NOTES ON ASTRONOMICAL PAPYRI

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This fragment was identified by Neugebauer as part of a planetary almanac, preserving the data for Mars's motion during two consecutive years. To be more precise, it is an example of the variety of almanac that I call a "monthly almanac".[2] Unlike the more common Greco-Egyptian "sign-entry" almanacs, which record simply the computed dates when each planet was supposed to have entered a new zodiacal sign, a monthly almanac organizes the planetary positions in a tabular framework, with a row for each month of the calendar and, for each planet, a pair of columns giving a day number within the month—only traces of this column are preserved in P. Nelson—and the corresponding planetary longitude (zodiacal sign and degrees). Most of the entries in P. Nelson are sign-entries, identifiable from their longitudes of zero degrees; the remainder may be expected to refer to first or last visibilities, stationary points, or (when nothing else occurred during the month) the longitude on the first day of the month. More than one position could be recorded on a single line if, for example, a sign-entry and first visibility occurred in the same month. Analogous tabular almanacs include *P. Tebt.* II.274 (covering A.D. 107/ 108 through 115/116),[3] *P. Lund* V.35b (covering A.D. 119/120),[4] and P.S.I. inv. 75D (covering A.D. 48/49 through 51/52).[5] A similar tabular layout, but with the role of the rows and columns exchanged, was used for the planetary data in the ephemeris *P. Harris* I.60 for A.D. 140.[6]

Because only one planet's positions are preserved, and moreover most of the day numbers within the (presumably Egyptian or Alexandrian[7]) months are lost, a unique date cannot be assigned to the fragment from its astronomical contents alone. In order to determine the range of possible dates, Neugebauer applied the fact that each of the planets has so-called 'goal-year' periods, that is, intervals containing a whole number of solar years after which it will repeat approximately the same sequence of positions. Hence by inspection in Tuckerman's tables, Neugebauer found one year (8/7 B.C.) in which Mars's motion adequately matched the pattern recorded in the second year of the papyrus almanac, and then used Mars's 'goal-year' periods of 47 and 79 years to obtain other years before and after 8/7 B.C. during which Mars exhibited nearly the same positions and speeds. In this way he found nine possible dates ranging from the early first century B.C. to the middle of the second century of our era. Further comparison of the papyrus with recomputations according to modern theory narrowed the choices down to just three of these years: 8/7 B.C. (assuming that the almanac used the Egyptian calendar), and A.D. 40/41 and 87/88 (assuming the Alexandrian calendar).

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[1] C. A. Nelson, "Astronomical Table", *BASP* 7 (1970) 35-38 (with photograph); O. Neugebauer, "On a Fragment from a Planetary Table", *ZPE* 7 (1971) 267-274.

[2] For this nomenclature, see A. Jones, "A Classification of Astronomical Tables on Papyrus" in *Ancient Astronomy and Celestial Divination*, ed. N. M. Swerdlow (Chicago, forthcoming).

[3] O. Neugebauer, "Egyptian Planetary Texts", *Trans. Am. Phil. Soc.* 32.2 (1942) 210-250 and plates 1-27, esp. 241-243 and pl. 25.

[4] E. J. Knudtzon and O. Neugebauer, "Zwei astronomische Texte", *Bulletin de la Société Royale des Lettres de Lund* 1946-1947, II.

[5] M. Manfredi and O. Neugebauer, "Greek Planetary Tables from the Time of Claudius", *ZPE* 11 (1973) 101-114 and plate III. A new fragment is published in A. Jones, "Three Astronomical Tables from Tebtunis", in the present volume.

[6] A. Jones, *ZPE* 100 (1994) 59–63. Further examples of monthly almanacs and almanac-ephemerides in A. Jones, *Astronomical Papyri from Oxyrhynchus*, Memoirs of the American Philosophical Society (forthcoming).

[7] In this article the reformed civil Egyptian calendar with intercalations every four years will be called the "Alexandrian calendar", whereas the "Egyptian calendar" means only the unreformed calendar, which remained useful for astronomical applications in the Roman period.

