

GYMNASIUM DEBTS AND NEW MOONS

By ERIC G. TURNER, M.A.

READER IN PAPYROLOGY IN THE UNIVERSITY OF LONDON

AND

OTTO NEUGEBAUER, PH.D., LL.D.

PROFESSOR OF THE HISTORY OF MATHEMATICS, BROWN UNIVERSITY.

Philadelphia, Arsinoite nome (?)

Height, 15 cm.

October, 180 B.C.

The papyrus here published (P. Ryl. Inv. 666) is of considerable interest for its information on Greek astronomy in the early second century B.C., and is therefore presented in the BULLETIN, on the invitation of the late Dr. Guppy, in advance of its appearance in the fourth volume of the Catalogue of Papyri.¹

The papyrus consists of seven fragments from a roll. On the recto the surviving first eight columns, the work of one hand but with corrections and marginal notes by a second, form part of an account of moneys due for recovery; beginning at col. ix another hand has set out the method for finding 'lunar' new moons and drawn up a table of equivalents. The verso was later used for an account arranged by days of the month, of which parts of 15 columns can be traced, but the writing is mainly effaced. The following may serve as a specimen of it, col. iii (4th hand) :

¹ προήρηκε Ἀπολλώνιος ² ἀπὸ τῶν εἴκοσι πέντε ³ ἀρταβῶν πέντε
λο(ιπὸν) κα (sic).

From internal evidence the date is 180 B.C., about October. The names which figure in recto cols. i-viii strongly suggest

¹ I take responsibility for § 1 of introduction, text, restorations, translation and commentary; § 2 of the introduction is by Professor Neugebauer. But there has been a fruitful give and take of ideas and queries. Mr. T. C. Skeat, in calling to my attention Professor Neugebauer's paper in *Quellen und Studien z. Gesch. der Mathematik*, 1938, acted as a *pronuba* to our union. I am grateful to him also for other assistance, especially for information about names found at Philadelphia. Some suggestions have been contributed by Sir Idris Bell and Mr. C. H. Roberts.—E.G.T.

Philadelphia as provenance: Euphron, Perdikkas, Kleitorios, Artemon and the very rare Ambilaos all occur in the Ptolemaic ostraca from Philadelphia published in *B.G.U.*, vii, while Ptolemarchos appears in *P. Frib.*, 34, also from Philadelphia, and there is also a Zenon who may be descended from his more famous namesake. The attribution to Philadelphia¹ is supported by the consideration that other papyri forming part of the same purchase for the Rylands Library (e.g., the Vineyard Lease published in *BULLETIN*, vol. 31 (1948), 148), are shown by internal evidence to come from there.

§ 1

The first eight columns on the recto deal with debts due for recovery (a *πρακτορεία* list? cf. *πρᾶξον* in l. 22 and often). On the debts in money, interest is charged at 2 per cent. per month, and the first five columns are occupied by a computation of interest for five months, while the grand total in l. 54 shows that the computation in its complete state covered a six months' period. It appears that the list covered the second half of the Egyptian year 181-180 B.C., and was probably drawn up in Thoth of 180 B.C. (compare l. 16, bad debts for the "24th year", i.e. of Epiphanes, and col. ix; also l. 1 of marginal entry at edge of col. viii). The computation then proceeds, after one deduction, perhaps of an amount already paid, to enumerate other debts: (1) various debts due in money, (2) quantities of oil, (3) 'common' or 'club' monies ([ἐ]πίκοινα χρήματα, l. 85) which appear to be the principal sums on which interest has been charged in the first five columns. If this is correct, the account is of sums due to a society or association (*σύννοδος*),² and certain entries point to its being a gymnasium.³ The most important of these is the

¹ All the gods mentioned in frag. vii are known to have been worshipped in Philadelphia (Cf. Préaux, *Les Grecs en Égypte*, p. 71).

² The possibly philanthropic use of 'club' moneys on loan is reminiscent of *ἔρανος* societies (cf. San Nicolò, *Aegypt. Vereinswesen*, i. 212 ff.) in which, however, no interest is charged for the *ἔρανος*.

³ See in general T. A. Brady, *The gymnasium in Ptolemaic Egypt*, *Univ. Missouri Studies*, 11 (1936), 9 ff.; and for the gymnasium in Philadelphia in the third century B.C. *PSI*, 391 (Zenon archive); at a slightly later date than this in second century, *BGU*, 1256.

entry in ll. 61-63 *πρᾶξον δὲ καὶ τ[οῦ]ς κεχρικότας ξένου[ς]* (see note *ad loc.*), while the mention of a funeral feast in l. 68 and reference elsewhere (l. 16; 75 ff.) to amounts due in oil support this view. Further weight is given to it by the fact that the names, with the exception of the Persian Arsaces and Egyptian Sarapammon (only marginal note in col. viii) are Greek or Macedonian throughout.

