (*Chrysippus, qui totam de divinatione duobus libris explicavit sententiam*), and “wrote one book on oracles and another on dreams” (*uno praeterea de oraculis, uno de somniis*), see *Ibid.* Other Stoics published many books on similar subject too, such as Diogenes of Babylon (Διογένης Βαβυλώνιος; ca. 230–150 B.C.) and Posidonius (Ποσειδώνιος; ca. 135–51 B.C.), the friend of Cicero, see *Ibid.* The Stoics supported as well the astrology developed by the Chaldeans as an especial art of divination:

Principio Assyrii, ut ab ultimis auctoritatem repetam, propter planitiam magnitudinemque regionum quas incolebant, cum caelum ex omni parte patens atque apertum intuerentur, traiectiones motusque stellarum observaverunt, quibus notati, quid cuique significaretur memoriae prodiderunt. Qua in natione Chaldaei, non ex artis sed ex gentis vocabulo nominati, diuturna observatione siderum scientiam putantur effecisse, ut praedici posset, quid cuique eventurum et quo quisque fato natus esset (Cicero, *De Divinatione* I, 2).

First of all – to seek authority from the most distant sources – the Assyrians, on account of the vast plains inhabited by them, and because of the open and unobstructed view of the heavens presented to them on every side, took observations of the paths and movements of the stars, and, having made note of them, transmitted to posterity what significance they had for each person. And in that same nation the Chaldeans – a name which they derived

not from their art but their race – have, it is thought, by means of long-continued observation of the constellations, perfected a science which enables them to foretell what any man's lot will be and for what fate he was born [19].

The special perspective of the Stoics on logical determinism and their support of all sorts of divination can be explained by some Semitic roots of many Stoic philosophers – e.g. their founder, Zeno, was a Phoenician. In the meanwhile, the Stoics had strongly negative attitudes towards *ιστορίαι* (“histories”) in the meaning of Herodotus, because they did not accept the existence of contingency.

In Semitic cultures of the Achaemenid Empire rooted mainly from the Akkadian one, a divination was usually formulated by means of the following implications: “if [Akkadian: *šumma*] we observe an omen p , an event q should take place”. This implication tells us about “[divine] decision” or “verdict” (Akkadian: *purussû*) inferred by *modus ponens*:

Divination: “if p , then q ”;

Observer: “there is an omen p ”

Diviner: “there is a forecasting of q ”

The Stoic instance of *modus ponens* taken by them from an astrological divination made by the Chaldeans, see Cicero's *On Fate (De Fato)* VI, 12 is as follows: (i) The first premise: “If somebody was born at the rise of Sirius, he never dies at sea” (*si quis oriente Canicula natus est, in mari non morietur*). (ii) The second premise: “Fabius was born at the rise of Sirius” (*Fabius oriente Canicula natus est*). (iii) Then, according to the inference rule of *modus ponens*, we draw the following conclusion: “Fabius never dies at sea” (*Fabius in mari non morietur*).

We can assume that the Stoic propositional logic grounded on implications (conditional statements) and *modus ponens* is a kind of their philosophical reflexion on the tradition of Semitic divinations based on conditional statements with *modus ponens*, too. The point is that this kind of formulation for divinations (forecasting) is well traced back since the Old Babylonian period (i.e. since ca. 1800 B.C.): “if (*šumma*) [an omen] p , [then a prognosis] q ”. The same form of implication was used in formulating articles in the Mesopotamian law codes since the earliest ones at the time of Ur III: “if [someone committed] p , [then he or she shall be sentenced to] q ”. Then the court sentence is delivered by *modus ponens*: he or she committed p , then the decision of court is q .

In the Old Babylonian period divinations usually started with the lexeme BE-*ma* with the obvious reading *šum₄-ma* “if”. In the Neo-Assyrian period another lexem DIŠ was used, just to designate “item” or “entry”, although this form “ $p:q$ ” of divinations had the meaning of implication, too. Divinations formulated by the implications in Akkadian were composed in long lists where all logical combinations for different contexts of occurring p and q are analyzed.