Unfortunately, this method of extrapolating from one good match to others by means of goal-year periods missed many possible dates. Some fall between the years that Neugebauer found, because Mars also has shorter, if somewhat less accurate, recurrence periods of 15 and 32 years. And while the accumulated error in the goal-year periods causes Neugebauer's sequences to die out after the second century, other valid sequences crop up that do not extend into the first century B.C. for the same reason.

On the other hand, the almanac must once have contained headings identifying the years to which it pertains, and traces of such a heading are partially legible in the first line, in the margin above the double rule that begins the first year's table. Nelson reads this line as] θ κ [, noting that the first letter could also be read as ε. This appears to be more than a single numeral for a regnal year. In the comparable tabular almanac *P. Tebt.* II.274, however, we find the year specified as ιε L λδ (fragment d, line 14). This is to be read as "year 15 of Trajan, which is year 34 of the era Titus" (counting from Titus's first regnal year). The same double count with the era Titus is employed in a sign-entry almanac written on a wooden tablet, Bodl. MS Gr. Class. F 7(P), covering Trajan 3-5 = era Titus 22-24 (i.e. A.D. 99/100 through 101/102).[8] Assuming that the same convention was used in P. Nelson, we can restore line 1 as either] ε L κδ [or] θL κθ [so that the two years covered by the fragment would be either Trajan 5-6 (A.D. 101/102 through 102/103) or Trajan 9-10 (A.D. 105/106 through 106/107). Either reading is compatible with the traces visible in the published photograph.
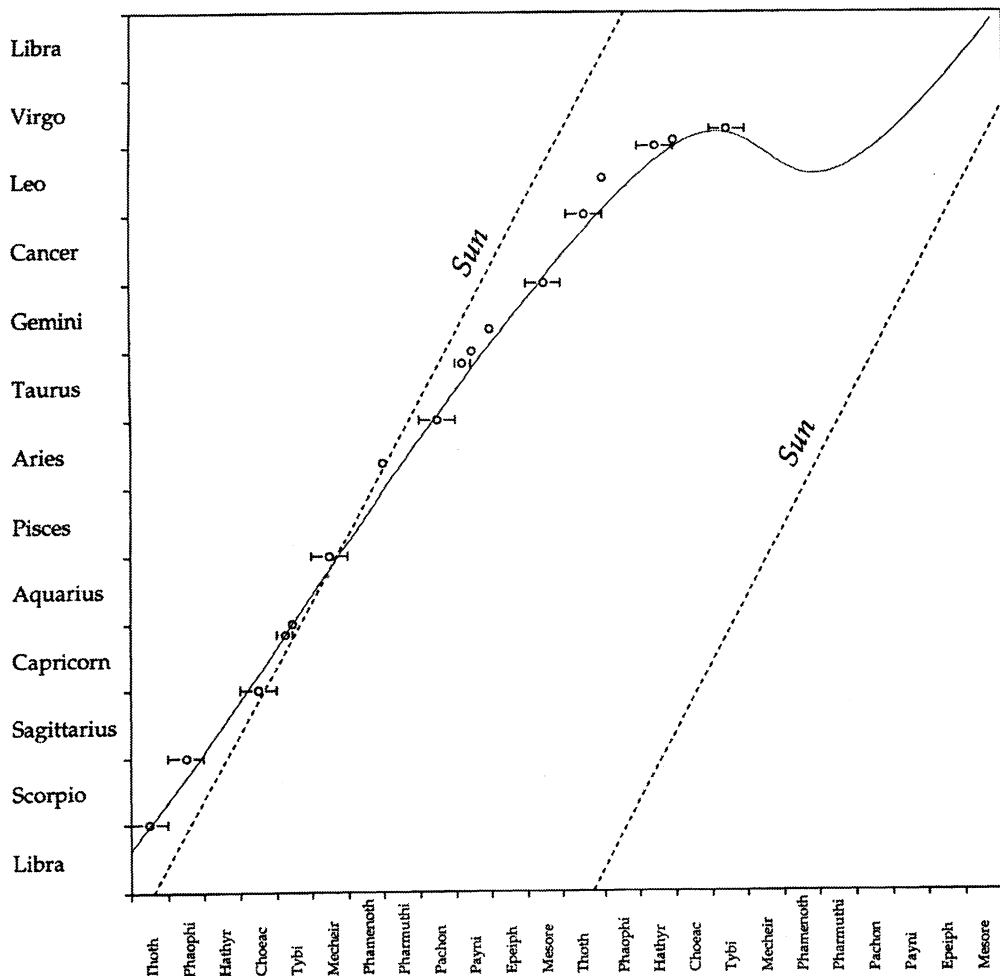

Fig. 1: Positions of Mars in the Almanac and Mars's Actual Motion in 101-103.

