Weights and Marketplaces from the Bronze Age to the Early Modern Period.
Proceedings of Two Workshops
Funded by the European Research Council (ERC)

Edited by Lorenz Rahmstorf and Edward Stratford

Weight & Value

Edited by Lorenz Rahmstorf
Seminar für Ur- und Frühgeschichte
Georg-August-Universität Göttingen

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2019

Weights and Marketplaces

from the Bronze Age to the Early Modern Period

Edited by

Lorenz Rahmstorf and Edward Stratford

with contributions from

Enrico Ascalone, Grégory Chambon, Jessica Dijkman, Gary M. Feinman, William B. Hafford, Hans Peter Hahn, Edward M. Harris, Kenneth Hirth, Thomas Höltken, Fang Hui, Nicola Ialongo, Jane Kershaw, Stephen A. Kowalewski, Lionel Marti, Anna Michailidou, Juan Carlos Moreno García, Linda M. Nicholas, Adelheid Otto, Karl M. Petruso, Luca Peyronel, Lorenz Rahmstorf, Felix Rösch, Edward Stratford, David A. Warburton, Elsbeth M. van der Wilt

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Cover:
Front cover (top left): Reconstruction of the scale from Bordjoš, Banat, Serbia, ca. 1200 BC (modified after Medović 1995, fig. 5, cf. p. 124).
Front cover (top right): Spool-shaped balance weights with markings from Tiryns, Argolid, Greece, mid and later third millennium BC. Courtesy of Lorenz Rahmstorf.
Front cover (bottom left): A cubo-octahedral weight from Cttam, East Yorkshire, England, ca. 9th century AD. Courtesy of Jane Kershaw.
Front cover (bottom right): A stone ´amulet` from Tepe Gawra, northern Iraq, ca. mid fifth millennium BC (Speiser 1935, pl. XLIIIb, cf. p. 30).
Back cover (top): Detail of the marketscene in the tomb-chapel of Nianchkhnum and Chnumhotep, Saqqara, Egypt, ca. 25th century BC (Moussa/Altenmüller 1977, fig. 10, cf. p. 182).
Back cover (bottom): Reconstruction drawing of the waterfront with market in Schleswig, Schleswig-Holstein, Germany, ca. 1100 AD. Courtesy of Felix Rösch.

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Preface by the editor of the series

The Seminar für Ur- und Frühgeschichte (Institute for Prehistory and Early Historical Archaeology) at the Georg-August-University of Göttingen has been publishing archaeological research for over more than half a century. Within the „Göttinger Schriften zur Vor- und Frühgeschichte" monograph series, 35 volumes – mostly PhD and Habilitation theses – have appeared since 1961, original archaeological data are presented and analysed in detail. The more recent „Göttinger Forschungen zur Ur- und Frühgeschichte" (three volumes so far), appeals also to a wider public and presents specific research areas of the Institute. „Neue Ausgrabungen und Forschungen in Niedersachsen", is a series designed to bring smaller studies such as MA theses from the region of Lower Saxony to publication. Within the monograph series „Studien zur nordeuropäischen Bronzezeit", which is funded by the Academy of Sciences and Literature in Mainz, the results of a research project directed by my predecessor, Karl-Heinz Willroth, are presented. Now, a new series „Weight & Value" – of which this is the first volume – sets a new and additional focus on weights, scales and weight regulated artefacts in prehistoric and early historical archaeology and the relevance of these objects for the reconstruction of ancient concepts of material value. The title was inspired by two books by Anna Michailidou with the same title. First and foremost, the results of the ERC-2014-CoG ‚WEIGHTANDVALUE: Weight metrology and its economic and social impact on Bronze Age Europe, West and South Asia' [Grant no. 648055] will be presented in the new series. However, as no series exists so far for the publication of detailed studies on early metrology and the material evidence, we hoped to establish this series for publications even after the ERC project has come to an end. There is a substantial need for a such a publication series dealing with issues of „weight and value" for the whole time-span from the Chalcolithic period and Bronze Age to the Medieval and early modern period. To attract an international author- and readership, the peer-reviewed series will be published in English (Current guidelines for submission can be found at the back of this volume).

This first volume presents two workshops in a series of workshops funded by the ERC-2014-CoG ‚WEIGHTANDVALUE'. The workshop „Weights and their identification. Methodological challenges in the study of ancient weights and metrological systems" was hosted at the Institut für Vorderasiatische Archäologie (Institute for Near Eastern Archaeology) at the Ludwig-Maximilians-University, Munich, which took place on 25-26 June 2016. I would like to thank Adelheid Otto and her team for their great hospitality in Munich. Most of the papers presented at this workshop are published in the first part of this book with the very welcome addition of Karl Petruso's paper who unfortunately was unable to attend. The workshop „Weights and marketplaces. The phenomenology of places of exchange within a diachronic and multi-cultural perspective" took place over a year later at the Seminar für Ur- und Frühgeschichte in Göttingen on October 19-21 2017. Not only nearly all participants submitted papers for the proceedings volume, but with Juan Carlos Moreno García, Felix Rösch, Gary M. Feinman, Fang Hui and Linda M. Nicholas, further renowned specialists, contributed to the theme of the workshop in the present volume, though they could not attend the event itself. I would like to thank all authors for their contributions and my co-editor Edward Stratford for his support. Editing and layout lay in the hands of Heinz-Peter Koch with the help of Sandra Busch-Hellwig. The printing and the open access of this publication has been financed by the ERC Grant.

Göttingen, July 2019

Lorenz Rahmstorf

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Weights and their identification: A short introduction to the workshop

by Lorenz Rahmstorf

Despite its significant impact on our understanding of the economic and social organisation of early societies, the study of metrological systems and weight-use has been highly neglected in the past. Previously, many assumptions were based on poorly researched and inadequately published material evidence. The aim of the workshop was to discuss new methodological approaches in order to assess and enlarge our data sets of weighing equipment in various regions, from the Atlantic to the Indus and dating from the late 4th millennium BC to the Early Medieval period. The theme of the workshop was chosen in order to define the basic problem of the ERC project: how can we identify weights and weighing systems in the archaeological record? This fundamental problem has rarely been considered. So far, the majority of weights in the archaeological literature belong to easily identifiable types, so called 'canonical weights'. Examples include sphendonoid weights in hematite or similar minerals in the east Mediterranean and western Asia or duck weights in Mesopotamia. Some of these weights bear inscriptions or markings. To date, not a single clearly marked weight is known from Bronze Age Europe (outside of Greece). For this reason, early weights are often difficult to recognise within the archaeological record. In order to discuss problems of identification and related issues of weight use, metrology and weight-regulated artefacts, a questionnaire was presented to the contributors:

Identification

- Various methodological approaches (archaeological, sequential and statistical) help to make the identification of weights plausible, yet the overall indications are often rather ambiguous. Can we develop a rigorous scheme of tests in order to assess the probability of the suggested identification?
- The problem of identification does not arise with weights of well-known shapes ('canonical weights') but is related to randomly produced weights, of only slightly modified or even purely natural forms. In the latter case even the terminology is not yet established (*cf.* pebble weights, unregulated weights, non-canonical weights)
- Their identification depends especially on the archaeological context (sets of such objects found in a closed context, at best with other indications of metrological practice, *e. g.* the presence of a scale) and on its full publication with the mass of the objects provided. Are there any other indications which we may use to support the identification of such objects as weights?
- Scale beams were most often made of perishable material (wood, bone). This holds true also for scale plates (bast, textile, wood, *etc.*). More detailed studies on archaeozoological material may increase our knowledge, especially in regard to small fragments.