These lists of omens were composed sometimes as codes, where all entities are introduced within a binary logic – each sign or event is examined as either

positive or negative. For instance, let us take the following four signs: ‘falcon’, ‘raven’, ‘on the right’, ‘on the left’. So, we obtain the four omens as 2^2 possible combinations of four signs: (i) ‘falcon’ \wedge ‘on the right’; (ii) ‘falcon’ \wedge ‘on the left’; (iii) ‘raven’ \wedge ‘on the right’; (iv) ‘raven’ \wedge ‘on the left’. Hence, the algorithm of composing omens is as follows. Let us take $2k$ signs of the first order, $2l$ signs of the second order, $2m$ signs of the third order, etc., where $k, l, m \geq 1$. The point is that there are considered only binary oppositions so that each sign has an opposition within a couple. Then we have $2^{(k+l+m+\dots)}$ of all possible combinations giving different antecedents of conditionals. As a consequence, taking the four signs, we deal with a code of four conditionals: (i) if ‘falcon’ \wedge ‘on the right’, then... ; (ii) if ‘falcon’ \wedge ‘on the left’, then... ; (iii) if ‘raven’ \wedge ‘on the right’, then... ; (iv) if ‘raven’ \wedge ‘on the left’, then... Taking $2k$ signs of the first order, $2l$ signs of the second order, $2m$ signs of the third order, etc., where $k, l, m \geq 1$, we always have $2^{(k+l+m+\dots)}$ conditionals for prediction.

In these omen codes any logical inconsistency is avoided. For instance, ‘falcon’ is a positive sign, but ‘raven’ is not; ‘on the right’ is a positive sign, but ‘on the left’ is not. Therefore the antecedents of codes give a Boolean matrix (truth table): (i) if ‘positive (falcon)’ \wedge ‘positive (on the right)’, then ... ; (ii) if ‘positive (falcon)’ \wedge ‘negative (on the left)’, then ... ; (iii) if ‘negative (raven)’ \wedge ‘positive (on the right)’, then ... ; (iv) if ‘negative (raven)’ \wedge ‘negative (on the left)’, then ... For $2k$ signs, we obtain 2^k antecedents in the form of Boolean matrix. In the consequents of conditionals, each opposite sign is contained in another conditional. So, for different oppositions at the place of antecedent we have different oppositions at the place of consequent. This type of composing conditionals can be named a *rule-based expert system* in the modern meaning. And any logical inconsistency (contradiction) is excluded there.

There are lists of divinations in Akkadian devoted to different subjects: from astrological to even quite ethical (e.g. omens about a city), see [20–27]. In this way, some Jewish commandments can be regarded as rudiments of some ethical divinations in Hebrew formulated by means of the conditional statements at first:

על שלש עברות נשים מתות בשעת לדתן, על שאינן זריירות בנדה ובסלה ובבדלוקת הנר

Women die in childbirth for the following three transgressions: Because [על] they are not careful with [obeying the laws] of menstruation; and because they are not careful [to separate some] batter [when baking to give to the priest]; and because they are not careful with the lighting of the [Sabbatical] lamp (*Mišnah Šabbat* II, 5).

In this passage, the breaking of the three Jewish commandments: “menstruation” (נִדָּה), “batter” (סִלְקָה), and “lighting the Sabbatical lamp” (הַדְּלִיקַת הַנֵּר), is represented as omens for a death of woman in her childbirth. Hence, usually the Akkadian divinations with an ethical dimension were expressed out in the form of implications: “If you perform something that is treated as a bad omen, then an evil event happens to you” and “If you perform something that

is treated as a good omen, then a favourable event happens to you”. Nevertheless, this formulation as conditionals was preserved in Judaism only as a rudiment in the Talmudic commentaries.

On the basis of analysis of different lists of divinations, presented as codes, we can formulate the following four general rules for composing omens [26, 27]:

- (a) The consequent of divination gives a positive forecasting (event) if and only if a singular omen in the antecedent is positive.
- (b) The consequent of divination gives a negative forecasting (event) if and only if a singular omen in the antecedent is negative.
- (c) Let us assume that there is more than one omen in the antecedent. The consequent of divination gives a negative forecasting (event) if and only if there are positive and negative omens in the antecedent simultaneously.
- (d) Let us assume that there is more than one omen in the antecedent. Then the consequent of divination gives a positive forecasting (event) if and only if all omens in the antecedent are positive or all omens in the antecedent are negative.

