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AN ASTRONOMICAL ALMANAC FOR THE YEAR 348/9

(P. Heid. Inv. No. 34)

BY

O. NEUGEBAUER

København 1956
i kommission hos Ejnar Munksgaard

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1. Introduction.

In the "Actes du V^e congrès international de papyrologie", Oxford 1937, F. Bilabel reported on an astronomical treatise in the Heidelberg collection of Greek papyri. He quoted the words χρ]όνος ȝω̣[διακος and mentioned tables with zodiacal signs, months, and days in 5-day intervals. As probable date he designated the 2nd or 3rd century A.D.

This description suggested an astronomical text of the type of P. Mich. Inv. 1454[1] or P. Lund Inv. 35b[2] and P. Tebt. 274[3]. I therefore wrote to Prof. Preisendanz who kindly arranged for photostats of the text to be sent to me. For additional information and collations I am greatly indebted to Dr. Jutta Seyfarth of the University Library, Heidelberg.

My initial guess that the text concerned planetary motions was confirmed as soon as I received the photostats. The above-quoted words are to be read

κρ]ονοϲ ȝε̣[υϲ

and are the column headings for Saturn and Jupiter. A rapid transcription of a few lines of the more easily readable dates and numbers showed that the first columns concern the day-by-day positions of the moon. These are followed by tables for Saturn and Jupiter at 5-day intervals. The Mars tables are lost in the broken columns between recto and verso. The preserved columns

[1] H. D. Curtis and F. E. Robbins, An Ephemeris of 467 A.D., Publications of the Observatory of the University of Michigan 6 (1935) p. 77—100.

[2] Erik J. Knudtzon-O. Neugebauer, Zwei astronomische Texte. Bull. de la Société Royale des Lettres de Lund, 1946—1947, II p. 85 ff.

[3] Cf. note 1 on p. 6.

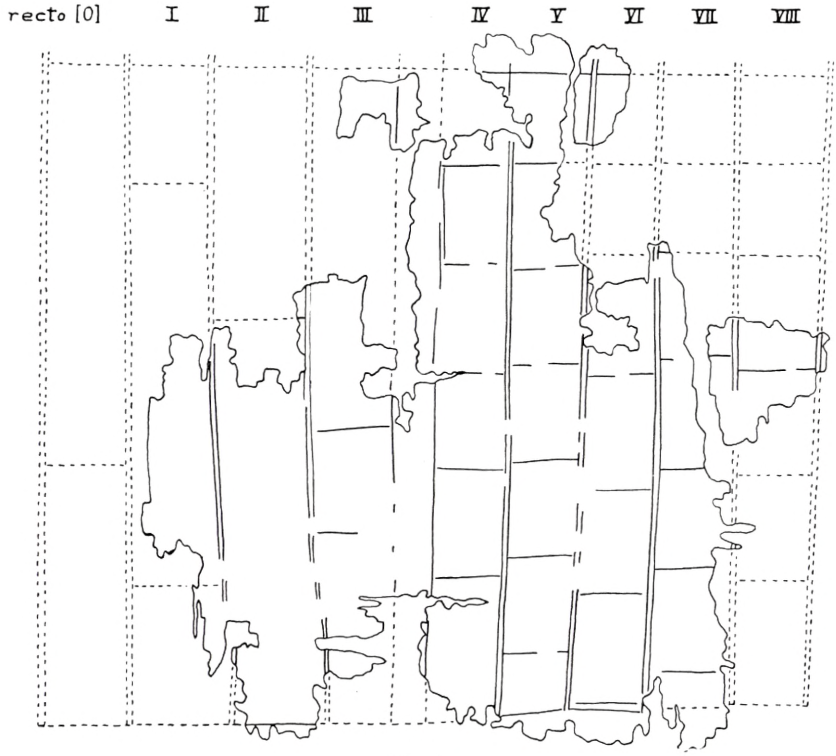

Fig. 1 a.

on the verso contain tables for Venus and Mercury and some additional tables which concern "hours" (ligature ω + ρ). It was thus quite simple to restore the original arrangement of the 8 columns of the recto and the first 5 columns of the verso (cf. Fig. 1), covering a total of 7 months of lunar motion and one year of motion for each of the five planets[1].

The dating of the text would have been a simple matter too, had it not been for some errors in the lunar tables which frustrated the ordinary procedure of combining the data for the two outer planets Jupiter and Saturn (which change position very slowly) with the data for the moon to fix the day. Consequently it was

[1] One should perhaps assume two more columns for the sun, preceding the columns for the moon. The corresponding space on the verso might have been left blank.

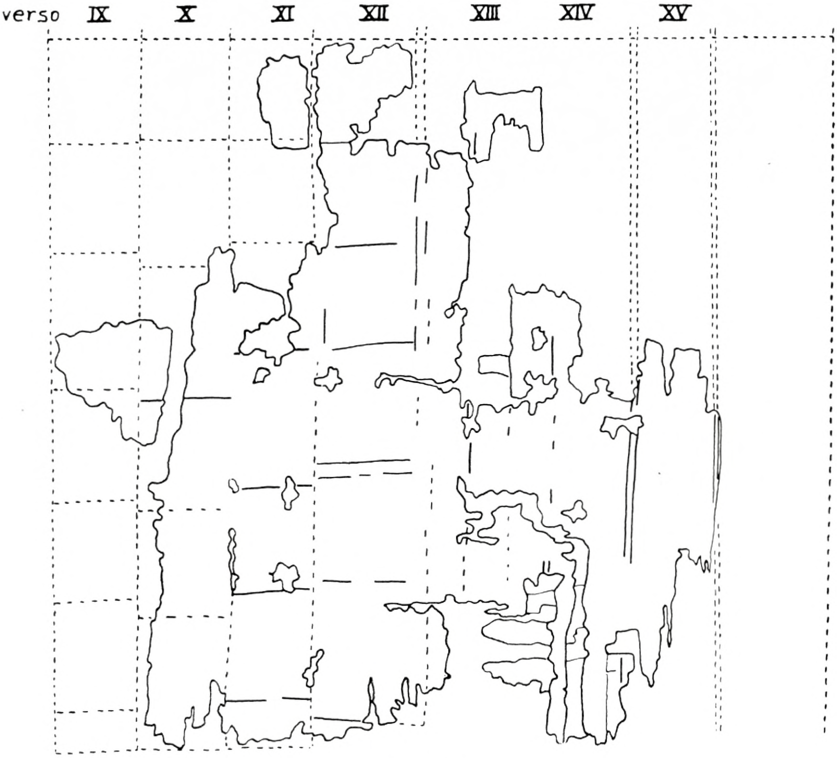

Fig. 1 b.

necessary to investigate in detail all the tables of the papyrus in order to establish their mutual coherence and reliability and to localize the error. As will be shown presently, the planetary tables are correct. They were computed for the year 348/349, thus about 150 years later than had been estimated on palaeographical grounds. This is a useful warning against applying criteria which were gathered from totally different types of manuscripts to texts which contain, for the most part, tabular matter.

