



# **In Time: Astronomy and Calendars in the Ancient Near East**

**June 12 - June 15, 2018**

## **Speakers:**

**Dr. Uzi Avner** (The Dead Sea-Arava Science Center)

**Prof. Liz Brack-Bernsen** (Regensburg University)

**Mr. Mourtaza Chopra** (Student Hebrew University)

**Dr. Jeanette C. Fincke** (University of Leiden, NINO)

**Dr. Rita Gautschy** (University of Basel)

**Dr. Hisashi Hayakawa** (Kyoto University)

**Prof. Wayne Horowitz** (Hebrew University)

**Prof. Hermann Hunger** (University of Vienna)

**Prof. Teije deJong** (University of Amsterdam)

**Dr. Gennady Kurtik** (Institute for the History of Science and Technology of the RAS)

**Dr. Natalie N. May** (Hebrew University)

**Prof. Dr. Dr. Mathieu Ossendrijver** (Humboldt University)

**Dr. Eshbal Ratzon** (University of Haifa)

**Mr. Marvin Schreiber** (Humboldt University)

**Prof. John Steele** (Brown University)

**Dr. Zack Wainer** (Hebrew University)

**Dr. Rita Watson** (Hebrew University)

**Dr. Hezi Yitzhaq** (Ben Gurion)

## **Organizers:**

**Jeanette C. Fincke, Wayne Horowitz, John Steele, Rita Watson, Janet Safford**

## PROGRAM:

(Abstracts to follow)

### **Tuesday: June 12, 2018**

5:33 Sunrise

8:00 Registration, *Boker Tov* (Coffee and Tea)

8:30 Welcome to the Israeli Institute for Advanced Studies of the Hebrew University

9:00 Moonshines

9:45 **Wayne Horowitz:** The Astronomical Book of Enuma Elish, The Great Star List, The Livingstone Materials, and Other Random Thoughts

10:45-11:00 **Coffee and Tea**

11:00 **Hermann Hunger:** The Length of Day and Night and their Parts

12:00 **Zackary Wainer:** In the Name of Accuracy? The Logic of Intercalation Schemes in the Commentary Series Šumma Sîn in Tāmartišu

13:00-13:50 **Lunch**

14:00 **Rita Watson:** Time and Notation: Articulating a Concept

15:00 **Gennady Kurtik:** <sup>mul</sup>UZ<sub>3</sub>, <sup>mul</sup>dGula, and the Early History of Mesopotamian Constellations

16:00-16:25 **Coffee and Tea**

16:30 **Hisashi Hayakawa:** The Earliest Datable Records and Drawings of Auroral Candidates: A Crossroad of Mesopotamian Astral Science and Modern Geophysics

17:30 **John Steele:** The Development of Observational Practice in the Late Babylonian Period

18:30 Free Evening in Jerusalem: a bus will make stops at the Israel Museum and at the Machaneh Yehudah market

19:44 Sunset

**Wednesday: June 13, 2018**

- 5:33 Sunrise
- 8:00-8:30 Coffee and Tea
- 8:30 **Lis Brack-Bernsen:** Babylonian Astronomy/Astrology Investigated using Modern and Babylonian Mathematics
- 9:30 **Mathieu Ossendrijver:** Evidence for Elementary Steps in Egyptian Procedure Texts for Mercury; Systems A1 and A2
- 10:30-10:55 **Coffee and Tea**
- 11:00 **Teije de Jong:** The Observational Basis of Babylonian Planetary Theory: Passages of Normal Stars and Calendar Dates
- 12:00 **Mourtaza Chopra:** Etymology and Epistemology, The Case of the Babylonian Lunar Six
- 13:00-13:50 **Lunch**
- 14:00 **Jeanette C. Fincke:** BM 37373: Another Text Referring to *Ziqpu* Constelations
- 15:00 **Rita Gautschy:** Hemerologies and Their Consideration in Sargonid Times
- 16:00-16:25 **Coffee and Tea**
- 16:30 **Marvin Schreiber:** The Word “House” ( $\acute{E} = b\bar{i}tu$ ) as a term in the Babylonian Astral Sciences.
- 17:30 **Natalie N. May:** The Babylonian ‘Man in the Moon’ Again
- 19:30 Speakers Dinner
- 19:45 Sunset

