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MEASURES (METPHTAI) AND DONKEYLOADS OF OIL IN *P. Wisc. II.80*

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MEASURES (μετρηταί) AND DONKEYLOADS OF OIL IN *P.WISC.* II.80

P.Wisc. II.80, a customs account dated to 114 A.D., presents an opportunity to view, in full realization of the mercurial nature of Egyptian measures, the capacity of a μετρητή (hereafter, metr.) of oil in terms of kg/lbs. While it is true that the Egyptian metr., like the artaba, is a measure and not a weight, a product stated in terms of metr. or artabas can be calculated in terms of weight if two elements are known: the number of standard measures that make up a metr. or an artaba, and the weight of a standard measure. For example, when a statutory (i.e., the public or legal) artaba of wheat is said to equal 3 Italic modii, and that one such modius of Alexandrian wheat weighs 20 5/6 Roman pounds, it is possible to obtain an estimate of the weight of that standard artaba as close to 20 kg or 44 lbs.¹

Pliny *N.H.* 18.66 supplied the datum for the weight of a modius Alexandrian wheat. Similarly, Epiphanius, born in Eleutheropolis (c. 345), provides information on the weight of oil in an Alexandrian xestes as well as the number of xestai in a sacred (i.e., a public or standard) metr. His text on weights and measures (*de mensuris et ponderibus*) survives in two versions, Syriac and Greek.² Of the two, the Syriac gives a fuller description of Alexandrian measures than the Greek; the Greek version has only a line or two summary of the Syriac. The Alexandrian metr and the weight of oil are treated under three rubrics, the artaba, the xestes, and the alabastron.

The following is the Syriac text in translation followed by the Greek epitome.

Concerning the *ardeb*: This measure was named by the Egyptians, and it consists of 72 *xestai* ... the *metrētēs* also has the same capacity according to the sacred measure... according to the Alexandrian *xestēs* 88 *xestai* fill the measure, but according to the sacred measure 82 (such) *xestai*;³ sometimes they reckon the capacity of the *metrētēs* as 84, sometimes as 88, and sometimes as 96 *xestai*; but according to the sacred measure it consists of 72 *xestai*, and the *metrētēs* is for liquids and the *ardeb* for produce" (47-48, §28).

Greek: ὁ μετρητής τὸ μέτρον ἔχει τῶν οὐβ' ἑξακτῶν κατὰ τὸ μέτρον τὸ ἅγιον (line 739).

Syriac: Concerning the *xestēs*: "Although the *xestēs* is particularly well known to everybody, yet we speak of it because its standard is variously fixed... For an Alexandrian *xestēs* holds a weight of 2 *librae* of oil, and the Italian *xestēs* holds 22 ounces; the *castrensis* also similarly holds 24 ounces, more or less..." (55, §39).⁴

Greek: ξέκτης ὁ Ἀλεξανδρῖνος δύο λίτρων φέρει ὀλκὴν ἐν τῷ ἐλαίῳ (line 762).

Syriac: The *shâtiftâ* of oil... is a vessel of glass in accordance with the name; but there is in it a *libra* of oil by weight, and in capacity there is half a *xestēs* (51, §34).

Greek: ἀλάβακτρον μύρου, βικίον μὲν ὑέλινον ἔστιν χωροῦν λίτραν ἐλαίου. τὸ δὲ μέτρον ξέκτου τὸ ἡμιον (line 751).

I have selected *P.Wisc.* 80 as a counterbalance to Epiphanius since, unlike other accounts in Sijpesteijn's *Customs Duties in Greco-Roman Egypt*, it is concerned primarily with donkeyloads of oil with a fixed customs fee of 5 drachmas per metr. If Epiphanius' figure of 2 pounds for the weight of an Alexandrian xestes is relevant for both these documents, it should then be possible to estimate the

¹ See my article in *ZPE* 122 (1998) which takes the implication of this figure further in terms of donkeyloads and Roman tax assessments.

² J. E. Dean (ed.), *Epiphanius' Treatise on Weights and Measures: The Syriac Version*, Studies in Ancient Oriental Civilization II (Chicago 1935). E. Metsoulas (ed.), "Τὸ περὶ μέτρων καὶ σταθμῶν ἔργον Ἐπιφανίου τοῦ Καλαμῖνος", *Θεολογία* 44 (1973) 157-198.

³ An error for 72? See what he says further on and the Greek text.

⁴ Duncan-Jones, *ZPE* 24 (1977) 59-60 uses this last figure in his discussion of the castrensis measure.

weight of one metr. of oil according to the "sacred measure", and, to take it one step further, to see if the number of metr. per donkeyload jibes with what we know of the animal's carrying capacity.

