Non-scribal Communication Media in the Bronze Age Aegean and Surrounding Areas

The semantics of a-literate and proto-literate media (seals, potmarks, mason's marks, seal-impressed pottery, ideograms and logograms, and related systems)

Edited by

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A measured world? Measures in Minoan daily life

Maria Emanuela Alberti

Abstract: Measures are embedded in human daily life: we measure the food we eat, the harvest of the year, the volume of our stocks and stores, the width of a field, the height of a building, the length and density of fabrics, the load of a donkey or a ship, the weight of precious metals; we measure the size of people and the extension of our families, the composition of working teams and the number of killed enemies; we measure the amount of taxes, the value of goods and the fluctuation of prices. And we measure as well the rain that falls, the season that change, the wind that blows and the time that flows.

Measures are then not only a way to communicate, but the means itself to think our world in practical terms. As such, they constitute the basis for any social action and a prerequisite for the continuation and development of human societies. Was Minoan Crete a measured world then? What impact had measures in Minoan daily life?

Researches on Minoan material culture are presently so rich to allow some first observations in this direction, on the basis of the evidence from both Proto- and Neopalatial times. Weighing systems, capacity of vases, architectonic modules and sizes of loom-weights seem all to point to a pervasive presence of measures in the material life.

From this perspective, Minoan society can also be seen as a network of measured relations and values.

Introduction[1]

Measurement is embedded in human daily life: we measure the food we eat, the harvest of the year, the volume of our stocks and stores, the width of a field, the height of a building, the length and density of fabrics, the load of a donkey or a ship, the weight of precious metals; we measure the size of people and the extension of our families, the composition of working teams and the number of killed enemies; we measure the amount of taxes, the value of goods and the fluctuation of prices. And we measure as well the rain that falls, the season that changes, the wind that blows and the time that flows. Measures are then not only a way to communicate, but one of the means we use to think about our

[1] I wish to thank the editors for inviting me to contribute to the present volume, and especially Margherita Jasink for her continuous encouragement. Also, I wish to thank especially Giulia Dionisio for her precious help during the editing phases and Judith Weingarten for reviewing the English. My warmest thanks to Maurizio Del Freo and Francesca Fulminante for providing me with some study materials. I was not able to access Maurizio Del Freo also provided some valuable discussion of the evidence. Many thanks also to Maia Pomadère for allowing me to mention some unpublished finds from the *Bâtiment Pi* at Malia, Crete.

world in practical terms. As such, they constitute a prerequisite for the continuation and development of human societies[2].

Was Minoan Crete a measured world then? What impact had measures in Minoan daily life? Research on Minoan material culture is presently rich enough to allow some first observations in this direction, on the basis of the evidence from both Proto- and Neopalatial times. Weighing systems, capacity of vases, architectonic modules and sizes of loom-weights seem all to point to a pervasive presence of measures in the material life. From this perspective, Minoan society can also be seen as a network of measured relations and values, independent of the existence of the palaces and of written records. On the other hand, palaces themselves cannot be conceived outside such a network of measures: their very function if not their very existence is grounded in the global quantification of their own world and territory. The administration of economy is above all quantification[3].

Measures in the Minoan world: Overview

In the last decades, the various aspects of measures and measuring in Minoan Crete have been investigated with different intensity, so that now weighing systems are substantially known, while capacity and linear measures are less understood. No effort has been made up to now to interpret the masses of loomweights in a metrological sense – an attempt that is proposed here for the first time. The present overview does not include the Linear A measuring system, mainly based on a fractional ground: its functioning and its correspondence with more concrete form of measures, such those examined here, are still poorly understood[4].

Weighing systems

Thanks to the work of many different scholars over the years, the functioning of the Minoan weighing systems during the Neopalatial period is nowadays quite clear (Tables 1 and 2)[5]. The core information comes from the evidence of Knossos and Mochlos in Crete and of Ayia Irini (Keos) and Akrotiri (Thera) in the Cyclades. The system(s) seem(s) to combine both local and Near Eastern elements. The larger units of weights – the talent, the double mina, the mina and the half mina – were similar to those in use in the Near East. On the other hand, Minoan units of lighter weight had no or only very problematic parallels in Anatolia and Syria, thus suggesting a possible Aegean origin for these units. This is especially the case for the basic Minoan unit of 60-65 g, called ***x***. It is largely attested throughout the islands. Its fraction ***k*** of 20-22 g could more easily be converted into Eastern shekels[6]. Beyond the main series, other parallel units were employed to weigh the wool (wool unit ***l*** of 3 kg, one fleece ***z*** of 750 g ca), according to habits and absolute

[2] Kula 1970; Michailidou 1999 and 2010; Morley 2010.

[3] Musti 1996: 627: «cultura della numerazione, della quantificazione».

[4] The script used in Minoan Crete, the Linear A, used «only one unit [...] for every kind of measurement, with all quantities expressed as multiples of the unit and fractions of the unit» (Bennett 1980: 165). However, only few signs are presently understood: 1/2, 1/4 and 3/4. Bennett 1950, 1980 and 1999; Karnava 2001; Montecchi 2009.

[5] The first studies are due to A. Evans (1900-1; 1906: 343-353; 1935). A synthesis of the scholarship can be found in Parise 1986a; Petruso 1992; Alberti 2003; 2011; 2016; Michailidou 2008a. See also Michailidou 1990, 2007; Brogan 2006.

[6] But not without problems. Actually, with some approximation it can be considered either twice times ***s*** (9.4 g) or ***h*** (11.4 g), but no correspondence is straightforward and the archaeological evidence is not large enough to clarify the matter once for all (Michailidou 2004: 318; Alberti and Parise 2005; Rahmstorf 2010 and 2016; Alberti 2011 and 2016).

values common to all the Eastern Mediterranean[7]. Another specialised unit for textiles ***f*** of 36 g ca has also been suggested[8]. The weighing of light masses is particularly difficult to understand[9]. The combined presence of standard series used to weigh all kinds of commodities and of some specialised ones points to the survival of some forms of *concrete counting* within a computational system already oriented towards the *abstract counting*[10]. It is presently difficult to reconstruct how these measures came into being throughout the centuries, and how was the situation during the Prepalatial and Protopalatial times, when the available evidence is scarce. What seems at least to be clear, is that the local development of weighing standards has always been in some form of relationship with the Near Eastern systems (Table 3; see below for the Protopalatial period)[11].

Capacity measures

Although some studies on vase capacities from Akrotiri, Thera (LC I, i.e. Neopalatial period), and Pylos, Messenia (LH IIIB2, i.e. Mycenaean period) were already attempted[12], the first survey of the available information for Minoan Crete is quite recent[13]. It includes data from MM IIB Malia, LM I Mochlos, Petras and Palaikastro, and Minoan pithoi, and comparisons from Akrotiri and Pylos[14]. It should be stressed that the published information on vase capacity is still very scarce for Crete; thus the offered outline is still preliminary and more study and data processing are needed to refine it. However, in general terms, the system of capacity measurement in the Bronze Age Aegean seems to have had a number of constant characteristics through the time, at least from MM IIB to the end of LB IIIB (Table 4). The basic standards are the **hemikadion** (11-12 lt), the **kados** (22-24 lt) and the «**heavy**» **kados** (28-32 lt)[15]. For very small quantities (smaller than the liter) the system includes a series of volumes with intervals of 0.10 or 0.20 lt, with clustering at **0.15-0.16 lt**, and at Malia also at **0.25 lt**. Above the litre, the volumes have intervals of ca. **0.45 lt.**; at Pylos, intervals are in this case of 0.20 and 0.40 lt. Larger measures are exact multiples of this possible standard of 0.45 lt: 24 for the hemikadion, 30 for the «heavy hemikadion», 48 for the kados and 60 for the «heavy kados». Mathematical ratios between the standards seem, therefore, to be preliminarily assessed: the main counting unit, however, could have been different according to places

[7] Parise 1986b and 1991; De Fidio 1998-9 and 1999.

[8] Parise1987.

[9] This is a highly hypothetical and debated topic: however, the balance weights from some Cyprus tombs seem to point to the existence of a small fraction ***j*** of 1.9 g ca that could be common to many of the Eastern shekels (Alberti 2006: Table IX-X, p. 333-4). In Aegean terms, the same ***j*** could also be seen as a 1/8 of 15.2 g (= ¼ ***x***), i.e. as 1/32 ***x***. In addition, some weights from Mochlos (LM IB) and Akrotiri (LC I) suggest the existence of an Aegean series of ***k*** (24-20 g), ½ ***k*** (12-10 g) and ¼ ***k*** (6.5 g) (Alberti in preparation; Michailidou 1990; Brogan 2006).

[10] Parise 1986a: 307; Parise 1991: 14; Michailidou 2001b: 54; Michailidou 2001a: 15-27.

[11] See Rahmstorf 2016 for a detailed discussion of a group of EBA Cycladic weights. Alberti in press for a reconsideration of the MM II evidence from Malia. See below.

[12] Doumas and Constantinides 1990 and Katsa Tomara 1990 (Akrotiri); Lang 1964 and Darcque 2005 (Pylos).

[13] Alberti 2012.

[14] Poursat and Knappett 2005 (Malia); Barnard and Brogan 2001 (Mochlos); Knappett and Cunningham 2003 (Palaikastro); Christakis 2005 (pithoi).

[15] The names are conventional and inspired by contemporary Ugaritic (*kd*), and later Greek (κάδος) standard names (e.g. Heltzer 1989; Zamora 2000). Actually, the term *ka-ti* occurs at least once in Linear B texts, in PY Tn 996.3, preceding the ideogram *206^{VAS}, which resembles a jar or hydria (Bennett 1955: 108; Ventris and Chadwick 1973: 551; Vandenabeele and Olivier 1979: 257; Aura Jorro and Adrados 1985: 331). The Syro-Canaanite jars from the Ulu-Burun shipwreck fall into three clusters of about 26,7 lt, 13 lt and 6,7 lt (Pulak 2001).

and periods (the possible use of the «heavy hemikadion» at Akrotiri being an example). The discussion of the absolute value of the measures for dry and liquid foodstuffs attested in Linear A and especially Linear B is outside the scope of the present work: however, the data presented and the analysis conducted here could perhaps contribute to this long-standing debate, which cannot be successfully undertaken without an adequate corpus of capacity measurements.

Linear measures

Among the number of studies on Minoan architecture, only a handful investigate the possible individuation of a linear module, in strict connection to the reconstruction of planning habits[16]. The main outcome of these extended architectural overviews is the evidence for a careful laying out of the buildings, be it according to a single or to a series of modules or to the use of grids. The modules that have been singled out through these analyses by the various scholars, however, seem at first glance quite diverse, showing only few correspondences. Some scepticism has been rightly raised, pointing out the difficulty of finding a single standard measure in structures that are actually a palimpsest of modifications, additions, demolitions, reconstructions, and this through time and space[17]. On the other hand, a recent examination of two buildings at Kommos stressed that the values of the actual standards detectable through the architectural analysis are minor variations of an average value that can be then considered as the «module». This might suggest that there were different measuring devices used for the same type of unit, i.e. slightly different feet, hands or the like[18]. It is here proposed that these variations are the evidence for a flexible use of the standards, which is absolutely similar to what happened for balance weights. A flexibility that allows both slight variations of the same units through space and time and the effort to reconstruct the standard values.