Morphology, material and size

- Sometimes morphologically distinct weight types were used in a similar way in specific cultures. What does this indicate? – were different shapes used for different units/weighing systems or for weighing specific goods and commodities?
- Moreover, were different weights used in different economic zones?
- What materials were used for the weights – stone, bronze, lead, *etc.*? Do we have any indications to why this specific material was chosen? Are there chronological, regional or cultural preferences?
- In several cases the mass range of the weights attested in a specific culture is rather limited. Sometimes we only know of rather light weights but we lack the heavy ones or the other way around. Does this merely reflect the current state of identification (*i. e.* very heavy or light weights were of different/unusual morphology and are not yet identified) or were only light or heavy commodities weighed out (*i. e.* economic implications)?

Metrological analyses

- Traditionally the metrological assignment of weights to certain units is often the result of the experience and authority of the scholar. The mass of the objects, however, often allows for various and contradicting interpretations. Can we move beyond this by applying *non-a priori* assumptions?
- The cosine quantogram analysis seems to be one key to make interpretations testable on a quantitative scale, but what is the effect of the sample size and material on the statistical detection of measurement units?
- Random non-quantal simulation data sets have so far only been used in very few studies in order to assess the validity of cosine quantogram analysis.

- To what extent may further studies in the textual data on different weight units used in different places enlarge our knowledge on contemporaneously used standards?

Weight-regulated artefacts, hoards and *Hacksilber*

- From textual evidence we know that metal artefacts were sometimes produced according to a specific weight representing multiples of a fraction of a certain weight-unit. Such objects can be called weight-regulated artefacts. The investigation of such classes of objects is still in its infancy, but it seems to be especially rewarding for objects made of gold and silver.
- While it is already difficult to prove that an object is a weight, it is even more difficult to present watertight evidence for the existence of so-called weight-regulated artefacts. Thousands of bronzes from the European Bronze Age are either often produced in a similar shape or are intentionally fragmented. So far, investigations of any metrological basis for these fragmentations have mostly failed to produce convincing evidence. However, a statistically significant approach has not yet been applied systematically.
- Extensive hoarding is a phenomenon often encountered in regions and periods when weights were used as well. This also often comprised the intentional fragmentation of artefacts of gold and silver (Hacksilber). What does this tell us about the general modes of exchange (barter/ Hacksilber/ monetary) and the origin of money?

Weights and their economic, political & social implications

- What does the use of weights indicate? The existence of precise and generally shared concepts of material value?
- It has been argued that the use of weights in Syro-Mesopotamia primarily indicates concerns with payment to the temples/palaces, and not necessarily evidence for trade and transactions such as buying and selling. Is this a realistic assumption in light of the archaeological evidence (*i. e.* the contextual distribution of weights and scales in various sites)?
- Moreover, to what extent is it possible to enrich the long-standing debate of the relevance of state-driven and independent ('private') economy in the ancient world with the archaeological evidence from weights and scales?
- Who was responsible for the dissemination of a certain weight standard in the first place and how weight systems were maintained/policed across large areas? By the 'state'?, the king?, traders?, the elite? As weights were used both in state societies (Western Asia) and in segmentary societies (Europe) it seems difficult to answer this question unequivocally.
- Who used weights, specialists or entire communities? If they were specialists what social rank did they hold in their societies?

Each of the contributors addressed some, but not all, of the questions in the papers. Yet in the aggregate, much of the intent of the questionnaire has been addressed. The result is a significant step forward in forming a methodology for identifying weights in the archaeological weights and a useful point of reflection for the field of metrology and for ancient economies. In the following, we briefly summarise the papers.

Karl Petruso's contribution provides a historiographic retrospective on the theories that can affect the exploration of ancients weights and weighing. Petruso asks if purely computational methods can be used, especially when they cannot account for practice on the ground, and when instead they are influenced by contemporary issues, such as propositions in the past that have been to easily swayed by the creation of the euro currency. In the past the importance of mathematical "correspondences" between different unit-systems was often overstated, since such correspondences can be traced between any pair of random numbers. Petruso argues that considering conversion mechanisms and its technology serve to correct past propositions based entirely on computational methods.

The second contribution on weights comes from **William B. Hafford**, who provides an overview of what the site of Tepe Gawra, lying at the northern end of Iraq, can supply for the development of weights and weighing already at the end of the fifth millennium. Working back in time through the archaeological layers of Tepe Gawra, Hafford traces material remains that support a development of weighing and weights as far back as the end of the fifth millennium. Hafford reviews possible weights, related objects, such as seals and accounting tokens, and their contexts to support his proposal. It is a fascinating hypothesis that the origins of weighing go back as early as the Ubaid period in Mesopotamia. Supportive evidence from other contemporaneous sites in the region would strengthen the case.

Enrico Ascalone examines potential weights from the recent excavations at Shahr-i Soktha, located in the Iranian portion of the Helmand valley to explore the potential for an otherwise poorly attested economic interface in the Iranian plateau. Ascalone finds candidates for weight stones dated to the second half of the third millennium that seem to match shape and weight profiles for both the Indus Valley and Mesopotamia/Syria. After reviewing the candidates, Ascalone strengthens the proposition that commerce overlapped between

Mesopotamia and the Harappan cultures as mediated by actors working with elements of weight systems in both regions.

Lionel Marti and **Grégory Chambon** offer a review of how the textual record in two instances, the Old Babylonian documents from Mari and Middle Assyrian documents, both from the second millennium BC, provide some of the interesting administrative contexts for the use of weights and weighing, even when they are less helpful in clarifying actual weights. The two authors find that the textual evidence does not always divulge weights that are, strictly speaking, the result of weighing procedures. Still, textual sources also demonstrate that actual mass was a concern in some contexts, with metals checked and weighed by administrative authorities.

Luca Peyronel reviews weighing in the Middle Bronze Age Near East and the archaeological and textual evidence for multiple regional standards (Mesopotamian, Levantine, *etc.*) and the presence at many sites of the ability to work with several systems. After a methodical review of weights, Peyronel gathers the data on silver hoards and closely analyzes those available from Ebla to make a proposal based on the preliminary analysis: that statistical analysis of hacksilver suggests that some pre-determined amounts of silver could have functioned as units that could easily traverse multiple ponderal systems, forming a meta-system, and bolstering the value of forthcoming analysis of his current project on the relation between metrology and silver circulation in the early second millennium Near East.

Anna Michailidou examines archaeological and textual evidence on weights and weighing from the Bronze Age Aegean and the second-millennium Near East to outline the relation between weight and value, not only in metals but also in other objects, including sheep fleeces and grain. Particularly metal objects were valued in direct relation to their weight, though ceremonial exchange could imbue increased value. Metals (silver, copper, gold, lead) as money did change hands in the Aegean economy of the mid and later second millennium, as evident in the Near East as well. In addition, she argues that in the Mycenaean period, lead could function as a medium for customary standards for metrology alongside stone balance weights.