Taking the weight of a Roman pound at 0.323 kg, 2 Roman pounds (or 0.646 kg) times the sacred measure of 72 xest. would equal in round numbers 46.5 kg or c. 100 lbs avoirdupois as the weight of 1 metr. of oil. If Epiphanius had in mind an Alexandrian pound of 0.349.33, the 2 pounds of oil would weigh 50 kg or 110 lbs per metr. In terms of liters, 2 Roman pounds or 24 ounces would represent 0.710 l and 51 l for a sacred measure.

Segrè (*Metrol.*, 30), equating artabs of wheat and ceramia of wine with a metr. of oil, maintains that 2.25 metr. of oil equals 202.5 Alex. lbs or 31 kg per metr. However, this figure is influenced (32 & n. 1) by Pollux' statement (*Script. Metrol.*, I 208) that the Alexandrian *kotulē* holds 8 ounces of oil (ἡ δὲ Ἀλεξανδρινὴ κοτύλη τοῦ ἐλαίου ἔχει οὐγκία α ἢ ...) or 16 oz per xest. The difference between Epiphanius and Pollux is one-third which would make Segrè's metr. c. 42 kg or 95 kg for 2.25 metr. The one-third difference in weight is significant not in abstract metrological terms but in how many metr. of oil can be loaded on the back of a donkey.

The weight which a donkey can carry is in the range of 90 kg or c. 200 lbs. Hence, 2 metr. of Egyptian oil weighing 91 kg or 200 lbs avd. would fall within the range of a "normal" load for a donkey.⁵ Sijpesteijn (*Customs Duties*, 53 and n. 4), citing Segrè, states that according to the customs documents the normal load of ἔλαιον was 2 or 2.25 metr. It would appear that the calculation per metr. for Epiphanius (46.5 kg) and the adjusted figure for Segrè/Pollux (42 kg) would fall within the range of a donkey's carrying capacity.

There is, however, an unknown cipher that must be taken into account if we use these figures in determining the "normal" donkeyload, even making allowances for some weights over 90 kg. The number that is lacking is the weight of the container(s) that was used in the transport of metr. of oil. With few exceptions, the customs documents only record metr. without any indication of their containers. The containers that would come to mind in the first instance would be clay jars. These jars, originally made mostly for wine, were often recycled as containers for other liquids or solids: "secondary use" in archaeological terminology. Jars that were used for oil include the knidion, keramion, aggeion, samathon, and the kapsakion⁶ but whether they were used to store oil for domestic purposes or as "transport amphoras" is not known. Be that as it may, clay jars were heavy even when empty and became far more so when filled with oil. Wheat, by contrast, measured out in artabas, presented no such problem since it was packed in sacks which did not substantially affect their weight when loaded on the back of a donkey.⁷

Before the era of underwater archaeology and the recovery of hundreds of so-called transport amphoras from the bottom of the sea, evidence for their capacity and for their weight when empty was limited.⁸ In recent years several studies have analyzed transport jars in just these terms. In the seventh-century Byzantine shipwreck a summary of large numbers of two types of jars produced an average capacity of 8.2 l for type 1 jars weighing 4.3 kg when empty; type 2 average 36.2 for capacity and 10.4 kg empty. In other words a jar holding 8.2 l of wine would weigh a total of 12.5 kg; type 2 would total

⁵ Note that the Semitic measure "homer" (Gk. γομορ) is cognate with *amôr*, a male donkey, and is associated with a donkeyload of wheat of c. 90 kg. See *The Anchor Bible Dictionary* (1992) VI.903. Hyland, A., *Equus. The Horse in the Roman World* (1990), 232 states, without documentation, "...that a donkey load was assessed at 300 Roman pounds (225 lb or 100 kg)." Epiphanius (Dean [n. 2] 40), in seeking an etymology for the biblical *letheh*, associates the word with Hebrew "'a lifting up' from the circumstance that a young man can lift up the measure of 15 *modii* of barley or wheat and place it on an ass." Although a tour de force for a young man, the statement indicates that a donkey can bear the weight of c. 100 kg or 220 lbs.

⁶ See e.g., *PSI* 8.960.3; *P. MilVogl.* 4.255.9; *P. Ryl.* 4.627.123; *P. Oxy.* 10.1290.1, 20.2273.6.

⁷ In my article (above, n. 1), I have estimated that sacks of 3 artabas of wheat that were used for the collection of tribute weighed about 150 lbs avd.

⁸ See e.g., L. Casson, *Ships and Seamanhip in the Ancient World* (1971) 160, n. 17; 170 n. 12, for the use of medieval jar weights in determining the tonnage of certain Roman vessels.