Plotting together all the possible modules that have been identified in the various architectural studies, it seems clear that they can be easily composed in an anthropometric system of cubits, feet and spans (Table 5). Two types of cubits are seemingly present, a larger one of 54 cm (***Mlc***), and a smaller one of 46.8 cm (***Mc***). The range of the represented feet is quite wide, the average value being of 32.55 cm (***Mf***). It is not clear whether the module of 27-28 cm is a half of a ***Mlc*** or a large version of the span. The actual span (***Ms***, an outstretched hand and ½ ***Mc***) is better to be seen in the average value of 23.45 (possibly up to 25.5 cm). The length of 19.15 cm is not easily connected to this system. The existence of a palm (***Mp***) of 7.5-7.8 cm and of a finger (***Mfn***) of 1.6-1.8 cm has been hypothesised here on the ground of the parallels with Egyptian metrology, but has not yet been detected in the architectural studies. Indeed, the modules singled out by the various scholars find direct parallels with the Egyptian and Mesopotamian standards (span, cubits): and in Egypt both a large «royal» and a regular cubit were used[19].

[16] Graham 1960 and 1987: 222-229, 254-5 (Minoan foot of 30.36 cm); Preziosi 1983 (use of grids; various units, especially of 27-28 cm and of 34-35 cm, and also one of 54 cm); Cherry 1985 (cubit of 46.8 cm, double foot of 60.6 cm); Bianco 2003 (foot of 32.55 cm, half-cubit of 23.45 cm and a less convincing unit of 19.15 cm). Summary and comments in Preziosi 2003; McEnroe 2010: 88-89; Shaw 2010: 303-305.

[17] Shaw 2010: 88-9.

[18] Bianco 2003: 417.

[19] Alberti *et al*. 2002: 711-714. Mesopotamia: cubit 50 cm, span 25 cm, finger 1.6 cm. Egypt: «royal» cubit 55 cm, regular cubit 45 cm, palm 7.5 cm, finger 1.8 cm.

The presence of a «foot» among Minoan units is worthy of note: such a measure is not common in the contemporary Near East, but will be used, in many variations, during Greek times.

Further investigation and data are obviously needed. However, if the proposed scheme holds true, it seems that the system of linear measures worked in the same way as the weighing system: each unit could cover a short range of absolute values and in turn could be used as the basis for building calculations. The linear measures were, as the weight standards, connected to each other and at the same time working as «parallel units» for planning. This means that each area and period or even each single project could have used a different unit as main module: this is the case in Kommos, where the foot seems to be the reference for the LM I structures and the span for the LM III building[20].

Measures and craftwork

Theoretically, weighing standards and other measures ought to be largely used during craftwork, influencing the masses and sizes of the most common products, e.g. metal or ivory items, clothes, and containers. Unfortunately, the studies in this direction are not well developed, though some important results are available, pointing to the actual use of measuring units in the production of cauldrons, chisels and sickles, at least at Akrotiri, Thera[21].

Another aspect that remains basically untouched is the meaning of the weighing values of loomweights, not in terms of craft needs and uses, but in relation to the standard measuring system. Indeed, it is now well-known that weight is one of the most important characteristics of a loomweight, potentially influencing the type of fabric to be produced[22]. However, how the weight of the tools was determined, and on which standards, is still to be assessed, though a recent survey underlines that the weights of loomweights within the same find-group could vary[23]. The hypothesis that loomweights were at least in some cases manufactured according to the standard weighing system is reinforced by the evidence from Akrotiri, Thera (LC I), where loomweights and balance weights are found together[24].

The pervasive presence of measures in the Minoan daily life emerges from dispersed types of evidence through the island. Because of excavation history and taphonomic issues, rarely all elements are present in each site. Some settlements preserve weights, others have whole vases or complete sets of loomweights to be measured, while for others cases again architectonical studies are available. It is not possible here to undertake a detailed examination of these dispersed traces. Instead, the following paragraphs present the few cases where more complete evidence is available.

[20] Bianco 2003.

[21] Michailidou 1999; 2001b: 97; 2003, 2008a: 100-130 and 2008b. For Mycenaean evidence: Michailidou 2001b: 101-102 and 2008b.

[22] Martensson *et al*. 2009; Andersson Strand 2012 and 2015; Cutler *et al*. 2013; Olofsson 2015; Olofsson *et al*. 2015, with references; Rahmstorf 2015.

[23] Firth 2015: 186.

[24] This is especially the case of the West House, that yielded 26 balance weights (lead discs) and 400 loomweights, but also of Sector A (Michailidou 1990; Tzachili 1990; Michailidou 2010). It is generally thought that in such contexts balance weights were to weigh the wool to be used in the textile manufacture. However, the weighing of loomweights can not be excluded.

Protopalatial measures

Malia, Quartier Mu

The largest data set that is presently available for the Protopalatial period comes from at *Quartier Mu* Malia, destroyed by the end of MM II (around 1700 BCE) and very well preserved until modern excavation. There, two large buildings with reception, residential, storage and cultic areas have been found: Building A and Building B. They also yielded evidence for substantial administrative and textile activity. Surrounding them, a series of small workshop-houses hosted various crafts: seal engraving, stone working, pottery production and metallurgy. This neighbourhood is considered as an example of the possible structure of at least part of the Protopalatial society, where important households had under their own control the activities of attached craftsmen and of areas in the countryside[25]. The excellent state of preservation of the findings and the various activities in the buildings provide the best chances to reconstruct the use of measures in Minoan daily life.

Balance weights are recorded from various areas of the complex: unfortunately, their number is low and no proper «set» has been found (Table 6)[26]. However, the widespread presence of the weights throughout the complex (Potter's Workshop, Building A, Building B, area of Building C) points to a frequent use in many fields of daily and productive activities. A pair of balance pans is also attested. The most interesting group of findings is from the Potter's Workshop: two limestone discs based on the ***k*** unit of 20 g ca, that could work with the third weight in the area, a stone cylinder of 9.7 g, as ½ ***k***, 1 ***k***, 3/2 ***k***. Other possibilities can not be excluded, such as a probable value within the **f** series. What it is striking here, though, is that apparently balance weights from various different traditions were being used together: if the two discs anticipate types and values of the Neopalatial phase, and could then be regarded as «Minoan», the cylinder seems more related to types and units of the EBA (especially mainland and Cyclades) or of the Near East (being 9.7 g a «Syrian» shekel ***s***)[27]. The special mark on its top could actually denote its Levantine value. The same «mixture» of types and standards is to be seen in the other weights from the complex: their types are all «Minoan», but their units seem to be both Near Eastern (***deben***, ***kar***) and Aegean (***x***). It seems that during MM II weighing was in a sort of experimental phase, where both Near Eastern and local experiences and traditions were explored and exploited. This allows a glimpse on the complexity of trade interconnections in the period for the site[28].

A number of whole or mendable vases has been recovered in the complex: and fortunately their volumes have been published, allowing a thorough study of the capacity system[29]. The main elements for the interpretation are provided by the necked jars (*jarres*

[25] Recent summary in Poursat 2010 and 2012 a. Detailed publications: Poursat *et al*. 1978; Detournay *et al*. 1980; Poursat 1996; Poursat and Knappett 2005; Poursat 2013.

[26] Alberti 2000 and in press; Poursat 1996: 123-124, pl. 57 f-j.

[27] During EBA, in mainland Greece and in some islands balance weights were spool-shaped items of rare stones, and followed Near Eastern weighing systems. See Rahmstorf 2006, 2010 and 2016.

[28] As it is also illustrated by another possible weight from the contemporary Dessenne Complex, also at Malia (Alberti in press). See also Poursat and Loubet 2005 for the evidence of external contacts in Protopalatial Malia.

[29] Alberti 2012, see above. Pottery publication: Poursat and Knappett 2005.

à col) and type 1 amphorae (Table 7): recurrent volumes point to the existence of a series based on two units, the **kados** (19-22 lt, with fractions and multiples) and the «**heavy**» **kados** (26-30 lt, with fractions and multiples). However, a closer look at the type 1 amphorae alone shows that their volumes form a series based on the unit of **0.45-0,5 lt**, always linked to the kados standards (Table 8). The same is true for type 2 amphorae (Table 9) and for type 2 jars, type 3a amphorae and type 2 *brocs* (Table 10): they cover a range between 3 and 41 lt, including both of the kados standards, thus providing an idea about the functioning of the system for medium quantities of liquid or dry goods. Other vessels can illustrate the measurement of small amounts: type 6 and 9 amphorae, type 1 *brocs*, jugs and cups (Table 11). The smallest recorded volume is of **0.10 lt**. Low volumes seem to compose a series with very small intervals, of ca. 0.10 lt. The standards of **0.15 lt**, **0.25 lt** and **0.45-0.5 lt** seem to be particularly important. The data from other less numerous vessel groups, such as basins, bowls, tripod jars and bridge-spouted jars fit the proposed series as well, as it the case for the capacity of two bronze cauldrons[30]. It is worth noting that external typological differences among medium-sized containers, such as large-based (type 1) *vs* narrow-based (type 2) amphorae, are not related to different volume standards: the reference series is always the same.

Unfortunately, metal finds from the area have not been fully published yet and the available information does not include their weight: it is therefore impossible to know whether weight standards played any role within their manufacture[31]. Nevertheless, this is quite probable, as the presence of a fragment of copper mineral, weighing 96 g, i.e. exactly one ***deben***, seems to suggest[32].

As for ground stone tools, their final shape is dictated more by the original form of the chosen stone or pebble than by actual manufacture according to measuring units. Anyway, some general observations can be made here on the tools from Quartier Mu, since their data are fully available[33]. The lengths of querns cluster at 17 cm ca. - 20-25 cm, 27-32 cm, 36-40 cm: this should better mirror some practical concerns or constraints, even if the second and third clusters could correspond to the linear measures ***Ms*** and ***Mf***. In any case, they are inferior to one cubit, i.e. an arm's length – the arm of the grinder. The weights of whetstones range mainly from 10 to 40 g, which is easily explained by the need of transportability. Pounders are represented in a number of sizes, as their weights cover a complete series between 60 g to more than 1 kg. Some of the main clusters do not seem to be connected to any standards (see e.g. the concentration around 150-180 g or the complete series 300-390 g), while in other cases clusters could hypothetically recall some well-known weight units: 20 k (210-240 g), half mina (250-270 g), 40 k (400 – 440 g), a Syrian mina or 5 deben (480-490 g), 10 x (580-650 g), 10 deben (950-970 g), a double mina (?) (1120 g, 1200 g). However, this is perhaps too forced an interpretation.

