71-78

WAX TABLETS IN THE PIERPONT MORGAN LIBRARY *

1. Introduction

The dealer from whom the tablets were purchased in 1981 provided the information that they came from Moghagha, located 100 miles south of Cairo. This locality would in antiquity have been part of the Oxyrhynchite Nome, near the Nile to the northeast of Oxyrhynchos.[1] Such information is not always reliable, but there is no obvious reason to reject it in the present case. In the case of a tablet in the Moen collection, P. J. Sijpesteijn indicates that the dealer gave "Abu el-Fadl" as the provenance, a place identified by Sijpesteijn with Cheikh Fadl, the ancient Kynopolis, which lies just opposite the Oxyrhynchite (cf. n. 3 below). The wooden tablet of which half is in the J. Paul Getty Museum and half in Würzburg[2] contains a date by the Oxyrhynchite era (to 474), and although the Würzburg half was acquired by A. Kiseleff near Sheik Ibada (Antinoopolis), the date points to an Oxyrhynchite origin. This tablet is, I believe, a model (rather than actual) contract, written by a scribe being trained in the style appropriate to the Oxyrhynchite. If, as seems likely, the other tablets of approximately this period published recently,[3] along with the Morgan codex, come from a single find despite conflicting provenances given by dealers, it seems likely that the true provenance was in the Oxyrhynchite. The same need not necessarily be true of those from the seventh century in the Vatican collection and elsewhere.[4]

The Morgan tablets form an ensemble of five pieces, all drilled four times along one margin to permit tying them together into a book. This is a common feature in the recent finds to which these are no doubt related.[5] Two of them are smooth and blank on one side each, showing that they were the outer

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* I am grateful to William Voelkle of the Pierpont Morgan Library for the invitation to publish these tablets and his cordial help throughout my work.

(1) Cf. the map at the end of P. Pruneti, *I centri abitati dell'Ossirinchite* (Pap.Flor. 9, Firenze 1981). Moghagha is located at 30'50" E. and 28'39" N.

(2) It is published in *The J. Paul Getty Museum Journal* 11 (1983) 161-68 by W. Brashear.

(3) For these, see W. Brashear, "Holz- und Wachstafeln der Sammlung Kiseleff," *Enchoria* 13 (1985) 13-23; P. J. Sijpesteijn, "A Wax Tablet in the Moen Collection," *StudPap* 21 (1982) 11-14; "A Wooden Tablet in the Moen Collection," *Cd'E* 56 (1981) 99-104.

(4) See W. Brashear, "Neue griechische Bruchzahlentabellen," *Enchoria* 12 (1984) 1-6.

(5) Cf. *Enchoria* 13, Taff. 1-10, 12-13; *MPER* n.s. XV, Taf. 79.

tablets. Their other sides, and both sides of the three others, were prepared for writing by being cut out and filled with wax. In several cases, portions of the wax surface have come away, exposing an earlier wax surface which also bears writing. This earlier writing was crossed out by vertical, horizontal, and diagonal scoring before the new layer of wax was added, and I have not succeeded in reading more than scattered letters of any earlier text. What is visible, however, seems to point to mathematical exercises of some sort; in several cases it is likely that the underlying text was a table of parts, written (as in the case of no. **5** recto = **78**) with the tablet held horizontally. All of the upper waxed surfaces contain writing, in varying states of preservation. The inner side of no. 1 (= **71**) and the corresponding sides of nos. **2-4** (= **73**, **75**, **77**) all have three raised knobs along the outer margin, to prevent the adjacent writing surfaces from coming into contact with one another.[6] The conservator at the Pierpont Morgan Library has determined, by examination of one knob which came off and was reattached, that these are half pistachio shells. The original order of the three inner tablets cannot be determined. That used here is arbitrary. The letters, as is normal, are formed showly in the wax. Each tablet is about 10 × 21 cm.

2. Measurements of Distance and Area

Much of the text on these tablets is concerned with problems in the plane and solid geometry of land. The following measures are found (in descending order):

Volume:	naubion = 3 cu. cubed, or 27 cubic cubits
Surface:	bikos (area unknown)
	hamma (or amma) = 1/64 aroura[7]
Length:	kalamos = 6 cubits[8]
	cubit (πῆχυς) = 24 daktyloi[9]
	daktylos

The one equivalence in this list which is not obvious is the conversion of areas calculated in cubits into hammata. In *P.Ryl.* II 64 we learn that one ham-

(6) This is a feature I have not seen elsewhere in published texts, but leather separators are found in wooden tablets discovered in the Dakleh Oasis by the Canadian excavations there; and cf. p. 70.