Let us exemplify these rules by some fragments in Akkadian to formalize them logically:

1. DIŠ NA *ana* Á.ÁŠ-šú ZI-*ma* ŠÚR.DÙ^{MUŠEN} TA 15 NA *ana* 2,30 NA *i-ti-iq* Á.ÁŠ-*su* KUR-*ad*
2. DIŠ KIMIN ŠÚR.DÙ^{MUŠEN} 15 NA *iz-ziz-ma ta- he-e* NA DU-*ak* NA.BI
KI DU-*ku* Á.TUG TUK-*ši*
3. DIŠ KIMIN Ú.NÁG.GA^{MUŠEN} *iz-zi-iz-ma* GÙB NA GÙ-*si* NA.BI KI
IGI.MEŠ-šú GAR-*nu* DU-*ma* HA.LA KÚ
6. DIŠ KIMIN KASKAL ZI-*ma* Ú.NÁG.GA^{MUŠEN} *ina* 15 NA GUB-*ma*
GÙ-*si* NA.BI KI IGI.MEŠ-šú GAR-*nu* NU DU-*ak* ŠÁ.BI NU DÙG.GA
24. DIŠ NA ŠE.NUMUN È-*ma* Ú.NÁG.GA^{MUŠEN} *ina* UGU-šú DU-*ma* *ina*
2,30 NA GÙ-*si* AB.SÍN GUN-*sà ut-tar*

1. If a man goes off on his errand and a falcon crosses from the right of the man to the left of the man – he will attain his desire.
2. If ditto a falcon stays on the right of the man and proceeds alongside the man – that man: wher(ever) he goes, he will have gain.
3. If ditto a raven stays and caws to the left of the man – that man: he will go where he decides and he will enjoy a profit.
6. If ditto goes on a journey and a raven proceeds to the right of the man and caws – that man: he won’t go where he decides and his heart won’t be satisfied.
24. If a man throws the seed and a raven goes upon it and caws to the left of the man – the furrow will increase its yield [26, pp. 92–94, 120]².

² In this fragment, we see a commutativity of conjunction – the omen “to the left/right” is located at different places in two verses: “[raven] stays and caws to the left of the man” (verse 3) and “raven proceeds to the right of the man and caws” (verse 6), but changing places does not change the meaning of conjunction. From other fragments in Akkadian,

Logical commentaries to these omens are as follows:

1. The omen “falcon” (f) is a positive sign as well as “crossing from the right of the man to the left of the man” (r) is positive as all other omens associated with the right side and moving from the right. Hence, in verse 1, there are two positive omens $f \wedge r$ in the antecedent, then, according to (d), it gives a favourable forecasting (p): $(f \wedge r) \Rightarrow p$.
2. The omen “falcon” (f) is positive, the omen “staying on the right of the man” (r) is positive, and the omen “proceeding alongside the man” (a) is positive. So, all the omens $f \wedge r \wedge a$ are positive simultaneously and, by (d), we obtain a favourable conclusion again (p): $(f \wedge r \wedge a) \Rightarrow p$.
3. The omen “raven” (the opposite to “falcon”: $\neg f$) is a negative sign, the omen “[raven] caws” ($\neg c$) is negative, too, the omen “to the left of the man” (the opposite to “right”: $\neg r$) is negative, also, to the same extent as all other omens connected to the left side. Thus, all the omens in the antecedent $\neg f \wedge \neg c \wedge \neg r$ are negative simultaneously. In accordance with (d), it gives a positive prediction (p): $(\neg f \wedge \neg c \wedge \neg r) \Rightarrow p$.
6. The omen “raven” ($\neg f$) is negative, the omen “[raven] caws” ($\neg c$) is negative, but the omen “proceeding to the right of the man” (r) is positive. We have a mix of negative and positive signs: $\neg f \wedge \neg c \wedge r$. It means that, according to (c), the prediction should be negative (the opposite to the positive forecasting: $\neg p$) and it is so: $(\neg f \wedge \neg c \wedge r) \Rightarrow \neg p$.
24. The omen “raven goes upon it” ($\neg f$) is negative, the omen “[raven] caws” ($\neg c$) is negative, the omen “to the left of the man” ($\neg r$) is negative. By (d), we obtain a positive prediction (p): $(\neg f \wedge \neg c \wedge \neg r) \Rightarrow p$.