A field where manufacture took actually place was the production of loomweights, and we could expect that some type of measuring was involved in the process, though the main requirement was to achieve a good combination of weight and thickness in relation to the actual use on a loom. Quartier Mu yielded a large amount of loomweights,

30 Detournay *et al.* 1980 : 82-84.

31 See e.g. Detournay *et al.* 1980, *passim*; Poursat 1996, *passim*.

32 Poursat 1996: 64, D 30.

33 Procopiou 2013: 197-212.

clustering in Building A, B and D. Thorough studies show that weaving activity took place on a certain scale there, with seemingly specialised areas for the production of different type of textiles[34]. However, once again no full catalogue has been published, so we must limit our investigation to the few available data (Table 12)[35]. In the overall assemblage of loomweights from Quartier Mu, meaningful clusters are based both on size and typology: discoid weights tend to be quite light, spherical weights are heavier and thicker, and torus weight are even heavier, while the cylindrical and the pyramidal truncated ones have more intermediate characteristics. In terms of size, four main groups are detectable: the first, with weight ranging from 75 to 150 g and thickness between 1.5 and 2.3 cm (mainly discoid weights); the second, with weight from 150 to 200 g and thickness between 2.5 and 3.5 cm (again mainly discoid exemples); the third one, again with a weight range of 75-150 but thickness from 4 to 5.2 cm (mainly spherical ones), and the fourth, weighing 300-380 g and having thickness between 6.5-7.2 cm (torus-type items)[36]. Thickness is then a key-factor: it makes the difference between the first and the second group, and has therefore to be considered meaningful also in term of manufacture. Are these thickness values, and the other ones recorded, related to any measure? It is here proposed that they are actually related to the Minoan finger (***Mfn***), representing one, two or more units (Table 12). That could provide the craftsman with an easy way to calculate the intended thickness of the loomweight during manufacture, in combination with length/height parameters. Shaping by hand (or moulds?) according to a simple linear system could then have been the way used to produce the loomweights. Also for weavers, looking at the thickness of loomweights of the same type could have been useful when setting up the loom. The few available data on single items seem to support this suggestion (Table 13)[37]: especially discoid exemplars seem to have quite standardised dimensions, as do most of the spherical ones. The question of their actual weight is more delicate: theoretically, manufacture aimed at the production of loomweights of a certain size and weight, so we could expect somehow standardised masses in the loomweights of the same set. Indeed, in most cases the two extremities of the masses of the same set do fit known metrological standards (Table 12 and 14). However, the weight of single items often falls in between these brackets, with no clear corresponding unit[38]. It does not seem possible to make further observations on the topic with presently available information. The only possible group of loomweights that might have been weighed when manufactured are hypothetically the torus ones: some of them are quite heavy, and their masses match some well-known standards (Table 15)[39]. While this picture is seemingly confirmed by findings from other contemporary excavations (see below), it could completely change once the full catalogue of the loomweights from the area is published.

The evidence from Quartier Mu, even with the obvious limitations of the available information, seems to suggest that measures were actually embedded in daily lives and were used in a number of occasions, both for the production and use of the most common objects.

[34] Cutler *et al.* 2013; Poursat *et al*. 2015 ; see also Poursat 2012b;
[35] Cutler *et al*. 2013: 99, 106, 108, 112, 114, Fig. 5.2, 5.3, 5.8, 5.9, 5.11, 5.13, 5.17, 5.19, 5.21.
[36] Cutler *et al*. 2013 : 99-100.
[37] Poursat 1996: 28, 32-33, 38-39, 52, 64.
[38] As it appears from the graphs in Cutler *et al.* 2013: Fig. 5.2, 5.3, 5.8, 5.9, 5.11, 5.13, 5.17, 5.19, 5.21.
[39] Cutler *et al*. 2013 : 106, 112, Fig. 5.4.

Malia, Bâtiment Pi (MM II)
A group of fifteen loomweights, which seem to follow some precise size and weight standards, have been found in room 22 of Bâtiment Pi, in the same site of Malia (MM II). They are all of the pyramidal truncated type. Their dimensions are very similar, their heights ranging from 4.2 to 4.7 cm, and their bases being of 3.8 x 3.4-4 cm, possibly respectively corresponding to 3 and to 2 ***Mfn***. Their weights vary between 56 and 72 g, with clusters around 66-68 g and an average of 64 g, i.e. a typical Aegean unit ***x***. The presence of a single item weighing 72 g (= 2 ***f***) is to be stressed: this could ideally «bridge» the standard series ***x*** and the (not well represented among balance weights) series ***f***. The value of 72 g ca (= 2 ***f***), that is quite common among the Quartier Mu loomweights (Table 12), could be hypothetically seen as a «heavier» version of the standard[40].

Knossos, Loomweight Basement of the Palace (MM II)
Over four hundred discoid loomweights were found by A. Evans in the so-called «Loomweight Basement» of the Palace at Knossos (MM II). The small portion of them that has been re-studied recently shows a striking uniformity in size and weight[41]: they measured between 9 and 10 cm in height and about 7.5 to 8.5 in width, what can be equated with five and four (i.e. one palm) ***Mfn*** respectively. Their weights range from 127 to 205 g, i.e. from 2 ***x*** to 3 ***x***, encompassing the value of 150 g (= 4 ***f***) that plays a major role within the Quartier Mu examples (see above).

By the end of the Protopalatial period, measuring standards were then quite developed and widespread throughout the island, and they were used for various types of crafts.

Neopalatial measures

Mochlos, The Artisans' Quarter (LM IB)
The wide array of metrological evidence available for *Quartier Mu* is presently unparalleled for the Neopalatial period. While in recent publications both stone tools and loomweights are generally presented in detail, not enough information is provided for vessel capacities and for the weight of metal items. However, the Artisans' Quarter of Mochlos is a good parallel of the workshop – houses of Quartier Mu and has been thoroughly published[42]. The complex consists of two buildings, Building A and B, both including living, cooking and working areas, with some external areas also used for craft activities. Stone vase making, textile production, metallurgy, pottery production and food processing and consuming are the activities that are more clearly attested there. The area seems to have been a focus of specialised craftsmanship for the nearby village, but lacks indicators of prestige productions such as seal engraving or jewellery making, and has not yielded any administrative or inscribed document.

[40] A series of very similar loomweights has been found in Palaikastro, all along a single street (LMI IB). They bear all on their tops the imprint of a single seal. Their weight is very homogenous, clustering around 111 g (3 *f*?). MacGillivray *et al.* 1990: 145-6.

[41] Burke 2010: 56-8.

[42] Soles 2003 (excavations and contexts); Barnard and Brogan 2003 (pottery); Soles and Davaras 2004 (small finds).

Weights and scale pans were found throughout the settlement, in areas where also storage jars, metal hoards and craftwork indicators were attested[43]. In most cases, weights are single finds, with only small clusters in the village (Building B.2 and C.7) and in the Artisans' Quarter[44]. There, Building A and Building B yielded a couple of weights each (Table 16). Though the large majority of the balance weights from the settlement as a whole are lead discs based on the Aegean main series ***x***, and only few are made of haematite, here haematite examples prevail. They come from rooms A4 and B7, especially connected with metalworking and stone vase making. Building B was also involved in textile production. The couple from room A4 includes a lead disc and a haematite cuboid, the first easily equated to a ½ ***x***, the other with a more dubious interpretation. While a value on the same basis ***x*** cannot be excluded[45], its mass corresponds to 5 Mesopotamian shekels ***mp***[46], and is in any case very close to the first «conversion» point of the others Near Eastern shekels, 47 g (theoretically equivalent to 4 ***h***, 5 ***s*** and 6 ***kar*** respectively, see above Table 3)[47]. Also the two haematite domed weights from Building B have a Levantine shape and material: they weigh respectively one ***mina*** and a ***double mina***, a standard common to many areas in the Eastern Mediterranean and Mesopotamia, and also at home in the Aegean[48]. Such heavy weights are generally connected to metalwork or textile activity, both attested in the building[49]. It is not clear if the marked stone pebble IC.210 should be included among the balance weights: the combination of a linear sign (though not precisely identical to a Linear A sign) and strokes could resemble more a «token» or «nodulus» than a balance weight proper. Its mass could fit the ***f*** value, but the three strokes, if they are to be intended as value marks, i.e. three units, point to the ***k*** unit[50]. Overall, the weights from the Artisans' Quarter seem to have Near Eastern models if not a Near Eastern origin: however, it is impossible to assess if they were used as such or according to their possible Aegean values.

Despite the large quantity of pottery found in the structures, capacity has been recorded only for a small number of conical cups and ogival cups (Tables 17 and 18)[51]. Most of the conical cups contain between 0.10 and 0.12 lt, with some smaller and larger example. It is not clear if the volume of 0.14 lt has to be considered as a variation of the 0.10-0.12 lt size or as a separate value/standard. Most of the ogival cups have a volume of 0.25-0.28 lt, with some smaller and larger examples. The value of 0.34 lt has to be seen a separate size. Both these dimensional clusters of **0.10-0.12 lt** and of **0.25-0.28 lt** find a parallel in the capacities of the smaller vessels from Quartier Mu (see above and Table 11) and can be roughly considered one the double of the other, being ideally fractions of the 0.45-0.5 lt unit. However, the sample is very limited.

[43] Brogan 2006: 279. Brogan 2006 is the source of most of the following paragraph on balance weights. See also Petruso 1992: 40-42 for an assessment of the data from the previous excavations and Soles 2005 for the presence of Levantine weights.

[44] Brogan 2006: 287.

[45] Brogan 2006: 273.

[46] Soles 2005: 431.

[47] See Parise 1981 and 1984; Alberti and Parise 2005; Alberti 2011: Table 1.

[48] Soles 2005: 431. Other two haematite weights are reported from the main settlement, weighing one «Western» mina each (478 g), and haematite was also imported raw (Soles 2005: 430-431; Brogan 2006: 276).

[49] Brogan 2006: 281.

[50] The findspot is controversial: B.6 (Soles and Davaras 2004: 52, fig. 17) or A.4 (Brogan 2006: 274, to be grouped with the other weights from the same room).

[51] Barnard and Brogan 2003: 35-45.

On the other hand, the evidence for metalwork is quite compelling, and it has been thoroughly studied[52]. A number of tools, waste, spill and finished products are recorded from the two buildings, in addition to various ingot fragments and other bronzes intended for recycling. For our purposes, the contents of a «foundry hoard» just at the exterior of Building A (northern room) deserve special consideration (Table 19). They include fifteen ingot fragments, two lumps of copper waste with a regular side, and some bronzes for recycling. Their weights seem to compose quite a regular series, and their relative values can be easily linked to the main ***x*** unit, from ½ ***x*** to 12 ***x***. This could confirm the suggestion that the ingots were cut according to approximated weight values, in order to be more easily used for production, transactions and accounting[53]. In addition, the dimensions of the ingot fragments from this «foundry hoard» are very similar within each dimensional cluster (e.g. the two fragments weighing ½ ***x*** measure 2.3 x 3.4 x 1.6 cm and 2.7 x 3.7 x 1.6 cm, while those weighing 1 ***x*** measure 2.7 x 3.9 x 2.2 cm and 3.2 x 3.7 x 2.1 cm): we can even speculate on the possibility that a simple linear system of measuring was used when cutting the various pieces, something like 2 x 2 x 1 ***Mfn*** and 3 x 3 x 2 ***Mfn*** respectively. Apparently, also the different items of scrap metal assembled in the hoard had an approximate weight on basis ***x***. The two lumps of copper waste are clearly one the double of the other, and are possibly related to another weighing standard. In some cases, an alternative interpretation according to other units is also possible, but the general pattern seems to point to ***x*** as the main reference for all the hoard. The few present inconsistencies are probably due to the approximation of the cutting procedure. As for the other metal items recorded from the two structures, they include some ingot fragments, finished objects and scrap metal (Table 20). A more or less sound metrological value can be proposed only for the ingot fragments, mainly based on the ***x*** unit, though in one case a possible ***dbn*** is attested (if not to be seen as 3/2 ***x***, IC.241). Finished objects are mostly incomplete and their masses could not be meaningfully measured. Most of the best preserved pieces (knife IC.269, spatula IC.276 and earring IC.274) are very light and do not seem to fit easily in any metrological series, while the heaviest (knife IC.277) could belong either to an Aegean or to a Levantine standard. The interpretation of the scrap metal items is even less clear, though most of the lighter objects could match some Levantine or Aegean unit. More generally, these materials raise the question of the interpretation of light masses[54]. The presence of some strip fragments is worthy of note, since bundles of strips, more or less of equal size, are known from metal hoards found in other areas of the settlement[55]. However, no similar bundles are known from the Artisans' Quarter. All in all, it seems that, out of the «foundry hoard», in these buildings only the ingot fragments had a metrological connotation and that all the other materials, even when intended for recycling, had no regular weights or token value. However, the preference for light masses mirrors the reduced size of the scale pans found in the settlement[56]. Overall, the evidence from the Artisans' Quarter on one hand attests the existence of metrological correlations as for «foundry hoards» and ingot fragments are concerned, and, on the

[52] Soles and Davaras 2004: 46-52; Brogan 2006: 283-6 and 2008; Soles 2008.
[53] Brogan 2006: 283.
[54] See above, fn. 9.
[55] Brogan 2006: 283; Soles 2008. No detailed information on the bundles' weight is available.
[56] Brogan 2006: 284.

other, could support an acquaintance with Levantine standards, as suggested above by the balance weights analysis.

