Babylonian planetary calculation in Greco-Roman Egypt

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Anybody who is eager to determine the precise position of stars or planets in the sky, can nowadays open their computer and find everything they seek with a few clicks through modern software. In antiquity, this was a little harder. Astronomical data were used in first instance to determine the fate of kings and empires, later also for the construction of horoscopes for private individuals. In the Berlin Papyrus Collection, multiple horoscopes are preserved as well (see for instance the oldest preserved, Greek horoscope on papyrus).

The philosopher Sextus Empiricus (2nd century AD) described in his work Πρὸς ἀστρολόγους “Against the Astrologers” (26-28), how the Babylonians performed the observation of planetary positions during childbirth. An astronomer sat on a mountain peak, whereas an assistant sat next to the woman in labor. When the delivery occurred, the assistant sounded a gong and the astronomer directly noted all relevant observational data. This tale is embellished by fantasy, but does not correspond to reality. Observations were often impossible: not all planets are always visible. For this reason, algorithms were employed to create astronomical tables. The positions in the horoscopes were then computed using the tables.

Part of such a table can be found on the object presented here, a papyrus from Oxyrhynchus in Greco-Roman Egypt. The fragment consists of five columns with black lining and is written in a small, rapid, cursive documentary script from the 1st century AD.[1] The table is broken on the left, bottom and right sides; the upper part however is complete. A second fragment of the same table, which consists of parts of columns 3, 4 and 5, is kept in Oxford. The reverse side, the front side of the papyrus, contains a legal proceeding. After this had lost its relevance, this astronomical table was written on the backside, until this as well had lost its importance and was thrown away. As all papyri from Oxyrhynchus, the papyrus originates from a landfill.

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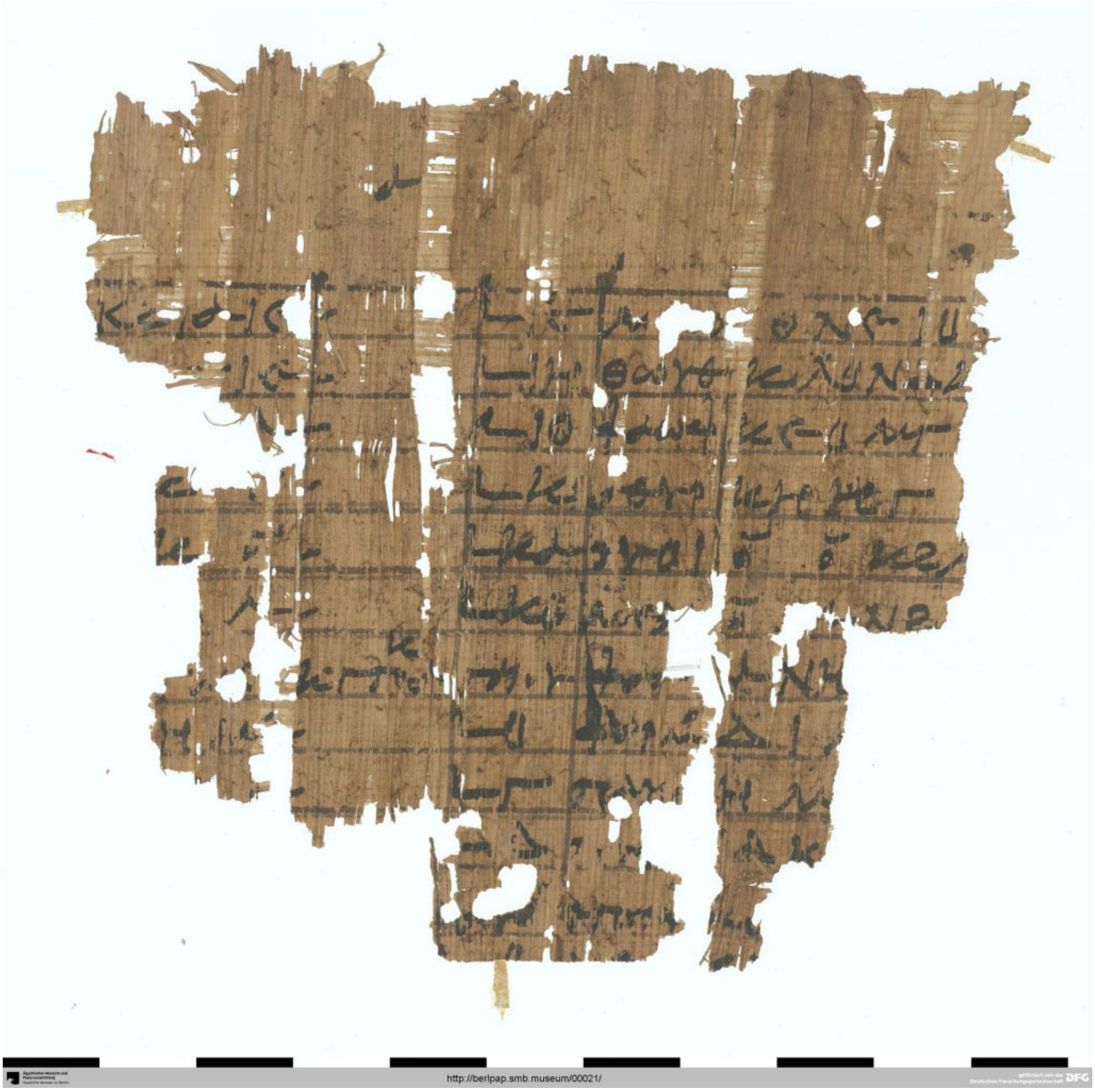
[1] Brashear & Jones (1999), 206.