Let $+1$ be a positive meaning of an appropriate omen and -1 be a negative meaning of omen. Let $[[p]]$ be a meaning of p that is either positive or negative. Then the example above can be presented as the following symbolic expressions:

1. $((+1 \wedge +1) \Rightarrow +1) = ((([f]) \wedge [[r]]) \Rightarrow [[p]])$.
2. $((+1 \wedge +1 \wedge +1) \Rightarrow +1) = ((([f]) \wedge [[r]] \wedge [[a]]) \Rightarrow [[p]])$.
3. $((-1 \wedge -1 \wedge -1) \Rightarrow +1) = ((([\neg f]) \wedge [[\neg c]] \wedge [[\neg r]]) \Rightarrow [[p]])$.
6. $((-1 \wedge -1 \wedge +1) \Rightarrow -1) = ((([\neg f]) \wedge [[\neg c]] \wedge [[r]]) \Rightarrow [[\neg p]])$.
24. $((-1 \wedge -1 \wedge -1) \Rightarrow +1) = ((([\neg f]) \wedge [[\neg c]] \wedge [[\neg r]]) \Rightarrow [[p]])$.

Now, we can reformulate rules (a), (b), (c), (d) symbolically:

- (a) $+1 \Rightarrow +1$.
- (b) $-1 \Rightarrow -1$.
- (c) $(-1 \wedge +1 \wedge \dots) \Rightarrow -1$.
- (d) $(+1 \wedge +1 \wedge \dots) \Rightarrow +1$, where there are only $+1$ in the antecedent;
 $(-1 \wedge -1 \wedge \dots) \Rightarrow +1$, where there are only -1 in the antecedent.

In this way we can reconstruct semantics for logical compositions of atomic propositions involved into predictions. So, we can check that in verses

we see that conjunction and disjunction were understood as commutative and associative operations and implication had the property of transitivity.

1, 2, 3, 6, 24, as well as in other Akkadian fragments, the following truth tables are implicitly used:

Truth table for \neg (negation):

[[omen/event]]	[[\neg omen/event]]
+1	-1
-1	+1

Truth table for \wedge (conjunction):

[[omen 1/event 1]]	[[omen 2/event 2]]	[[omen 1/event 1]] \wedge [[omen 2/event 2]]
+1	+1	+1
+1	-1	-1
-1	+1	-1
-1	-1	-1

Truth table for \Rightarrow (implication):

[[omen 1/event 1]]	[[omen 2/event 2]]	[[omen 1/event 1]] \Rightarrow [[omen 2/event 2]]
+1	+1	+1
+1	-1	-1
-1	+1	+1
-1	-1	+1

According to these truth tables, we have that in the considered example in Akkadian the divination list contains only propositional axioms (tautologies):

1. $((+1 \wedge +1) \Rightarrow +1) = +1$.
2. $((+1 \wedge +1 \wedge +1) \Rightarrow +1) = +1$.
3. $((-1 \wedge -1 \wedge -1) \Rightarrow +1) = +1$.
6. $((-1 \wedge -1 \wedge +1) \Rightarrow -1) = +1$.
24. $((-1 \wedge -1 \wedge -1) \Rightarrow +1) = +1$.

Furthermore, rules (a), (b), (c), (d) define how these axioms should be formulated:

- (a) $(+1 \Rightarrow +1) = +1$.
- (b) $(-1 \Rightarrow -1) = +1$.
- (c) $((-1 \wedge +1 \wedge \dots) \Rightarrow -1) = +1$.
- (d) $((+1 \wedge +1 \wedge \dots) \Rightarrow +1) = +1$;
 $((-1 \wedge -1 \wedge \dots) \Rightarrow +1) = +1$.

Let us consider another Akkadian fragment with an appropriate divination.