The stone tools from the area have been published in great detail[57]. As mentioned above, it is not sure if measures entered at all in the process of choosing these implements. However, their general dimensions and weight affect greatly their practical use, so that some tentative observations may be of some use. Hammerstones and heavy oblong handstones (Table 21) could have been chosen according to their length: and it actually seems that their lengths could be referred to a rough fingers (***Mfn***) measuring. Also their weight can mostly be easily counted in standard unit ***x***. The latter is also possible for smaller handstones (Table 22). The sub-cuboid cobbles with abraded surfaces are made in non-local stone and have mostly a faceted surface: because of that, they have been hypothetically likened to balance weights[58]. However, most of them have been found in clear craft activity context (with ochre, with mortar) or have use wear from craft activity (abrasion and percussion): so they have to be considered essentially as polishers/grinders. Among the few remnants, only IC.352 and IC.353 have a sound weight/relative value, while IC.356 has the more convincing shape (Table 23). However, the whole group has better to be seen as craft tools. In the same way, the evident use-wear on IC.466 point to a practical use as drill-bit, even if its weight of 62 g could be linked to the ***x*** unit[59]. The dimensions of saddle querns are quite meaningful: they can theoretically be equated to various measures of length (Table 24). What is more important in practical terms, however, is that their proportions tend to be the same, the length being roughly the double of the width, and that the length itself is generally in some relationship with the cubit (***Mc*** or ***Mlc***). This is clearly in connection to the actual function of the implements, that could not exceed the extension of the grinder's arms, as we have seen above for Quartier Mu. Minor units of length can be hypothetically proposed for the dimensions of stone palettes and stone tables (Table 24).

A number of loomweight have been found in the two buildings. Quite interestingly, their findspots «[…] suggest that some, if not all, fell from the roofs where the actual looms were set up»[60]. As is underlined in the publication, each of the recorded types has its specific weight-range[61]. The most numerous elliptical ones (Type A) cluster in three groups, covering the larger range of all types: the large ones weighing 150 to 270 g, the medium ones from 70 to 150 g and the small ones from 30 to 70 g. The second group, the rounded loomweights (Type B) have a more restricted range of weights, from 80 to 160 g. Still narrower is the range for the few discoid ones (Type C), from 60 to 70 g, and of the few trapezoidal ones (Type D), from 40 to 65 g. The only spherical one weighs 158 g. There are then some similarities with the evidence from Quartier Mu (see above). A closer examination of the catalogue allows further insights, on the relative value of their weights and on possible patterns for their sizes – though the analysis is necessarily limited to the complete or nearly complete items. Plotting together the data of the elliptical

[57] Carter 2004.

[58] Carter 2004: 67-68, 79 and table 9.

[59] Carter 2004: 82, with thorough discussion. It can perhaps be suggested that it was a bore-core selected first to act as a balance weight, within the earlier tradition of «spool-shaped» weights (see above), and then re-used as a drill-bit. However, this is very hypothetical.

[60] Soles *et al*. 2004: 28.

[61] Soles *et al*. 2004: 28-33.

loomweights (Type A), it is clear that their masses actually correspond to precise weight standards, allowing for some approximation: they range from the single unit ***x*** to the ***half mina*** (Table 25). In addition, it seems that the items having similar weight have also similar size, what is hardly a surprise, but gives us a clue as to how a craftsman could have reached the desired weight when shaping the clay into loomweights, be it by hand or by mould. The group of loomweights from room B.8 is particularly informative, in terms of consistence of dimensions/weight and of weight range. As for the rounded loomweights (Type B, Table 26), their weights correspond to a single unit ***x*** or ***f*** or to their doubles. The few recorded discoid examples (Type C, Table 27) seem to be specialised in representing the main unit ***x*** both in Building B and in the more distant Chalinomouri farmstead, while the trapezoidal loomweights from Building A (Type D, always Table 27) better embody the first fraction of the main unit, i.e. 2/3 ***x*** (= 2 ***k***) and ***x*** itself. In addition to clay loomweights proper, also a stone loomweight and various naturally perforated weights have to be taken into account, even though the latter ones could have been used for a variety of purposes[62]. Their weights fit quite nicely the standard series, the lightest examples actually matching the loomweights masses (Table 28). This is especially clear if looking at the evidence from Building A (Table 29): as expected the lowest units are represented by the trapezoidal loomweights, the main unit ***x*** by the trapezoidal and the elliptical ones, and the medium units by the rounded and elliptical items. The way the masses of naturally perforated weights fit in is remarkable. In particular, with reference to rooms A.2 and A.4, a series based on ca. 40-48 g (= 2 ***k***) stands out beside the examples of the ***x*** unit: 2 ***k***, 4 ***k***, 8 ***k***, possibly involving also the unusual weight of 860 g as 40 ***k***. The more classical ***minas*** weights from room A.5 could either be ascribed to the weaving activity or to actual weighing operations. The overall view of the analysed evidence (Table 30), incorporating also two pierced sherds found in the Chalinomouri farmstead, illustrates once again the typological specialisation for weight ranges and the flexible character of both elliptical loomweights and naturally perforated weights[63]. In addition, it is clear that the loomweights belonged to at least three different series of weight standards: the main unit ***x*** (57-67 g), the unit ***f*** (32-36 g) and especially its double 2***f*** (70-78 g), and the unit ***k*** (20-24 g), here present with its multiples of 2***k***, 4***k*** and 8***k***. The series of ***x*** and ***k*** are interrelated, being ***k*** = 1/3 ***x***. In abstract terms, all the weights together form a continuous series of values, with very short intervals, best to be seen as based on ***k*** or ½ ***k***. This could provide the weaver with a highly sophisticated mean, allowing the perfect calibration of the loomweight arrangement according to the various needs of the work. However, the concentration of loomweights based on 2***k*** in Building A (see above) and of the few based on 2***f*** in Building B[64] points to precise choices of the weavers and to possible specialisation of weight series for type of textiles, though the evidence from Building B is quite variegated[65]. As for the heaviest examples (multiples

[62] «From their various shapes, sizes, and findspots, it is unlikely that they [naturally perforated weights] fulfilled a single function» (Carter 2004: 81). Two have been found in room A.4, that yielded also various clay loomweights: «It suggests that many of the smaller examples were employed in weaving, with the larger pieces used as tetherstones for animals, or possibly anchors.» (*Ibidem*).

[63] Pierced sherds: Soles *et al.* 2004: 33.

[64] NPW IC.440 A-B road; A: IC.94 A-B road, IC.104 B.2, IC.108 B.8.

[65] On the possible relationship between weight standard and loomweights and on the textile-related evidence of Building B, see Brogan 2006: 281.

of the ***mina***), all naturally perforated weights, as mentioned above they are probably more linked to the actual weighing of commodities, wool, textiles, metals, clay, etc., than to proper weaving activities. On the other hand, the possibility that they were used for completely different purposes, their weight matching only by chance some weighing units, is still open. The attempt to give a metrological interpretation to the loomweight dimensions according to a possible ***Mfn*** unit is admittedly quite hypothetical, also because the finger actual dimensions, i.e. the thickness of the thinner loomweights, vary considerably. On the other hand, it could mirror the variety of the actual craftsman's hands that were shaping the objects, from adult man to woman or child, or reflect the use of moulds or other modelling devices. What is striking, in any case, is the close correspondence between size and weight within each loomweight type (always Table 30): it is clear that some manufacturing pattern is at work here, with some easy way to produce a loomweight of a certain type and weight. For example, the lightest of the elliptical ones (Type A) weighs around one main unit ***x*** and its dimensions in ***Mfn*** are 3 x 3 x 1-2 (a trait common to other types of loomweights). The one coming immediately after, weighing 2 ***f***, i.e. just something more than ***x***, is 4 x 3 x 1 ***Mfn***: only one dimension is augmented. To reach a step further, the double of ***x***, all dimensions are doubled: 4 x 4 x 2. And so on. Obviously, this is a mere suggestion, and data does not always support this interpretation.

Kommos, Building T (MM III – LM IA)

According to recent studies, Building T at Kommos was built at the end of MM III following a module of 32.55 cm, i.e. a ***Mf***. Linear measures of 12 and 14 modules (4.56 and 3.91 m) are especially recurrent[66]. A group of discoid loomweights has been found there, in the LM IA final-LM IB Early room 29: their dimensions (H: 5.9-6.8 cm; W: 5.9-6.7 cm; Th.: 1.6-2.3 cm) and their weights (54-76 g) are quite homogeneous, with only a heavier example (160 g)[67]. The dimensions can be roughly equated to 3 x 3 x 1 ***Mfn***. As for the weights, the large majority weighs 70 g, while others weigh 54, 60, 76 and 80 g. While each of these masses could have a different relative value (2***f***, ***x***, ***x***, 2***f***-4***k***, 4***k***), it is probably better to see all the loomweights as a group and so as ideally ranging between 60 and 70 g. This would raise once again the question of the actual meaning of the 70 g unit, i.e. a measure of the «parallel» series based on the (not well attested among balance weights) ***f*** value, or an approximate version of the main unit ***x***, perhaps due to manufacture reasons (see above, Malia Bâtiment Pi). The loomweights from Room 29 could possibly be considered as working together with those from Room 22 (92 g, 105 g, 120 g), mostly in relation to the ***x*** series.

Knossos, Acropolis Houses (LM IA)

A number of loomweights has been found in room 1 of the LM IA House of the Knossos Acropolis[68]. The large majority are spherical or spherical grooved, and compose a continue series of masses from 110 to 900 g. It is not always easy to detect precise measure standards in this sequence: however, the spherical items seem more clearly related to the

[66] Bianco 2003; see above.

[67] Dabney 1996: Table 4.1; Shaw 2006: 43-46, 729-738, Table 4.2 . The latter has been chosen here as reference, since the weight of some items is not the same in both publications.

[68] Catling *et al.* 1979: 44-51, 63-65, Deposit F.

main unit x than the spherical grooved ones, that are possibly better connected to the $2f$ series. Heavy examples, if their weight is not approximated, are again mostly multiples of x, in the same way of the few cylindrical and «obloid» loomweights.