**Thursday: June 14, 2018** (Sunrise 5:33)

5:33 Sunrise

9:00 Bus Departs from Givat Ram, Bet Belgia

10:00 Qumran (view from the Bus)

11:00 Arrive at Dead Sea, Free Time for Lunch, Swimming, Touring, Shopping  
(Dead Sea activities are at participants' own expenses)

13:00 Bus Departs from Dead Sea

14:30 Arrive at Mitzpe Ramon, Registration, Snacks, Check in to Rooms

16:00 Mizpe Ramon Geological Program

18:45 Dinner

19:46 Sunset

20:00 Evening Program

**Eshbal Ratson:** Adaptations of Mesopotamian Calendrical and Astronomical  
Knowledge in the Dead Sea Scrolls

**Hezi Yitzhaq:** “Sun, stand still over Gibeon; and Moon, in the valley of Aijalon”  
Annular solar eclipse on October 30, 1207 BCE ?

**Uzi Avner:** Celestial Symbolism of the Ibex in Rock Engravings

Astronomical Observations

Snacks and Shmooze

**Friday, June 15, 2018**

5:36 Sunrise

8:00 Breakfast

9:00 Depart for Ben Gurion Airport and then Return to Jerusalem

Sabbath Candle Lighting (Jerusalem) 19:06

## **Abstracts**

(In Alphabetical Order)

### **Dr. Uzi Avner:**

#### **Celestial Symbolism of the Ibex in Rock Engravings**

The desert area of the Negev, Sinai and southern Jordan contains many thousands of rock carvings, from various periods; most dominant is the male ibex, in these deserts and even far beyond. It often recurs with dogs or other predators, with archer, with snakes, with feet or sandals, with *orante* figures, celestial bodies and other motifs. The ibex is also dominant in other kinds of art in the ancient Near East and beyond.

The frequent occurrences of the ibex over the ages and on large geographical areas, indicate some symbolic role. Furthermore, its repeating association with several motifs suggests that it represented a young god. Since some ibexes are also depicted mirrored (one up, one upside down), or killed by dogs, predators and hunters, they may symbolize a young god that dies and is resurrects every year, such as Dumuzi, Ba'al, Adonis and probably Osiris. A possible identification of the ibex as a star constellation has been suggested by several scholars, based on the art of the 6th to 4th millennia BC, however, no cosmological text clearly demonstrates it.

By the 3rd millennium BC, the ibex lost its dominance in some parts of the Near East. In Mesopotamia and Iran it was replaced by the combating lions and bulls, another celestial drama. The desert peoples, however, maintained their adherence to the symbolism of the ibex until about 1000 years ago.

The celestial connection and interpretation of the ibex's role, supported by ancient art and mythology, may have an affect on the approach to rock-art in general.

### **Prof. Liz Brack-Bernsen**

#### **Babylonian Astronomy/Astrology investigated using modern and Babylonian Mathematics**

This talk intends to illustrate if or how our understanding of Babylonian Astronomy/Astrology may be guided or influenced by our knowledge of modern and Babylonian mathematics. Modern mathematics can be used as a very efficient and accurate instrument for analyzing numbers and procedures, but we must be careful and question which part of our understanding was known to the Babylonians. Do we sometimes tacitly transmit our concepts and knowledge into the ancient texts? This problem will be discussed in connection with an astrological and an astronomical cuneiform text. Babylonian mathematics will be presented and characterized by some exercises. With the old mathematics in mind, we examine how much of our modern understanding may already have been known to the Babylonians.