(7) For the hamma as 1/64 aroura, see *P.Michael.* 42A.10n., citing also *P.Cair.Masp.* II 67151.106 and 67169bis.47; *P.Rainer Cent.* 155; *P.Stras.* 579.14n.; J. C. Shelton, *ZPE* 42 (1981) 91-98.

(8) The kalamos of 6 cubits is attested by *R.Ryl.* II 64.

(9) The answer on **3**.6-7 (= **74**) shows that this system is in use in our tablets, for the answer to "how many daktyloi is 1 1/2 cubits?" is 36.

ma equals two kalamoi, or 12 cubits.[10] Confirmation is found in *P.Lond.* V 1718.81. This, obviously, refers to the hamma as a measure of length. It is a reasonable inference that a hamma as a measure of area is one hamma by one hamma, just as a cubit as a measure of area is one square cubit.[11] One hamma is then 144 square cubits. Is this equal to 1/64 aroura? Moving from the other direction, 1/64 of the aroura, on the standard basis of an aroura of 100 × 100 cubits, i.e. one schoinion by one schoinion, would be 156.25 square cubits. *P.Lond.* V 1718, however, distinguishes between the ἱερατικόν and the γεωμετρικόν, the former 100 cubits and the latter 96 cubits. It is clear that the latter is the one used in the computations of parts of the aroura, including in our tablets.[12] The hamma of 1/64 aroura is thus 144 square cubits.

A recent study of measures in Demotic documents by Sven Vleeming[13] sheds confirmatory light on the situation. Demotic had no term for 1/64 aroura, using instead 1 1/2 *mḥ-itn*, the *mḥ-itn* being the "ground cubit" of one cubit times the length of the aroura, or, in usual reckoning, 100 square cubits (cf. n. 11 above). Now obviously 1 1/2 × 100 = 150, not 156.25 nor 144. As Vleeming (pp. 209-10) has remarked, the aroura was in fact not in practical reality always quite 100 cubits (one schoinion) on a side. On the premise that these tablets, and perhaps many texts, start from an assumption of 96 cubits on side, a hamma of 144 square cubits would in fact be both 1 1/2 *mḥ-itn* (1 1/2 × 96 = 144) and 1/64 of an aroura (9216/64 = 144).

Unfortunately, few of the problems in these tablets provide the answers. One that does is **1**.7-11 (= **71**), where the volume of a circular cistern is computed (using a crude formula for pi, see notes ad loc.), arriving apparently at the correct answer (the surface is damaged). Another problem, however, which is found in **1**.12-14 (= **71**) and **3**.1-5 (= **74**), is less helpful. An area of 3 hammata is dug to the depth of 3 daktyloi: how many naubia? It is simple to compute 3 × 144 = 432 square cubits for the surface. Three daktyloi are 1/8 cubit, so 432 × 1/8 = 54 cubic cubits, or exactly 2 naubia. Unfortunately, the answer given is 5 1/3. No conceivable value for the hamma would produce this answer, and it is probable that one of the 3's in the problem is an error for 8.[14]

(10) See B. Boyaval, *ZPE* 28 (1978) 205-08 on this text.

(11) This emerges from the simple number of cubits given as small change from a larger unit in texts where it is used with the aroura or bikos as a measure of area, e.g. *BASP* 7 (1970) 78.19 (9 bikoi, 164 1/2 cubits). There is also attested a "cubit" which appears with various qualifiers and which is 100 square cubits, which Keenan mistakenly took to be the cubit used in this papyrus (n. to line 19 on p. 81). See further below.

(12) Cf. J. C. Shelton, *ZPE* 42 (1981) 96 on this point.

(13) "Demotic Measures of Length and Surface, Chiefly of the Ptolemaic Period," *Pap.Lugd.Bat.* XXIII, pp. 208-29.

(14) If one computes in the reverse direction, 5 1/3 na. = 144 cubic cubits; if 3 daktyloi is right, 1152 square cubits of surface would be required to get that volume, yielding a hamma of 384 square cubits. It is more likely that one of the 3's in the problem is wrong: if either one were an 8, the answer would be right.