Malia, Bâtiment Pi (LM IA)
Preliminary studies have been made of a large part of the LM IA materials from the complex which allows some first insights on volume measures. The capacity of the conical cups from rooms 10, 11 and 13 cluster in three groups: a large one (capacity 0.07 lt), a medium one, comprising the majority of the examples (capacity 0.05-0.06 lt), and a small one (capacity 0.025 lt). The second and the third groups are one the double of the other. They seem to be generally smaller of the conical cups from Mochlos (see above). Exception to this pattern are however present, and few conical cups are significantly larger, having a volume of 0.1 lt, similar to that of most of the Mochlos items, to be possibly seen as the double of the 0.05-0.06 lt volume. Both the 0.1 lt and the 0.07 lt measures find a parallel in the evidence from Palaikastro, where the 0.07 lt value is the most represented during the LM IA[69].

Communicating through a network of measures
This is the first attempt toward a global reading of the archaeological evidence for Minoan measures and many more studies will obviously be needed to achieve more solid results and to build up a picture of chronological and regional variations. Nevertheless, what clearly emerges from the present analysis is that Minoan material culture preserves at least some traces of the use of standard measurements. Although some of the proposed interpretations are admittedly somewhat forced and may turn out wrong after further investigations, we can start to see Minoan daily life as based on a network of measures, involving all aspects of practical activity. This has an enormous impact on communication: standardized measures means that an architect could direct and check the work of teams of builders, a cook could create and teach his/her recipes, a buyer could choose the desired vessel at the market, not to speak of scribes and administration. If a family had an unexpected guest, they could send their child to ask a neighbour for an exact quantity of flour or honey. If a metalworker needed some raw metal, he could ask the supplier (be it a palatial bureaucrat or a merchant) for this weight of bronze or that size of ingot fragments, and once back in his workshop, tell an assistant to use that size of hammer on the anvil. If a group of weavers intended to arm the loom in a certain way, they could discuss among themselves the right size/weight of loomweight to be used, and then decide to ask the potter or some other craftsman to produce exactly what they wanted – and it could be done easily, thanks again to measures. Measures would tell a team of grinders which querns to use, which containers to fill and then how long to work. Or they would dictate to a feast overseer how many bowls and cups to ask from his attendants, and how many bulls and goats to request from the butchers or the shepherds. Measures, no matter how concrete or abstract, are the backbone of practical communication within a society: and the Minoans were certainly communicating through measures, because Minoan Crete was a measured world.

[69] Knappett and Cunningham 2003: 115-116, 162.

«Minoan» (Neopalatial) System
MMIII-LMI

1	*L*	30.000 g	480
1/30	*M* *double mina*	1.000 g	16
1/60	*Mina*	500 g ca	8
1/480	*x*	60-65 g	1
1/1440 (1/1500)	*k*	20 g	1/3

duodecimal and sexagesimal progressive fractions

Table 1. Simplified structure of the weighing system used during the Neopalatial period in the Aegean, reconstructed on the basis of the attested groups of weights. The wool (*l*) and textile (*f*) units and the smaller hypothetical fractions are not considered. For a detailed view, see Alberti 2011a

«Minoan» (Neopalatial) System
MMIII-LMI

1	*talent*	30.000 g ca	480			
1/10			48	*Wool unit*	3.000 g ca	4
1/30	*double mina*	1.000 g ca	16			
1/40			12	*One fleece*	720-780 g	1
1/60	*mina*	500 g ca	8			
1/120	*half mina*	250 g ca	4			
1/480	*x*	60-65 g	1			
				f	36,7 g	1/20

Table 2. Main structure of the weighing system used during the Neopalatial period in the Aegean, including the wool and textile (*f*) units. For a detailed view, see Alberti 2011a

Egypt		«Western» Units Ugarit, Karkemish (Syria), Khatti (Anatolia)		Ashdod (Palestina)			
		1	1 **talent** 28.2 kg				
				1	1 **talent** 23.5 kg (= 5/6 talent 28.2 kg)		
						30	1 **«double» mina** 783.3 g (= *z*)
	5 ***dbn*** 470 g	60	1 **mina** 470 g	50	1 **mina** 470 g		
						60	1 **mina** 391,5 g
	1 ***dbn*** 90,95 g		**shekels** for 1 mina				
		40	***h*** 11.75 g				**Shekels** for both minas
10	1 ***qdt*** 9,09 g	50	***s*** 9.4 g			100	
12	1 ***s'ty*** 7,83 g	60	***kar*** 7.83 g				***k*** 7.83 g
						50	
			(4 ***h*** = 5 ***s*** = 6 ***kar***)				

A – Levant and Egypt

Mesopotamia	
1	1 **talent** 30,3 kg
30	1 **«double» mina** 1008 g
60	1 **mina** 504 g
60	**Shekels for** 1 mina ***mp*** 8,4 g

B - Mesopotamia

Table 3. Main Near Eastern weight systems during the Bronze Age. Parallel divisions and conversion systems (modified from Alberti and Parise 2005: Table 1)

Volume lt	Unit 0.5 lt	Unit 1.5 lt	Hemikadion	Kados	«Heavy Kados»
0.15			1/64	1/128	
0.25	1/2	1/6			1/128
0.4/0.6	1	1/3			1/64
0.7			1/16	1/32	
0.9					1/32
(1)	(2)	(2/3)			
1.3-1.4			1/8	1/16	
1.5/1.7; 1.6	3	1			
1.8-1.9					1/16
2	4				
2.7-2.8	5		¼	1/8	
3.3	6	2			
3.7-4	8				1/8
4.2-4.5; 4.6	9 or 10	3			
4.8-5	10				
5.5	**12**		½	1/4	
6.3	14	4			
7.5	16	5			¼
8.5-9	18	5? or 6	3/4	3/8	
9.5	20				
10.5	22	7			3/8 (= 3/4 hemikadion)
11.5	**24**		1	½	
12; 12	25	8	1	½	
13.5	28	9			
13.8-14.00	29			1+1.5 lt?	½ hemikadion?
14.5	**30**				½
15		10	3/2	¾	
16			3/2	¾	
17	36		3/2	¾	
18					
22-24	48	16	2	1	
28-32	60	20			1
37	72		3	3/2	
40				2	
45-50	120			2	

Table 4. Simplified structure of the Minoan capacity system as proposed in Alberti 2012. In bold the most represented values

Lenght (cm)	Possible measure	Mp (?)	Mf	Mc	Mlc
60.6	Double Mf	8	2		
54	Mc large (= 1 Mc + 1 Mp?)	7			1
46.8	Mc (= 1 Mf + 2 Mp?)	6		1	
30.3-30.4; **32.55**; 34-35	Mf (= 1/2 Mc + Mp?)	5?	1		3/5
27-28?	½ Mc large				1/2
23.45, **[25.5]**, 27-28?	Ms	4?		1/2	
19.15	???????	3?			
7.5	Mp (?)	1			
1.8	Mfn	1/4			

Table 5. Minoan linear measures plotted together (M.E. Alberti).

The represented lengths have all been reported in various architectural studies as possible modules, with the exception of the palm and the finger, that are hypothetical. In bold, average values. In bracket, reconstructed values.

Mc = Minoan cubit

Mlc = Minoan large cubit

Mf = Minoan foot

Mfn = Minoan finger

Mp = Minoan palm

Ms = Minoan span or outstretched hand

Context	Inv. N.	Type	Weight (g.)	Aeg. Rel. Value	NE Rel. Val.	Resultant Unit (g.)	Marks	Preservation
Mu Potier VIII4	B 89	Limestone disc	21.45 (+).	**k**;1/3 x?		k = 21.45 (+); x = 64.35 (+);	One circle engraved on one face	Good. Overweight. Concretions.
Mu Potier VIII4	B 90	Limestone disc	34.84 (-).	**f**; 2/3 x? **3/2 k**	**4 mp**	f = 34.84 (-); x = 52.26 (-) k = 23.22 (-) mp = 8.71		Good
Mu Potier VIII4	B 88	Stone cylinder	9.7		s	s = 9.7	One arrow (three converging lines) on one end	
Mu B, IV4.	68 M 463	Stone disc	95 ca.	**4k; 3/2 x**;	**1 *dbn* = 10 *qdt/s***	k = 23.75; x = 63.33 dbn = 95; qdt/s = 9.5		
Mu A III 13.	M71/ B92bis	Lead parallelep.	16.5 ca.	**1/4 x**	2 mp	x = 66 mp = 8.25		
Mu, area of C	M69/ B55bis	Lead disc	14.40 (+).	**2 w**; 1/4 x?	**2 *kar***	w = 7.5 (+); x = 57.6 (+) kar = 7.5 (+)	Two strokes on one face	

Table 6. Malia, Quartier Mu (MM IIB): balance weights. Modified from Alberti 2000: table II; Alberti 2007b: table 2; Alberti in press: table 1

Recurrent volumes (lt.)	Kados	«Heavy» Kados
5.5	¼	
10-12	½	
13-15 (mostly ca 14)		½
19-22	1	
26-27		1
40	2	
63-5	3	2
90-95	4	3

Table 7. Malia, Quartier Mu (MM IIB): capacity measures. Necked jars (*jarres à col*) and amphorae of type 1: recurrent volumes point to the existence of a series based on the ***«kados»*** (19-22 lt, with fractions and multiples) and the ***«heavy» kados*** (26-30 lt, with fractions and multiples) (reworked from Alberti 2012: Table 2)

Volumes (lt)	N. Exemplars	Unit 0.45-0.5 lt	Kados	«Heavy» Kados
11.4	2	24	½	
12.2-12.5	3	26	½	
13 ca	2	27		½
14 ca	1	29		½
14.5	1	30	=	½
21 ca	1	42	1	
24 ca	1	48	1	

Table 8. Malia, Quartier Mu (MM IIB): capacity measures. Amphorae type 1: recorded capacities form a continuous series based on the ***unit of 0.45-0.5 lt*** ca, connected to the ***kados*** standards

Volumes (lt)	N. Exemplars	Unit 0.45-0.5 lt	Kados	«Heavy» Kados
3	1	6		
3.7	1	8		1/8
4.1	1	8		1/8
5.5	1	12	1/4	
6	1	13		
6.9	1	14		
7	2	15		
8 ca	1	17		
9	1	19		
11 ca	5	23	½	
11.5	1	24	½	
12.5 ca	2	26	½	
13	1			½
14.5 ca	1	30		½
15.5	1	32		
15.9	1	33		
16.5	1	34		
17 ca	2	35		
18.9	1	40		
20 ca	1	44	1	
21	1	48	1	
45	2		2	

Table 9. Malia, Quartier Mu (MM IIB): capacity measures. Amphorae type 2: recorded capacities form a continuous series based on the ***unit of 0.45-0.5 lt*** ca, connected to the ***kados*** standards

Recurrent volumes (lt)	Unit 0.45-0.5 lt
3	6
3.7-4 (1/8 «heavy kados»)	8
4.5	10
5.7 (1/4 kados)	12
6	13
6.5	14
7	15
7.5 (1/4 «heavy» kados)	16
8	17
8.5 (3/8 of kados)	18
9.5	20
10	21
10.5 (3/8 of «heavy» kados)	22
11	23
11.5 (1/2 kados)	24
12; 12	25
12.5	26
13.5	
14.5 (1/2 «heavy» kados)	30
15	
24-25 kados	48
29 «heavy kados"	60
36 (3/2 kados)	
41 (2 kados)	

Table 10. Malia, Quartier Mu (MM IIB): capacity measures. Jars of type 2, amphorae of type 3a and *brocs* of type 2: the series of measures has intervals of ca 0.45 lt and is as well connected to the ***«kados»*** standards (shaded standards are not attested in these groups but have been hypothetically restored) (Alberti 2012: Table 3)