- 48'. DIŠ KA₅.A *ina* E₂ [NA TU]-*ub* E₂ BI ŠU KUR-*su* : ŠUB-*di*
 49'. DIŠ KA₅.A UR.GI₇ *it-ru-ud* TUR URU LAL-*ti* KI.LAM
 50'. DIŠ KA₅.A *ana* UR.GI₇ TE-*h* i ZAH₂ KUR BI
 51'. DIŠ KA₅.A *ana* UDU.NITA₂ TE-*h* i BIR-*a* h KUR BI
 52'. DIŠ KA₅.A *ina* KASKAL TA [ZAG LU₂] *ana* GUB₃LU₂ DIB-*iq* LU₂
 BI A₂.AŠ₂-*su* KUR-*ad*₂
 53'. DIŠ KA₅.A *ina* KASKAL TA GUB₃ LU₂ *ana* ZAG LU₂ DIB-*iq* LU₂
 BI A₂.AŠ₂-*su* NU KUR-*ad*₂
 54'. DIŠ KA₅.A *ana* IGI LU₂ *i-šur-ma* *ina* GIR₃.2-*šu*₂ SAḤAR.ḤI.A *is-lu*
 LU₂ BI *bu-ti-iq-ta*₅ IGI-*mar*
 55'. DIŠ KA₅.A *ana* ZAG LU₂ DIB NU KUR-*ad*₂ A₂.AŠ₂
 56'. DIŠ KA₅.A *ana* GUB₃ LU₂ DIB KUR-*ad*₂ A₂.AŠ₂
 57'. DIŠ LU₂ *ana* A₂.AŠ₂-*šu*₂ ZI-*ma* KA₅.A TA 15 LU₂ *ana* 150 LU₂
 DIB-*iq* LU₂ BI KI DU INIM *h*a-*di-e* TE-*šu*₂
 58'. DIŠ LU₂ *ana* A₂.AŠ₂-*šu*₂ ZI-*ma* KA₅.A TA 150 LU₂ *ana* 15 LU₂
 DIB-*iq* LU₂ BI I.BI₂.ZA IGI-*mar*
 59'. DIŠ LU₂ *ana* A₂.AŠ₂-*šu*₂ ZI-*ma* KA₅.A *ana* 15 LU₂ GU₃-*si-ma* ta-
*h*i-*e* LU₂ KAŠ₄-*um* NA BI KI ZI-*u*₂ *šal-ti i-ger-ru-šu*₂ NIG₂.SIG₅ IGI
 48'. If a fox en[ters a man's] house, the hand (of a god) will affect that house / it will be abandoned.
 49'. If a fox chases away a dog – diminution of the city; reduction of prices.
 50'. If a fox approaches a dog (sexually) – destruction of that land.
 51'. If a fox approaches a sheep (sexually) – dispersal of that land.
 52'. If a fox on the road crosses from [a man's right] to a man's left, that man will attain his wish.
 53'. If a fox on the road crosses from a man's left to a man's right, that man will not attain his wish.
 54'. If a fox circles around in front of a man (and) scratches up dirt with its feet, that man will see a flood.
 55'. If a fox crosses toward a man's right – no attainment of a wish.
 56'. If a fox crosses toward a man's left – attainment of a wish.
 57'. If a man is going about his business and a fox crosses from the man's right to the man's left, joyful news will come to that man wherever he goes.
 58'. If a man is going about his business and a fox crosses from the man's left to the man's right, that man will experience losses.
 59'. If a man is going about his business and a fox cries out on the man's right and runs toward the man, they will file suit against that man wherever he goes on his business, (but) he will experience good fortune [20, pp. 36–37].

Symbolically:

48'. "Fox entering a man's house" is negative, then it gives an unfavourable forecasting: $(-1 \Rightarrow -1) = +1$.

49'. "Fox chasing away a dog" is negative, therefore the conclusion is negative, too: $(-1 \Rightarrow -1) = +1$.

50'. "Fox approaching a dog" is negative, then the conclusion is negative: $(-1 \Rightarrow -1) = +1$.

51'. "Fox approaching a seep" is negative, then the prediction is negative: $(-1 \Rightarrow -1) = +1$.

52'. "Fox crossing from a man's right to a man's left" is positive, from which we infer a positive prediction: $(+1 \Rightarrow +1) = +1$.