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[8] O. Neugebauer, "The Date of the Planetary Tables Bodleian MS. Gr. Class. F 7 (P)", *CE* 47 (1972) 224-226.

A check in Tuckerman's tables shows at once that the earlier dating satisfies one of the criteria imposed by the almanac: Mars's first station, marking the beginning of the retrogradation, falls in Virgo (152°) about the beginning of January, i.e. during the Alexandrian month Tybi.[9] In Fig. 1 I have plotted the positions recorded in the almanac (small circles, with error bars to indicate admissible ranges of dates) along with Mars's actual motion during the years 101-103. Following Neugebauer I add a constant 5° to Tuckerman's longitudes to approximate the sidereal convention of Roman-period tables. The concordance is excellent: Mars entered each zodiacal sign either during the expected month or within a day of it, a discrepancy that is well within the accuracy of ancient astronomical prediction. For the first year one can also compare the sign-entries in Bodl. MS Gr. Class. F 7(P), which has just two detectable divergences from our almanac: entry into Gemini on Payni 14 instead of Payni 15 (line 11), and entry into Cancer on Epeiph 29 instead of Mesore (line 13). Such discrepancies merely demonstrate that there was not one standard set of tables circulating among Egyptian astrologers.

With three known instances, it is now clear that the "Era Titus" was for a while a standard convention for numbering years in astronomical almanacs. The range of years covered in the three almanacs was from A.D. 99/100 (Trajan 3) or earlier to 115/116 (Trajan 19) or later, but of course the almanacs were copied after the latest regnal years that they contain—possibly even several decades later. We need not presume that the era was already in use from the beginning of Domitian's reign, although that is of course possible. Outside of this astronomical context I am not aware of any instances of the use of the Era Titus.[10] I doubt whether an era that is found only in such a specialized situation would have had a political motivation. Perhaps Titus 1 marked the initial year for some standard set of astronomical tables or computational methods on which the almanacs were based.

II. *P. Laur.* IV.144

This is a typical sign-entry almanac. For a sequence of years, the dates of entry into zodiacal signs are tabulated for each of the five planets in the standard order Saturn, Jupiter, Mars, Venus, Mercury. Each line consists of three or two numbers: the number of the month, counted from Thoth (omitted if it is the same as for the preceding entry), the day of the month, and the number of the sign, counted from Virgo. The sign occupied by a planet on Thoth 1 sometimes is given as the first entry for the year. The "recto" of the papyrus preserves parts of three columns, covering sign-entries of Venus and Mercury for three consecutive years. On the "verso", there are again parts of three columns with sign-entries for the same two planets, while the third column also has traces from the last two lines of Mars's sign-entries.

In spite of the loss of all data for the outer planets, which because of their slower progress are the most useful for establishing the date of almanacs, Neugebauer was able to establish that the sign entries of Venus and Mercury in A.D. 68/69 through 70/71 were in satisfactory agreement with the preserved sign entries of the "recto", although we shall presently see that this is not, as he believed, the unique possible dating. The "verso" is less legible because of rubbing, and from the transcription in the original edition Neugebauer concluded that there were too many errors to allow a secure dating. Reexamination suggests that at least some of these errors result from the difficulty of reading the poorly legible and

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[9] Neugebauer assumes a somewhat higher longitude for the opposition (and hence also the first station) in the almanac, because he follows Nelson in reading the longitude in line 20 as κγ. The correct reading of this line is probably η ϛ(τηριγμός), indicating first station at Virgo 8°.