Recurrent volumes (lt)	Unit 0.45-0.5 lt
0.10	
0.15	
0.20	1/2
0.24-0.25	1/2
0.30	½?
0.30-0.38	
0.4-0.6	1
0.6	
0.7	1+1/2?
0.8	
0.9	2
1.1-1.2	2?, 2+1/2?
1.3-1.4	2?, 2+1/2
1.5/1.7; 1.6	3

1.8-1.9	3 + ½?
2	4
2.4-2.6	4 + ½?
2.7-2.8	5
2.9-3.1	6
3.3-3.4	7
3.7	8
4.5	10

Table 11. Malia, Quartier Mu (MM IIB): capacity measures. Amphorae of types 6 and 9, *brocs* of type 1, jugs and cups: minor volumes seem to compose a series with very small intervals, of ca. 0.10 lt. The standards of ***0.25 lt.*** and ***0.45-0.5 lt***. seem to be particularly important. Shaded: recurrent volumes for cups (Alberti 2012: Table 4)

Findspot of loomweights	Weight Range (g)	Relative Value of Weight	Thickness Range (cm)	Relative Value of Thickness (Mfn)
Quartier Mu all 1	75-150	2 ***f***, 4 ***f***	1.5-2.3	1
Quartier Mu all 2	150-200	4 ***f***, 3 ***x***, 10 ***k***	2.5-3.5	2
Quartier Mu all 3	75-150	2 ***f***, 4 ***f***	4-5.2	3
Quartier Mu all 4 (mostly from Building D)	300-380	5 ***x***, 6 ***x***	6.5-7.2	4 (= 1 palm)
Building A I.8	105-185 (mostly 110-145)	2 ***x***?, 3 ***x***	4-5.5 (4-5)	3
Building A III.1	90-450	1 ***dbn***, 5 ***dbn***	1.7-6.2	1-4
Building B	55-240	***x***, 4 ***x***	1.8-6.6	1-4
Building D	300-380	5 ***x***, 6 ***x***	6.5-7.2	4
Building E	70-160	2 ***f***, 4 ***f***	1.6-5.5	1-3
Potter's Workshop	70-230	2 ***f***, 6 ***f***?	1.8-6.2	1-4
Founder's Workshop	100-170	3 ***f***? 5***f***?	1.7-5.1	1-3
Southern Workshop	70-150	2 ***f***, 4 ***f***	1.8-3.9	1-2
Building C	50-405		1.6-6	1-4
Building C small torus	335-405	5 ***x*** or 10 ***f***, 6 ***x*** or 12 ***f***	3.3-4	2

Table 12. Malia, Quartier Mu (MM IIB). Main groups of loomweights : findspot, weight and thickness (Cutler *et al*. 2013: 99, 106, 108, 112, 114; large torus weights excluded) and proposed relative value

N. inv.	Description	Major dimensions	Relative Value of Major Dimension	Thickness	Relative Value of Thickness (Mfn)
B 10	3 discoids	D 7,5	1 ***Mp***	1.8-2.2	1
B 31	8 discoids	D 7-7.7	1 ***Mp***	1.8-2.1	1
B 64	1 discoid	D 6.2	1 ***Mp***? (small)	2.8	2
B 64	1 discoid	D 7.5	1 ***Mp***	2	1
B 11	3 spherical	D 5.1-5.6	3 ***Mfn***		
B 65	1 spherical	D 5.6	3 ***Mfn***		
B 123	9 spherical	D 4.5-6.2	3 ***Mfn***?		
C 8	1 spherical	D 5	3 ***Mfn***		
D 17	1 spherical	D 6.5	3 ***Mfn*** (large) or 1 ***Mp*** (small)		
B 32	1 parallelep.	H 4.3 L 3.5	3 ***Mfn***? 2 ***Mfn***		
B 124	1 parallelep.	H 5.8 L 3.1-3.3	3 ***Mfn***, 2 ***Mfn***		
B 125	1 piriform	H 6.5 L 5.5	1 ***Mp*** ? (small), 3 ***Mfn***	4.7	3? (small)
C 8	1 torus	D 8.4	5 ***Mfn*** or the double of thickness	4.2	3? (small)

Table 13. Malia, Quartier Mu (MM IIB): dimensions of loomweights (Poursat 1996 *passim*) and proposed relative values

Type	Weight Range (g)	Relative Value
Type 1	40-380	2 ***k***, 6 ***x***
Type 2	285-725	8 ***f***? 20 ***f***?
Type 3	20-255	***k***, ***half mina***
Type 4	120-410	2 ***x***, 20 ***k***
Type 5	20-195	***k***, 3 ***x***
Type 6	65-370	***x***, 6 ***x***
Type 7	40-305	2 ***k***, ?
Type 8	50-385	?, 6 ***x***
Type 9	100-500	1 ***dbn***?, 3 ***f***?, ***mina***
Type 10	40-515	2 ***k***, ***mina***
Type 11	120-440	2 ***x*** (= 6 ***k***), 20 ***k***
Type 12	110-270	2 ***x***? 3 ***dbn***
Type 13	120-150	2 ***x***, 4 ***f***
Type 14	500-540	***mina***, ***mina***
Type 15 (pebbles)	30-420	½ ***x***? ***f***? 20 ***k***

Table 14. Malia, Quartier Mu (MM IIB): weight range of loomweights per type (Poursat 2013: 89-94) and possible relative value according to Aegean and Near Eastern standards

Findspot	Weight (g)	Relative Value
Building A I.8	620	10 ***x***
Building A I.8	1040	***Double Mina***
Building A III.1	450	«Western» ***Mina*** or 5 ***dbn***
Potter's Workshop	1400	3 ***Minas***

Table 15. Malia, Quartier Mu (MM IIB): torus loomweights (Cutler *et al.* 2013: 106, 112) and their possible metrological interpretation

Context	Inv. N.	Type	Weight (g)	Aeg. Rel. Value	NE Rel. Val.	Resultant Unit (g)	Marks	Preservation
A 4	IC. 297/ Pb 6	Lead disc	30.85	½ ***x***		***x*** = 61.70		Intact
A 4	GS 935	Haematite cuboid	42	2/3 ***x*** 4 ***k***	4 ***h*** 5 ***s*** 6 ***kar*** 5 ***mp***	***x*** = 63 ***k*** = 10.5 ***h*** = 10.5 ***s*** = 8.44 ***kar*** = 7 ***mp*** = 8.4		Intact
B6 (A4 according to Brogan 2006)	IC. 210 / S31	Limestone pebble	38.6	3 ***k*** (?) 2/3 ***x*** (?) ***f*** (?)		***k*** = 12.8 ***x*** = 57.9 ***f*** = 38.6	A linear sign on top and 3 incised lines around the circumference	Intact
B.7	GS 875	Haematite domed	552.7	***Mina***		***Mina*** = 552.7 (Aegean and Mesopot.)		Intact
B.7	GS 876	Haematite domed	1092.2	***Double mina***		***Double Mina*** = 1092.2		Intact

Table 16. Mochlos, Artisans' Quarter (LM IB) : balance weights (Soles and Davaras 2004: 40, 52, 78-79; Brogan 2006: 273)

N. Exemplars	Volume (lt)	Unit of 0.45-0.5 lt
2	0.085	
2	0.090	
1	0.095	
5	0.100	¼?
3	0.105	¼?
2	0.110	1/4
3	0.120	1/4
1	0.125	1/4
1	0.130	
2	0.140	¼?
1	0.145	

Table 17. Mochlos, Artisans' Quarter (LM IB): capacity of conical cups (Barnard and Brogan 2003: 37-41) and proposed relative values

N. Exemplars	Volume (lt)	Unit of 0.45-0.5 lt
1	0.220	1/2
1	0.235	1/2
4	0.250	1/2
3	0.285	1/2
1	0.295	
1	0.300	
1	0.310	
2	0.340	¾ ?

Table 18. Mochlos, Artisans' Quarter (LM IB): capacity of ogival cups (Barnard and Brogan 2003: 44-45) and proposed relative value

Inv. N.	Type	Dimensions (cm)	Weight (g)	Aeg. Rel. Value	NE Rel. Val.	Resultant Unit (g)	Marks
IC.240	Ingot fragment, copper	2.4 × 2.6 × 1.5	29	½ ***x***		***x*** = 58	
IC.239	Ingot fragment, copper	2.3 × 3.4 × 1.6	31	½ ***x***		***x*** = 62	
IC.238	Ingot fragment, copper	2.7 × 3.7 × 1.6	35	½ ***x***?1 ***f***?	5 ***kar***?	***x*** = 70 ***f*** = 35 ***kar***= 7	
IC.230	Ingot fragment, copper	2.7 × 3.9 × 2.2	61.4	***x***		***x*** = 61.4	
IC.234	Ingot fragment, copper	3.2 × 3.7 × 2.1	62.6	***x***		***x*** = 62.6	
IC.231	Ingot fragment, copper	2.8 × 4.9 × 2.3	75.5 (possibly 80 g?)	3/2 ***x***? 1+1/3 ***x*** = 4/3 ***x*** 2 ***f***?	10 ***kar***?	***x*** = 50.33 ***x*** = 56.62 ***f*** = 37.75 ***kar*** = 7.5	
IC.228	Ingot fragment, copper	3.5 × 3.9 × 2.6	89.2	1+½ ***x*** = 3/2 ***x***		***x*** = 59.46	
IC.227	Ingot fragment, copper	3.2 × 5.5 × 2	116.1	2 ***x***		***x*** = 58.05	
IC.229	Ingot fragment, copper	3.9 × 6 × 2	133.9	2 ***x***		***x*** = 66.95	
IC.232	Bun (?) ingot fragment, copper	3.9 × 4.7 × 2.2	136.9	2 ***x***		***x*** = 68.45	
IC.233	Ingot fragment, copper	3.9 × 5.5 × 2.8	139.6	2 ***x***?		***x*** = 69.8	
IC.235	Ingot fragment, copper	4.5 × 3.7 × 4.3	174.2	3 ***x***		***x*** = 58.06	
IC.237	Ingot fragment, copper	4.6 × 7.5 × 2.6	214.8	3 ***x***? 4 ***x***?		***x*** = 71.6 ***x*** = 53.7	
IC.236	Ingot fragment, copper	4.7 × 5.3 × 3.7	230.8	4 ***x***		***x*** = 57.7	

IC.226	Oxhide ingot fragment, copper	7.2 x 10.6 x 4	797.9	***Z*** (fleece) = 12 ***x***	***Double Mina*** (Ashdod) = 100 ***kar***	***x*** = 66.49 ***kar*** = 7.979	
IC.250	Casting waste, smooth on one side, copper	4.9 x 5.7 x 1.2	76.7	1+1/3 ***x*** = 4/3 ***x*** 2 ***f***?	10 ***kar***?	***x*** = 57.52 ***f*** = 38.35 ***kar*** = 7.67	
IC.249	Casting waste, smooth on one side, copper	7.1 x 8.5 x 1.1	149.6	2+½ ***x*** = 5/2 ***x*** 4 ***f***?	20 ***kar***?	***x*** = 59.84 ***f*** = 37.4 ***kar*** = 7.48	
IC.285	Scrap metal: handle, copper-tin alloy	Pres Length 5.3	27.5	½ ***x***?		***x*** = 55	
IC.280	Scrap metal: frgs of a bowl, copper-tin alloy	H 5.9 Rim d. 16	181.6	3 ***x***		***x*** = 60.53	
IC.279	Scrap metal: frgs of lekane, copper-tin alloy	H 9.5, est. Rim d. 22.6	183.4	3 ***x***		***x*** = 61.13	