## **Mr. Mourtaza Chopra**

### **Etymology and Epistemology, The Case of the Babylonian Lunar Six**

This paper will examine the etymology issues of the Lunar Six as a means of testing together the directions in my ongoing PhD research on the intellectual background of the late Mesopotamian mathematical-astronomy.

## **Dr. Jeanette C. Fincke**

### **BM 37373: Another text referring to *ziqpu* - constellations**

In my lecture I want to present the results of Wayne Horowitz and my study of the fragment BM 37373, conducted in the framework of our project on “The Great Star List and Related Texts” funded by the Israel Science Foundation. Both sides of the fragment deal with *ziqpu*-stars from different aspects, and lead to the establishment of a new sub-group of *ziqpu*-star lists. The obverse gives the number of stars in each *ziqpu*-constellation, just as is done in what was at the time a unique Late Babylonian tablet from Uruk published by Schaumberger in 1952 (*ZA* 50) and in the so-called Sippar Planisphere published by Horowitz and Al-Rawi in 2001 (*Iraq* 63). The reverse gives a *Rising Scheme*, describing the rising and setting of the Sun in relation to the *ziqpu*-stars, following the “simple scheme” (see J. Steele, *Rising Time Schemes in Babylonian Astronomy* (Springer 2017)).

## **Dr. Rita Gautschy**

### **Hemerologies and their consideration in Sargonid times**

Hemerologies are concerned with the daily and monthly cycles of people’s lives in ancient Mesopotamia. The most widespread text of this genre was the so-called Babylonian Almanac that contains one entry for each day. For some days there are only short statements such as “favourable” or “unfavourable”, other days contain more elaborate prescriptions, prohibitions or even threats. The topics in the Almanac cover the whole range from agrarian works, health or politics to eclipses.

This paper is concerned with the question whether the entries in the Babylonian Almanac were considered in (royal) daily life during the Sargonid time as suggested by Alasdair Livingstone<sup>1</sup> or whether the available data may be explained in an alternative way too, namely by more mundane facts such as e.g. scribes working on certain days during “the week”. My data sample contains 300 legal texts from Niniveh from the 8th and 7th century BCE, its main part is concerned with the buying and selling of land and slaves.<sup>2</sup> To my knowledge Mesopotamian astronomical texts from the 2nd and early 1st millennium BCE do not explicitly mention the time unit of “a week”. On the contrary, astronomical texts as well as texts documenting construction works of tombs in the Valley of the Kings clearly show that in ancient Egypt a week had 10 days. These 10 days were further subdivided in 8 days of work and 2 days off for the workmen. The legal texts from Niniveh show suspicious 5 and/or 10-days spacing in busy months, suggesting that a similar division of the month into “weeks” may have existed in Mesopotamia as well.

**Dr. Hisashi Hayakawa**

**The Earliest Datable Records and Drawings of Auroral Candidates: A Crossroad of Mesopotamian Astral Science and Modern Geophysics**

(co-author of paper: Yasuyuki Mitsuma)

The Astronomical Diaries from Babylonia (ADB) contains the record of highly continuous and systematic astrological and meteorological observations made in Babylon from the seventh to the first centuries BCE. Surveying these diaries, we have found nine records of aurora-like phenomena, spanning from BCE 652 to BCE 61, in ADB. In this presentation, we show the result of a survey of those records. Philological and scientific examinations on these records suggest that five of them can be considered as likely candidate for aurora observations. Notably, these records of auroral-like phenomena mostly fall in the active phase of the solar activity reconstructed from radioisotope proxies. They provide unique information about the solar and aurora activities in the first millennium BCE, considering scarce of total amount of contemporary historical documents.

**Prof. Wayne Horowitz**

**The Astronomical Book of Enuma Elish, The Great Star List, The Livingstone Materials, and Other Random Thoughts**

Enuma Elish V opens with Marduk commanding the stars, Moon, and Sun to perform their astronomical and calendrical duties in the sky. Exegesis and related materials are to be found in the mystical and explanatory texts collected by Alasdair Livingstone in his 1986 monograph *Mystical and Mythological Explanatory Works of Assyrian and Babylonian Scholars*. The title of this paper reflects my areas of research during my stay at this Spring Semester 2018 at the Israel Institute of Advanced Studies, our hosts at the Hebrew University of Jerusalem. The paper itself will provide me with an opportunity to share my findings with the Regensburg group.