P. 16511 V: “Planetary Epoch Table“, https://berlpap.smb.museum/00021/?lang=en

The third column consists of year numbers, which are represented by the Greek L-shaped ἔτος („year“) sign together with a number. The year numbers usually increase by 1, but sometimes also by 2. Thus, in the first four lines we find the years ις, ιη, ιθ, κ: 16, 18, 19, 20. These are regnal years of Roman emperors, and in line 7 it also becomes clear of which emperors. Here column 3 does not contain a year number, but only Γαίου, which is clarified by the addition of κγ το κ(αὶ) α in column 2, which together means „23, also 1 of Gaius“. The described year is year 23 of emperor Tiberius’ reign, 37 AD, which is also year 1 of emperor Gaius’ (Caligula’s) reign. The remainder of the second column contains horizontal strokes only and, apparently, its function is to separate column 1 from the other columns.[2]

Column 4 contains Egyptian month names in Greek script, with full spellings for short names such as Θωύθ „Thouth" (line 2), Ἀθύρ „Hathyr" (line 4) and Τῦβι „Tybi" (line 5); as well as abbreviated ones for longer names such as Φαῶφ „Phaoph" for Φαῶφι „Phaophi" (line 3), and Φαρμο „Pharmo" for Φαρμοῦθι „Pharmouthi" (line 8). The ο in Φαρμο is written in superscript to indicate that the word is an abbreviation.

Column 5 always starts with a number between 0 and 29, followed by one or often more numbers. These indicate the days of the month and subsequent fractions of these days in the Babylonian sexagesimal system. This notation clearly results from computation and already shows that we are not dealing with a purely Egyptian table. Another unusual characteristic is the use of day 0, instead of day 30 of the preceding month, in lines 5 and 6.

In summary, each line contains a time entry, with intervals of around 13 months each. This time period is characteristic for the planet Jupiter and analysis based on modern data shows that the denoted dates are moments in which Jupiter is located at its so called first station: the place where the planet's motion becomes retrograde. The letter α above the table could represent the number 1 and thus refer to this; this interpretation, however, is uncertain.[3] Interestingly, for astronomical calculations the unreformed Egyptian calendar, which does not contain leap days, had been kept in use for a long time, as this calendar was easier for calculation. In everyday life, the reformed Egyptian calendar had been in use for a century and a half already at the time when this papyrus was written.

Most tables of this type did not only contain time entries, but also the related planetary positions, expressed in the zodiacal coordinate system. In this case, these positions were probably included in column 6 and the following. But what were the contents of the first column? It is evident that it contained numbers, but since the beginning is broken off and the numbers are mostly fractions, it is complicated to draw a conclusion. They could be related to another celestial phenomenon of Jupiter, or maybe represent positions of the same phenomenon, but prior to year 16 of Tiberius' reign. The fact that the table begins arbitrarily with year number 16 without mentioning the name of Tiberius supports the hypothesis that something else may have preceded it.

[2] Britton & Jones (2000), 350.
[3] Britton & Jones (2000), 350.

It was surprising to find tables in Egypt which were created by Babylonian methods. Transferring Babylonian algorithms to Egypt is not trivial: the complicated Babylonian algorithms had to be adapted to the Egyptian calendar and local observations had to be used for the planetary positions due to the change in geographical location. This shows that there was advanced knowledge of Babylonian algorithms in Egypt. The table is also surprisingly accurate: the date never deviates from the phenomenon by more than 2 days, while Jupiter can be seen by observation up to about 10 days before or after the calculated date.[4]

This article was first published on the website of BerlPap – Berliner Papyrusdatenbank, „Object of the month“.

Literature

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[4] Britton & Jones (2000), 370.