Table 19. Mochlos, Artisans' Quarter (LM IB): «foundry hoard» in the northern room of Building A (Soles and Davaras 2004: 46-52) and proposed relative value. The fifteen ingot fragments weigh all together 2.33 kg: this value can be equated to 2 ***Double Minas*** and 5 ***x***

Context	Inv. N.	Type	Dimensions (cm)	Weight (g)	Aeg. Rel. Value	NE Rel. Val.	Resultant Unit (g)
A.1 workroom	IC.241	Oxhide (?) ingot fragment, copper	2.7 x 4.5 x 2.9	98.9	3/2 ***x***	1 ***dbn*** = 10 ***s***	***x*** = 65.93 ***s*** = 9.89
A.2	IC.275	Pin, various fragments, copper-tin	various	1.4 (-)		***j***?	***j*** =1.4 (-)
A.2	IC.269	Small knife, intact, copper	5.2 x 0.2	1.6		***j***?	***j*** = 1.6
A.2	IC.281	Scrap, copper, tweezers, frgs	Pres length 2.2	1.7		***j***?	***j*** = 1.7
A.2	IC.300/ Pb 32	Scrap. Lead flat fragment	1.4 x 2.2 x 0.4	5.7	½ ***e***	½ ***h*** 3 ***j***?	***e*** = 11.4 ***h*** = 11.4 ***j*** = 1.9
A.2	IC.301/ Pb 34	Scrap. Flat lead strip, broken. Pierced with three rivet holes	Pres length 5.7 cm, w. 1.2 cm, th 0.15-0.3 cm	5.9	½ ***e***	½ ***h*** 3 ***j***?	***e*** = 11.8 ***h*** = 11.8 ***j*** = 1.96
A.2	IC.299/ Pb 31	Scrap, lead flat fragment	Pres h. 1.1 cm, pres length 3.1	8.1		1 ***mp***	***mp*** = 8.1
A.4 workroom	IC.288	Scrap, copper	-	2.2		***j***?	***j*** = 2.2
A.4	IC.287	Frgs of flat copper item(s)	various	3.7		2 ***j***?	***j*** = 1.85
A.4	IC.296	Scrap, metal: two rounded pieces, copper-tin alloy	various	8.9 and 4.2		1 ***mp*** and ½ ***mp***	***mp*** = 8.9 ***mp*** =8.4
A.4	IC.244	Ingot fragment, copper	2 x 3.2 x 1.8	29.5	½ ***x***	4 ***kar*** 3 ***s***	***x*** = 59 ***kar*** = 7.37 ***s*** = 9.8
A.6	IC.267	Hook, two non-joining pieces, copper-tin alloy	Pres. length: 5.2	5.3	½ ***e***	½ ***h*** 3 ***j***?	***e*** = 10.6 ***h*** = 10.6 ***j*** = 1.76
A.6 Shrine?	IC.243	Ingot fragment, copper	8.4 x 9.2 x 4.1	667.9	10 ***x***	1 Mina Lagash	***x*** = 66.79

A.RY	IC.277	Knife, nearly intact, copper-tin alloy	17.5 x 2.6	42.6	2 *k* 2/3 *x*	5 *mp* 6 *kar* 4 *s*	*k* = 21.3 *x* = 63.9 *mp* = 8.52 *kar* = 7.1 *s* = 10.65
B.1	IC.268	Chisel, copper, one end broken	Pres. length 4.1	12.1 (-)	¼ *x*?		*x* = 48 (-)
B.3	IC.294	Scrap metal: knife, uncomplete, copper-tin alloy	Pres length 3.9	2.5 (-)		*j*?	*j* = 2.5
B.3	IC.295	Scrap metal: tang, uncomplete, copper-tin alloy	Pres length 2.6	4.4		½ *mp*?	*mp* = 8.8
B.4	IC.272	Needle, uncomplete, copper-tin alloy	Pres. Length 1.1	1.9 (-)		*j*?	*j* = 1.9
B.4	IC.245	Strip, broken at one end, copper, bent in two places	30 x 0.8	4.5		½ *mp*? ½ *s*?	*mp* = 9 *s* = 9
B.4	IC.276	Spatula or scraper, complete, copper-tin alloy	Length 5.5, width of blade 2.2	12.5	1/5 *x*?	6 *j*?	*x* = 62.5 *j* = 2.08
B.8	IC.274	Earring, almost intact, copper	D. 1.9	1.8		j?	*j* = 1.8
B.9	IC.292	Scrap, broken, copper-tin alloy	Pres length 3.4	1.4		*j*?	*j* = 1.4
B.9	IC.293	Scrap, rounded (rivet?), copper-tin	1.3 x 1.9	4.6		½ *mp*? ½ *s*?	*mp* = 9.2 *s* = 9.2
B.9	IC.291	Scrap, rounded (rivet?), copper	1.3 x 1.8	5.2	½ *e*?	½ *h*? 3 *j*?	*e* = 10.4 *h* = 10.4 *j* = 1.73
B.10	IC.282	Scrap, copper, flat rectangular piece, pierced	Pres length 5.7	15.7	¼ *x*		*x* = 62.8
B.13E Living/ sleeping space?	IC.242	Ingot fragment, copper	6.3 x 6.6 x 4.3	539	1 mina		*mina* = 539

Table 20. Mochlos, Artisans' Quarter (LM IB): metal objects and scrap for recycling (Soles and Davaras 2004: 46-52). Objects weighing less than 1 g are not included

N. Inv.	Dimensions (cm), lenght first	Weight (gr)	Rel. Value of Lenght (*Mfn*)	Rel. Value of Weight
IC.309	10.9 x 9.7 x 7.2	1175		18 *x*
IC.307	4.8 x 6.2 x 2.5	560	3	10 *x*
IC.312	5.7 x 4.06 x 3.04	110	3	2 *x*
IC.316	5.9 x 4.6 x 3.9	166	3	3 *x*?
IC.306	6.9 x 6 x 4.3-5.4	398	4	6 *x*
IC.302	9.26 x 7.46 x 4.13	424	5	20 *k*? 7 *x*?
IC.304	9.1 x 7.3 x 6	755	5	12 *x*
IC.308	11.9 x 10.6 x 7.3	1290	6	20 *x*
IC.315	11.1 x 7.8 x 6.2	765	6	12 *x*
IC.305	12.5x 7.5 x 6.6	1145	7	18 *x*
IC.310	12.7 x 9.8 x 10.1	1965	7	30 *x*
IC.311	12.8 x 9.5 x 7.8	1480	7	24 *x*
IC.303	16.5 x 6.8 x 5.0	1385	9	24 *x*
IC.313	16.5 x 4.9 x 3.6	480	9	8 *x*

IC.335	15.8 x 8.4 x 5.1	1550	8	24 ***x*** = a ***double mina*** + a ***mina*** or 3 ***minas***
IC.334	16 x 7.5 x 4.5	1370	9	22 ***x***
IC.331	17 x 15 x 3	1305	9 or 10?	20 ***x*** or 22 ***x***?
IC.332	17.9 x 11 x 4	2040	9 or 10?	32 ***x*** = 2 ***double minas***
IC.330	19.6 x 9.5 x 4	1900	10	30 ***x*** = almost 2 ***double minas***
IC.333	18.5 x 11 x 5	1935	10	32 ***x*** = 2 ***double minas***
IC.329	21 x 11 x 5.5	2500	12	40 ***x*** = 2 ***double minas*** + a ***mina***
IC.336	20 x 11.6 x 4.6	1955	10 or 11	32 ***x*** = 2 ***double minas***

Table 21.Mochlos, Artisans' Quarter (LM IB): hammerstones (above, IC.309-IC.313) and heavy oblong handstones (below, IC.335-IC.336) (Carter 2004: 63-64 and 65-66, ground stone tools type 1 and 4) and the possible relative value of their length and weight. Only complete examples are included

N. Inv.	Dimensions (cm)	Weight (gr)	Rel. Value of Weight
IC.317	11.5 x 17.3 x 4.4	900	15 ***x***
IC.318	11.7 x 8.5 x 6.0	1225	20 ***x***
IC.319	11.6 x 10 x 5	1685	28 ***x***
IC.320	8.6 x 6 x 5	480	8 ***x***
IC.321	15.03 x 8.6 x 6.9	1580	24 ***x***
IC.322	10.8 x 9.5 x 6.1	1125	18 ***x***
IC.323	12.28 x 10.35 x 7.04	1365	22 ***x***
IC.324	9.7 x 9.2 x 3.7	570	10 ***x***
IC.325	9.7 x 10.1 x 5.13	795	12 ***x***
IC.326	16.5 x 10.7 x 6.2	1915	30 ***x***

Table 22. Mochlos, Artisans' Quarter (LM IB): small handstones (Carter 2004: 64-5, ground stone tools type 2) and possible relative value of their weight. Only complete examples are included

Inv. N.	Description	Weight (g)	Aeg. Rel. Val.	NE Rel. Val.	Resultant Unit (g)	Marks
IC.350	Amphibolite, rough, only one face smoothed flat by abrasion	620	10 ***x***		***x*** = 62	
IC.352	Amphibolite, 6 facets by polishing, rounded rougher edges	530	***Mina*** = 8 ***x***		***Mina*** = 530, ***x*** = 66.25	Found in pithos IC 445
IC.353	Amphibolite, discoid, intensive polishing, two facets	201	10 ***k***		***k*** = 20.1	
IC.354	Amphibolite, sub-cuboid	157	4 ***f***?, 3/2 ***dbn***?		***f*** = 39.25 ***dbn*** = 104.66	Faceted by abrasion
IC.356	Green quartzite, polished flat in a number of places	148	4 ***f***?, 3/2 ***dbn***?		***f*** = 37 ***dbn***= 98.66	

Table 23. Mochlos, Artisans' Quarter (LM IB): sub-cuboid polishers with polished and faceted surfaces as possible balance weights (Carter 2004: 67-8, 79, table 9, ground stone tools type 6a)

N. Inv.	Dimensions (cm): Length, Width and Height	Weight (gr)	Ratio Width: Length	Rel. Value of Lenght	Rel. Value of Width
IC.401	37 x 16 x 55	5950	1 : 2.3	4 *Mp* (less than 1 *Mc*)	2 *Mp*
IC.402	43 x 19 x 4	2160	1 : 2.2	6 *Mp* (about 1 *Mc*)	3 *Mp*?
IC.403	26 x 16.3 x 4.5	3590	1 : 1.61	3 *Mp* or ½ *Mc* large	2 *Mp*
IC.405	32.75 x 21.9 x 3.52	5025	1 : 1.49	1 *Mf*	3 *Mp*, 1 *Ms*?
IC.412	19.1 x 15.1 x 6	2560	1 : 2.6	3 *Mp*	2 *Mp*
IC.413	37 x 27.5 x 6.7	/	1 : 1.34	5 *Mp*	½ *Mlc*?