**Prof. Hermann Hunger**

**The Length of Day and Night and their Parts**

This paper will consider two topics: the length of day and night, and their subdivisions. The length of daylight and night varies in the course of the year, and the way in which the Mesopotamians handled this variation will be discussed. On the other hand, there are different ways to measure intervals of time shorter than a day, and an overview of these time indications will be given.

## **Prof. Teije deJong**

### **The Observational Basis of Babylonian Planetary Theory: Passages of Normal Stars and Calendar Dates**

In this paper I attempt to provide an answer to the question how the Babylonian scholars arrived at their mathematical theory of planetary motion. Although no texts are preserved in which they tell us how they did it we have a fairly complete picture of the nature of the observational material on which they must have based their theory. Calendar dates on which the planetary synodic phenomena occur are directly recorded in the Astronomical Diaries and longitudes of the planets in the Babylonian zodiac could be determined with an accuracy of  $1^\circ$  to  $2^\circ$  from observations of angular distances to Normal Stars with known positions. The key concept in the Babylonian approach is the realization that synodic time intervals can be derived from synodic arcs (and vice versa) by using period relations. I will discuss system A theory of the planets Saturn, Jupiter, Mars and Venus which becomes increasingly sophisticated in this order. The process of theory formation involved the derivation of long “exact” periods by linear combination of “Goal–Year” periods, the invention of a  $360^\circ$  zodiac, the discovery of the variable motion of the planets and the development of the numerical method to model this as a step function. I will show that the Babylonian scholars based their models on the positions of the planets near the stationary points in their orbits determined from observations of the distances of the planets to Normal Stars. At first and last appearance of the planets, when positions cannot be determined with respect to stars because of the brightness of the twilight sky, positions could be constructed from observed time intervals between synodic phases and average planetary velocities.

## **Dr. Gennady Kurtik**

### **<sup>mul</sup>UZ<sub>3</sub>, <sup>mul</sup>dGula, and the early history of Mesopotamian constellations**

This paper will consider some problems related to the two mentioned constellation names that tradition associates with Lyra in historical development.

## **Dr. Natalie N. May**

### **The Babylonian ‘Man in the Moon’ Again**

It has been argued that drawing was included in curricula of Babylonian scribal schools. The paper addresses the drawings on astronomical tablets. Particularly, I will discuss the image on one of the micro-zodiac tablets, VAT 7851, which was called by Paul Alain Beaulieu “The Babylonian ‘Man in the Moon.’” Analysing written sources and juxtaposing them with the pictorial repertory related to astronomical milieu allows to firmly identify the image on VAT 7851. This identification based on the new precise reproduction of the drawing on this tablet will be suggested on occasion of Regensburg workshop in Jerusalem.

## **Prof. Dr. Dr. Mathieu Ossendrijver**

### **Evidence for Elementary Steps in Egyptian Procedure Texts for Mercury Systems A1 and A2**

The Babylonian algorithms known as Mercury systems A1 and A2 are now attested in demotic procedure texts from Roman Egypt. Unexpectedly they employ a formulation involving the concept of elementary steps - a division of the zodiac into tiny intervals of variable length. Van der Waerden and Aaboe both suggested that all Babylonian systems of type A are based on elementary steps, but they are not mentioned explicitly in any Babylonian text. In this presentation the evidence is presented and possible implications are discussed.