46.6.kg.⁹ Peacock and Williams present a wider range of common amphoras, some 5 types and subtypes, showing volume, empty weight and liters per kg of weight. They averaged 25.20 l full, 15 kg empty, 1.68 l/kg; 30.13 l full, 18 kg empty, 1.67 l/kg; 62.83 l full, 28.42 kg empty, 2.21 l/kg; 62.70 l full, 17.83 kg empty, 3.52 l/kg; 56.18 l full, 15.86 kg empty, 3.56 l/kg.¹⁰

This sampling of volume of liquid that could be carried per kg of fired clay illustrates the difficulty in rationalizing a donkeyload of 2 metr. of oil in a clay jar container. Taking into consideration the Dressel 20, cited by Peacock and Williams as being more efficient than the other types, a metr. of 46.5 kg or 51 l of oil would add 1 kg per 2.21 l to its weight or a total of 69.5 kg.

There is also the question of how many jars were used per metr., one or more than one, and how they would be mounted on the donkey. Although the papyri give ample evidence for the manufacture of jars for wine and the availability of knidion jars, none seem to have been made specially for oil. When empty, these jars were available for oil and other liquids. V. Grace measured the capacity of a knidion jar and found one to contain 29 l and another 31 l.¹¹ At this rate, without taking into consideration the weight of the empty jar, a metr. of oil would require 2 jars; for 2 metr., 4 jars. Cockle's analysis of *P.Oxy.* 50.3595-3597 dealing with the manufacture of 27,000 "Oxyrhynchite" 4-choes wine jars, estimates that each jar had a capacity of 19.41 l.¹² or 5 jars for 2 metr. When the weight of the jars is added to these figures, it would far exceed the carrying capacity of a donkey. All told, it does not appear that clay jars were used in the transport of donkeyloads of oil.

If a case has been made for Epiphanius' 2 Roman pounds of oil and the unlikelihood that clay jars were used in the transport of donkeyloads of oil, there remains the question of what kind of container was used for the transport of oil. *P.Wisc.* 80 provides the answer: ἄσκοί (skins), better known as wine-skins.

As stated at the outset, quantities of oil in *P.Wisc.* 80 are generally cited in metr. without any mention of containers. The same is true in *Customs Duties*. In 80 there is the mention of 1 ἡμικάδιον of oil in lines 86 and 94, but from the duty paid on each, it would appear that it was a measure of 1/2 metr.¹³ There is also mention of the puzzling ἐπιγ(), ἐπιγο() and ἐπιγομ() in lines 67, 84, 86, 90, 117, 119, translated as "containers" but which seem to have the meaning of "loads."¹⁴ Leaving aside the resolution of this problem, it is fair to say that the ἄσκός is the only specific container for oil mentioned in the custom accounts.

There are six citations for ἄσκός in *P.Wisc.* 80 : lines 67, 84, 88, 117, 155, 157.¹⁵ The last two speak of ἄσκούς μικρούς. Of the six, all, with the exception of 88 are combined with some form of ἐπιγο() which obscure the number of metr. contained within each skin. The remaining one, 88, records "Sabinius, oil, 2 skins, 1 1/2 metr. on 1 donkey" [Σαβίνω, ἐλαίο(υ) ἄσκ(ούς) β μετ(ρητήν) α (ἥμισυ) ἐφ' ὄνω

⁹ G.F. Bass and F.H. van Doorninck, Jr., *Yassi Adda* (1982), I.161-163. A more detailed analysis was conducted by P.G. van Alfen, *JRA* 9(1996) 189-213.

¹⁰ D.P.S. Peacock and D.F. Williams, *Amphorae and the Roman Economy* (1986), 51 -53. See also P.M. Wallace Matheson and M.B. Wallace, *Hesperia* 51 (1982) p. 311: "Four encrusted Rhodian amphoras from the Kyrenia wreck have capacities ranging from 24.74 to 26.79 liters with weights ranging from 14.07 to 15.75 kilos." F. Benoit, *L'Epave du grand Congloué a Marseille* (1961) 63 n. 6, Rhodian and Italic amphoras weigh 11/13 kg, contain 25/36 l; Italic amphoras of Sestius weigh 15/16 kg, contain 19 l. C. G. Koehler and M. Wallace, *AJA* 91 (1987), 54 (appendix): "Large jars gross capacity of 38.0 l; small jars 10.87 l."

¹¹ "Standard Pottery Containers of the Ancient Greek World," *Hesperia, Supplement* 8 (1947) 185-186.

¹² *AJA* 71 (1980) 91 and 96, with reservation for Segre's figures.

¹³ *Script. Metrol.* I.337, citing the *Suda*, has ἡμικάδιον, τὸ ἡμίμετρον. Note also the 1/2 metr. for a ἡμικάδιον in *Stud. Pal.* 22.105.6. *Custom Duties* No. 14 indicates 1 metr., but the total for the account is 2 1/2 metr.