What of the bikos, that elusive measure? It is found often enough in the papyri, but never with an equivalence.[15] Here it appears in the most complicated problem found in the tablets, the computation of the area of what must be a trapezoid (**2** verso 5-9 = **73**): North, 6 kalamoi; South, 6 kalamoi; East, 6 kalamoi; West, 1/2 + 1/3 (kalamoi, presumably), or 36 cubits on all sides except the West, which is 5. The pupil must first compute the height of the trapezoid using the Pythagorean Theorem,[16] finding the square root of 1055 3/4, which is about 32 1/2 (the square of which is 1056 1/4), then compute the area of the trapezoid ((36 + 5)/2 × 32 1/2), yielding 666 1/4 square cubits. Alas, we are not told how many bikoi this is.

We are, however, perhaps not quite clueless. For the next line, after one of those dividing lines sprinkled throughout the tablets, says cryptically "1 1/2 ἐπὶ αμ( )". Now αμ( ) is presumably the hamma. One might guess that the hamma stood in the relationship of 1 1/2:1 to some unit, and which more likely to be at stake here than the bikos? But which would be the 1 and which the 1 1/2? If we recall the fact that 1 1/2 *mḥ-itn* was the Demotic expression for 1/64 aroura, i.e. hamma, we may suppose that the bikos is the *mḥ-itn*, the "ground cubit" or πῆχυς στερεοῦ (96 square cubits in the *geometrikon* aroura) of *P. Grenf.* I 25.3. But there is an obstacle to that interpretation. In *SB* XII 10786, the Tebtunis papyrus published by Keenan and mentioned above (n. 11), we find an area of 9 bikoi and 164 1/2 cubits. Since the "ground cubit" was only 96 or 100 cubits, depending on points discussed earlier, it seems unlikely that a sum would be given in this fashion.[17] Rather, we expect a bikos to be more than 164 1/2 cubits. The only obvious upper limit is that 9 bikoi and 164 1/2 cubits should not be more than aroura: that is, 10 bikoi should be no more than 9216 cubits. Now if the 1 1/2:1 ratio is reversed, the bikos would be 1 1/2 hamma, or 216 cubits, a figure which would fit well enough. It is, I hope, clear that this suggestion is no more than that.

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(15) The most recent voice of despair I have noted is John Whitehorne, *P.Oxy*. XLIX 3461.6n. (1982).

(16) Cf. *SB* XIV 11973 for a text in which just that computation is required, albeit with much simpler numbers than here.

(17) A counterargument can be offered: more than one lot is involved, and the writer may have summed their areas without reducing the result. But this seems to me less likely.

3. The Texts

Tablet 1

71 TAVV. LXXXII-LXXXIII

VERSO

εἰδέαν βατερου τοῦ
λάκ(κου) τ̣ὸ̣ μῆκος πηχ(ῶν) .,
ἄνω π{α}λάτος πηχ(ῶν) δ,
4 κ̣άτω πλάτος πηχ(ῶν) δ, βά̣[θο]ς
π̣ηχ(ῶν) ιε, πόσε ναύβ(ια);
λε ι μ´

λάκκος στρογγύλον
8 μετρήσομεν· ἄνω διά[μ]-
ετων πηχ(ῶν) $\overline{κ}$, κάτω δ[ιά]-
μετων πηχ(ῶν) $\overline{κ}$, βάθος
πηχ(ῶν) ιε, πόσε ναύβ(ια); $\overline{ρξ[ζ]}$

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12 ἅμματα $\overline{γ}$ σκαπφθέ̣ν̣-,
τα ἐπὶ τὸ βάθος δακ(τύλων) $\overline{γ}$,
πόσε ναύβ(ια); ε γ´

ναύβ(ιον) τετράκ(ωνον) τὸ μῆκ[ο]ς
16 πηχ(ῶν) $\overline{γ}$, τὰ πλάτη
πηχ(ῶν) $\overline{θ}$, βάθος πηχ(ῶν) ζ,
απόσε ναύβ(ια); συνον[
// ἔχουσαν τῆς κοι̣ν̣[
20 [.]σ.[. . . . .]. . .κατ( ). .[
traces

1 ἰδέαν 5 πόσα 7 στρογγύλος 8 μετρήσωμεν 8-10 διάμετρον 11, 14 πόσα 15 τετράγωνον 18 πόσα

Translation

1-6: Form . . . of the cistern: the length . cubits, the upper breadth 4 cubits, the lower breadth 4 cubits, the depth 15 cubits: how many naubia? 35 . . . (?).