§ 2

The introduction to the astronomical section of this papyrus refers to the first year of Ptolemy VI, Philometor, thus to the time of 180 B.C. The scarcity of information on Greek astronomy before the *Almagest* lends special interest to any document from this early period. The introduction also mentions as the main contents of the text the determination of the character of lunar months by means of a 25-year cycle which states that

25 Egyptian years = 309 synodic months = 9,125 days.

The use of this cycle is well-known from the *Almagest* in which it forms the basis for the computation of the mean syzygies.¹ Only in recent years, however, has its importance for ancient astronomy become fully evident with the deciphering of the Demotic *P. Carlsberg*, 9.² Here the 25-year cycle for the first time was seen to be associated with contemporary starting points, the earliest of which was Tiberius 6 (= Augustus 49), the latest, Antoninus 8 (= Augustus 174). Since then it has been recognised that *P. Ryl.*, 27, also utilises the same cycle, extending its use from Cleopatra 21 (= Augustus - 1) to the time of Gallus (Augustus 282). At the same time it has become clear³ that *P. Lund*, 35a, also is based on the same method as *P. Ryl.*, 27, covering at least the years from Nero 6 to Trajan 12. Our present text shows that the 25-year cycle goes back to the early second century B.C. Other elements in *P. Ryl.*, 27 and *P. Lund*, 35a are known from

¹ Book VI, chapters 2 and 3. The epoch is the year Nabonassar 1.

² Neugebauer-Volten, *Quellen u. Studien z. Gesch. d. Math.*, sec. B, vol. 4 (1938) pp. 383-406.

³ This will be shown in a forthcoming publication of the Danish Academy, *Hist.-filol. Medd.* 32, 2 (1949).

Babylonian astronomical texts of the Seleucid period.¹ The 25-year cycle, however, must have its origin in Egypt because it holds only for the Egyptian anni vagi of 365 days each. The importance of a real lunar calendar has become increasingly evident² for all periods of Egyptian history. Parker has given good arguments for assuming that the scheme of P. Carlsberg 9 was invented in the fourth century B.C. Whether we should seek Greek influence here or not remains a matter of mere speculation.

Before discussing in detail the relation of our new text to the 25-year cycle, we shall investigate the relation between Egyptian months and the signs of the zodiac, given in col. x. Obviously any fixed relation between 30-day months and zodiacal signs can be no more than approximately correct not only because the sun travels less than 360° in 360 days but also because the solar movement is slower near the apogee in Gemini and faster at the perigee in Sagittarius.³ But aside from these small corrections, the months of the Egyptian calendar change their position with respect to the seasons comparatively so rapidly that a co-ordination of months and zodiacal signs can have only a very limited validity. Thus it is rather surprising to find a list as given in col. x in a text which on the other hand is concerned with a 25-year cycle, when the beginning of an Egyptian month moves back about 6° in a simple cycle. Yet a somewhat similar observation can be made for another astronomical papyrus of the same period, the so-called "Eudoxus papyrus", *P. Par.*, 1. In the latter papyrus, it is stated⁴ that, according to Eudoxus and Democritus, the winter solstice falls on Hathyr 20 or 19. This statement is certainly wrong for the period of Eudoxus but leads to agreement for about 185 B.C. Similarly, *P. Hibeh*, 27, gives fixed dates for the equinoxes and the summer solstice leading to a date of about

¹ Knudtzon-Neugebauer, *Bull. Soc. R. des Lettres de Lund*, 1946-1947, ii, p. 81.

² An exhaustive study of the Egyptian calendar by R. A. Parker is to be published soon in Chicago.

³ Nevertheless the association of months and zodiacal signs is very common in all calendars of a luni-solar character. An extreme case is the calendar of Dionysius (time of Philadelphus) where the months are named after the signs of the zodiac. Cf. *Pauly-Wissowa, RE*, 5, 991 (No. 143). Cf. also *P. Oxy.*, 465.

⁴ XXII, 21 ff., ed. Blass.

300 B.C.¹ Thus we have to accept the fact that correlations between the zodiac and the wandering year were not considered without value in spite of their short-lived character.

As in the cases just quoted, we must ask ourselves when the month of Thoth coincides with the sign of Scorpio as required by our text. If one computes the longitude of the sun for Thoth 1 from -200 to -169 one finds values decreasing from Libra 16 to Libra 9. This apparent disagreement with the statement of our text can be resolved by introducing Eudoxus's norm for the division of the zodiac. As is known, e.g., from Hipparchus,² Eudoxus called the vernal point Aries 15. Consequently in his system one would call the above-mentioned interval "Scorpio 1 to Libra 24". For the years around 180 B.C. one would obtain Libra 27 or 26 for the longitude of the sun at the first of Thoth. Thus it is fairly correct when our text identifies Thoth and Scorpio using the norm of Eudoxus, for the zodiacal signs. The same norm is used in *P. Hibeh*, 27.

We now can turn to the discussion of the 25-year cycle. We know from *P. Carlsberg*, 9, that a starting point of a cycle was Tiberius 6, Thoth 1. The corresponding Julian date is A.D. 19, Aug. 19. Eight cycles earlier, we find for the first of Thoth the date -181 ,³ Oct. 8. Our papyrus states that the first year of the cycle is "the same as the first year as reckoned by . . . Philometor, etc.". Now Philometor succeeded to the throne in summer -179 (see note on line 108) and his first year in the Egyptian reckoning, which we believe to be the only one worth taking into account here, ran from the date of his accession to -179 , Thoth 1, but could retrospectively be regarded as extending back to -180 , Thoth 1. This fictitious retrospective extension we hold to be intended, and to be indicated by the unusually circumstantial description of the year. This makes the first year of the cycle run from -180 to -179 . In other words, the years of the 25-year cycle are counted in the

¹ The accuracy of computations of this type should not be over-estimated. An error of ± 2 days in the determination of the equinoxes corresponds to an uncertainty of about ± 8 years in the date.

² Cf., e.g., J. G. Smyly ad *P. Hibeh*, 27, p. 141.