Astronomically the new text is of interest because it represents a new type of planetary tables. Until now we only had tables which are either calendarically arranged[1] or are lists of

[1] P. Mich. Inv. 1454 (cf. p. 3 note 1) and perhaps P. Harris 60.

dates of entry of the planets into the zodiacal signs extending over many years[1]. In Section 8 we shall point to the mediaeval continuation of this new type of Greek planetary tables[2].

2. The Calendar.

If we plot the dates and longitudes of Mercury obtainable from col. XII, we can with sufficient accuracy estimate the conjunctions with the sun (cf. Fig. 2):

sup. conj. I 6: ♍ 13 = ♈ 163
inf. conj. III 3: ♏ 10 = ♈ 220

corresponding to a solar motion of 57° in 57 days[3]. Thus we may say that at I 6 the sun had a longitude of about 163°. For the first centuries A.D. this corresponds to a Julian date of about Sept. 7, leading to I 1 = Sept. 2, in close agreement with the norm of the Alexandrian calendar I 1 = Aug. 29 or 30. Thus the Egyptian calendar is excluded except for the period of coincidence in the time of Augustus.

Even the small discrepancy of about 3 days is only apparent. If "♍ 13" would not be identified with a (tropical) longitude of 163° but with $\lambda = 160$, we would have found exact agreement with the Alexandrian calendar. The investigation of numerous horoscopes has shown that a difference of this order in longitudes is actually to be expected. This means that ancient tables counted longitudes siderially from a point which in our norm had a longitude which increases from about $\lambda = -5$ toward zero

[1] This is the best represented class since we have also large demotic texts of this type; cf. O. Neugebauer, Egyptian planetary texts, Trans. Am. Philos. Soc. NS 32 (1942) p. 209—250 (P. dem. Berlin 8279, Stobart Tablets, P. Tebt. 274) and Knudtzon-Neugebauer, quoted p. 3 note 2. Such tables were obviously constructed for astrological purposes. Given the date of a nativity, it is possible at a glance to say in which signs the planets were located at the given moment—information which usually sufficed for the astrologer. This is particularly the case for most of the horoscopes from the first two centuries A.D. Exceptions are some comparatively early papyri (P. Lond. 98 and 130 or P. Paris 19 and 19 bis) and the late horoscopes from the collections of Palchus, Rhetorius, etc. Cf. for details a monograph on "Greek Horoscopes" by O. Neugebauer and H. B. Van Hoesen, to be submitted for publication to the American Philosophical Society.

[2] Below p. 14.

[3] Note also the agreement of this first estimate with the value of half the synodic period which is 115.9 days.

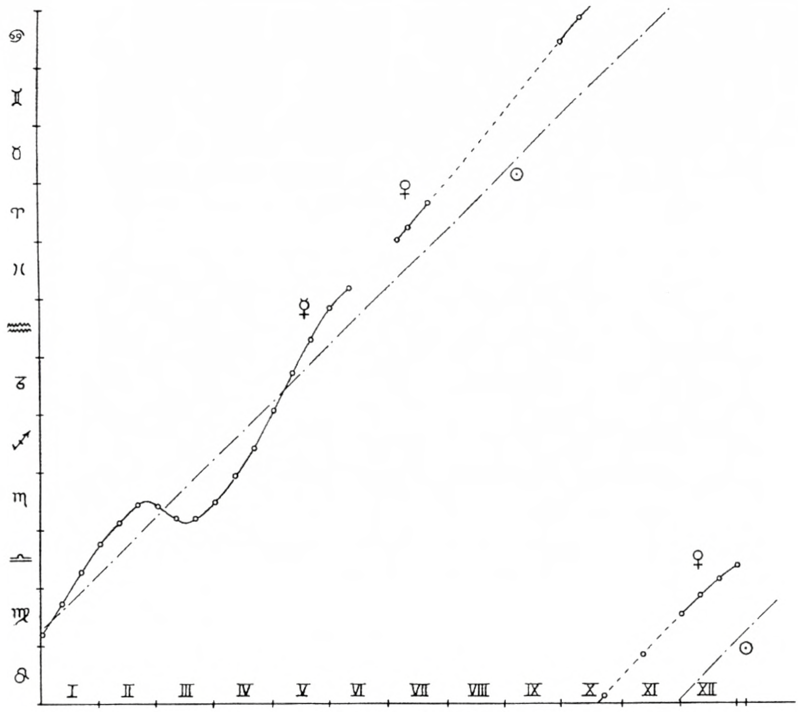

Fig. 2.

during the first centuries A.D. These differences are too small and change too slowly for use in establishing an accurate dating of our document. It is nevertheless clear that for a text of the first centuries A.D. the above-quoted solar longitudes agree with expectation.

3. Saturn.

The section for Saturn is the best preserved part of the papyrus and is therefore best suited to describe the principle of arrangement. For each month of one year the longitudes of the planet are listed at the days 1, 6, . . ., 26. At the end of the year are added the epagomenal day 1 and the first day of the next year. When the planet remains in the same zodiacal sign for a whole month, the name of the sign is given with day 1. When the planet crosses a boundary between two signs the first-listed date within the new sign receives the name, e. g., ♓ in II 16 or ♈ in V 21.