7-11: Let us measure a circular cistern: upper diameter 20 cubits, lower diameter 20 cubits, depth 15 cubits: how many naubia? 167.

12-14: 3 hammata excavated to the depth of 3 daktyloi: how many naubia? 5 1/3.

15-18: A rectangular naubion: the length 3 cubits, the sides 9 cubits, the depth 6 cubits, how many naubia?

Notes

1. What βατερου means, I cannot say. Parallelism with the second problem on this tablet would suggest that it should refer to the shape of the cistern, but I cannot find any suitable word. One might suppose a botched writing of βαθυτέρου, "rather deep", but this is no deeper than the cistern in the next problem.

4. The writing projects into the margin, with only the last letter, sigma, clearly discernible. There are other scratches, some looking vaguely like letters, on the margins; I do not make any sense of them.

6. Since we do not have the length of the cistern, we cannot tell if these letters can represent the answer. If the length were 16, the result would be 35.55 naubia. It is not inconceivable that what I read as iota and mu could be the sign for half followed by mu, which would bring us very close (although kappa, for 1/20, would be better than mu, if only it were readable). But the horizontal line under this line was written first, as is indicated by the fact the letters cross it in places and are squeezed in, so that the precise shape of the iota/half cannot be determined with certainty: does a horizontal stroke, coinciding with the divider, exist? On balance iota seems to me the better reading.

7-11. The shape is cylindrical, with upper and lower diameters the same. Using the usual Egyptian approximate value of 3 for pi, the area of the circle is 300 square cubits, the volume 4500 cubic cubits, or 166 2/3 naubia. Because the process of computation is not described, we cannot be certain what it was, but in all probability it was the "Egyptian method" described by B. Boyaval, *ZPE* 28 (1978) 203-05: Square the diameter, subtract a quarter of the result, and multiply times the depth. *PSI* III 186 verso, discussed by Boyaval, also involves a round cistern. Its text is further improved by J. C. Shelton, *ZPE* 42 (1981) 99-102, with further illustration of the computational method. It is not clear if line 7 is a heading or the object of μετρήσομεν in line 8; if the latter, then the apparatus should correct to λάκκον.

12-14. See introduction for the erroneous computation. This passage is repeated in **3** recto 1-5 (= **74**). The form σκαπφθέντα is striking; the normal aorist passive participle of σκάπτω is σκαφέντα, and though Greek of this period sometimes introduced first aorist passive forms where Attic used the second (see Gignac, *Grammar* II 308-11), the form we have here has a superfluous pi even before the hypothetical first aorist form. Neither Gignac nor Mandilaras (*The Verb in the Greek Non-literary Papyri* [Athens 1973]) gives any example of a first aorist of this verb.

15-18. This passage is repeated in **2** recto 6-10 (= **72**) and **3** recto 8-12 (= **74**). I do not see what τετραχ( ) can be except a form of τετράγωνος (cf. *P.Mich.* XIII 662.26 for the same spelling); but I cannot cite any example of the naubion used as a shape of volume rather than as a measure, as it seems to be used here. The curious alpha at the start of αποσε is paralleled in **3** recto 12 (= **74**); there is no reason to suppose that this is a mistake for the relative ὁπόσος. What the following text means, I do not know.

Tablet 2

72 TAV. LXXXIV

RECTO (inverted)

ἐὰν .λ..ον.
μ̣έρ(ος) τῆς . . κ( )
πολλῆται (ὑπὲρ)
νο(μισματίων) $\overline{\kappa\epsilon}$, τὸ $\overline{\eta}$

μέρ(ος) πόσε κατ(αλαμβάνει);

ναύβ(ιον) τετράκ(ωνον)
τὸ μῆκ(ος) πηχ(ῶν) λ,
τὸ πλάτ(ος) πηχ(ῶν) η,
βάθος πήχ(εος) α L,
πόσε ναύβ(ια);

. . . .

3 πωλῆται 5 πόσα 6 τετράγ(ωνον) 10 πόσα

73 TAV. LXXXV

VERSO (inverted)

ἅμματα β
σκαπφθέντα
ἐπὶ τὸ βάθος
δακ(τύλων) ι, πόσε
ναύβ(ια);

α L γ′ traces
πόσε π[ή]χ(εις)

ε γ′ κάλαμ(οι)
ἐκ τετρακ(ώνου)

4 ϊ tab.; πόσα 7 πόσαι 9 τετραγ(ώνου)

Translation

Recto 1-5: If a . . . part of a . . . is sold for 25 solidi, how many does the 8th part bring?