Nicola Ialongo and **Lorenz Rahmstorf** provide a description of the archaeological evidence for balance weights in Europe in the pre-literate Bronze-Age, arguing that by the middle of the second millennium, a technology of weight-based exchange had diffused from the Italian peninsula across the whole of Europe. Drawing on more than five-hundred candidates for weights, five shapes are found important (rectangular, disc, spherical, Kannelurensteine, and piriform) that closely group according to quantitative analysis using frequency distribution analysis and cosine quantogram analysis. The study functions as a first step in charting the development of weight-based commerce in Europe.

Jane Kershaw takes stock of the patterns of weights in Viking-Age Scandinavia and England and also argues to move beyond pure metrology, proposing that the results of her review of Viking weights show those weights were both less 'regulated' than supposed and more broadly distributed in rural contexts and among women. Despite characteristics that they were regulated, both kinds of distinctive weights in the Viking world were part of a more complex system than previously understood. The broader distribution, even in rural areas, of the complex to manufacture oblate-spheroid weights suggest that they functioned for larger Meanwhile, the higher variability in weight and alloy composition of smaller cubo-octehedral weights suggest that they were not centrally manufactured, despite the fact that they were clearly used in urban areas for very small transactions.

Balancing from weight to value and *vice versa*

Weight-regulated artifacts and currency in Aegean and Near Eastern pre-coinage economies

by Anna Michailidou

Weight, value, Linear B, metal standards, wool standards, lead balance weights

The focus of this paper is on the stage between measuring by weight and value estimating in the 'money barter' economies of the Bronze Age Aegean and the Near East. Commodities crucial for the subject of standardization are reviewed: copper, silver, gold, lead and wool. With the help of Aegean weight-regulated items and the relevant bibliography based on Near Eastern textual evidence, we proceed to pursue questions on commodity values and on their possible role as currencies. A new enquiry is introduced on lead standards and their possible function as unit of account or cheaper money, along with their participation in the metric system throughout the Aegean.

***Von Gewicht zu Wert und** vice versa*
Gewichtsregulierte Artefakte und Währung in ägäischen und vorderasiatischen Ökonomien vor der Verwendung von Münzen

Gewicht, Wert, Linear B, Maßeinheiten von Metall, Maßeinheiten von Wolle, Bleigewichte

Der Beitrag untersucht das Stadium zwischen dem Wiegen nach Gewicht und der Wertschätzung in "Tauschgeld"-Wirtschaften in der Ägäis und im Vorderen Orient während der Bronzezeit. Handelswaren, die sich für eine Standardisierung besonders anboten, wie Kupfer, Silber, Gold, Blei und Wolle, werden betrachtet. Unter Berücksichtigung der ägäischen gewichtsregulierten Gegenstände und den relevanten textlichen Belegen aus dem Vorderen Orient analysieren wir Fragen des Materialwerts von Handelswaren und ihre mögliche Rolle als Währungen. Weiterhin werden standardisierte Bleiobjekte und ihre Funktion als Verrechnungseinheiten oder als Kleingeld sowie deren Nutzung innerhalb des ägäischen metrischen Systems behandelt.

The concept of money: an introduction

Almost a decade ago, the first chapter in an introductory volume to the above subject started with the following statement: "The project on Weight and Value is a study of the relationship between two concepts pertaining to pre-coinage societies of the Bronze Age in the Eastern Mediterranean and the Near East: *weight*, which can determine the degree of standardization for the quantity of a circulating commodity, and *value*, which represents the degree of the commodity's importance in the exchange network" (Michailidou 2005, 15). The first archaeologist to connect the material reality of weight to the economic concept of value was Arthur Evans (Evans 1906; *cf.* Michailidou 2004). Christos Tsountas (1893) and Barry Kemp (1991, 248) both contributed to the view that balance weights stand only one step before the invention of coinage. One may add the argument that in regard to the Aristotelian requirements for coinage by virtue of *being metal, weighed and guaranteed* (Aristotle, *Politics* I, iii, 14-15), it was the official stone balance weight which in many pre-coinage states of the Orient was bearing the mark of the central authority accompanied by the mark of denomination (*cf.* Michailidou 2001a). It is as if the guarantee sign was at the last stage simply transferred from the surface of the stone balance weight to the piece of standardized metal, transforming it to a coin. The minting of coins in the 1st millennium represents not only "the end point" in the gradual development of the invention of money (according to Rahmstorf 2016, 20)[1], but a radical *innovation*. This *καινοτομία*[2] liberated the currency of metal from the dubious measurement by the balance: the authorized metal pieces would now simply be counted in easy agreement of both parts, the seller and the buyer, without any interference of witnesses or experts of the balance, as was the rule in the previous stage, before the innovation of coinage (*cf.* Joannès 1989).

Turning back to the 2nd millennium we have first to agree that any definition of the Late Bronze Age as a period of *pre-monetary* stage of economy, is wrong. As rightly put, although "coinage is money, money is not necessarily coinage" (*cf.* references in Rahmstorf 2016). In general terms, money is "anything that serves as a commonly accepted medium of exchange" (Harris 2008, 178), with a priority to grain and metals. As is evident from some of the dialogues on the Old Kingdom Egyptian "market scenes", such as: "*Here is a very beautiful cane, my friend! A measure of wheat for it*", or "x *cubits of cloth in exchange for 6 shat*", the notion of money far preceded coinage, existing within the barter economy system in foodstuffs (*cf.* Michailidou 2015, 674). The critical point is that money, whether it is an index of value or a store of wealth or a means of payment, it certainly needs to be measured; so Rahmstorf (2016, 37) correctly attributes the evolution of metric systems of weight to the value-estimating process and I may add that metric systems of capacity would have been equally important for measuring grain (or oil) not only in storage but also in payments in kind. Of course, qualities, such as durability and convertibility, led to the preference for metals over grain, although both metal and grain sometimes co-existed in prices in Near Eastern texts (Powell 1978; 1996). There is a vast bibliography on money[3] where prices and means of payment more usually do not coincide. Paraphrasing the saying "Money makes the world go round", Pare entitled his book "Metals make the world go round" (Pare 2000). Metal value is a monetary concept in pre-coinage early societies, and clearly indicative of this are the 24 '*metal dehens*' mentioned in a letter of the farmer Hekanakhte of the 11th dynasty in Egypt, referring not to 24 weight units/*deben* of copper, but to 24 pieces of copper (of unspecified shape) each weighing one *deben* (*ca.* 90 g) and sent for payment of the land rent (James 1962, 44, n. 57). The term 'money' reflects a vaguer concept than 'currency' – the later referring to *codified forms of money* – and currency in turn is a vaguer concept than coinage which refers to formalized metal bullion guaranteed by a state.

Commodity standards by weight

In this chapter we will concentrate on the step between measuring the weight and estimating the value of a circulating commodity. This step is the *standardization of the commodities by weight (or volume) and quite often also by form.* Copper and all other metals, in addition to wool and some other commodities (*cf.* Michailidou 2010, 74-75) were measured and accounted by weight.