³ Astronomical notation which inserts a zero between A.D. 1 and 1 B.C. is used here. In historical notation -181 is equivalent to 182 B.C.

same way as Philometor's regnal years while his first year would coincide with the second year of the norm adopted by *P. Carlsberg*, 9. Because any year in a periodically repeating scheme can be considered as the "first" year of the cycle the only essential point to investigate is the agreement of the dates of the new moons.

P. Carlsberg, 9, gives a cyclic scheme for lunar phenomena of the following type. We indicate by the columns i to xii the twelve months of the Egyptian civil year. Each column contains 25 lines for the consecutive years of the cycle. For our present purpose it suffices to reproduce the scheme for the first three years only ¹ :

	i	ii	iii	iv	v	vi	vii	viii	ix	x	xi	xii
1	.	1	.	30	.	29	.	28	.	27	.	26
2	.	20	.	19	.	18	.	17	.	16	.	15
3	.	9	.	8	.	7	.	6	.	5	.	4

The meaning of this scheme is obvious. In general two consecutive entries (e.g., in the first year, iv, 30 and vi, 29) are two times $29\frac{1}{2}$ days apart. Occasionally, however (e.g. ii, 1 and iv, 30 of year 1), twice $29\frac{1}{2}$ days plus 30 days lie between two entries. A civil year of this type obviously participates in 13 lunar months.² And it can be shown that the complete scheme contains exactly 309 lunar months totalling 9,125 days.

It also can be shown from the dates in *P. Carlsberg*, 9, that they correspond to new moons. Thus our scheme has to be interpreted in the following way. If in the first year of a cycle the new moon will be first visible on ii, 1, then iv, 30 will be again a new moon, etc.

Many questions arise in connection with this scheme. First of all one must inquire about the date which should be adopted for the months where no dates are given. Parker tried to restore a definite rule for the missing entries by means of attested double dates.³ We shall see that our present text can be restored in such a way that the same sequence of hollow and full months is obtained for the beginning of year 2 and of year 3 of the cycle.

¹ For the complete scheme cf. Neugebauer-Volten, quoted in note p. 82.

² Years of this type were called "great years".

³ Parker (cf. note p. 83), Chapter II.

Another question concerns the exact lunar phenomenon which was meant to be found in our text. In line 125 we read *αἱ δὲ κατὰ σ[ελήνην νομην]ῆναι*. The addition of *κατὰ σελήνην* obviously means that we are dealing here with phenomena of the real lunar calendar, in contrast to any civil calendar which is not regulated (either directly through observation or indirectly by computation) by the real moon. Thus the first day of an Egyptian month may be called *νομηνία* though it be without relation to any lunar phenomenon, whereas *νομηνία κατὰ σελήνην* must mean the first day of a real lunar month,¹ where "real" is to be understood as guaranteed by cyclic computation. Actually, however, this method of computing accumulated an error of about .048 days each cycle because 309 mean synodic months are this amount shorter than 9,125 days. Because the dates in *P. Carlsberg, 9*, agree quite closely with first visibility for the cycle beginning in A.D. 144, a cycle beginning about 180 B.C. should show a lag of about one-half day. Nevertheless the agreement will still be good enough to interpret the dates in question as the dates of first evening visibility of the new crescent. This is exactly what one would expect to be the meaning of *νομηνία κατὰ σελήνην*.

We can now return to our remark that the month Thoth in line 127 refers to the first year of Philometor and to the second year of a cycle. For such a year *P. Carlsberg, 9*, would give

. 20 . 19

whereas we find in our text in col. x

20 19 19 19.

Because the cyclic year shows no other year with 19 in the 4th place and only for year 16 a 19 in the second place (followed by 18 in the 4th), it is evident that we must consider the entry in our text a modification of the scheme for the second year. On this basis the year numbers have been restored in lines 126, 139, etc.

¹ Our papyrus disproves the assumption of the editors of *P. Hibeh, 27*, that *κατὰ σελήνην* does not imply "any real reference to the moon" (p. 152). It must be admitted, however, that it is often difficult to establish the exact astronomical significance of this expression. As far as the Athenian calendar is concerned cf. Pritchett-Neugebauer, *Calendars of Athens*, pp. 12 ff. The term also occurs in horoscopes from Dura, *Report IV*, Nos. 220 and 236 (third century A.D.).

As is seen from column xi our text explicitly indicated whether a month was full or hollow. The number of days mentioned must mean the number of days in the month whose beginning date is given in the same line. Unfortunately no more dates are preserved after column x. If we assume for the third year the same modification of dates of the Carlsberg cycle as in the second year we obtain the following information from cols. x and xi of our text

Year of Carlsberg Cycle	i	ii	iii	iv	v	vi	vii	viii	ix	x	xi	xii
2	20	19	19	19	?							
	(29)	(30)	(30)	?	?							
3	(9)	(8)	(8)	(8)	(7)	(7)	(6)	(6)	(5)	(5)	(4)	(4)
	29	30	30	29	30	29	30	29	30	(29)	(30)	

This shows that month i is hollow in both years and similarly that the months ii and iii are full in year 2 and in year 3. It must be emphasised, however, that this conclusion is based on the assumption that we placed correctly the fragment on which the number of days are written. If this fragment belongs to a later column, no conclusions at all are possible.

We must finally discuss the size and purpose of our text. It is plausible to assume that a complete list of 25 years was given. This would require about 1½ metres of additional text. The “unplaced fragment” can only be placed after the list of months. Column ix is written across an original join in the papyrus. The presence of the astronomical text, therefore, is not due to the accidental make up of a roll from “waste” paper to carry the accounts on the verso.