53'. "Fox crossing from a man's left to a man's right" is negative, then we deduce a negative event: $(-1 \Rightarrow -1) = +1$.

54'. "Fox circling around in front of a man" is positive, but "fox scratching up dirt with its feet" is negative, that we summarize that the expected event should be negative: $((+1 \wedge -1) \Rightarrow -1) = +1$.

55'. "Fox crossing toward a man's right [from left]" is negative and the prediction is negative: $(-1 \Rightarrow -1) = +1$.

56'. "Fox crossing toward a man's left [from right]" is positive and the prediction is positive: $(+1 \Rightarrow +1) = +1$.

57'. "Fox crossing from the man's right to the man's left" is positive and the forecasting is positive: $(+1 \Rightarrow +1) = +1$.

58'. "Fox crossing from the man's left to the man's right" is negative and the conclusion is negative: $(-1 \Rightarrow -1) = +1$.

59'. "Fox crying out on the man's right" is positive and "fox running toward the man" is positive, then the prediction concerns "good fortune": $((+1 \wedge +1) \Rightarrow +1) = +1$.

Hence, in divination lists presented as codes, we observe an intuition of Boolean algebra $\langle \{-1, +1\}, \neg, \wedge, \Rightarrow \rangle$ and each singular prediction is composed as a tautology (always true expression, i.e. with the value +1) of this algebra. It shows that the Babylonians not only possessed the perfect logical competence, but also used some logical-algebraic constructions.

In Biblical verses we find out the same understanding of right and left hands as positive and negative omens respectively. The normal situation is that the Lord ("a wise man's heart") is at the right hand and Satan ("a fool's heart") at the left:

לב הקם לימינו ולב פסיל לשמאלו:

A wise man's heart is **at his right hand**; but a fool's heart **at his left** (*Ecclesiastes* 10:2).

הנה שמרך הנה צלך על-גד מינך:

The Lord is your Keeper. **The Lord** is your shade **on your right hand** (*Psalms* 121:5).

“Being before” and “being on the back” are two additional Biblical omens with the same treatment as in the Akkadian divinations – as positive and negative omens respectively. A natural place for good forces (angels and the Lord) is to be before us and a natural place for evil forces (Satan) is to be on the back of us:

שׁוֹיְתִי יְהִנֶּה לְנִגְדֵי תַמִּיד כִּי אִמְיִנִי בְּלִאֲמוֹט:

I have set **the Lord** always **before me**: because *he is at my right hand*, I shall not be moved (*Psalm 16:8*).

If Satan stands at the right hand of a man, it means that it is unnatural (e.g. it is a combination of positive and negative singular omens at once) and this presages a strongly unfavourable event for this man:

הַפְקֵד עָלָיו רָשָׁע וְשָׁטָן יַעֲמֵד עַל-יְמִינוֹ:

Set thou a wicked man over him: and let **Satan** stand **at his right hand** (*Psalm 109:6*).

Let us consider two predictions in one passage:

שָׁמְאָלוֹ תַחַת לְרֵאשִׁי וְיְמִינוֹ תַחֲבֹקֵנִי:

His **left hand** [is] **under** my head, and his **right hand** doth **embrace** me (*Song of Songs 2:6*).

In the first prediction (שָׁמְאָלוֹ תַחַת לְרֵאשִׁי) we have a combination of two negative omens which should give a favourable forecasting:

$$(((\text{[“his left hand”]}) \wedge [\text{[“under my head”]})]) \Rightarrow [[p]] = ((-1 \wedge -1) \Rightarrow +1) = +1.$$

In the second prediction (וְיְמִינוֹ תַחֲבֹקֵנִי) we have a combination of two positive omens which should give a favourable conclusion, also:

$$(((\text{[“his right hand”]}) \wedge [\text{[“embracing me”]})]) \Rightarrow [[p]] = ((+1 \wedge +1) \Rightarrow +1) = +1.$$