Standards of copper

We know that during the Late Bronze Age copper as raw material was circulated in long distance trade in the standardized form of ox-hide ingots or bun ingots (*cf.* Pulak 2005 for the Uluburun cargo) and was stored (and weighed) in palaces and settlements. In the records of the Mycenaean palatial archives, there is no obvious distinction between copper or bronze (Michailidou 2008b, perhaps due to a lack of relevant experience of the scribes?). In the Linear B script, both the word *ka-ko* and the ideogram AES appear on the tablets.

1 If indeed we are to accept that there is an end to this process, where paper money and plastic money, even bit-coin have followed since then.

2 This ancient Greek word metaphorically meaning the innovation, had as first meaning the naming of the opening a new vein in ancient Greek mines (the verb *καινοτομέω* = *cut fresh into*).

3 *Cf.* references in the chapter "Demand for Goods. From Use Value to Exchange Value and the Means of Payment", Michailidou 2008a, 205-216. See also more recently Peyronel 2014b and the contributions in "*The Archaeology of Money*" (eds. Haselgrove/Krmnicek 2016).

▲*Fig. 1. Both bronze lavers, found in different houses at Akrotiri, Thera, are approximately of the same size and approximately of the same weight value (ca. 1500 g).*

Ingots are also found in fragments kept in hoards in settlements (*cf.* Soles 2008 for Mochlos, Crete). Breaking the ingot facilitated measurement and transport, while also offering the opportunity to check the quality (Michailidou 2008a, 104-105, n. 166). And in Old Assyrian texts, the term "broken off" is used for copper (and silver) pieces occasionally transported in packets (Veenhof 2014, 401-402). Copper of good quality was distinguished by the name of production area in Anatolia in the Old Assyrian period, perhaps this distinction was based on the typical shape and/or marks on the ingots (Dercksen 1996).

For copper ingots kept in houses as *personal property*, an illuminating information on their value comes from the following Old Babylonian letter:

> "*About the bronze hatchet and the bronze ingot which were left for you as pledge, ...I did not have any corn available and did not send any, but at the sheep-shearing I will send you 2 shekels worth of wool...On the day I send the wool, send me the bronze hatchet and the bronze ingot*"
>
> (Postgate 1992, 193, text 10.3)

In the above text, the amount of wool to be sent is not specified by its actual quantity but by its silver value (2 shekels) and it should be conceived as equal to the value of the amount of corn promised.

Heavy bronze tools were a kind of property as well. Apart from their great utility value, they required a great amount of metal for their manufacture. An example from a Deir el-Medina 'ostracon' illuminates how a woman was accused in court of stealing the chisel that her neighbor had buried under the threshold of his house (McDowell 1999, 187). In a modern house in the area of Archanes, Crete, a Minoan chisel was found hidden in a gap between stones of the interior wall (Sakellarakis/Sakellaraki 1997, 602). Two ingot fragments found between the stones of an additional wall in the upper storey of a house in the Bronze Age settlement at Akrotiri, Thera (Michailidou 2008a, 101-104, fig. II.82-II.93) may be considered as a hidden property: with the smaller ingot fragment, of 341 g, various items could be produced by a smith, from fish-hooks (*e. g.* of 12 g) to daggers (of 303 g) or chisels (of 272 g), *etc.* (Michailidou 2001b, 97, tab. 1). The big ingot fragment of *ca.* 3 kg (2956 g) would be sufficient for the manufacture of two vessels like the two lavers from Akrotiri (Fig. 1), deriving from different houses yet having similar size and weight, that is, representing *a possible standard* of 1500 g for this shape and size of vessel (Michailidou 2008a, 112-113, fig. II.102-II.104). Each one of them could be weighed with a lead balance weight of 1 ½ kg such as the inscribed disc (Fig. 2) from Mochlos, Crete (Olivier 1989; Michailidou 2001a, 56-57, fig. 4; 2008a, 113, fig. II.105) Standardization in size/type would be helpful to assess the capacity, transport costs, and exchange value of the vessel itself and of its contents.

It is significant that some Old Assyrian documents list the inventory of bronze household items and their total weight, *e. g.* 93 items from a single merchant's house weighing over a total of 100 minas (Dercksen 1996, 76-78; see also Michailidou 2008a, 269, n. 429-430). Because of the paucity of Aegean texts on the subject of prices, we turn again

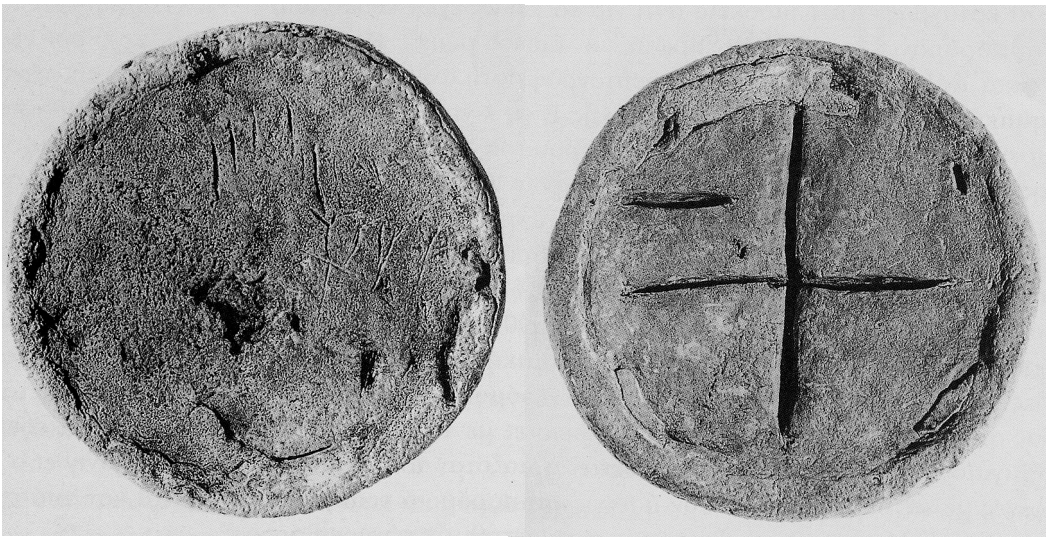

Fig. 2. A lead balance weight from Mochlos, Crete, with a Linear A inscription, of 1 ½ kg weight value.

to the Egyptian texts on ostraca (Janssen 1975, 101), where nearly all the vessels mentioned in the price entries are made of metal, and face the difficulty of determining whether it is the weight of the copper item itself or its price in quantities of copper that is recorded in the private transactions among the Deir el-Medina inhabitants. It seems that in principle, the weight of a copper vessel is equivalent to its exchange value when measured in copper, if we take the example of an Egyptian ostracon, where a bronze vessel of 20 *deben* (*ca.* 1800 g) and a basket of 4 *deben* (evidently the price of the basket) are recorded as giving *a total* (price of) 24 *deben* (of copper).

Standards of silver

Precious objects of silver and gold are recorded side by side in early Near Eastern documents. In Sumerian they had analogous names: silver was *kug-babbar*, "shining white", while gold was *kug-gi* "shining yellow" (Krispijn 2016, 8). And various forms of silver standards in circulation are textually documented in the Near East: *e. g.* ingots, rings, coils and scrap metal (Peyronel 2010; 2014b).