The mention of Hermes, Demeter, Hephaistos together with “new moon” points to a calendar of festivals, analogous to *P. Hibeh*, 27. Perhaps this calendar gives the motivation for the combination of a scheme for lunar months with the business account of the Gymnasium. Hermes and Demeter might properly be objects of gymnasium worship, but Hephaistos is not so easy to account for.

Column 1 (Fragment i)

Parts of 3 lines

	Ἄρσά[κη]ν	(ταλ.) [α]	(δραχμὰς)	ρκ
5	Πτ[ολ]έμ[αρχ]ον	[(ταλ.) α	(δρ.)	ρκ
	Εὐ[φ]ρονα	(ταλ.) α	(δρ.)	ρ[κ]
	Πτολεμαῖον Περδίκ(κου)	ἸΒ	(δρ.)	μ
	ἄλλω[ς] διὰ Μ[ε]νεκράτ[ο]υ	ἸΓ	(δρ.)	[ξ]
	Μενεκ[ρ]άτην	ἸΓ	(δρ.)	ξ
10	Τρύφω[ν]α Κλειτορίου	ἸΑ	(δρ.)	κ
	Χιων[ί]δην	(δρ.) ρ	(δρ.)	β
	(γίνεται) τόκος	φμβ		

Column 2

	[6] Φαρμοῦ[θι			
	[6].			
15	[2?]νη[ν τ]ιμὴν τ[ῆς σ]τά-			
	θμης ἐλαίου κδ (ἔτους)			πε
	Ἄθη[ν]όδωρον καὶ Ἀρτέμωνα			μ
ζ(ητηῆσον)	Διοσκουρ[ί]δην	β ⁻	(δρ.)	ι
	Κράτην	α		ε
20	Πτολεμαῖον Ἀμβ(ιλάου)	α		ε (γίνονται) ρμε
	(γίνονται) τῆς διμήνου Ἀυκθ			
	πρ[ᾶ]ξον δὲ καὶ τοῦ Παχών			
	Ἄρσάκην	(ταλ.) α		ρκ

Column 3

	Π[τολέμ]αρχ[ο]ν	(ταλ.) α		ρκ
25	Εὐ[φ]ρων	(ταλ.) α		ρκ
	Πτολεμαῖον Περ(δίκκου)	ἸΕ		ρ
	Τρύφωνα Κλειτο(ρίου)	ἸΑ		κ
	Χιωνίδην	ρ		β
	(γίνεται) τόκος	υπβ		
30	Παῦνι			
	Ἄρσάκην	(ταλ.) α		ρκ
	Πτολέμαρχον	(ταλ.) α		ρκ
	Εὐφρονα	ἸΓ		ξ
	Πτολεμαῖον Περ(δίκκου)	ἸΕ		ρ
35	Τρύφω[ν]α	ἸΑ		κ

25 read Εὐφρονα

Column 4 (Fragment ii)

	Χιωνίδην	[ρ.] (δρ.)	β
	(γίνεται) τόκος	[υ]κβ	
	Ἐπεὶφ		
	Ἄρσάκην	(ταλ.) α	ρκ
40	Πτο[λ]έμαρχ[ο]ν	(ταλ.) α	ρκ
	Ε[ϋ]φρονα	Ἶ	ξ
	Πτολεμαῖον	Περ(δίκκου)	Ἶ
	Τρύφωνα	Κλει(τορίου)	Ἶ
	Χιωνίδην	ρ	β
45	(γίνεται) τόκος	υκβ	

Column 5

	[Μεσορ]ῆ ὁμ[οί]ως		
	Ἄρσάκην	(ταλ.) α	ρκ
	Πτ[ο]λέμαρχον	(ταλ.) α	ρκ
	Εϋφρονα	Ἶ	ξ
50	Πτολεμα[ῖον Π]ερ(δίκκου)	Ἶ	ρ
	[Τ]ρύφων[α Κ]λειτο(ρίου)	Ἶ	κ
	Χιωνί[δ]ην	ρ	β
	(γίνεται) τόκ[ο]ς	υκβ	
	(γίνονται) τόκου	Ἶ	βωλβ
55	διὰ Εὐμ(ένους) στήθμης καὶ		
	ἔκτων	ρμε	

Column 6

	(γίνονται) Ἶ	ΒΤ[οζ]
	ἱερεῖς	δεδωκώς
	Ζήνων[ι ἔ]ως	
60	[Πα]χὼν	Τ[ο]
	λο(ιπὸν)	Ἶ
	Πρᾶξον δὲ καὶ τ[οῦ]ς κε-	
	χρικότας ξένου[ς]	ἀπὸ
	Παχὼν ἅ ἀν[ὰ λ]όγ(ον)	
65	λ	ρν
	Δαβρέαν καὶ Σέ[λευκον (?)]	
	περιλειμμ[άτων κ]	
	61 λο(ιπὸν) :	ο Παρ.

Column 7 (Fragment iii)

Περ[ι]δείπνου τῆς Ἐστιεί[ο]υ
ἀδελφῆς πζ

70 Ἀ[πολ]λοφάνη[ν] ἐν Κρο-
κοδίλων Π[ό]λει ψη
(γίνονται) τλε (γίνονται) Ἰτμβ

Ζήνω^{α[...]}κεῖ [ν]ι Φανο() [...].. [...] Πτολεμ[αῖον(?)] . των
εν. [...].. [...]ηνησ[.....ἔ]κατοστῶν [] [...]δαμι..