[10] *P. Lond.* I.130 (No. 81 in O. Neugebauer and H. B. van Hoesen, *Greek Horoscopes*, Memoirs of the American Philosophical Society 48 (Philadelphia 1959) is a horoscope for a birthdate on April 1, A.D. 81, called the "third year of the divine Titus". Neugebauer and van Hoesen (p. 24) assert that this was later than Titus' death and hence an early example of the Era Titus; but this seems to result from a mere confusion of calendars, since Titus died in September of 81. The Alexandrian year A.D. 80/81 was correctly called Titus 3 according to the normal convention that the year of accession is the first regnal year.

ambiguous traces. I therefore give below a corrected transcription and translation of the three columns of the "verso".[11]

As it turns out, the "verso" can be dated with less ambiguity than the "recto" because it has a little of the data for Mars as well as for Venus and Mercury. Our procedure will begin by finding the years for which the sign entries of Venus are in approximate agreement with those of the papyrus; then we will use the sign entries for Mars and Mercury to reduce the number of candidates. In column iii we have a retrogradation of Venus between Pharmuthi 2 and Mesore 12, i.e. between the end of March and the beginning of August, with Venus remaining in one sign (Gemini). Because of Venus's almost exact recurrence period of five synodic cycles in eight years, one can find extended sequences of years at 8-year intervals during which such a retrogradation occurred.[12] One such sequence begins with 6/5 B.C. and ends with A.D. 43/44; the next ranges from 238/239 through 286/287.[13] No other possible sequence occurs between the beginning of the Roman period and the late fifth century. To allow for possible discrepancies between the ancient methods of computing the almanac and our recomputations, we can extend both sequences by 40 years more either way.

Our second criterion is Mars's recorded entry into Leo during the epagomenals of the same year. Allowing a five-day leeway, this never occured in the years of the first sequence, and in the second only during the years 214/215, 246/247, 278/279, and 310/312. Again in the same year, a retrogradation keeps Mercury in Capricorn between Choeac 16 and Mecheir 20. This, together with the other recorded sign entries for Mercury, is more or less compatible with Mercury's motion in 246/247 and 278/279, but not in 214/215 or 310/311.

Returning to the "recto", we note that to the left of the remains of the first column, lines 16-20, there is a blank patch of papyrus wide enough to make it almost certain that this was the original left margin of the page. Hence either the last year on the "verso" immediately preceded the first year on the "recto", or it came later by one less than twice the number of years covered by one page. Inspection of a recomputed almanac for the years following either of the two possible datings of the "verso" verifies the first hypothesis and also shows that the later dating is correct: the sign entries on the "recto" fit the motions of Venus and Mercury very well in 279/280 through 281/282, whereas in 247/248 through 249/250 Mercury's retrogradations took place too early for satisfactory agreement with the papyrus. The next possible dating for the "recto" is in each case 32 years later, which would require an implausibly capacious page width.

P. Laur. IV.144 is thus part of the outer edge of a codex page, giving dates of sign entry for the six years A.D. 276/277 through 281/282; the "verso" as identified in the original edition is actually the recto. The fragment does not provide information from which one can deduce the exact number of columns on each page; a plausible width would be about ten columns, so that the almanac when complete would have covered at least the interval from the middle of the 260s to 282. An astrologer would actually have needed tables extending backwards about a life-span in order to be able to cast horoscopes for customers of all ages.

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[11] Professor R. Pintaudi kindly took the trouble to check my transcription (based on the published photograph) against the papyrus, and suggested one or two corrections that I gratefully adopt.

[12] For this purpose I used a computer-generated almanac prepared by Mr J. Anderson for the years 30 B.C. through A.D. 470, computed using Ptolemy's *Handy Tables* together with Theon of Alexandria's formula for converting Ptolemy's tropical longitudes to sidereal longitudes.

[13] In attempting to date the "recto" Neugebauer considered only one sequence of 8-year cycles extrapolated from the early first century.

Column i

lines	Text			Translation			Recomputation		
							(Venus, A.D. 276/277)		
61a	α	]	α	1	x]	1	1	23	1
61b	β	..	β]	2	xx	2]	2	17	2
61c	γ	..	γ]	3	xx	3]	3	11	3
62	δ	ς	δ	4]	6	4	4	4	4
		κ]ζ	ε		2]7	5	4	28	5
64	ε	ι]η	ς	5	1]8	6	5	22	6
	ς	ι]	ζ	6	1]x	7	6	16	7
	ζ	..]	η	7	xx]	8	7	10	8
	η	]	θ	8	x]	9	8	4	9
68		..]	ï		xx]	10	8	29	10
	θ	..]	ια	9	xx]	11	9	25	11
	ι	..]	ιβ	10	xx]	12	10	20	12
	ια	..]	α	11	xx]	1	11	17	1
72	ιβ	..]	β	12	xx]	2	12	15	2
							(Mercury, 276/277)		
	α	α]	α	1	1]	1	1	1	1
		..]	β		xx]	2	1	13	2
	β	]	γ	2	x]	3	2	4	3