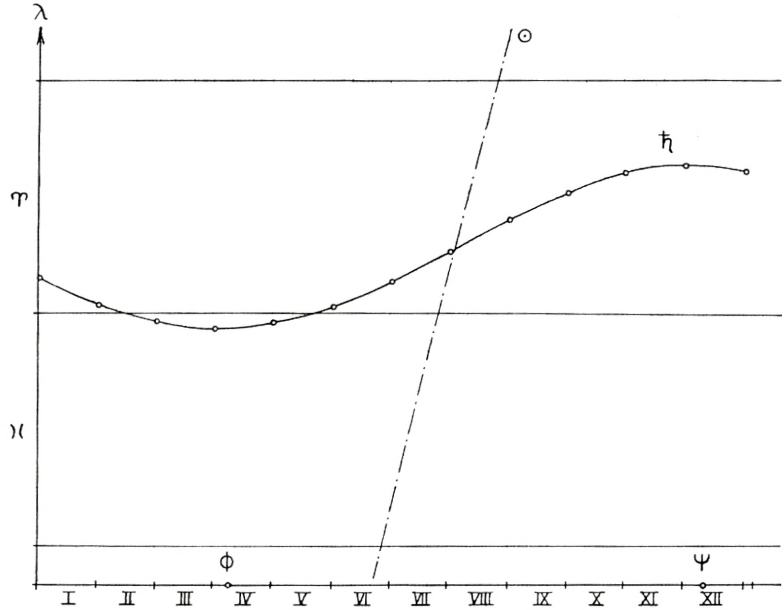

Fig. 3.

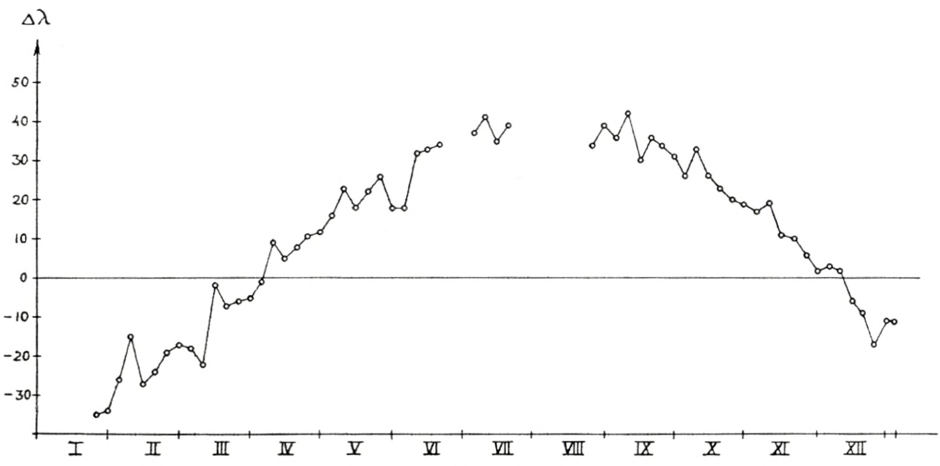

Fig. 4.

A graphical representation of the motion (cf. Fig. 3) shows a reasonably smooth variation of the longitudes as function of time[1] but the investigation of the differences (Fig. 4) reveals many cases where a better adjustment would have been possible.

[1] Plotted only for the first days of each month.

4. Jupiter.

Though much less well preserved, the two columns for Jupiter show essentially the same features as the preceding columns for Saturn (Fig. 5). Once, however, the principle of

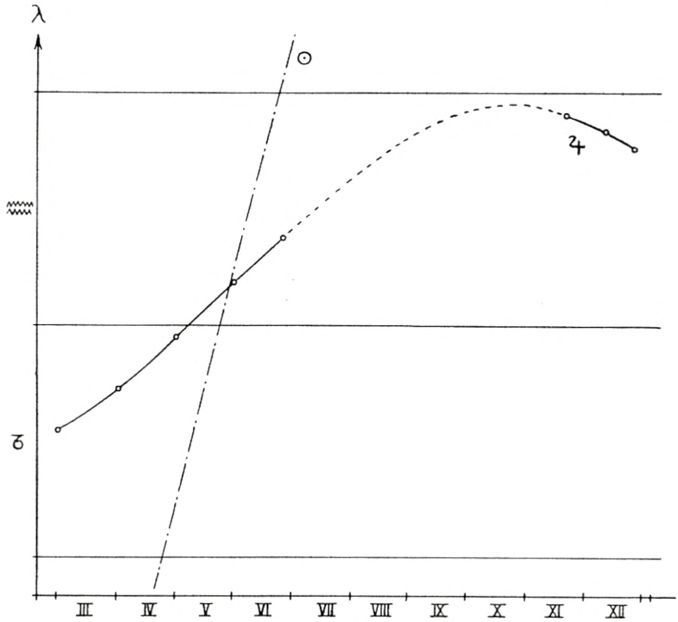

Fig. 5.

tabulation at 5-day intervals is violated, namely, when in V 9 Jupiter enters Aquarius (longitude ≈ 0;3). Similar cases are found in the tables for the inner planets.

5. Venus and Mercury.

According to our reconstruction (cf. Fig. 1) the first half of the table for Mars formed the last column of the recto, while the second half began the text on the verso. All this being destroyed, the verso begins now with the very badly damaged table for Venus. The writing in the first column is almost completely obliterated; in the second column only months VII and X to XII provide a consistent sequence of positions (cf. Fig. 2). Since the mean position of the sun was determined with a very narrow margin of incertitude from the longitudes of Mercury, one can now also find for Venus the elongations from the sun. The graph shows that maximum elongation as evening star occurred close to the end of month XI. Consequently the preceding superior conjunction (about 220 days earlier) must be located near IV 20. This agrees perfectly with the result of extrapolation from the positions known for months VII and X. Thus Venus, Mercury and the sun constitute a mutually consistent set of data. This is important to know in view of the problem of dating the text.