χα(λκοῖ) ψη

75 Π[ρᾶ]ξον δὲ καὶ τοὺς ὀφε[ί-]
[λο]ντας ἐλαί[ο]υ (γίνονται) Ἰκ
λο(ιπὸν)..

Μενεκ[ρᾶ]την ἐλαίου
κο(τύλας) ι[.] (τέταρτον)

Πτολεμ[αῖο]ν Ἀμβιλίου

80 ὑδρ[ί]αν α⁻ κο(τύλας) κ

Column 8 (Fragment iv)

[Ἀ]πολλοφάνη ὑδρ[ί]ας .⁻ κο(τύλας) ς (τέταρτον)

[...]ρραμην ὑδ(ρίας) . κο(τύλην) α

[4-5] . εα [ὑ]δ(ρίας) η κο(τύλας) δ []

πρᾶξον δὲ καὶ [το]ὺς ὀφείλ[ο]ντας

85 [ἔ]πίκοινα χρήματα

(2nd Hand)-ιβ Θωὺθ

Ἀρσά[κη]ν (ταλ.) α

Πτολέμαρχον (ταλ.) [α]

Εὐφρονα Ἰ

[Π]το[λεμ]αῖον Περ(δίκκου). Ἰ

90 Τρύφ[ω]να [Ἀ]

[Χιω]ν[ίδην] (δρ.) ρ

(γίνονται) τάλαντα γ Ἰγρ

ἀπέ[χ]ει Ζήνων
ἄς π[ρ]οσοφειλη-
σα πρὸς τὴν
πρακτορίαν 5

Ἀπολλοφάνου

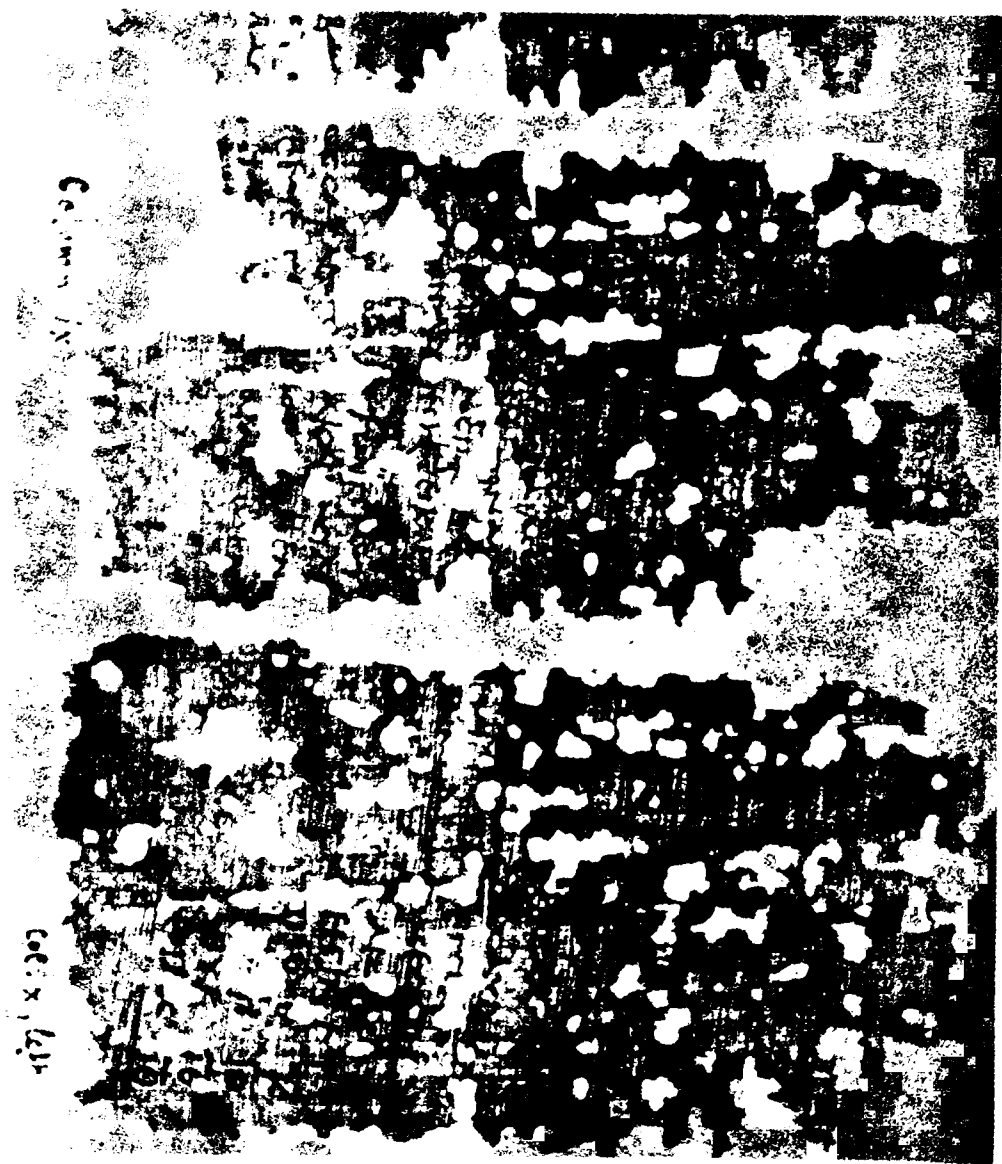
(δρ.) []