Why, then, is silver not recorded in the Linear B tablets? Apart from the description in the tablet PY Sa 287 of a pair of wheels as *a-ku-ro de-de-me-no*, that is, fastened with *ἄργυρος* (=silver), this metal is not mentioned. There is a more recent view, still under discussion, expressed by Godart (2009, 114) who supports the existence of an ideogram for silver in the tablets Tn 316 (listing gold-AUR vessels) and Tn 996 (listing copper-AES vessels) He names it ARG as abbreviation of ARGentum. There is also a discussion on the KN Og series, where some unspecified commodity/ies are listed by weight. As already mentioned (Michailidou 2001b, 104-105; Dialismas 2001, 123-124), the quantities of these unknown commodity/ies are not converted to talents but remain as multiples of the subdivision units *M* or *P*: they are possibly accounted according to the actual process of weighing, therefore these records of multiples of smaller units may indicate accounts of precious metals.

In contrast to the Mycenaean texts, silver artifacts are included in the archaeological record: 30 silver objects were found in the Shaft Graves of the Mycenae acropolis (Kelder 2016, 307), not to forget two silver cups found in the Vapheio tholos tomb (Davis 1977; Killian-Dirlmeier 1987) and many others (Aulsebrook 2018, 92-96). Because silver is rare in later periods, Kelder poses the question: "what happened to the silver that was extracted from the mines of Laurion?" (Kelder 2016, 311). But in the Annals of Thutmoses III, silver objects are mentioned as sent by the prince of Tanaju (=Mycenae), and there is a view that the earlier Tôd treasure, found in Egypt, with more than 153 silver cups, perhaps included vessels of Mycenaean craftsmanship (as Kelder 2016, 312-314). Silver cups certainly represented a reserve of value exchanged as a diplomatic gift among rulers. Perhaps this may be one of the reasons why silver items are not as yet securely identified in the Linear B tablets, which mainly covered the internal bureaucratic needs (although accounts of textiles produced for exports exist).

Though the majority are found in fragmentary condition, silver vessels did exist both in Minoan Crete and Mycenaean Greece (see more in Davis 1977; Sakellarakis/Sakellaraki 1997, 605; Mountjoy 2003, 164-165). A good example of preservation is the silver cup from a Mycenaean burial weighing 261 g, *ca. N* 1 in Linear B units (Michailidou 2001b, fig. 15). Silver vases were found in houses as personal property: in the South House near the palace of Knossos, 3 silver bowls and a small jug were found tightly placed one inside the other and fallen from the room above the basement Pillar Crypt. Unfortunately they are not intact, so no estimation of their original weight is possible. Mountjoy (2003, 166) emphasizes: "Evans idea that they were stored together in a container is more plausible. They could simply be part

of the house furniture, the private possession of the resident of the house caught in a disaster". They certainly represent wealth accumulation. Strongly indicative for silver as house property are some Old Assyrian texts where silver cups appear among the valuable assets present in the house of a trader who has died, *e. g.* in one of them we read about "the 4 cups that are in his house" (Veenhof 2014, 400).

Standards of gold

At the highest levels of the exchange system – ceremonial gift exchanges – it was gold that, as a prestige material, was the gift par excellence. The Near Eastern political entities acquired it from Egypt in the form of artifacts but also as raw material in the form of gold-dust or ingots (and rings): *e. g.* in an Amarna letter "much gold that has not been worked" is asked from the Pharaoh (Moran 1992, EA 20:72; see also Peyronel 2014b, 357-359). And Egyptian wall-paintings inform us that gold might be stored (a) as gold dust in bags, (b) as ingots or nuggets, and (c) as ring-ingots (*cf.* Michailidou 2001b, fig. 6). In contrast to many records of gold (and silver) vessels as gifts or tributes, frequently of standard shapes and weight (Peyronel 2014b, 360 with references), there is less archaeological evidence. Two gold bowls from Ugarit were found on the acropolis near the Baal temple weighing 179 g (=20 Levantine shekels) and 218 g (= 30 Syrian shekels of 7.5 g), while another one-handled silver bowl decorated with gold from a tomb at Enkomi has a precise parallel in the bowl from the tomb at Dendra in Mycenaean Greece (Peyronel 2014b, 361).

The Akkadian word for gold was *hurāṣu*, from which comes the loan word *ku-ru-so* in the Linear B Mycenaean script. The Pylos tablet Jo 438 is as yet the only textual Mycenaean evidence of gold recorded by weight (since no weight estimation follows the gold vessels of the other tablet, the Tn 316). Petruso (1992, 64) has well observed that the records of gold in Jo 438 are tallied from the quantity defined as *M* 1 (that is the Mycenaean metrogram for one double mina equivalent to 1 kg) down to the quantity defined as *P* 3 (*P* is the Mycenaean metrogram for a weight of 20-22 g) a quantity equivalent to the earlier Minoan unit of 61-65 g. The recorded total of *ca.* 6 kg gold offerings to the palace of Pylos (Chadwick 1998-1999) is far from small if we take into account that two shekels of gold (about 17 g) were considered enough to organize a whole banquet, as mentioned in a Middle Assyrian letter (van Driel/Jas 1991, 65). The tablet Jo 438 certainly poses the question as to what form gold took in circulation. Since gold cups, recorded as gifts among rulers, are mentioned in many Near Eastern texts, together with their weight, it would be interesting to take into account any weight measures on intact Mycenaean vessels (*e. g.* in Davis 1977). Thus, the Linear B record of a donation of gold weighing *M* 1 could represent a gold cup like, for instance, the gold goblet inv. no. 351 in the National Archaeological Museum (Athens) coming from the Mycenaean shaft grave IV and weighing 1004 g (Michailidou 2001b, fig. 7). Each one of the eight contributions of the quantity *N* 1 could represent gold in the form of a cup like the no. 629 in the National Archaeological Museum coming from the Mycenaean shaft grave V (Michailidou 2001b, fig. 11) and weighing 253.6 g. The donation of a quantity of *P* 3 (four records) could have been in the form of a gold cup like the no. 73 in the National Archaeological Museum from the Mycenaean shaft grave III, weighing 65.5 g, and so on (*cf.* Michailidou 2001b, fig. 7-20, tab. 2). Although the above mentioned gold vases from the Mycenae shaft graves are of an earlier date, it is significant that similar weight standards existed for gold cups of the (later) period of the Linear B tablets. In addition, some of their shapes are even comparable to Linear B ideograms of vases. For example, the gold cup no. 6441 in the National Archaeological Museum (Michailidou 2001b, fig. 18), found with LH IIIA pottery in a pit burial below the floor of a tholos tomb at Marathon, is related to the ideogram * 221 and weighs 66.7 g, very close to one Minoan unit (or to *P* 3 in Linear B metrograms). Four gold chalices, of identical shape (Davis 1977, 291-293), were found in a LH II-IIIA1 hoard outside the Mycenaean Acropolis (*cf.* Fig. 3), and their shape is related to the ideogram * 215 (Vandenabeele/Olivier 1979). The weight 314.7 g, for one of them (Michailidou 2001b, fig. 17), is equivalent to 5 Minoan units, perhaps to be recorded as *N* 1 *P* 3 (or *P* 15) in Linear B metrograms. The two famous gold "Vapheio cups" of 280.5 g and 276 g respectively (Davis 1977, 256-257) could be estimated as 21 Egyptian *deben of gold* (of 13.3 g) or 3 New kingdom *deben* (of 91-93 g). However, such pieces of art in precious metal certainly pose the unresolved question for an added value by their magnificent workmanship.