6. The Date.

Knowing now the position of the sun during the whole year in question, we can also relate the positions of Jupiter and Saturn to the solar longitudes (cf. the graphs of Fig. 3 and 5). This provides us in both cases within very narrow limits with the dates of conjunction, namely, VIII 3 for Saturn and V 28 for Jupiter. For Saturn we know with equal accuracy the dates of the preceding and following stationary points (cf. Fig. 4), namely, IV 12 and XII 10, which are in excellent agreement with the astronomically required facts. For Jupiter our information is not equally complete but Fig. 5 shows also here the basic correctness of the table. Consequently there can be no doubt that the tables for all four planets, Saturn, Jupiter, Venus, and Mercury, were computed for the same year and are essentially correct. This shows us that agreement between one tabular value and modern computation assures agreement also for the remaining data of the same planet.

We start our investigation with Saturn and Jupiter since their common period of about 59 or 60 years greatly reduces the number of possibilities. We chose as required points of agreement for Saturn VIII 6 and for Jupiter V 26, dates which must be close to conjunction with the sun. According to the text the corresponding longitudes are ♈ 8 and ♒ 4 respectively. The corresponding Julian dates are April 1 and January 21. For these dates the year -6 (= 7 B.C.) gives an approximate possibility since we find

— 6 April 1 ♄: ♓ 16 = ♈ 8 — 22°
— 6 Jan. 21 ♃: ♒ 24 = ♒ 4 + 20°

From this initial position we proceed in steps of 59 years, thus rapidly improving Jupiter's position for the critical date and also slowly moving Saturn closer. Fig. 6 shows the result. The years + 112 and + 171 would be possibilities for Jupiter but Saturn still shows an error of about — 20°. It is obviously useless to proceed beyond + 230 in steps of 59 years since the negative deviation of Jupiter rapidly increases numerically. Thus we must now

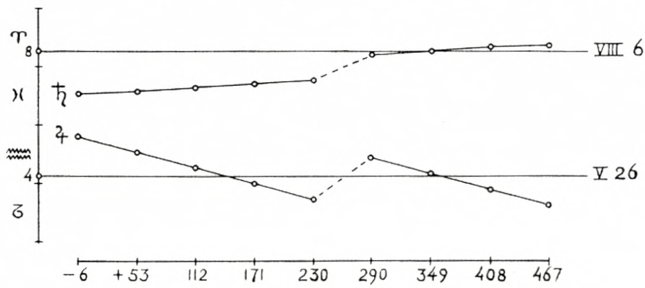

Fig. 6.

insert one step of 60 years which gives Jupiter again a positive deviation of about 9° and brings Saturn very close to exact agreement. In the next step of 59 years both planets reach the required longitude and then they begin again to deviate in the opposite direction, obviously ruling out any further agreement for centuries thereafter. Thus 349 A.D. is the only possibility for the tables of Saturn and Jupiter.

All that remains to be done is to check this result for any one suitable date for Mercury and Venus. One may choose, e. g., for Mercury the date I 6 of the same calendar year, corresponding to the Julian date 348 Sept. 3. For this day Mercury, according to the text, should be at a longitude of ♍ 13;21 and close to superior conjunction[1]. For Venus I selected XI 26 = 349 July 20 with a longitude of about ♍ 11;30[2] given by the table and, according to our reconstruction of the solar motion, close to maximum elongation as evening star[3].

[1] Cf. above p. 6.
[2] Only the minutes are not accurately known.
[3] Cf. above p. 10.

Modern computation[1] shows excellent agreement in both cases. We find for Mercury $\lambda = ♍ 17$, about one day before mean superior conjunction and for Venus $\lambda = ♍ 13;30$ at maximum elongation. The slight differences in the longitudes are of course due to the small inaccuracies of ancient as well as of our modern method of computing, combined with a small difference of about 2° in definition of the zero point[2]. Thus all four planetary tables require the date 348/349 for the year in question.

7. The Moon.

The first columns of the recto and the last columns of the verso remain to be discussed. That both concern the moon is obvious from the day-to-day longitudes in the first columns and by the heading ϲεληνοι[of the last preserved section.

This latter section causes great difficulties. Below the strange heading ϲεληνοι[one finds 12 lines, each beginning with the ligature of ω and ρ for ὥρα. In six cases, five of which form a sequence, the letter η follows. Since it is very unlikely that in six months the 8th hour should play a role, one might assume that η stands for ἡμερινή, i. e., hour of the daytime. The remaining cases should then be understood as hours of the night; the letters which follow in five cases, interpreted as numbers, do not contradict this hypothesis: 1, 10, 9, 2, 5(?) could all be hours of the night. In the second line, ὥρα seems to be followed by τησ.γ, which I cannot explain. In the next line ωρ(α) ι(?) is followed by a letter which looks exactly like Coptic š and then by ȝ. In the remaining lines, which are partly broken away, occur several symbols which may be fractions; the last symbol in line 31, e. g., is known for $^1/_2$.

At least three lines following this section are left blank as

[1] Using the tables by P. V. NEUGEBAUER, Astronomische Nachrichten 248 (1933) col. 161 ff. These tables have a margin of error of about ± 1° in longitude.

[2] The detailed investigation of the longitudes given in P. Mich. Inv. 1454 by H. D. CURTIS showed a deviation of about 2;30° for the ephemeris of 467 A.D. (l. c. p. 88 and p. 91 f.). My experience with numerous horoscopes ranging from the first century B.C. to the 8th cent. A.D. shows that the deviations in the definition of the zero point show frequent individual fluctuations even if the general trend follows the expected variation with precession.

far as can be judged from the small remnants. A similar group of 12 "hours" might have been listed above the present section; only the last line ωρ(α) . . ȝ is preserved. One might conjecture that these two sections gave the moments of new moons and full moons, respectively, for the year in question.[1]

To the left of this last column, only traces from the ends of lines are visible. Apparently all lines ended in]ραιc, but I

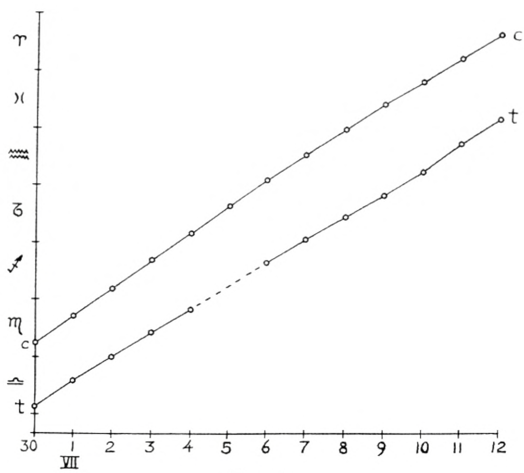

Fig. 7.

see no plausible explanation for a column ending in ημεραιc (?) or similar words.