Σαραπάμμω-

νι[] (ταλ.) . β

(γίνονται) τν 10

line 3 read προσωφείλησα



Column 9

Column 10

P. RYL. INV. 666 FRAGMENT IV COLUMNS 9 AND 10 (REDUCED 1/2)

Column 9 (3rd Hand)

- [Βασιλε]υό[ν]των [βασι]λίσσης [Κλεοπάτρα]ς
 [καὶ βασι]λέως Πτ[ολε]μαίου το[ῦ υἱοῦ θε]ῶν
 Ἐπ[ιφ]ανῶν ἔτους α. παράπ[ηγμα τ]ῶν
 95 κατ[ὰ σ]ελήνην νομηنيῶ[ν ὡς εἰσι κ]α-
 τὰ [τὰς ἡ]μέρας τῶ[ν] κατ' Αἰγυπ[τίους δωδε]κα-
 μή[νω]ν τεταγμένοι, οὗ ἐστὶν ἡ π[ερ]ίο-
 δ[ος ἔ]τη μὲν εἴκ[ο]σι πέν^{τε}, μῆνες δ[ὲ σ]ὺν
 ἐμβ[ο]λίμ[ο]ις τριακόσιοι ἐννέα, ἡμέρ[αι] δὲ
 100 ἐν[ακ]ισχ[ίλ]ιαὶ ἑκατὸν εἴκ[ο]σι πέντε. [σ]η-
 μαί[νε]ι δὲ καὶ τοὺς κατὰ σελήνην μῆ-
 νας καὶ τούτων τίνες ἡσὶ πλήρη[ς] κ[αὶ] τίνες
 κοῖλ[οι κ]αὶ π[ο]ίο[ι] αὐτῶν ἐμβόλιμοι κα[ὶ ἐ]ν τίνι
 ζω[ιδί]ωι ἡλι[ο]ς καθ' ἕκαστον μῆν[α στή]σεται.
 105 ὄ[ταν] διέλθει τὰ εἴκοσι πέ[ν]τε ἔ[τη] πάλιν
 ἐπ[ὶ τῆ]ν αὐτὴν ἀρχὴν ἡξει καὶ τὸ[ν α]ὐτὸν
 τρόπ[ο]ν ἀλ[λάξ]εται. ἔστιν δὲ πρῶ[το]ν ἔτος
 τῆς περιόδου [τ]ὸ αὐτὸ τῶι πρώτῳ[ι] ὡς
 βασίλισσα Κλεοπάτ[ρ]α καὶ βασιλεὺ[ς Π]τολεμαῖος
 110 ὁ υ[ί]ὸς θεοὶ Ἐπιφ[αν]εῖς ἄγουσιν ἐν [ῶι] καὶ τὴν
 βασιλείαν [π]αρ[ε]λάβοσαν. ὁ δὲ ἡλ[ι]ος καθ[έστ]η
 102 ἡσί, read εἰσί; πλήρης, read πλήρεις; 105 read διελθῆι

Column 10

- μῆνα ἔ[καστον
 Θωὺθ Σκ[ορπί]ωι
 Φαῶφι Τοξό[τηι
 115 Ἄθῦρ Αἰγ[οκέ]ρωι
 Χοίαχ Ἐ[δ]ρ[οχό]ωι
 Τῦβι Ἰχθύσι
 Μεχειρ Κρί[ωι
 Φαμενώθ Τα[ύρωι
 120 Φαρμούθι Δι[δύμοι]ς
 Παχὼν Κα[ρκίν]ωι
 Παῦνι Λέ[οντι]]....
 Ἐπειφ Πα[ρθέν]ωι
 Μεσορῆ Χη[λαῖ]ς

- 125 αἰ δὲ κατὰ σ[ελήνην νουμη]νίαι (Fragment v)
 εἰσὶν ἔτους [πρώτου
 Θωὺθ κ [ἡμέραι κθ]
 Φ[α]ῶφι ἰθ ἡ[μέραι λ]
 Ἐθὺρ ἰθ ἡ[μέραι λ]
- 130 Χοίαχ ἰθ [ἡμέραι κθ]

Column 11 (Fragment v)

4 lines lost

- 135 Π[αχὼν
 Π[αῦνι
 Ἐπε[ἰφ
 Με[σορῆ]

Ἐτ[ους δευτέρου

- 140 Θω[ὺθ
 Φαῶ[φι
 Ἐθὺ[ρ
 Χοία[χ
 Τῦβ[ι
 145 Μεχ[εῖρ
 Φαμ[ενὼθ
 Φαρμ[οῦθι
 Παχ[ὼν
 Two lines lost

Column 12 (Fragment vi)

- ἡμέ[ραι κθ]
 ἡμέ[ραι λ Π[αχὼν
 ἡμε[ραι λ [Παῦνι
 ἡμε[ραι κθ [Ἐπειφ
 ἡμέ[ραι λ Μ[εσορῆ
 ἡμέ[ραι κθ Ἐ[τους τετάρτου
 ἡμέ[ραι λ [
 ἡμέ[ραι κθ [
 ἡμέ[ραι λ

Fragment vii, unplaced (same hand as Column 9 onwards)

- (1)]..[(2)].ωι Ἐρμῆ[ς (3) τι δι[(4)]νω Δημή[τηρ
 (5)]ος Ἐφάιστο[ς (6) κατὰ σελ[ήνην] νουμ[ηνη] (7)].[

COMMENTARY

Lines 1-12 (reckoning of interest due for Pharmuthi): 'collect from Arsaces on 1 talent, 120 drachmae; from Ptolemarchus on 1 tal., 120 dr.; from Euphron on 1 tal., 120 dr.; from Ptolemy son of Perdiccas on 2,000 dr., 40 dr.; in sundry ways due through Menecrates, on 3,000 dr., 60 dr.; from Menecrates on 3,000 dr., 60 dr.; from Tryphon, son of Cleitorios on 1,000 dr., 20 dr.; from Chionides on 100 dr., 2 dr. Total interest, 542 drachmae.'