Thus, from the point of view of manufacture, the weight values of most of the Mycenaean cups of precious metal clearly fall within both the earlier "Minoan" unit (61.0-65.5 g) and the later Linear B units *M* (*dimnaion*) and *P* (20-22 g). A lead balance weight from Akrotiri, Thera (Fig. 4), coming from a house where also a few Linear A tablets and Minoan sealings were found, represents this weight value of the *dimnaion* and is marked with two triangles. Possibly kept as a trade standard in the upper floor of the house of a priest or merchant (Michailidou 2008a, 90, 248) it introduces us to the subject of standards of lead.

Standards of lead

Lead objects were widespread throughout Anatolia, North Mesopotamia and the Levant from the Late Chalcolithic period onwards, while the term of lead in cuneiform sources is in Sumerian *a-gar* and in Akkadian *abāru,* (*cf.* Peyronel 2016 with many references). In the Mycenaean tablets, the

Fig. 3. Gold chalices, gold rings and gold coils from Mycenae, in the National Museum at Athens.

term used for lead is *mo-ri-wo-do* (documented in the tablet Kn Og 1527).

In the Aegean Late Bronze Age, lead was used for various objects, sheeting, rivets and pot mends, figurines, net weight sinkers, wire, spearheads, bullets, jewelry in the form of rings and pendants, even vessels and above all balance weights (Mossman 2000). The Minoan metric system based on the unit of 61.0-65.5 g had a wide diffusion in the whole Aegean area (*cf.* Petruso 1992; Niemeyer 2013; Bertemes 2013). It is easily identified by the discoid shape of the balance weights themselves, made either of stone or, more commonly, of lead. Lead weights were used as trading standards throughout the Aegean. A transitional stage between Minoan and Mycenaean metrology is quite apparent in the functional cluster of 9 lead balance weights found in the LH II A Vapheio tholos tomb (Tsountas 1889; Kilian-Dirlmeier 1987; Michailidou 2008a, 156-177). As Alberti (2006, 318, tab. II) emphasized, every multiple from the Minoan unit to four Mycenaean *M*-units can be composed and the whole cluster is consistent with the Minoan system of 62-65 g, in fact the smallest of the balance weights is of this particular value. Particularly noticeable is the emphasis on the existence of three samples of the unit *M*, which is the prevailing unit in the Mycenaean Linear B tablets, at the expense of the Minoan unit of which there is only one specimen (Michailidou 2008a, 167). Thus, although, in Alberti's words, the Vapheio cluster is "strongly embedded in the Minoan tradition", we probably have here the adaptation of the old system to the new bureaucracy because it was managing *greater quantities* of products (*cf.* the addition of a new Linear B sign for the number 10,000 to the old numerical system of Linear A). We should consider that the smallest balance weight is equivalent to P3, the smallest quantity of gold recorded on the Linear B tablet Jo 438. And the larger balance weights of *M* 1, are each equivalent to the larger offer of gold in the same tablet.

Another lead disc from Akrotiri (Fig. 5) displaying four dots is regarded by Nicola Parise (1986) as denoting a weight unit corresponding to one sheep's fleece and he assigns the same nominal value to other lead balance weights from the Cycladic islands of Thera and Kea (of weight values from 690 to 744 g). It seems that there was a widespread diffusion of a common standard referring to one sheep's fleece and that, before the evolution of precise systems of measurement, wool was regularly bartered in terms of its most natural unit, namely the clip of one sheep at shearing time. If we take into account that in the contemporary Linear A script of the Aegean, quantities of commodities were recorded as fractions of a greater unit, then the four dots on this disc may indicate that it corresponds to the fraction of one fourth of a greater wool unit which should have the same value with the later Linear B wool unit LANA of *3 kilograms* (Michailidou 2008a, 92-93, fig. II.66, 228-230, fig. V.13-V.15a). It is very significant that, like metals, wool was also standardized by weight.

Standards of wool

Wool was certainly among the staple commodities used in everyday life (with the exception of Egypt, where linen cloth prevailed, though wool was also used for blankets *etc.*, Michailidou 2008a, 184). It is quite indicative that in an arrangement of adoption in Old Babylonian Ur, the

'son' adopted by a couple was promised to inherit all their possessions, while he, in return, would support them with provisions of 360 liters barley, six liters sesame oil and *3 kilograms wool* (= 6 minas) each year (van de Mieroop 1992, 217: *BIN* 2, no. 73). In Ur-III texts we see the following annual rations of wool: 4 minas for the adult man, 3 minas for the woman and 2 minas for the child (Biga 2014, 144-147).

Wool is a good example of a storable wealth, easy to arrange in standard shapes such as balls, hanks, bales, often estimated also in loads of donkeys. It had the qualities required for a trade item, particularly if dyed (*cf.* van Soldt 1990 for colored wool in Ugarit and Michailidou 2008a, 185, 203-204). Important – for indicating inter-system correlations – is the following text: "Seven talents of wool (measured) with the talent of Aššod, and (measured) with the talent of Ugarit five talents" (van Soldt 1990, 334). Obviously, it was not an easy process to actually weigh in talents. This unit was more useful for recording totals. By using smaller units, such as minas or shekels, both weighing and evaluating became easier. The quantity of a double mina or a mina of wool was also used, *e. g.* this was the weight of a standard bale of wool for sale in Egypt, in later times (*e. g.* in Hellenistic times: Michailidou 2008a, 202).

According to Old Assyrian texts, wool was not transported in wagons but by donkeys, inside bags or packed by large pieces of cloth, each one holding about 45 kg of wool, that is 1.5 talents (Lassen 2010, 167). A real 'standard of wool' is the fleece (called *mašku*: Veenhof 1972, 132-134 and Michailidou 2008a, 183) as also suggested for other cultures (see below the view by M.-L. Nosch). A special weight for wool also existed in Kültepe, as we read in a text where 65 stones for wool are mentioned but without information on weight (Dercksen 2016, 18). This reminds us of the existence of the earliest stone mina of wool of Dudu of 680 g weight, contemporary to a weight from Ebla of *ca.* 666 g (Peyronel 2014a, 126).

Turning to the Aegean Bronze Age, few records of wool are preserved in Linear A tablets. As Palaima (1994, 317) noted, wool occurs on tablets from Hagia Triada, Phaestos and Khania in quantities not easily determined, except one entry which is possibly connected to the amount of five talents, that is, 150 kg (see more recently Millitelo 2014). For the subject of Mycenaean wool and weights one should further consult Marie-Louise Nosch (2014, 392-393) who specifies clearly how the Mycenaean LANA unit for wool, although equivalent to ⅒ of the talent, is not a fractional sign but a logogram for the commodity of wool in a particular quantity, that is, 3 kg. She also comments on the well-consolidated relationship between the weight of a fleece and the weight system: since fleeces naturally vary in weight (*e. g.* in Alalakh text 1 sheep gives 1 ½ minas wool, that is a fleece of 704.7 g), such a "standard sized fleece" is theoretical, therefore "the concrete counting has been replaced by an abstract counting and measuring system for wool" (Nosch 2014, 392).