Returning to the columns at the beginning of the recto we reach familiar ground, namely day-by-day longitudes of the moon. Since we have found that the planetary tables concern the year 348/349, it is easy to check the lunar positions. The earliest securely read longitude is ♍ 7;58 for V 8, which corresponds to 349 Jan. 3. The latest certain position is ♍ 13;26 exactly two months later, VII 8 = 349 March 4.

Computing the longitudes of the moon[2] for these dates one

[1] The 6th column of the Michigan ephemeris gives the time of transition of the moon from one sign into the next (cf. Curtis-Robbins p. 95). Against a similar interpretation of the "hours" in the present text speaks the fact that each single month would require 12 or 13 entries plus names for months and zodiacal signs, all of which are absent.

[2] For these computations I used the tables in P. V. Neugebauer, Tafeln zur astronomischen Chronologie II (Leipzig 1914). Since the hour is unknown it is of course sufficient to compute only the columns L and M for Greenwich noon.

finds ♐ 16 and ♓ 0, respectively, thus 38° and 45° ahead of the text.

The increase of the deviation from 38° to 45° during two months, however, is not systematic. If we compare V 8 ♍ 7;58 with VII 3 ♍ 13;26, we have two dates 55 days apart or an interval of very nearly two anomalistic months. Consequently the lunar anomaly should have no effect on the progress in longitude, and this is indeed the case. The mean motion during 55 days is 2 rotations plus 4;42°, thus only 0;14° more than in the text. This fact, combined with the observed increase of 7° of the deviation, points toward irregular variations in the lunar motion as represented by the text. This is indeed confirmed by all sections where enough is preserved to check the velocities. In column I, e. g., we find that the lunar velocity varies in 7 days from mean to minimum and back to mean instead of requiring 13 or 14 days for this change. Similarly one can observe that the velocities from VI 30 to VII 12 vary irregularly and with a trend opposite to the computed one (cf. Fig. 7, where curve *c* represents computation, *t* the text).

Apparently the lunar anomaly was not correctly computed when the lunar tables were composed. As mentioned before, the preserved parts of the text do not suffice, however, to explain the systematic deviation which amounts to about 3 days of deviation in lunar motion. Nevertheless the obvious irregularities show the unreliability of the lunar tables and therefore do not invalidate the date which was obtained from the planetary ephemerides.

8. The "Almanacs".

In his interesting "Estudios sobre Azarquiel"[1] Professor Millás Vallicrosa has traced a whole class of late mediaeval "almanacs" to tables which are preserved in an Arabic manuscript, completed in 655 A.H. (= 1257 A.D.), under the name "Canon of Aumatius in the revised version by . . . . Azarquiel".[2] The epoch year of the tables is the year "Alexander" 1400[3],

[1] Madrid-Granada 1943—1950. Quoted henceforth as M.-V.

[2] From the colophon at the end of the tables, M.-V. p. 234. Also H. Suter, Die Mathematiker u. Astronomen der Araber (Leipzig 1900) p. 109 note d.

[3] M.-V. p. 117 et passim.

i. e., Seleucid Era 1400 = A.D. 1089. As STEINSCHNEIDER has suggested, "Aumatius" is in all probability Ammonius, the son of Hermias,[1] born about 440/450 A.D.[2] The existence of tables by Ammonius is independently attested through Greek sources which go under the name of Stephanus.[3]

In this search for ancient prototypes of Azarquiel's almanac, MILLÁS VALLICROSA had nothing at his disposal but a passage supposedly from Theon, discovered by DELAMBRE, in which rules were given for the layout of an ephemeris.[4] Indeed the ephemeris of the Michigan papyrus turned out to follow almost exactly the Theonic rules. But the arrangement in question is not identical with the arrangement of the almanacs of which the text published by MILLÁS VALLICROSA is the earliest known example. Its planetary tables are not part of a day-by-day calendar, an "ephemeris" in the proper sense of the word, but tables which give for each individual planet its true longitudes year by year, in ten-day intervals for Saturn and Jupiter, in five-day intervals for the three remaining planets.[5] Thus the arrangement is the same as in the Heidelberg papyrus, the only difference being that the papyrus gives longitudes in degrees and minutes whereas the almanac gives degrees only while adding the formal Julian equivalents to the "Coptic" months, though the computation is in fact still based on the Alexandrian calendar with its epagomenal days at the end of Mesore, causing "August" to be 35 or 36 days long. Through our papyrus it is now made obvious that the planetary tables of Azarquiel had Greek predecessors at least 750 years earlier.

In fact the evidence of a continued astronomical tradition in planetary theory can be carried back from the Spanish tables of the year 1400 of the Seleucid Era to the very beginning of this era. Azarquiel's planetary tables do not give the planetary

[1] M. STEINSCHNEIDER, Die europäischen Übersetzungen aus dem Arabischen, I (S.B. phil.-hist. Kl. Akad. Wiss. [Wien] 149 (1905) Abh. IV p. 52); also M.-V. p. 236.

[2] P. TANNERY, Mémoires Scientifiques II p. 123 ff.

[3] M.-V. p. 236 and Catal. Cod. Astrol. Graec. 2 p. 182.

[4] M.-V. p. 235; DELAMBRE, Histoire de l'astronomie ancienne II p. 635. The text and an English translation is now published by CURTIS and ROBBINS (cf. p. 3 note 1) from an earlier and better manuscript, which, however, makes the association with Theon somewhat doubtful; cf. CURTIS-ROBBINS p. 82, note 1.