Lines 1-72 may be set out in tabular form as follows :—

Interest for Phamenoth (entry lost)	(542 drachmae ?)	
„ „ Pharmuthi, ll. 4-12	542	„
Extra items for Phamenoth and Pharmuthi	145 drachmae	
¹ Two months total, 2l.	1,429	„
Interest for Pachon, ll. 22-39	482	„
„ „ Payni, ll. 30-37	422	„
„ „ Epeiph, ll. 38-45	422	„
„ „ Mesore, ll. 46-53	422	„
	—	
Total interest, l. 54		2,832 drach.
Additional item for 'verification' and 'sixths' ll. 55-56	145 drachmae	
New total, l. 57		2,977 „
Deduction, ll. 58-60	970 drachmae	
New total, l. 61		2,007 „
Various dues :		
ll. 62-65 Strangers, for use of rubbing oil	150 (?) drachmae	
ll. 66-67 Dabreas and (Seleucus) for balances	20 (?) „	
ll. 68-69 The same, for a funeral feast	87 „	
ll. 70-71 Apollophanes	98 (?) „	
	—	
Sub-total	335	
New grand total, l. 72		<u>2,342</u> „

- l. 4. At least one column has been lost at the beginning. Ἀρσάκην: presumably a Persian. Entries are in the accusative after a previous πρᾶξον, cf. l. 22.
- l. 5. Πτολέμαρχος: cf. ll. 24, 32, 40, 48, 87. *P. Fribourg*, 34.
- l. 11. Χιωνίδης: cf. ll. 28, 36, 44, 52, 91. Not in Preisige, *Namenbuch*.
- ll. 13-21: sums due, reckoned for a two months' period, but obscure owing to mutilation of the head of the column.
- ll. 15-16. [. . .]νη[ν conceals a name. στάθμη: verification or certification as in *P. Teb.*, 5, 88? The restoration seems certain in view of l. 55.
- l. 18. The interpretation and expansion of ζ(ητῆσον) = 'check,' is due to Mr. C. H. Roberts.
- l. 20. Ἀμβ(ιλίου): expansion from l. 79 where Ἀμβ() ἐλαίου cannot be read. Cf. *B.G.U.* 1541 (Ptolemaic ostrakon from Philadelphia), where editors suggest the name is a Macedonian form of the name Ἀμφίλαος (with β for φ). Mr. Skeat informs me that Ἀββίλαος appears in *P. Lond. Inv.* 2099 (Zenon papyrus from Philadelphia).
- ll. 22-54. Reckoning of interest due for Pachon, Payni, Epeiph and Mesore.

¹ Not reckoned in the total of l. 54 which only covers interest, and in any case not reconcilable with it. If the 145 dr. of l. 20 is also left out of the grand total of interest, the interest due for Phamenoth will have been 542 dr., exactly that for Pharmuthi.

- l. 25. Ptolemaios has borrowed a further 3,000 drachmae.
- l. 33. Euphron has repaid 3,000 dr. in Pachon (not charged for during Payni).
- ll. 55-56. *Εὐμ(ένους)* is a far from certain reading, but *στάθμης* (cf. ll. 15-16) and *ἔκτων* (though enigmatical) seem unavoidable. After *Εὐ* there is room at most for two letters.
- ll. 58-61. A deduction from the total, cf. l. 61. *ἀφ]αιρεῖν* cannot be read. It is uncertain whether the line was indented, and whether anything is missing before *]αι*. The *α* (or possibly) *ε* is represented only by a linking stroke. Zeno (cf. l. 73, and margin of col. viii) was perhaps an officer of the association. For the name at Philadelphia in the early second century B.C. cf. *P. Fribourg*, 34. Edgar (*P. Mich. Zeno*, p. 48) has suggested that he was a descendant of the famous Zeno.
- ll. 62-72. Various other sums due for collection.
τ[οῦ]ς κεχρικότας ξένου[ς]: for *ξένος* used for non-members of a club, cf. e.g. *P. Teb.* 894, fr. 2, 5, etc. The phrase here suggests outsiders (non-members) who have used rubbing oil in a bathing establishment or gymnasium, while members were entitled to its use free, or else perhaps made *ἐλαιοχ[ριστία]*, *B.G.U.*, 1813, 12 (cf. Claire Préaux, *Économie royale des Lagides*, p. 402, n. 2). In *P. Oxy.*, 1413, 19 and 20; 1665, 5 (third century A.D.) *χρίειν* is used absolutely for 'supply oil' (for use in the baths).
- l. 66. *Δαβρέαν*: for the name cf. *P. Teb.*, 793, 10; 890, 115, etc.
- l. 67. *περίλειμμα* is cited in *L.S.J.*, only from Plato, *Menexenos*, 236.
- l. 68. For *Ἔστιείος* as name (if this is the correct interpretation and expansion) cf. *P. Teb.*, III, index.
- ll. 73-74. A later insertion in smaller letters by the same hand. In the right margin opposite l. 73 and below, another later entry by the same hand.
- ll. 75-83. Quantities of oil due. Are these quotas (in arrear) regularly due from members?
- l. 80. *ὑδρ[ίαν]*, cf. 81-83, which, combined, make the reading fairly certain. The pitcher in local use as measure contained more than 20 *κότυλαι*.
- ll. 84-91. Money debts described as *ἐπίκουνα χρήματα*. Cf. Introduction.
 In the right hand margin under date 12 Thoth a second hand has made an entry relating to state of the accounts. For Apollophanes cf. ll. 70 and 80.
- ll. 92-130: 'Year 1 of Queen Cleopatra and King Ptolemy the son, gods Epiphaneis. Table of lunar new moons, showing how they are related to the days of the Egyptian twelvemonth. The period of the table is 25 years, 309 months (including intercalary months), 9,125 days. It indicates the lunar months and which of them are full, which hollow, which intercalated; and in what sign of the Zodiac the sun will be during each month. When the sun has traversed the 25 years it will return to the same starting point and revolve in the same manner. The first year of the period is the same as the first year as reckoned by Queen Cleopatra and King Ptolemy the son, gods Epiphaneis, in which also they took over the kingdom. The sun stood each month as follows: Thoth in Scorpio, Phaophi in Sagittarius, Hathyr in Capricorn, Choiak in Aquarius, Tybi in Pisces, Mecheir in Aries, Phamenoth in Taurus, Pharmuthi in Gemini, Pachon