Recto 6-10: A rectangular naubion: the length 30 cubits, the width 8 cubits, depth 1 1/2 cubits: how many naubia?

Verso 1-5: 2 hammata excavated to the depth of 10 daktyloi: how many naubia?

Verso 8-9: 5 1/3 kalamoi in a square . . .

Notes

Recto 1-5. This problem is clearly somewhat similar to 3 verso 8-12 (= **75**), where again something (artabas in that case) is sold. Here, damage to line 1 hinders interpretation, as does uncertainty about what was intended in line 2. One expects some part to be mentioned in line 1, but the lambda does not square easily with any likely fraction. In line 2, perhaps there has been some correction; οἰκ, οἰκ(ίας) may be possible, but it cannot all be seen.

Recto 6-10. Cf. **1** verso 15-21 (= **71**) for a similar problem. The answer would be 13 1/3 naubia. It is not clear if the descending stroke from the beta of ναύβιον is an abbreviation mark or, since it is crossed by a stroke, an iota.

Verso 1-5. See **1** verso 12-14 (= **71**) for a similar problem. The answer is 4 4/9 naubia.

Verso 6-7. Much of the top layer of wax is missing in this section. Line 6 might continue ι κάλαμ(οι), but I am not certain enough of the reading to include it in the text.

Verso 8-9. It is not clear whether a third line to this problem was written; if so, the wax on which it was written is all now lost. If this refers to 5 1/3 square kalamoi, it would equal 1024 square cubits, or 7 1/9 hammata.

Tablet 3

74 Tav. LXXXVI

RECTO (inverted)

ἄ̣μματα γ σκαπ-
φ̣θέντα ἐπὶ τὸ
βάθ(ος) δακ(τύλων) γ,
π̣ό̣σε ναύβ(ια);
ε γ

αL πήχ(εις) πόσε
δάκ(τυλοι); λ̣̅ς̅

ναύβ(ιον) τετράκ(ωνον)
[τὸ] μ̣ῆ̣κ̣(ος) πη̣χ(ῶν) γ′,
τ̣ὸ πλάτ(ος) πηχ(ῶν) θ,
[τ]ὸ̣ βά̣θος π̣ηχ(ῶν) ς,
α̣π̣[ό]σ̣ε̣ ν̣[αύβ(ια);]

4 πόσα 6 πόσοι 8 τετράγ(ωνον) 12 πόσα

75 Tav. LXXXVII

VERSO

† διῶρυξ·
ποταμὸν με-
τρήσομεν·
τὸ μῆκ(ος) πηχ(ῶν) ͵Γ,
τὸ πλάτ(ος) πηχ(ῶν) ς,
βάθος πηχ(ῶν) γ ιε,
πόσε ναύβ(ια);

ι̅β̅ ἀρτάβας πο̣-

λῆται (ὑπὲρ) κ(ερατίων) ιθ,
τὰς βL κ(εράτια)
πόσε ἀρτάβας
καταλαμ̣[βάνει;]

2-3 μετρήσωμεν 7 πόσα 8 ἀρτάβαι 8-9 πωλεῖται or πωλῆται 10 τὰ 11 πόσας ἀρτάβας

Translation

Recto 1-5: 3 hammata excavated to the depth of 3 daktyloi: how many naubia? 5 1/3.

Recto 6-7: 1 1/2 cubits: how many daktyloi? 36.

Recto 8-12: A square naubion: the length 3 cubits, the side 9 cubits, the depth 6 cubits, how many naubia?

Verso 1-7: Canal. Let us measure a canal, its length 3000 cubits, its width 6 cubits, its depth 3 1/15 cubits. How many naubia?

Verso 8-12: (If) 12 artabas are sold for 19 keratia, how many artabas do 2 1/2 keratia get?

Notes

Recto 1-5. This is a copy of **1** verso 12-14 (=**71**).

Recto 6-7. The answer is correct.

Recto 8-12. This is a copy of **1** verso 15-21 (=**71**).

Verso 1-7. The volume amounts to 55,200 cubic cubits, which is 2044 4/9 naubia. In line 6, it looks as if the scribe added something in the left margin, perhaps the expected τὸ before βάθος.