[5] M.-V. p. 72—237 in particular p. 177—214. The day numbers listed are 1, 11, 21 or 1, 6, 11, 16, . . . as in our text.

longitudes for one year only but for whole cycles of years, characteristic for each planet: 59 years for Saturn, 83 for Jupiter, 79 for Mars, 8 for Venus, and 46 for Mercury. After completion of these cycles the longitudes repeat themselves except for small corrections.[1] Exactly these periods are used in certain classes of Babylonian texts of the Seleucid and Parthian times[2] and are again at the basis of Hipparchus' investigation of planetary motion;[3] they are also known to Greek astrology[4]. Numerous lists of corrections are preserved in cuneiform texts[5] exactly as variants of Azarquiel's values are found in the later almanacs.[6] It is only with the new measurements and theories of Tycho Brahe and Kepler that the first groping phase of planetary theory comes to a close.

Notes to the Readings.

The planetary tables show that each column had between 42 and almost 50 lines. The lunar tables require for 7 months a total of 217 lines for 4 columns, or 54 lines per column. The wider spacing of the planetary tables agrees with this estimate. The transcription does not reproduce these details and the line numbering is only meant to be approximate.

Column I. The dates are restored by the following argument. We know that 55 days should produce an increase of about 4;40° in longitude. This leads, e. g., to the pair [Athyr 16:] ♐ 10;40 and Tybi 11: ♐ 15;32 with very nearly the expected difference. The traces of dates found at the left edge of some lines of column I do not disprove this restoration.

Column III. A detached fragment from the beginning of this column shows some small traces of writing. — The available space at the end of the column seems to indicate that the table for Phamenoth (month VII) was not completed, but ended at about day 22.

[1] These corrections are listed in ch. 4 of the introduction (M.-V. p. 121).

[2] Cf. A. Sachs, A Classification of the Babylonian Astronomical Tablets of the Seleucid Period, Journ. of Cuneiform Studies 2 (1948) p. 271—290, esp. p. 283.

[3] This will be shown in a forthcoming paper, "Notes on Hipparchus", by the present author.

[4] Cf. e. g., Catal. Cod. Astrol. Graec. 7, p. 120 f.

[5] Cf. O. Neugebauer, Astronomical Cuneiform Texts, London 1955, vol. II.

[6] E. g. M.-V. p. 360.

Line 37, ιχ̣ι ε: no other reading seems possible; one expects ιχθ ε. An interpretation ιχ(θ) ιε is astronomically excluded.

Column IV, line 26: a marginal note (represented by s in the translation) here and in column V between lines 41 and 42 undoubtedly indicates the first and second station respectively. A similar note is found in column VII line 29 for the second station of Jupiter. In all three cases a letter ρ seems fairly certain and some abbreviation or symbol for ϲτεριγμοϲ or ϲτεριξει may be assumed but I cannot explain the traces of the remaining letters.

Column V, lines 41 and 42: cf. col. IV, line 26.

Column VI, line 33: inserted in smaller letters between lines 32 and 34. — Instead of ÷ γ̣ one could perhaps read ÷ alone.

Line 34, λ̣α: or μ̣α; neither λ nor μ is a very satisfactory interpretation of the traces; ÷ seems to be excluded.

Line 35, αμ̣: the best reading would be α ÷ but it is excluded by the resulting differences.

Column VII. The numbers at the end of lines 21, 22, and 25 and column VIII lines 21 to 25 are written on a detached fragment. It follows from the division lines and the dates visible on this fragment that it can only be placed at one of four places: between col. VI and VII months I and VII or between columns VII and VIII in three positions, the lowest being assumed in the transcription. The first position is made unlikely by the fact that the day numbers in the right column are one line too low. Among the three remaining positions the middle one is excluded by the verso.

Line 29: marginal note in very cramped writing with last letter ρ, perhap ϲτερ; cf. col. IV line 26.

Column VIII: Cf. col. VII.

Column XII. In lines 27, 31, and 41, one date is added each time to the ordinary scheme because Mercury is then entering a new zodiacal sign. At the margin is written a sign or a mark which is hardly a letter.

Line 28 ε?: looks more like γ or ϛ.

Line 43 ϛ: written over κ.

Columns XIII and XIV. This part of the papyrus is badly worn and not even the divisions between columns are certain. In fact I am not sure that the second column for Mercury (which should be col. XIV) was actually given in our text. Traces of vertical ruling seem to indicate three or four narrow columns instead of two columns of ordinary width.

Column XV. Signs which are not obvious letters I have copied fairly accurately. In line 37 one could read θ or ε.