in Cancer, Payni in Leo, Epeiph in Virgo, Mesore in Libra. The lunar new moons in the first year are : Thoth 20 . . . Phaophi 19 . . . Hathyr 19 . . . Choiak 19.

ll. 92-94: for the date formula cf. l. 108-110, and *P. Frib.*, 12, 33; *P. Teb.*, 822, 978.

παράπ[ηγμα] : a tempting restoration (not too short for the space since all the letters are long ones) which gives an excellent sense, a good antecedent for οὐ in l. 97, and a good subject for *σημαί[νε]* in ll. 100-101. A *παράπηγμα* is defined by Diels, *Fragmente der Vorsokratiker*,⁵ II, 142 ff. (cf. also A. Wilhelm, *Epitumbion H. Swoboda*, 344-345), as a list in bronze or marble of the days of the solar year according to the Zodiac together with the ordinary weather phenomena (*ἐπισημασίαι*). Close to the days were holes into which the dates according to the civil calendar could be plugged. If our restoration is correct, *παράπηγμα* is used in an extended sense, and the fixed basis is provided by the twelve months of the Egyptian year. It is not necessary to assume, though it may be the case, that the papyrus is simply a draft for a solid calendar, perhaps built of wood, for a public display of the equivalents. The term *παράπηγμα*, despite its origin from *παραπηγνύναι*, the extant examples from Ephesus (*Sitzungsberichte der Berliner Akademie*, 1904, 904 ff.) and Diels' definition need not be restricted to an artefact in three dimensions; it seems not unnatural to suppose that by the second century B.C. the sense might have been extended to a paper table of (quasi-chronological) equivalents.

(Note by O.N. : 92-94, *παράπηγμα* is used frequently by Geminus, *El. astr.* XVII, for "calendar". Once (148, 26 Manitius) one finds ἐν τοῖς ψηφίσμασιν where one would expect ἐν τοῖς παραπήγμασιν. For the latest discussion of *παράπηγμα* cf. A. Rehm article "Episemasiai" *RE Suppl.* VII (1940), 175-198 and *Parapegmastudien*, *Abh. Bayerische Akad. d. Wiss., phil.-hist. Abt., N.F.*, 19 (1941), 145 pp.)

l. 96. δωδε|κα|μή[νων] : The restoration is a little long, but there is a great variety in the amount of room required for restorations. In line 92 where exactly the same space is to be filled the restoration calls for 9 letters. δωδεκάμηνον, as Mr. Skeat points out, is well attested as a compound word.

ll. 108-110. ὡς . . ἄγουσι : a formal and technical expression, cf. *SIG.*³, 704, I' and K'.

The ἔτος α of Cleopatra and Philometor began probably in Summer 180 B.C. The latest date at present known for Epiphanes is 20th May 180 B.C., according to T. C. Skeat, *Mizraim*, 6, p. 33.

l. 117. From here onwards a thicker pen has been used, but the hand is the same.

l. 125. νομη]νίαι : the ends of ll. 123 and 125 are preserved on fragment ν, which also carries the initial letters of col. xi. Assuming this scrap to belong to the column immediately succeeding col. x, five months are lost between its starting point and the foot of col. x. This brings νίαι immediately opposite l. 125. Below l. 125 the papyrus carries the same left hand margin, but no letters appear. Lines 126-130 are therefore at least four letters shorter than l. 125. For the restoration ἡμέραι κθ cf. line 140 and note.

- l. 140. The ends of lines of col. xi are on another separate fragment (No. vi). If \dot{I} I[of l. 141, \dot{M} [of l. 144 and \dot{E} [of l. 145 are assumed to be the initial letters of a new column (it is unfortunate that the scrap is damaged at the point where it might have shown a *paragaphus* between ll. 144 and 145, cf. 124-125 and 133-134), in that order they must represent the months as restored. By placing them where this new series is to be expected we obtain the correct positions for the ends of lines of col. xi.