¹⁴ N.V. Clausen, *Aegyptus* 9 (1928) 268-271; P.J. Sijpesteijn, *ZPE* 65 (1986) 174: "For the moment it seems better not to resolve the abbreviation in the Wisconsin papyrus although it is certain that it must have been kind of container." Cf. γόμος in Palmyrene inscriptions (*OGIS* II 629, pp. 328-29; *ESAR* IV.251) where it clearly means a "load".

¹⁵ *Customs duties* Nos. 58, 65, 67, 85, 111, and 112 make no mention of these ἄσκοί.

α].¹⁶ The two skins hold 1 1/2 metrr., about 34 kg/75 lbs each, for a total of 68 kg/150 lbs plus the weight of the skins. This would be a reasonable load for one donkey. *SB.12.10906*, No. 15 in *Custom Duties*, dated to AD 96, records 4 metrr. ἐν ἄκκοῖς τέσσαρσι on two donkeys, the equivalent of 2 metrr. each per donkey, or 91 kg/200 lbs.¹⁷

If there is substance to the position that metrr. of oil cited in *P.Wisc. 80* and *Customs Duties* represent skins of oil (ἐλαίου ἄκκοί), the question arises of whether a skin was capable of holding as much as a metrr. of oil, and were such skins in evidence in antiquity. For the answer, we have to turn once more to the Syriac edition of Epiphanius' weights and measures. Under the rubric of the *nēvel* of wine, Epiphanius states:

The *nēvel* is a measure that is put into two wineskins (a measure) which consists of 150 *xestai*.... Further this means a "taking up that which a man, after filling would draw up by manpower from the pit of the wine press, as much as he is able to lift with his two hands. But the *nēvel* is interpreted "something to be carried," which is a load of wine (p. 50, §32).¹⁸

These two skins, each of 150 xes. of wine, would weigh in terms of Roman librae, 100kg/220 lbs; Alexandrian, 105 kg/230 lbs. In terms of oil, the weight would be reduced 0.9 to 90 kg/198 lbs Roman; 94.5 kg/208 lbs Alexandrian. A skin containing one or 1 1/2 metrr. of oil could be conveniently be placed across the donkeys back; 2 metrr. in skins could be slung one on each side the donkey. Two skins containing 1 1/2 metrr. could be handled in the same way. Small skins (ἄκκοι μικροί) could handle amounts of oil smaller than a metrr. or the equivalent of a metrr. Since the customs documents deal with transactions between Egyptian districts (epistrategiae), skins of oil would not suffer the abuse and loss taken by containers used in overseas shipments.

To sum up, Epiphanius was aware of the changeable values attributed to the xestes, stating that "its standard is variously fixed among many peoples" and goes on to give its range from the Italian to the Alexandrian. However, born and reared in the wine and oil producing region of Southern Palestine, educated at Alexandria and in the monastic communities of Egypt, Epiphanius knew from personal experience the varieties of weights and measures in both regions. His statements regarding the sacred measure, the 2 librae of oil in an Alexandrian xestes, and the use of skins in decanting wine presses have an authority that should take precedence over less knowledgeable sources.

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¹⁶ The editor translates ἄκκοῦς as "sacks" which is inappropriate for oil.

¹⁷ There are a number of loads that exceed 2 metrr. Multiple loads (e.g., 4 1/2 metrr. on 2 donkeys; 21 metrr. on 9 donkeys) do not necessarily indicate that they were split equally among the number of donkeys. How much a donkey can carry is determined by a number of factors, such as age, size, sex, strength, and the distance to be covered, all of which go into calculating the weight a donkey can carry. A count of the number of metrrs placed on a single donkey in *Custom Duties* is as follows: 1 metrr., cited 9 times; 1 1/2, 12 times; 2, 23 times; 2 1/4, twice; 2 1/2, once; 3, once; 4, once. With regard to the last or the two figures, allowance should be made for inaccurate entries.

¹⁸ The editor notes that the Syriac text could be read "ass", but a marginal note states "that which is drunk and not that which brays." The last six words of the text can be read "which is a donkeyload" rather than "a load of wine." For the use of skins as containers for oil in the Palmyrene customs inscriptions, see J. Teixidor, *Semitica* 24 (1984) 100, nts. 22 and 26; for the use of ἐν ἄκκοῖς in the Greek version, *OGIS* II 629, p. 329, 49-60. See also *ESAR* IV, p. 251. On the character of the *nēvel*, see my article, "πάτιον/πάθιον A Wineskin" *ZPE* 121 (1998) 226-228.