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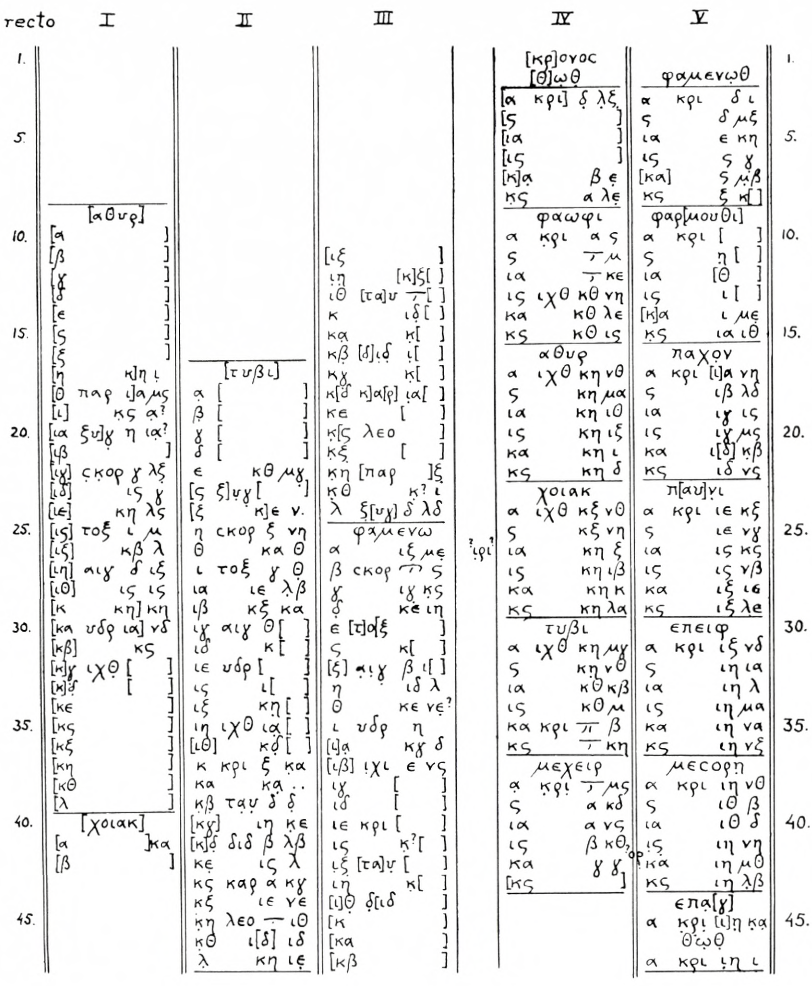
Færdig fra trykkeriet den 20. august 1956.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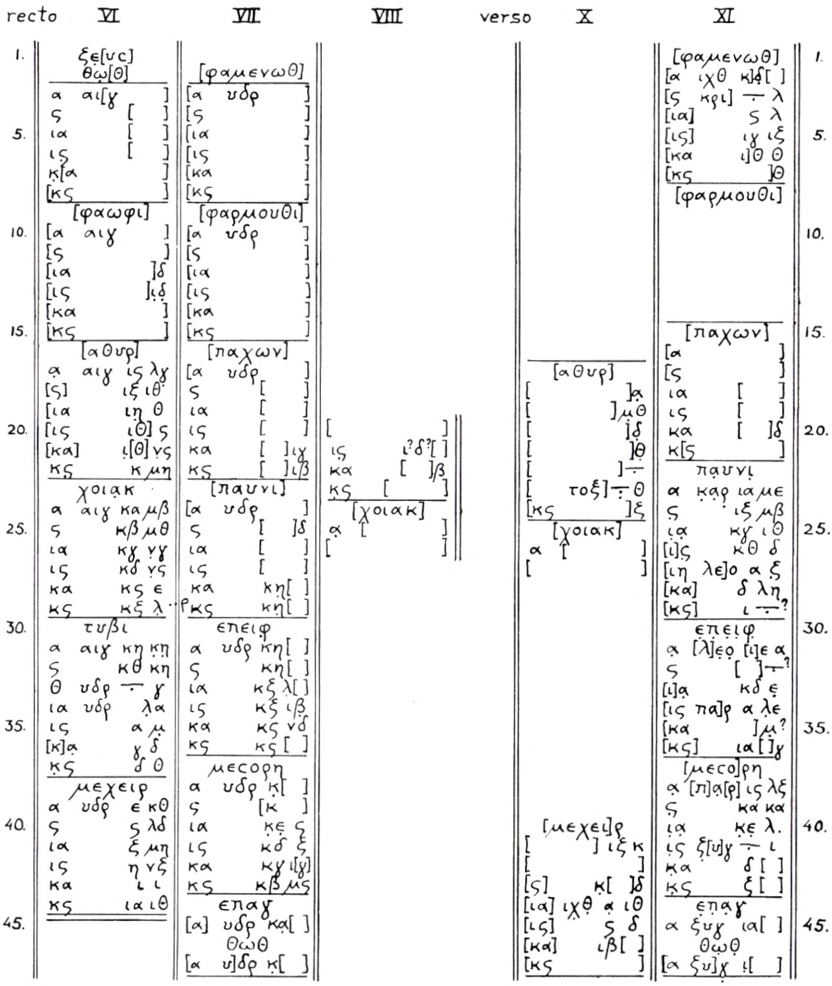
I
II
III
IV
V

Plate II



verso

XII

[ε]ρ[μηϲ]
Θω[θ]
[α] παρ δ λ
[ς] ιγ κα
ια κα μ
[ι]ς ξυγ ⏤ ια
[κ]α η λ
[κ]ς ις[ ]
φαωφι
α ξυγ κγ μ
[ς] ς[κ]ορ ⏤ μγ
[ι]α ς ιθ
[ι]ς ι λς
[κα] ιγ ις
[κς] ιγ λβ
αθυρ
α ϲκορ ια μ
ς η κδ
ια ε νε
ις δ λθ
κα ε μς
κς θ γ
χοιακ
α ϲκορ ιδ θ
[ς] κ λδ
ια κη ⏤
ιδ τοξ α η
ις ε? να
κα ιδ λα?
κς κγ λγ
λ αιγ ⏤ μγ
τυβι
α αιγ β λς
ς ια ν
ια κα δ
[ι]ς υδρ ⏤ ις
κα η ς
κς ις κς
μεχειρ
α υδρ κδ μ
ε ιχθ ⏤ λγ
ς α μγ
ια ς κα
ις [ι]α λδ
κα [ ]β
κς [ ]

XIII

ιρ?
αρ

XIV

ρα
ε?
ρ
ε?ρα
ραις
ρ
ραις
ραις
ραις
ς
η]με?ραις
η?[
]ις[

XV

φ [illegible]
σεληνοι
φ α [illegible]
φ τ Η [illegible]
[φ] [illegible]
φ θ [illegible]
φ Η [illegible]
φ Η [illegible]
φ Η [illegible]
φ Η [illegible]
φ Η [illegible]
φ [illegible]
φ [illegible]
φ Η

recto

I

[III]		
[1		]
[2		]
[3		]
[4		]
[5		]
[6		]
[7		]
[8		2]8,10
[9	♍	1]1,46
[10]		26,1?
[11	♎]	8,11?
[12		]
[13]	♏	3,37?
[14]		16,3
[15]		28,36
[16]	♐	10,40
[17]		22,30
[18]	♑	4,17
[19]		16,16
[20		28]28
[21	♒	11,]54
[22]		26
[2]3	♓	[ ]
[2]4		[ ]
[25	♈	]
[26		]
[27		]
[28		]
[29		]
[30		]
[IV]		
[1		]21
[2		]