In the Rabbinical Judaism as well as in the much older Akkadian culture, we must be vigilant to omens which are scattered at all steps before us. Let us consider an example of this reflexion on omens, taken from the Talmud (*Šabbat 32a*). A rabbi must have crossed a river in a ferry in which a gentile sat. Rav (רב; ca. from 175 A.D. to 247 A.D.) said that he would not cross a river under this condition, because a judgment can be reckoned with the gentile, and Rav will be caught together with him when the gentile is punished indeed (רב לא עבר במברא דיתוב ביה עכו"ם אמר דילמא מיפקיד ליה דינא עליה ומתפיסנא בהדיה). Whereas, Šmu'el (שמואל; ca. from 165 A.D. to 254 A.D.) said that he would cross a river in a ferry with the gentile, because “Satan does not have dominion over two nations at once: he settles his accounts with people from each nationality separately” (שמואל לא עבר אלא במברא דאית ביה עכו"ם אמר שטנא בתרי אומי לא שליט), see *Ibid.* The reasoning of Šmu'el is especially interesting. He assumes that for each event (such as a punishment) there exists a separate omen and different nations cannot be judged by the same omens. It is a kind of logical determinism: nothing happens without its own omen.

According to the divination texts in Akkadian, to the same extent we should be able to read the “word” (Akkadian: *amatu*; Neo-Assyrian: *abutu*) as a message from gods:

^dSAG.ME.GAR *ina* EGIR 30 *i-ti-ti-zi an-ni-u pi-šir-š[ú]* / DIŠ
MUL.SAG.ME.GAR *ina* [EGIR ^d30] GUB-iz MÍ.KÚR *ina* KUR
[GÁL-ší] / LUGAL *be-lí* ^Γa^Γ-[*bu-tú*] *in-nu*-^Γa^Γ [*ší-i*]

Jupiter stood behind the moon; this is its interpretation: “If Jupiter stands [behind the Moon] – there will be hostility in the land.” Oh king, my lord, [this is] a **w[ord]** concerning us! [10, p. 283].

Thus, the Stoic philosophers are increasingly voicing their concern about the Semitic way of divinations formulated by means of conditional statements from which an appropriate forecasting is inferred by *modus ponens*. This thinking was rooted from the Akkadian art of divination through conditionals. Many rudiments of this thinking are contained in the Bible and the Talmud, as well. Therefore, the logical determinism, expressed well explicitly by the Stoics at first, has its origin in the Akkadian divinations in fact, where this determinism was represented as an intuition that each event has its own omen and, therefore, it can be explained completely by conditionals.

Indeed, according to the Babylonians, for each event q there is a suitable omen p such that $p \Rightarrow q$ is an always true proposition. In the Stoic words “nothing happens without a cause” (*nihil enim fieri sine causa potest*), see the *On Divination (De Divinatione)* II, 61. Therefore we can apply *modus ponens* to infer q from $p \Rightarrow q$. So, each actual event q is inferable from some axioms. Then we can apply the necessitation rule and infer $\Box q$. As we see, logical determinism and eternalism were first established in Babylonia in fact. Each actual event q is necessary.

As we know, conditional propositions for the Stoics express cause-and-effect or sign-and-prediction relations, for example ‘if it is day, then it is light’. In the lost *Introduction to Syllogisms*, Chrysippus proposed ‘five non-demonstrable arguments (modes)’ (inference rules) for inferring from causes/signs or effects/predictions:

- *Modus ponendo ponens*: “If it is day, then it is light; it is day now; hence it is light” (Sextus Empiricus, *Adversus Mathematicos* VIII, 224; *Adversus Logicos* II, 431; *Pyrrhoniae Hypotyposes* II, 157); if p , then q ; p ; then q .
- *Modus tollendo tollens*: “If it is day, then it is light; it is not light; hence it is not day” (Sextus Empiricus, *Adversus Mathematicos* VIII, 225; *Adversus Logicos* II, 433; *Pyrrhoniae Hypotyposes* II, 157); if p , then q ; not q ; then not p .
- *Modus ponendo tollens*: “It cannot take place that it is both day and night; it is day now; hence it is not night” (Sextus Empiricus, *Adversus Mathematicos* VIII, 225; *Pyrrhoniae Hypotyposes* II, 157); $\neg (p \wedge q)$; p ; then $\neg q$.