Column ii

lines	Text			Translation			Recomputation		
							(Venus, 277/278)		
77	η]	ς	[ζ	8]	6	[7	7	30	7
	θ	γ	η	9	3	8	8	25	8
		κε	θ		25	9	9	20	9
80	ï	κ	ï	10	20	10	10	15	10
	ια	ιε	ια	11	15	11	11	9	11
	ιβ	ï	ιβ	12	10	12	12	4	12
	επ	γ	α	ep	3	1	12	28	1
							(Mercury, 277/278)		
84	α	α	α	1	1	1	1	1	1
		ια	β		11	2	1	6	2
	γ	ζ	γ	3	7	3	3	13	3
	δ	δ	δ	4	4	4	4	2	4
88		κγ	ε		23	5	4	19	5

Column ii (continued)

lines	Text			Translation			Recomputation		
89	ε	ιγ	ς	5	13	6	5	7	6
	ς	η	ε	6	8	5	no reentry		
		ιη	ς		18	6	no reentry		
92	ζ	ιθ	ζ	7	19	7	7	14	7
		κη	η		28	8	8	1	8
	η	ιζ	θ	8	17	9	8	17	9
	θ	ς	ï	9	6	10	9	4	10
96	ια	ιε	ια	11	15	11	11	11	11
		λ	ιβ		30	12	11	28	12

Column iii

lines	Text			Translation			Recomputation		
							(Mars, 278/279)		
	ι[α	..	ια	1[1	xx	11	11	13	11
	επ	β	ιβ	ep	2	12	13	1	12
							(Venus, 278/279)		
100	α	α	α	1	1	1	1	1	1
		ιζ	β		17	2	1	17	2
	β	ια	γ	2	11	3	2	11	3
	γ	ε	δ	3	5	4	3	5	4
104		κη	ε		28	5	3	29	5
	δ	κγ	[ς	4	23	[6	4	23	6
	ε	ιζ	[ζ	5	17	[7	5	17	7
	ς	ια	η	6	11	8	6	13	8
108	ζ	ε	[θ	7	5	[9	7	9	9
	η	β	[ι	8	2	[10	8	10	10
	ιβ	ιβ	[ια	12	12	[11	12	17	11
							(Mercury, 278/279)		
	α	α	β	1	1	2	1	2	2
112		κβ	[α		22	[1	1	27	1
	β	ιη	[β	2	18	[2	2	13	2
	γ	η	[γ	3	8	[3	3	7	3
		κη	[δ		28	[4	3	24	4
116	δ	ις	[ε	4	16	[5	4	12	5
	ς	κ[	ς	6	2[x	6	6	20	6
	ζ	.	[ζ	7	x	[7	7	7	7

Notes to the transcription:

 61a: traces, not noted in original edition.

 76: I can see no trace from this line.

 83 and 99: *Ȣ*, a compendium representing ἐπ(αγόμεναι).

 101: a small speck at the beginning of the column, probably not intentional.

III. *P. Ant.* III.141[14]

As published by J. W. B. Barns, this text comprised three fragments, of which (i) preserves part of the top line of a column. Barns conjectured that fragment (ii) "almost certainly" joins (i), with (iii) "perhaps immediately" below. This was, however, an oversight, because the bottom line (line 36) of fragment (iii) is in fact the upper half of the top line (line 15) of (ii); the two pieces have now been joined. It still seems very probable that fragment (i) gives the top lines of the same column. Barns did not remark that the hand in the bottom five lines, i.e. lines 20–24 of the former fragment (ii), is different from the rest, which could indicate that these lines are part of an annotation rather than a continuation of the main text. The interlinear corrections may also be in this second hand.