Table 24. Mochlos, Artisans' Quarter (LM IB): saddle querns (above, IC.401-403), palettes (centre, IC.405) and stone tables (below, IC. 412-413) (Carter 2004: 73-74, 76, ground stone tools type 14, 15 and 18) and possible relative value of their length and width. Only complete examples are included

N. inv.	Findspot	Dimensions (cm)	Weight (g)	Rel. Value of Dimensions (*Mfn*)	Rel. Value of Weight
IC.106	B.13W	4.9 x 4 x 1.5	54	4-3 x 3? x 1	***x***
IC.111	B.13W	6 x 5.2 x 2.2	62	3 x 3 x 1	***x***
IC.110	B.above	5.7 x 4.9 x 2.2	62	3 x 3 x 1	***x***
IC.88	A.4	7.4 x 5.6 x 1.5	62 (-) (probably 80 g)	4 x 3 x 2	4/3 ***x***, 4 ***k***
IC.94	A-B road	6.5 x 5.8 x 2.2	78	4 x 3 x 1-2	2 ***f***
IC.122	B.RY	7.5 x 6.1 x 2.2	120	4 x 4-3 x 2	2 ***x***
IC.116	A.RY	8 x 7.8 x 2.5	162	5 x 4-5 x 2	3 ***x***? 8 ***k***
IC.104	B.2	8.3 x 6.9 x 2.4	148	5 x 4 x 2	4 ***f***
IC.120	B.2	8.8 x 7.4 x 3.4	190	5 x 4-5 x 2	3 ***x***
IC.126	Kiln A	10 x 8 x 2.6 (-)	140 (-)	6 x 5 x 2?	3 ***x*** 10 ***k***?
IC.112	Kiln A	9.4 x 8.6 x 3.1 (-)	174 (-)	6-5 x 5 x 2	3 ***x***
IC.89	B.5	8.8 x 8.2 x 2.6	186 (-)	5 x 5 x 2?	3 ***x***
IC.93	N.Terrace	10 x 8.6 x 3.2	254	6? x 5 x2	4 ***x*** = half ***mina***
IC.108	B.8	6.2 (-) x 5.3 x 2.1	66 (-)	4 x 3 x 1	2 ***f***
IC.100	B.8	9.7 x 8 x 2.9	204 (-)	6 x 5 x 2	10 ***k***? 4 ***x***?
IC.102	B.8	10.1 x 8.5 x 2.6	216	6 x 5 x 2	10 ***k***? 4 ***x***?
IC.101	B.8	10.5 x 8.5 x 3.3	268	6 x 5 x 2	4 ***x*** = half ***mina***

Table 25. Mochlos, Artisans' Quarter (LM IB): elliptical loomweights (Type A) (Soles *et al*. 2004: 29-31) and proposed relative value of their dimensions and weight. The evidence from room B.8 is particularly consistent (grouped below, IC.108-101). Only complete or nearly complete items are included

N. inv.	Findspot	Dimensions (cm)	Weight (g)	Rel. Value of Dimensions (*Mfn*)	Rel. Value of Weight
IC.130	A.4	8.7 x 7.9 x 2.4	156	6 x 5 x 2	4 ***f***, 8 ***k***
IC.129	B.3	7.8 x 7.3 x 2.5	112 (-)	4 x 4 x 2	2 ***x***?
IC.133	B.6	6.4 x 6 x 2.4	82	4 x 4 x 1-2	4/3 ***x***, 4 ***k***, 2 ***f***? 3/2 ***x***?
IC.138	A.9	6.4 x 6.5 x 2.4	80	4 x 4 x 1-2	2 ***f***? 3/2 ***x***?
IC.139	B.10	6 x 6.4 x 2.2	84 (-) (possibly 112 g)	4 x 4 x 1	4/3 ***x***, 4 ***k*** 2 ***f***? 3/2 ***x***? 2 ***x***?
IC.140	B.10	5.1 x 5.3 x 2.3	62 (-)	3 x 3 x 1	***x***

Table 26. Mochlos, Artisans' Quarter (LM IB): rounded loomweights (Type B) (Soles *et al*. 2004: 31-32) and proposed relative value of their dimensions and weight. Only complete or nearly complete items are included

N. inv.	Findspot	Dimensions (cm)	Weight (g)	Rel. Value of Dimensions (*Mfn*)	Rel. Value of Weight
IC.147	A-B road	6.4 × 5.7 × 1.6	60	4 × 4 × 1	*x*
IC.148	B.4	6.5 × 6.1 × 1.7	68	4 × 4 × 1	*x*? 2*f*?
IC.149	Chalinomouri	5.7 × 5.8 × 1.8	66	3? × 3? × 1	*x*
IC.153	A.2	5.2 × 4.6 × 2.4	62	3 × 3 ×1	*x*
IC.154	A.2	5.1 × 3.9 × 0.2(?)	48	3 × 2 × 1	2 ***k*** = 2/3 ***x***
IC.151	A.4	4.8 × 3.8 × 2.3	48	3 × 2 × 1	2 ***k*** = 2/3 ***x***
IC.152	A.4	4.5 × 3.8 × 2.2	42	3 × 2 × 1	2 ***k*** = 2/3 ***x***

Table 27. Mochlos, Artisans' Quarter (LM IB): discoid (Type C, above, IC.147-9) and trapezoidal loomweights (Type D, below, IC.151-4) (Soles *et al.* 2004: 32-33 and 33-34) and proposed relative value of their dimensions and weight. IC.149 from the Chalinomouri farmstead (LM IB) is added here to better illustrate the weight range. The thickness of IC.154 should possibly be restored as 2.2 cm. Only complete or nearly complete items are included

N. inv.	Findspot	Dimensions (cm)	Weight (g)	Rel. Value of Dimensions (*Mfn*)	Rel. Value of Weight
IC.445	A.2	4.9 × 4.3 × 2.5	56		*x*
IC.443	A-B road	8.5 × 3.7 × 1.9	62		*x*
IC.440	A-B road	5.9 × 4.7 × 2	70		2 ***f***
IC.441	A.4	6.8 × 4 × 3.1	86		4/3 ***x***, 4 ***k***
IC.437	A.4	12.57 × 9.8 × 5.6	860		14 ***x***
IC.439	A.5	6.6 × 5.9 × 5.7	258		4 ***x*** = ½ ***Mina***
IC.438	A.5	14.5 × 9.8 × 9.8	1585		3 ***Minas*** = one ***Double Mina*** and half
IC.444	B.2	19 × 14 × 7.6	2830		3 ***Double Minas*** ca.
IC.436, stone discoid	B.NW of room 7	5.5 × 1.6-1.7	90	3 × 1	3/2 ***x***

Table 28. Mochlos, Artisans' Quarter (LM IB): the stone loomweight IC.436 and the naturally perforated weights IC.437-445 (Carter 2004: 81, ground stone tools types 24 and 25) and proposed relative values of their dimensions and weight. Only complete or nearly complete items are included

N. inv.	Type	Findspot	Dimensions (cm)	Weight (g)	Rel. Value of Dimensions (*Mfn*)	Rel. Value of Weight
IC.445	NPW	A.2	4.9 × 4.3 × 2.5	56		***x*** = 3 ***k***
IC.153	Type D trapezoidal	A.2	5.2 × 4.6 × 2.4	62	3 × 3 × 1	***x*** = 3 ***k***
IC.154	Type D trapezoidal	A.2	5.1 × 3.9 × 0.2(?)	48	3 × 2 × 1	2 ***k*** = 2/3 ***x***
IC.151	Type D trapezoidal	A.4	4.8 × 3.8 × 2.3	48	3 × 2 × 1	2 ***k*** = 2/3 ***x***
IC.152	Type D trapezoidal	A.4	4.5 × 3.8 × 2.2	42	3 × 2 × 1	2 ***k*** = 2/3 ***x***
IC.88	Type A elliptical	A.4	7.4 × 5.6 × 1.5	62 (-) (probably 80 g)	4 × 3 × 2	4/3 ***x***, 4 ***k***
IC.441	NPW	A.4	6.8 × 4 × 3.1	86		4/3 ***x***, 4 ***k***
IC.130	Type B rounded	A.4	8.7 × 7.9 × 2.4	156	6 × 5 × 2	4 ***f***, 8 ***k***
IC.437	NPW	A.4	12.57 × 9.8 × 5.6	860		14 ***x***?, 40 ***k***?
IC.439	NPW	A.5	6.6 × 5.9 × 5.7	258		4 ***x*** = ½ ***Mina***
IC.438	NPW	A.5	14.5 × 9.8 × 9.8	1585		3 ***Minas*** = one ***Double Mina*** and half
IC.138	Type B rounded	A.9	6.4 × 6.5 × 2.4	80	4 × 4 × 1-2	4/3 ***x***, 4 ***k*** 2 ***f***? 3/2 ***x***?
IC.116	Type A elliptical	A.RY	8 × 7.8 × 2.5	162	5 × 4-5 × 2.5	3 ***x***? 8 ***k***

IC.126	Type A elliptical	Kiln A	10 × 8 × 2.6 (-)	140 (-)	6 × 5 × 2?	3 ***x***, 10 ***k***?
IC.112	Type A elliptical	Kiln A	9.4 × 8.6 × 3.1 (-)	174 (-)	6-5 × 5 × 2	3 ***x***
IC.443	NPW	A-B road	8.5 × 3.7 × 1.9	62		***x***
IC.440	NPW	A-B road	5.9 × 4.7 × 2	70		2 ***f***

Table 29. Mochlos, Artisans' Quarter (LM IB): typology, dimensions, weight and proposed relative values of the loomweights from Building A. NPW = Naturally Perforated Weight. Only complete or nearly complete items are included

Type	**Weight range (g)**	**Relative Value Weight *x***	**Relative value weight *f***	**Relative value weight *k***	***k* as a general series**	**Relative value Dimensions (*Mfn*)**
NPW	2830	3 ***Double Minas*** ca				
NPW	1585	3 ***Minas***				
NPW	860	14 ***x***		40 ***k***	40	
NPW, Type A elliptical	254-268	4 ***x*** = half ***Mina***			13	6 × 5 × 2 Type A elliptical
Type A elliptical, Type E spherical	210-220			10 ***k***	10	6 × 5 × 2 Type A elliptical
Type A elliptical	190	3 ***x***			8.5	5 × 5 × 2 Type A elliptical
Type A elliptical, Type B rounded	156-162			8 ***k***	8	5 × 4-5 × 2 Type A elliptical 6 × 5 × 2 Type B rounded
Type A elliptical	148		4 ***f***		7	5 × 4 × 2 Type A elliptical
Type A elliptical	120	2 ***x***		6 ***k***	6	4 × 4 × 2 Type A elliptical, Type B rounded
Stone discoid IC.436	90	3/2 ***x***			4.5	
NPW, Type B rounded	80-86	3/2 ***x***		4 ***k***	4	4 × 4 × 1-2 Type B rounded
NPW, Type A elliptical	70-78		2 ***f***		3.5	4 × 3 × 1 Type A elliptical
NPW, Type A elliptical, Type C discs, Type D trapezoidal	56-66	1 ***x***		3 ***k***	3	3 × 3 × 1-2 Type A elliptical, Type B rounded, Type D trapezoidal; 4 × 4 × 1 Type C discs (and 3 × 3 × 1 at Chalinomouri)
Type D trapezoidal, Pierced sherd IC.156	42-48	2/3 x		2 k	2	3 × 2 × 1 Type D trapezoidal
Pierced sherd IC.157	32-36		1 f			

Table 30. Mochlos, Artisans' Quarter (LM IB): summary of the analysis of loomweights. Types, weight ranges and their relative values, possible relative values in ***Mfn*** of their dimensions. NPW = Naturally Perforated Weights (typology as in Soles *et al*. 2004: 28-33, and Carter 2004: 81, ground stone tools type 25)

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