- *Modus tollendo ponens* I: “It is either light or dark; but it is light; hence it is not dark” (Sextus Empiricus, *Adversus Mathematicos* VIII, 225; *Pyrrhoniae Hypotyposes* II, 158); $p \vee q$; p ; \neg then q .
- *Modus tollendo ponens* II: “It is either light or dark; but it is not dark; hence it is light” (Sextus Empiricus, *Pyrrhoniae Hypotyposes* II, 158); $p \vee q$; $\neg q$; then p .

According to the Stoics, the implication possesses the property of transitivity: “When we have in a deduction combined premises of any conclusion, we potentially have in them as well this conclusion though it is not expressed explicitly” (Sextus Empiricus, *Adversus Mathematicos* VIII, 231).

By using the five non-demonstrable arguments enumerated above, it is possible to check whether our reasoning is logically correct. For instance, let us check the following conclusion:

If phenomena similarly are all being in an identical state, signs are phenomena, then signs similarly are all being in an identical state. Nevertheless, signs anyway are not similarly all being in an identical state. And phenomena similarly are all being in an identical state, therefore, signs are not phenomena (Sextus Empiricus, *Adversus Mathematicos* VIII, 234).

In the form of the Stoic way of formalization by using numerals: “If it is the first and the second, then it is the third [A.S.: the transitivity of implication]; it is not the third, but it is the first; therefore, it is not the second” (Sextus Empiricus, *Adversus Mathematicos* VIII, 235). Formally: $(p \wedge q) \Rightarrow r$; $\neg r \wedge p$; then $\neg q$. From here it is obvious that the given proof consists of the 2nd and 3rd modes, namely, first, $(p \wedge q) \Rightarrow r$; $\neg r$; then $\neg (p \wedge q)$; second, $\neg (p \wedge q)$; p ; then $\neg q$.

Each antecedent in proof trees is called a ‘sign’ by the Stoics: “A sign is a premise, being a basis in a correct conclusion from true to true, and it opens the conclusion and permanently it appears as a present sign for available” (Sextus Empiricus, *Adversus Mathematicos* VIII, 256). Therefore signs logically determine conclusions irrespective of the fact of whether implication takes place now, in the past or in the future. As we see, premises are treated by the Stoics as signs or omens.

So, in the Stoic logic there is no place for contingency, i.e. the statement “both it is possible to be and it is possible not to be” is always false. In the meanwhile, it means that debates have no meaning. Indeed, from two points of view only one is true, and any compromises therefore are eliminated – they are not possible logically:

Someone who said: “Never take decisions without having listened to both sides,” was objected to by Zeno by means of the following reasoning. Either the first put forward exhaustive arguments (then there is no need to listen to the second because the required is found out). Or he did not put them forward (he was not on call of court or, answering, was not intelligible, it is all the same). Hence, either he proved his correctness or did not prove. So, in any case there is no

need to listen to the second (Plutarch, *De Stoicorum repugnantiis* VIII, 1034e).

To sum up, the Stoic doctrine about destiny is, actually, a specific theory of modal logic in which modal operators “possible” and “necessary” satisfy the logic $\mathbf{K}=\mathbf{}$, see Tables 1, 2. But this approach was nothing more than a reflexive conceptualization of Babylonian logical teaching about divination.

6. Conclusion

In this paper, I have logically compared the three literary genres: the historical prose of Ancient Greece, the *'aggādōt* from the Talmud, and the omens in Akkadian. It was pointed out that the Greek historical prose was grounded on the idea of existence of contingent events. This idea is fully rejected in Judaism as well as in the Akkadian divinations. As a result, the phenomenon of historical prose in the meaning of Herodotus was excluded in these Semitic cultures – it was out of their ways of thinking. But instead, in the *'aggādōt* and Akkadian divinations we observe an intuition of logical determinism: everything can be explained by omens therefore everything appears necessarily or it disappears necessarily. This intuition was well expressed later in the Stoic philosophy: everything can be explained by causes or signs (omens). As a consequence, many correct forms of applying sophisticated logical inference rules in the texts in Akkadian are not accidental – this derives from the intuition of logical determinism intrinsic to some Semitic cultures rooted from the Akkadian one.

It is worth noting that the Stoic logical approach to conditionals causing their logical determinism is supported in the Indian logic, too – in the schools of Yogācāra and Nyāya, see [28].

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