## **Prof. Eshbal Ratzon**

### **Adaptations of Mesopotamian Calendrical and Astronomical Knowledge in the Dead Sea Scrolls**

The 364-day year is best known from the Dead Sea Scrolls. However, it has been demonstrated that the Qumranites imported this construct from Mesopotamian sources. In these sources the 364-day year was a rough estimation of the solar year. In addition, a schematic lunar calendar of alternating hollow and full months was easily adapted to the 364-day year by an intercalation of an additional month once every three years. The oldest Jewish text familiar with this triennial cycle is 4Q208, a copy of the Aramaic Astronomical Book of Enoch. A new reconstruction of this scroll reveals that the scribes of the Aramaic Astronomical Book, while attempting to apply the triennial cycle to reality, discovered a discrepancy between this calendar and the true lunar month. This discrepancy leads to a regression of the beginning of the new month. Therefore, in the scroll 4Q209, which was previously assumed to be a mere copy of the very ancient manuscript of 4Q208, they adapted the calendar to this regression. A further regression can be seen in later calendrical scrolls (4Q317 and 4Q321). However, eventually, the moon was abandoned as a means to determine the months, and the community used the ideal solar calendar of 364 days. It probably took many years for the discrepancy between the 364-day year and the true solar year to be discovered.

## **Mr. Marvin Schreiber**

### **The Word “House” (É = bītu) as a term in the Babylonian Astral Sciences.**

My paper will be concerned with: The word “House” (É = bītu) as a term in the Babylonian astral sciences. The paper aims to present the different ways in which the term “house” is used for months and zodiacal signs, and the various contexts in which it appears.

## **Prof. John Steele**

### **The Development of Observational Practice in the Late Babylonian Period**

In this presentation I will examine the development of observational practice during the Late Babylonian period — what astronomical phenomena were observed, how they were observed, and how the observations were recorded. I will then discuss the significance of these developments for our understanding of Late Babylonian astronomy more generally, and in particular for attempts to reconstruct the development of mathematical astronomy.

## **Dr. Zack Wainer**

### **"In the Name of Accuracy? The Logic of Intercalation Schemes in the Commentary Series *Šumma Šin ina Tāmartišu*"**

The end of Tablet 4 of the commentary series *Šumma Šin ina Tāmartišu* (*SIT*) includes a number of different statements about intercalation, many of which are similar to ideas known from MUL.APIN and the greater Mesopotamian celestial-divinatory tradition. Some of these concepts exhibit crucial differences in *SIT* as compared to other compositions from the Neo-Assyrian period. While one could consider these variations to be simple errors in transmission at first glance, I think that they possess a distinct air of intentionality when considered as a whole. If these statements in *SIT* 4 about intercalation do represent an alternative tradition to the knowledge contained in texts like MUL.APIN, then they beg some interesting questions that I will elucidate and endeavor to answer in this presentation.

Through my talk, I will analyze the intercalation statements at the end of *SIT* 4 as both self-contained concepts and comments that critically converse with other text(s). I will examine how these statements problematize the modern conception of intercalation as an important measure for keeping the accuracy of a luni-solar calendar, and how they fit within the Neo-Assyrian scholarly tradition. After a discussion of how *SIT* 4 tries to position itself with respect to central celestial-divinatory texts like MUL.APIN, I will conclude by illustrating how this portion of *SIT* sheds light on Neo-Assyrian scholarly attitudes towards intercalation.

## **Dr. Rita Watson**

### **Time and Notation: Articulating a Concept**

The cognitive representation of time is biologically based and evolutionarily ancient. The way in which it is encoded influences its role in thought. A new form of symbolic encoding arose in archaic Uruk, where the administrative requirements of a burgeoning grain-based economy meant that the natural cycles of time, marked by the intervals and appearances of the sun and moon and the yearly seasons of planting and harvest, had to be represented in abstract graphic form. Managing the flow of commodities required detailed and reliable record keeping. The notational system that emerged appears to capture cognitive representations quite directly. The role of notation in developing concepts of time and quantity is explored.

## **Dr. Hezi Yitzhaq**

### **"Sun, stand still over Gibeon; and Moon, in the valley of Aijalon"- Annular solar eclipse on October 30, 1207 BCE**