Barns's commentary adopts an interpretation of the papyrus offered by Neugebauer, according to which the text is concerned with methods of deriving the ascendant point for a horoscope, related to a chapter in Vettius Valens, *Anthologiae* (I 4–5 in Kroll's edition, which is I 4 in Pingree's). Since in appeal to Valens there is always danger of *obscurum per obscurius*, it will be worth while to review what this chapter is about.

The ascendant is the point of the ecliptic (or zodiac) rising at the moment in question, and although it is usually an item of astrological significance, there is a legitimate astronomical method of determining it. After finding the point of the celestial equator that always rises (for an observer on a particular terrestrial latitude) simultaneously with the point of the ecliptic occupied by the sun, one counts off 15° eastwards for every hour elapsed since sunrise. The point of the ecliptic corresponding to this equatorial point is the ascendant.

In the chapter in question, Valens presents us with ten or so methods of finding the ascendant. The fourth one (Pingree §8) appears to be a terse statement of the correct rule.[15] All the rest are false rules. Some are wholly fictitious, and would only by accident or "fudging" yield a result close to the true ascendant for a particular date and time; others at least prescribe counting off from the sun's position a number of degrees in the neighbourhood of 15° per hour since sunrise, either along the equator or along the ecliptic. The entire chapter has come down to us marred by corruptions, transpositions, and possibly interpolations.

Neugebauer likened the contents of *P. Ant.* III.141 to passages in Valens' chapter that concern the computation of certain numbers called "gnomons" that are supposed to provide a test according to which the given time for a horoscope can be corrected either way by a fraction of an hour.[16] On the other hand, the verbal parallels cited in the notes belong to others among Valens' many rules. Since there seems to be no way to join up these isolated resemblances into a coherent procedure, and, what is more, the preserved text has no recognizable allusion to the ascendant, it seems likely that Neugebauer was on the wrong track.

In fact there is reason to suspect that the papyrus is not really astrological at all, but rather a description, with examples, of a method of calculating the longitude of the moon for a given date. Such a result is pretty clearly obtained in lines 32–35 + 15–16, one of the few passages where an almost unbroken text can be read. Unfortunately many of the steps that precede and follow these lines remain ob-

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[14] I wish to thank Dr R. A. Coles for checking and correcting my revisions to this papyrus.

[15] It is correct if "counting off degrees πρὸς ἀναφοράν" implies adding to the oblique ascension and converting back to ecliptic longitude.

[16] Similarly in O. Neugebauer and H. B. van Hoesen, "Astrological Papyri and Ostraca: Bibliographical Notes", *Proceedings of the American Philosophical Society* 108 (1964) 57–72, esp. 58.

scure, but it is possible that the discovery of new papyri may eventually cast some further light on this one, as has happened before now for several other astronomical papyri. In the meantime, I append some supplementary notes in the hope that they may help someone else to recover the meaning of this difficult text.

fr. 1.1. If the restoration τετραετ]ηρίδοc is correct, we are dealing with a procedure, or tables, based on a calendar with 365 days and an intercalary day every fourth year, probably the Alexandrian calendar. See on line 23 below.

2. The transcription should be corrected to read,]υιδ̅ εἰc ιε ιφ̅ ι αι ει .[. This is surely a dating formula, "hour 10 of the night of the 14th into the 15th", but it is difficult to make sense of the upsilon at the beginning of the line where we expect the name of the month.

3–4. The symbol ϛ′ that follows numerals in line 4 and several subsequent lines may simply be an optional "numeral marker" rather than a sign for one half. If one assumes an approximate mean progress of the moon of 13° 10' per day, then the motion per equinoctial hour would be 32' 55", and the motion in 14 hours would be 7° 40'. It is not so obvious where the 14 hours themselves come from, however. The number is too large to represent the equivalent in equinoctial hours of 10 seasonal hours of night for any plausible terrestrial latitude. While it is true, as Neugebauer points out, that the longest night of the year for the latitude of Alexandria (and effectively the rest of Egypt) was traditionally taken to be 14 equinoctial hours, one has difficulty seeing how this datum could be applied in the present context. The best explanation I can offer is that the 14 hours is supposed to be the time interval in (equinoctial) hours from the tenth hour of night to the *following* sunset, and hence the 7° 40' is the moon's progress during that time. Perhaps the number of hours was obtained by simply subtracting ten hours from 24, thus disregarding the deviation between seasonal and equinoctial hours. I would tentatively restore the end of line 4 as ταύταc ἀ[πόγραψαι, instructing one to register an interim result.