▲*Fig. 4. A lead balance weight from Akrotiri, Thera, inscribed with two triangles, may represent a two-mina standard.*

▲*Fig. 5. A lead balance weight from Akrotiri, Thera, marked with four dots, may represent the weight of one sheep's fleece.*

The fullest series of lead discoid weights from a single house in Akrotiri on Thera, is considered as used for weighing wool, since also in the upper

▲*Fig. 6. Silver rings, experimentally "weighed" in the smallest balance pan from Akrotiri, Thera.*

floor of this house a large number of loom weights were found (Michailidou 2007; 2008a, 66-73). Although contemporary with the period of Linear A tablets, in the conversion of the larger specimens of the cluster into units of wool (Michailidou 1990, tab. III) it emerges that all might be multiples of Linear B denominations either of the M-unit or of the wool unit LANA calculated in weight M 3 = 3 kg. There must have been little difference in the scale of ponderal values – despite the different way of writing them – between the Linear A records, with which the balance weights are contemporary, and the Linear B accounts. Nosch (2014, 393) supports – to my full agreement – that this combined wool logogram and metrogram LANA of Linear B script is well integrated into the LBA Eastern Mediterranean system of the talent and mina.

The important wool product, the textile, deserves a separate treatment as a trade item par excellence (for standardised and mass produced Mycenaean textiles, see Nosch 2012, 50; *cf.* also Tzachili 2001a; 2001b; Michailidou 2008a, 193-202).

Commodity money: The means of payment

Powell's (*e. g.* in 1999, 227-228) definitions that barley and copper in Mesopotamia were the cheap money and silver the most expensive, are currently accepted by most scholars. In our discussion we will exclude barley because it was measured by volume. In Near Eastern texts, the Akkadian verb *šaqālu* "to weigh" is used also for the action of paying (*cf.* Renger 1984, 102). Unfortunately, no Mycenaean accounts with values or prices of commodities are preserved (with very rare possible exceptions: Sacconi 2005).

Silver 'money'

Silver was the main metal used as reserve of wealth and standard of equivalence from at least *ca.* 2500-2350 BC (Peyronel 2010; 2014b). According to Krispijn (2016, 8) silver occurs as a means of payment already in the ancient *kudurrus*, the earliest contracts of landed property. And the use of silver in the dairy texts might indicate the ratio of 1 shekel silver to 5 liters of fat, which seem to be one of the earliest price equivalencies in history (Krispijn 2016, 9).

The difference in the rate of exchange of silver in Ashur and Anatolia was the commercial basis for the success of the Old Assyrian trade caravans (Veenhof 2014, 393). Veenhof seeks in texts the shape in which silver circulated: apart from terms to be interpreted as bracelets, rings and coils and also broken ingots – forms known also in Ur III and Old Babylonian periods (*cf.* Powell 1978; 1996) – Veenhof states that "silver was also stocked and circulated in the shape of cups, *kāsum*" which he defines as another form of "concrete money". The weight of their silver is frequently mentioned, often preceding the noun, as if the amount of silver mattered more than its shape (Veenhof 2014, 400). Finally, some moulds found in Kültepe/ Kanesh, with matrices possibly meant for ingots, "might have yielded circular bars with a weight of ½, 1 and 1 ½ mina of silver". It seems that silver was refined and more probably cast into ingots in Anatolia before being shipped to Ashur (Veenhof 2014, 417). Some marks – a cross for instance – on the moulds from Kültepe, perhaps facilitated the use of the produced ingots as weight-regulated objects (*cf.* Müller-Karpe 1994, taf. 20.4,6a; also Michailidou 2008a, 60, fig. II.23)

As Peyronel (2010, 927) put it: "the debate on silver revolves around two basic questions: can we consider silver a form of currency? And how frequently silver passed from hand to hand?" There existed a reluctance to offer raw silver as gift: silver is listed among gifts only in the form of manufactured items (Peyronel 2014b, 360).

It seems that although there was a preference in payments in other commodities against the silver prices, silver did indeed change hands. Kleber notes in the Old Babylonian period, when silver in ingots and rings/coils remained high-range money with a higher significance for the commercial sphere than for local market, that it was still available to parts of the urban population, particularly used whenever geographical distances had to be bridged (Kleber 2016, 38; see also Dogan/Michailidou 2008, 41-45 for silver carried by merchants).

For the Aegean/Minoan world, a monetary system based on metals is equally likely (*cf.* Michailidou 2008a, 266-267), although there is no secure textual documentation as yet to support this hypothesis. I have suggested that some silver rings found in a "shop" at the settlement of Akrotiri, Thera, may in fact represent this form of money, since they are found in the same room where two balances, with the biggest and the smallest balance

pans, were left behind (Michailidou 2008a, fig. V.54-55). The total weight of the rings (Fig. 6) is *ca.* 8.4 g, approximately 1 Mesopotamian shekel of silver. If we take the liberty to imagine the owner of the rings as travelling to the Near East in regions where commodity values prevailed according to the Eshnuna Law Code, then he could be able to exchange the rings for quantities of various goods, such as 300 liters barley or three liters best-quality oil or three minas copper or six minas wool *etc.* (Michailidou 2008a, 267). For a possible function of small axe-heads as currency, we note that the approximate weights of the (fragmented) silver axes of Arkalochori, Crete, vary from at least 2 shekels to half a shekel, and one shekel in Mesopotamia usually represents a month's payment for many trades (for more on the silver (and gold) axe heads of no functional use possibly serving as currency, see mainly Michailidou (2003) and below chapter on copper money).

Vargyas has drawn attention to cases where Mesopotamians used silver inside small, *pre-weighed and stamped* linen bags, as *e. g.* in the hoard from Larsa, dated 1738 BC (Vargyas 2002, 113). The importance of a later "sealed silver" in a hoard from Tel Dor (11th-10th century) lies in the fact that it consisted mainly of small flat tokens cast in the shape of small coins and other pieces of cut silver (Stern 2001). For silver money still evaluated by weight and not merely counted in coins during the 1st millennium *cf.* chapters (with references) in Kleber/Pirngruber (2016).

Payments in copper

The language of value, although connected with the weight value of metals is not confined to it. Postgate points out that the metal pieces had both the practical value that the raw material of finished artefacts gave them as well as any value assigned to them *by society* as currency (Postgate 1992, 204, n. 345).

In the Sumerian debate between copper and silver (Vanstiphout 1992; Michailidou 2008a, 124), copper emphasizes its great utility value against Silver's lack of practical use and describes silver as "forgotten in the soil inside the house" (from Peyronel 2014b, 355). We must emphasize that apart from its utility value, copper had also a pre-coinage function at the beginning of the 3rd millennium (Peyronel 2014b, 355) and it seems that it never ceased to have such a role in private, at a lower range, transactions, as *e. g.* recorded in the Deir el-Medina accounts already mentioned above.