II

[V]		
1	[♌	]
2		[ ]
3	[♍	]
4		[ ]
5		29,43
[6	♎	]
[7		2]5,5[0?
8	♏	7,58
9		21,9
10	♐	3,9
11		15,32
12		27,21
13	♑	9,[ ]
14		20,[ ]
15	♒	[ ]
16		1[0?]
17		28?[ ]
18	♓	11?[ ]
[19]		24[ ]
20	♈	7,21
21		21[ ]
22	♉	4,4?
[23]		18,25
[2]4	♊	2,32
25		16,30
26	♑	1,23
27		15,55
28	♌	0,19
29	ʼ	1[4],14
30		28,15

III

[17		]
18		[2]7,[ ]
19	[♉]	0[ ]
20		14[ ]
21		2[0?]
22	♊	1[0?]
23		2[0?]
2[4	♋	11[ ]
25		[ ]
2[6	♌	]
27		[ ]
28	[♍	]7
29		20,?10
30	[♎]	4,34
VII		
1		17,45?
2	♏	0,6
3		13,26
4		25,18
5	♐	[ ]
6		2[0?]
[7]	♑	2,1[0?
8		14,30
9		25,55?
10	♒	8
[11]		23,4
[12]	♓	5,56
13		[ ]
14		[ ]
15	♈	[ ]
16		2[0?]
17	[♉	]
18		2[0?]
[1]9	[♊	]
[20		]

IV

Saturn

I		
[1	♈]	4,37
[6		]
[11		]
[16		]
[2]1		2,5
26		1,35
II		
1	♈	1,6
6		0,40
11		0,25
16	♓	29,48
21		29,35
26		29,16
III		
1	♓	28,59
6		28,41
11		28,19
16		28,17
21		28,10
26		28,4
IV		
1	♓	27,59
6		27,58
s 11		28,7
16		28,12
21		28,20
26		28,31
V		
1	♓	28,43
6		28,59
11		29,22
16		29,40
21	♈	0,2
26		0,28
VI		
1	♈	0,46
6		1,24
11		1,56
16		2,29
21		3,3
[26		]

V

VII		
1	♈	4,10
6		4,47
11		5,28
16		6,3
[21]		6,42
26		7,2[0?
VIII		
1	♈	[ ]
6		8[ ]
11		[9,]
16		10[ ]
[2]1		10,45
[2]6		11,19
IX		
1	♈	[1]1,58
6		12,34
11		13,16
16		13,46
21		1[4],22
26		14,56
X		
1	♈	15,27
6		15,53
11		16,26
16		16,52
21		17,15
26		17,35
XI		
1	♈	17,54
6		18,11
11		18,30
16		18,41
21		18,51
26		18,57
XII		
1	♈	18,59
6		19,2
11		19,4
s 16		18,58
21		18,49
26		18,32
Epag.		
1	♈	[18]21
I		
1	♈	18,10

recto

VI — Jupiter

	I	
1	♑	[ ]
6		[ ]
11		[ ]
16		.[ ]
2[1		]
[26		]
	[II]	
[1	♑	]
[6		]
[11		]4
[16		]14
[21		]
[26		]
	[III]	
1	♑	16,33
[6]		17,19
[11		18,9
[16		19,]6
[21]		1[9,]56
26		20,48
	IV	
1	♑	21,42
6		22,49
11		23,53
16		24,56
21		26,5
26		27,30
	V	
1	♑	28,28
6		29,28
9	♒	0,3?
11	♒	?31
16		1,40?
[21]		3,4
26		4,9
	VI	
1	♒	5,29
6		6,34
11		7,48
16		8,57
21		10,10
26		11,19

VII

	[VII]	
	[VIII]	
	[IX]	
[1	♒	]
6		[ ]
11		[ ]
16		[ ]
21		[ ]13
26		[ ]12
	[X]	
[1	♒	]
6		[ ]4
11		[ ]
16		[ ]
21		28[ ]
^{5}26		28[ ]
	XI	
1	♒	28[ ]
6		28[ ]
11		27,3[0?
16		27,12?
21		26,54
26		26,[ ]
	XII	
1	♒	2[0?]
6		[ ]
11		25,6
16		24,7
21		23,1[3]
26		22,46
	Epag.	
[1]	♒	21?[ ]
	I	
[1]	♒	2[0?]

verso

X — [Venus]

	[III]	
[		]1
[		]49
[		]4
[		]9
[		],0
[	♐]	0,9
[26		]7
	[IV]	
1	[	]
[		]
	[VI]	
[	]	17,20
[		]
[6]		2[0?]4
[11]	♓	1,19
[16]		6,4
[21]		12[ ]
[26		]

XI

	[VII]	
[1	♓	2]4[ ]
[6	♈]	0,30
[11]		6,30
[16]		13,17
[21		1]9,9
[26		]9
	[VIII]	
	[IX]	
[1		]
[6		]
11		[ ]
16		[ ]
21		[ ]4
2[6		]
	X	
1	♋	11,45
6		17,42
11		23,19
[1]6		29,4
[18	♌]	1,7
[21]		4,38
[26]		10,0?
	XI	
1	[♌]	[1]5,1
6		[ ]0?
[1]1		24,5
[16]	♍	1,35
[21		]40?
[26]		11,[ ]3
	XII	
1	♍	16,37
6		21,21
11		25,3[0?
16	♎	0,10
21		4,[ ]
26		7,[ ]
	Epag.	
1	♎	11[ ]
	I	
[1	♎]	1[0?]

XII — Mercury

	I	
[1]	♍	4,30
[6]		13,21
[1]1		21,40
[1]6	♎	0,11
[2]1		8,30
[2]6		16[ ]
	II	
1	♎	2[3],40
[6]	♏	0,43
[1]1		6,19
[1]6		10,36
[21]		13,16
[26]		13,32
	III	
1	♏	11,40
6		8,24
11		5,55
16		4,39
21		5,46
26		9,3
	IV	
1	♏	• 14,9
[6]		20,34
11		28,0
14	♐	1,8
16		5?,51
21		14,31?
26		23,33
30	♑	0,43
	V	
1	♑	2,36
6		11,5[0?
11		21,4
[1]6	♒	0,16
21		8,6
26		16,26
	VI	
1	♒	24,40
5	♓	0,33
6		1,43
11		6,21
16		[1]1,34
21		[ ]2
26		[ ]

No. 34r
22.5 × 20.8 cm

No. 34 v

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