Verso 8-12. The interpretation reflected in the apparatus and translation has the advantages of (a) understanding a price for wheat (understood here) not too far from the normal range of 7-12 artabas per solidus (19 keratia for 12 artabas means 15 artabas per solidus), and (b) accounting for all of the text. It has the signal disadvantage that computing the answer would have been messy. If wheat is at 1 7/12 keratia/art., how much wheat does 2 1/2 keratia buy? But I cannot see any better way out.

Tablet 4

76 TAV. LXXXVIII

RECTO (inverted)

† συνον[
ἔχουσα
κοινόν
σ̣ι̣[

Scattered letters under cross-hatching for remainder of side.

Only a part of the original top surface survives, and those areas are scattered. For line 1, compare **1** verso 18 (=**71**). In line 3, it is not possible to read σχοίνιον.

77 Tav. lxxxix

VERSO

α̣L πήχεις
ἀπερχομενο̣ν̣
κάλαμος
φ, πόσε ἅμμ(ατα);

βορρᾶ καλάμ(ων) ϛ,
νότου καλάμ(ων) ϛ,
ἀπηλιώτ(ου) καλάμ(ων)
ϛ̄, λιβὸς L γ′,
πόσε βῖκ(οι);

αL ἐπὶ ἅμ(μα)

2 ἀπερχόμενοι 3 καλάμους 4 πόσα 9 πόσοι

Translation

1-4: 1 1/2 cubit extending 500 kalamoi: how many hammata?

5-9: On the north, 6 kalamoi; on the south, 6 kalamoi; on the east, 6 kalamoi; on the west, 1/2 1/3; how many bikoi?

10: 1 1/2 times the hamma.

Notes

1-4. I cannot parallel this usage of ἀπέρχομαι. An area 3000 cubits (500 kalamoi) times 1 1/2 cubit would be 4500 square cubits, or 46 7/8 hammata. Line 2 extends onto the wooden border.

5-9. We are dealing with a trapezoid with one dimension much smaller than the others: not far removed from an isosceles triangle, in fact. See the introduction for a discussion of the geometry.

10. See introduction for the interpretation of this line.

Tablet 5

78 Tavv. xc-xci

RECTO (rotated sideways)

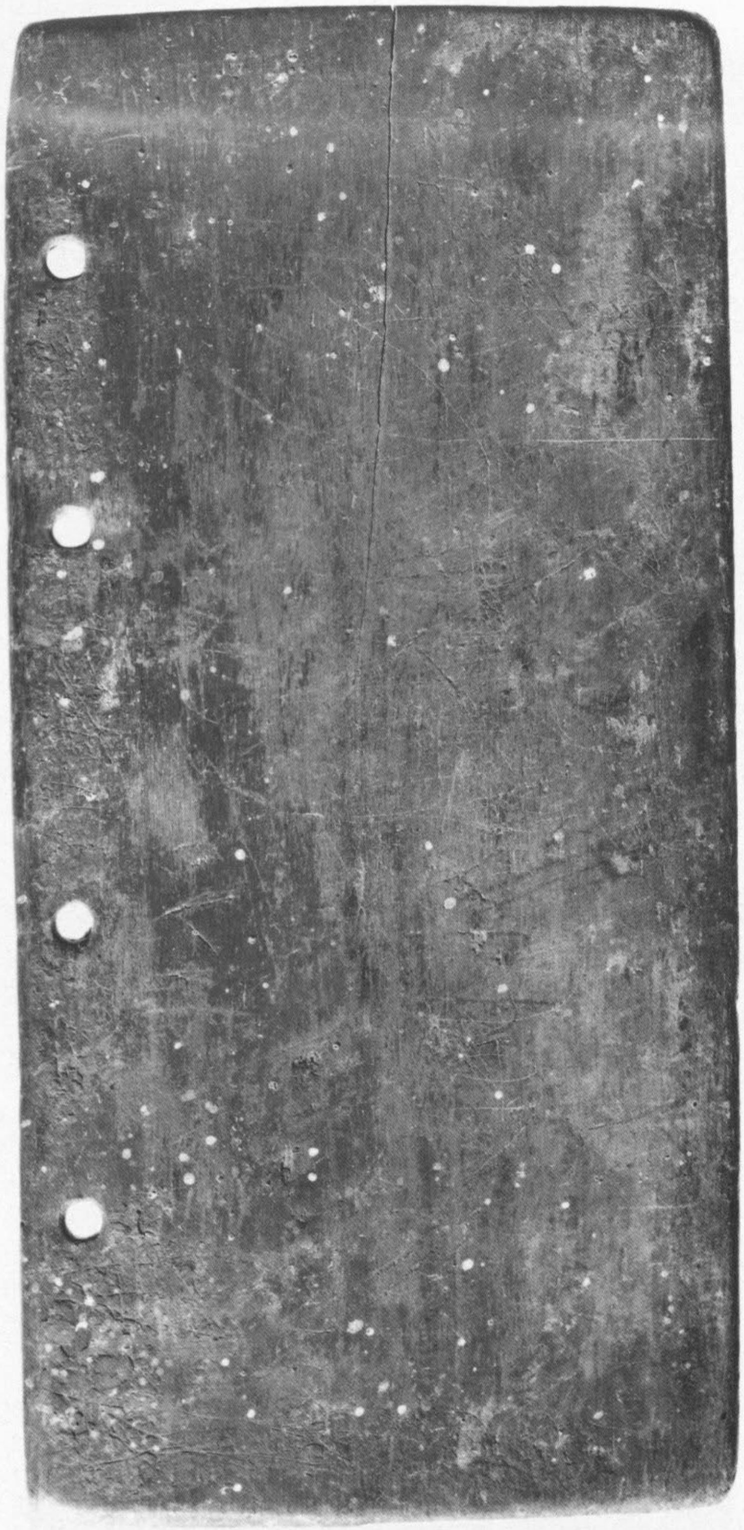
This side contains a "division table", or "table of parts"; a list of such texts is found in D. Fowler, "Tables of Parts," *ZPE* 53 (1983) 263-64. The present table is of division by 17 and forms a direct parallel to P.Vat. gr. 55A (= 7). Unlike the latter, however, which continues the series all the way to 17 divided by 17, the present table stops with 10 divided by 17, at which point no more room was left. The method of the table is to present for each number from 1 to 10 the result of its division by 17, stated in fractions with the numerator 1, then to verify the result by multiplying each term times 17 and giving its result; the sum of those results adds to 17 in each case, though this is not explicitly stated.