5–7. The beginning of line 6 may read,]κϛ̅. I am not sure what this number represents, but it is probably related in some way to the number of days (from the date in line 2?) to a given date for a horoscope. This result, or something based on it, is registered as an interim result at the end of line 7. I am not sure of what is being done in lines 8–14 (for a conjecture, see below following these notes).

26. On physical grounds this line cannot preserve the beginning of line 14 of fr. i. The operations down to line 30, the last part of which has been badly garbled by the scribe, are again uncertain.

31–34. A totalling up of interim results. Whatever number was arrived at by the beginning of line 31 is added to a previously recorded 2° 50', and the sum is then added to the 7° 40' of motion corresponding to 14 hours, which had been found above in line 4. In line 33, perhaps read cυν αἷc .

34–35 + fr. ii, 15–17. The first numeral in line 35 should be read as ιε̅ and the following line (combining fr. iii 36 and fr. ii 15) becomes]ε̂ε̂δ' ἂν καταλήξῃ ὁ [cυν]καταριθ[. I would also read the end of line 16 as τοcούτω⟨ν⟩ Μ̅ [. The total obtained in the last step, which seems not to be given outright in the preserved text, is a number of degrees to be "counted off", i.e. added, to the end of the fifteenth degree (or equivalently the beginning of the sixteenth degree) of Cancer. The result is the position of the moon, apparently at sunset of the day in question. Sentences on the model of ὅπου δ' ἂν καταλήξῃ ὁ ἀριθμός, ἐκεῖ ἔcται ὁ ἀcτήρ are frequent in Vettius Valens, Paulus Alexandrinus, and similar instructional texts.

17–18. One is supposed to do likewise for (the rest of?) something, "until it is completed". [τῆc τετραετηρ]ίδοc seems too long for the available space. Could the broken word be cελ]ίδοc, meaning a column of a table? This would make sense if one were generating an ephemeris of lunar positions on consecutive days, but it would seem to conflict with the "day of geniture" of line 5.

18–19. The text offers a test or criterion, or perhaps merely a method of computation (Valens often uses κριθήc[εται in this sense), for what is not clear.

20–24. These lines, for which the hand is different, may be a marginal note or supplement rather than the continuation of the preceding text. I can make little of lines 20–22 (although I suspect that the symbol ♄´ in line 22 is not the numeral ζ but a compendium for a word like ἀριθμόν). As Neugebauer noted, 129° 22' in line 23 is the moon's mean progress in one Egyptian year of 365 days, and this would make sense if we are dealing with computations or a table involving the Egyptian calendar. In line 24 one can possibly read the numeral towards the end of the line as ρλβ although the identity of the middle digit is doubtful. This could be the whole number part of the progress in 365 days corrected somehow for anomaly, or of the mean progress in a solar year of 365¼ days (approximately 132° 40').

Very hesitantly, I would suggest that the computation of the moon's position was carried out in the following way. One began with a conjunction or full moon, for which one knew by other means (e.g. from a table) the date and time and the positions of the sun and moon. In the particular example, we may be dealing with a conjunction that was supposed to have occurred on Epeiph 15/16 (July 9/10) at the tenth hour of night, with the sun and moon at approximately Cancer 16°. One can then calculate the moon's position at the following sunset, on the assumption of progress at mean speed, by adding a quantity proportional to the number of hours remaining in the day (7° 40' in the example); similarly, one

would add a quantity (2° 50' in the example) proportional to the number of days between this date and a given later date in order to obtain the moon's position on the given date, still assuming mean progress.

This position would then have to be adjusted to take into account the variations in the moon's speed, and this, I believe, is what is being done in lines 8–14 and 26–30. The procedure would likely involve breaking up the time elapsed between the starting date and the given date into three parts: a middle interval comprising a whole number of periods of the moon's anomaly (about 27½ days, during which the moon's overall speed is equal to its mean speed) and intervals shorter than a period of anomaly at the beginning and the end. The 12 and 14 days mentioned in these lines would refer to these flanking intervals, for which a correction in the moon's position would have to be found.

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