τọ̀ ιζ [ἐ]ṿ ψήφων [τ]νβ̣ L γ′ ιζ λ̣δ̣ ṿα̣
τῆς μιᾶς τὸ ιζ ιζ α
τῶν β ιβ να ξη̄ ιβ α γ′ ιβ να γ′ ξη d
τῶν γ ιβ ιζ να ξη ιβ α γ′ ιβ ιζ α να γ′ ξη̄ d
τῶν δ ιβ ιε ιζ ξη πε ιβ α γ′ ιβ ιε α ι λ ιζ α ξη̄ d πε̄ ε̄
τῶν ε d λδ ξη d δ d λδ L ξη d
τῶν ϛ γ′ να γ′ ε β’ να γ′
τῶν ζ γ′ ιζ να γ′ ε β’ ιζ α να γ′
τῶν η γ′ ιε ιζ πε γ′ ε β’ ιε α ι λ ιζ α πε ε̄
τῶν θ L λδ L η L λδ L
τῶν ι L ιζ λδ L η L ιζ α λδ L

1 ψήφοις

Translation

1/17 (1/17 of 6000) = 352 1/2 1/3 1/17 1/34 1/51
of one, 1/17 = 1/17
of 2 = 1/12 1/51 1/68: 1/2 (× 17) = 1 1/3 1/12; 1/51 (× 17) = 1/3; 1/68 (× 17) = 1/4
of 3 = 1/12 1/17 1/51 1/68: 1/12 (× 17) = 1 1/3 1/12; 1/17 (× 17) = 1; 1/51 (× 17) = 1/3; 1/68 (× 17) = 1/4
of 4 = 1/12 1/15 1/17 1/68 1/85: 1/12 (× 17) = 1 1/3 1/12; 1/15 (× 17) = 1 1/10 1/30; 1/17 (× 17) = 1; 1/68 (× 17) = 1/4; 1/85 (× 17) = 1/5
of 5 = 1/4 1/34 1/68: 1/4 (× 17) = 4 1/4; 1/34 (× 17) = 1/2; 1/68 (× 17) = 1/4
of 6 = 1/3 1/51: 1/3 (× 17) = 5 2/3; 1/51 (× 17) = 1/3
of 7 = 1/3 1/17 1/51: 1/3 (× 17) = 5 2/3; 1/17 (× 17) = 1; 1/51 (× 17) = 1/3
of 8 = 1/3 1/15 1/17 1/85: 1/3 (× 17) = 5 2/3; 1/15 (× 17) = 1 1/10 1/30; 1/17 (× 17) = 1; 1/85 (× 17) = 1/5
of 9 = 1/2 1/34: 1/2 (× 17) = 8 1/2; 1/34 (× 17) = 1/2
of 10 = 1/2 1/17 1/34: 1/2 (× 17) = 8 1/2; 1/17 (× 17) = 1; 1/34 (× 17) = 1/2

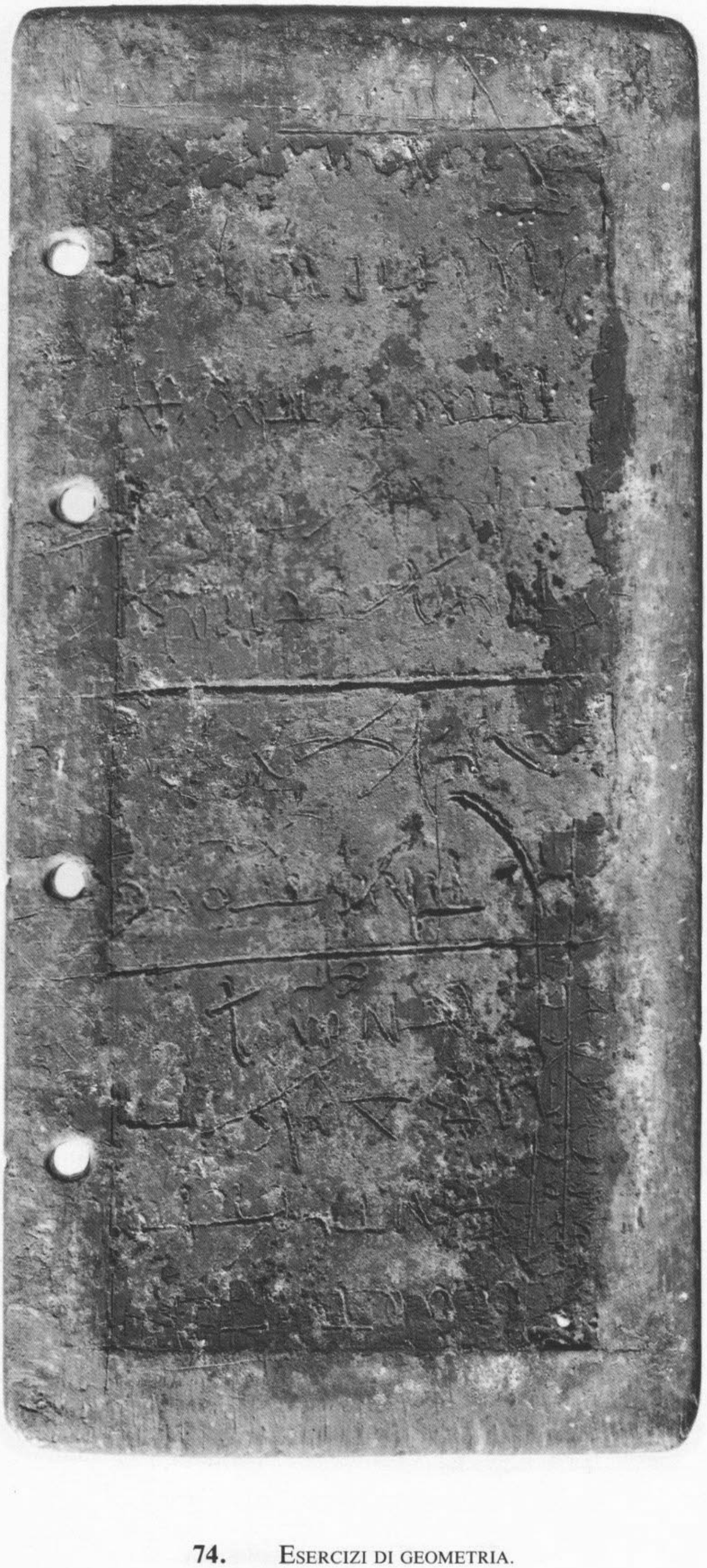


71. Lato esterno.

71. Esercizi di geometria.

72. Esercizi di geometria.

73. Esercizi di geometria.



74. Esercizi di geometria.

75. Esercizi di geometria.

76. Esercizi di geometria.

77. Esercizi di geometria.

78. Tabella di frazioni su base 1/17.

78. Lato esterno.