Even agricultural tools were widely accepted for minor expenses in the Near East. In the Sumerian debate, the use value of the sickle is emphasized, as copper declares to silver: "*...At harvest time you don't give man the bronze sickle. That's why no one takes any notice of you...*" (Piggot 1996, 167). In texts recording transactions within Anatolia, 'old sickles' were used as means of payment by Old Assyrian merchants (Dercksen 1996, 223), along with copper scrap (Dercksen 1996, 221-222). The following text is an example:

"*I gave them two minas of tin, [x] minas in sickles, their expenses*"

(CAD *s. v. nigallu*)

Aegean economies need not differ in this aspect. Scrap metal found at Akrotiri, like broken and non repairable copper sickles, apart from recycling, may occasionally be kept to be given in private transactions (see Michailidou 2008a, 116-129).

Metal household vessels were acceptable to creditors as 'money' as, for instance, in a well known Egyptian papyrus (Gardiner 1935; Michailidou 2001b, 99; 2005, 39-40) where the value of a Syrian slave stated at 4 *deben* and 1 *qedet* of silver, is paid in copper vessels and cloth, with their values stated in silver at a ratio of copper/silver 100/1 (in the Ramesside period). No distinction in value is made between beaten *copper* plate and *bronze* vessels, which the seller claims that she has bought from her neighbors.

Copper may also have circulated in codified forms of currency of very low weight values, as is the view expressed for rings, strips and particularly bided strips (Fig. 7) found in Akrotiri, in the same room where also one balance and a set of lead balance weights, all under 300 g in weight, were found (Michailidou 2008a, 284-285, fig. V.74-75). Thus the tenant of the house was in a position to "weigh out" copper in codified forms for payment in transactions of lower values. Apart from Akrotiri on Thera, such bands of copper strips, possibly functioning as a liquid asset (Brogan 2006; Soles 2008), are found also in various places in Crete (Mochlos, Gournia and Juchtas). I have also suggested that 'sacred' representative money may take the form of small non-functional double axes, like the gold and silver miniature double axes from

▲*Fig. 7. Copper rings, each currently weighing ca. 1 g and bound strips, currently weighing ca. 5.5 g, from Akrotiri, Thera.*

Arkalochori on Crete, perhaps of similar function as the *ḫaṣṣinnu* (=axe heads) cited by a text from Mari, elsewhere discussed (Michailidou 2003). Particularly for the same term in Nuzi texts, Oppenheim (1938, 659) has remarked "Notons bien qu'il ne s'agit pas d'une véritable hache, mais d'une *monnaie de bronze* en forme de hache". I believe that a 'cheaper' form of sacred money may be represented by the thin copper cut-outs in the shape of axe-heads from Juchtas on Crete with no provision for the shaft and obviously mass-produced (Michailidou 2005, fig. 9).

Payments in gold

From a letter sent by the ruler of Ashur to the colony of Old Assyrian traders at Kanesh, we learn that there existed a law (inscribed on a stela) which prohibited the sale of gold to non-Assyrians on penalty of death, since the goal was the shipment of all gold acquired by the caravan-trade back to Ashur. There, gold functioned as a standard of value in the *naruqqu*-system (the contributions of merchants to the joint-stock capital funds managed by individuals over the course of roughly a decade), although the actual investments were paid in silver. The rate of exchange between silver and gold was 4 to 1 at the time of investment, whilst the market value was 7 or 8 to 1, guaranteeing the investor a 100 % profit if the fund was successful (*cf.* Dercksen 2004, 81-86 with also the references).

What about the form of circulated gold? We have already mentioned cups and axe-heads of precious metals, which have something in common, possibly following the same way of circulation, as tribute, as gift and as a votive offering (*cf.* Zaccagnini 1991, 374). Veenhof (2014, 400) applies the term "concrete money" to the goblets of precious metals (*cf.* also Powell 1996, 238), and I have used the term "special purpose money" and "sacred money" even "representational monies" for the gold and silver axe heads and the cut-outs of copper in the same shape (Michailidou 2003, 313, n. 109-113).

Another form, significant to our study on forms of currency is the discoid one. Even at the beginning of archaic states, in the kingdom of Ebla of the Early Bronze Age, along with silver and gold bracelets and rings with standardized weights circulated among elites, there were gold and silver plates or DIB (= *discs*), with masses ranging from 10 shekels (*ca.* 78 g) up to 1 mina (470 g), suggesting that specific needs imposed a highly standardized manufacture (Peyronel 2014b, 363, n. 37-38).

If we now turn to the Aegean, Luján (2011, 30) comments that the PY Jo 438 tablet, already discussed above, is at least indicative of a circulation of gold inside the Mycenaean kingdoms. To the gold cups already mentioned, we may add the gold discs without any means of attachment, found in enormous numbers in the Mycenae shaft Grave III (701 pieces), of two sizes weighing 1.5 and 3.0 g (= ⅓ of the Levantine/Syrian shekel), recalling the Homeric *chryssio* talanta (*Χρυσοῖο τάλαντα*), which Phaeacians offered to Odysseus as gifts: one *φάρος* (cloak) one *χιτών* (tunic) and one *χρυσοῖο τάλαντον* (gold talent). In Homeric texts the talanta of gold are sometimes weighed and gold is descibed as precious (*τιμήεις*) and well worked (*εὐεργής*), so probably Homer conceived of gold in a physical form close to that of the Mycenaean discs (Svoronos 1906; Nicolet-Pierre 2006; Michailidou 2008a, 135-149)

Was there *a gold standard* in Mycenaean times? Texts in Babylonia from the reign of Burnaburias II (1359-1333 BC) display the innovation of replacing silver by gold as the index of value. This interlude in the Kassite period, with the introduction of gold standard in Kassite Babylonia, may be explained by a possible shortage of silver, an interruption in commercial routes or an excess of gold (see Kleber 2016). Depending on qualities, the ratios recorded are 1:8 between "red gold" and silver, or 1:4 between "white gold" and silver. In Babylonia, physical gold rarely changed hands: in an interesting text on a lawsuit after a purchase of a slave, she is said to be bought for nine shekels of white gold but the payment is stated by the term KU.BABBAR-*ia*, meaning "my money" and consisting of other various undefined commodities. Whenever gold money – in contrast to the commodity of gold – is specifically listed, *e. g.* in an unpublished merchant's archive, it is difficult to decide its form (Kleber 2016, 39-40, n. 17).

Gold ring-ingots from the Acropolis treasure at Mycenae were weighed by Thomas (1938/39, 72). They are exhibited in the National Museum at Athens (Fig. 3) together with the four gold chalices, already mentioned, and some gold coils. The rings are of the same diameter (2.5 cm) with weight-values as published of 21, 21, 21, 22 and 17 g, and Thomas considers them as probable forms of currency (*cf.* also Ridgeway 1889, 91). If the above measures are correct (*cf.* a different view by Petruso 1992, 12), then they can be attributed to the Linear B unit P, equivalent to 20-22 g and very appropriate for estimating precious metals. As for the gold coils, they are regarded by Thomas "as currency media, or more accurately, bullion in portable form from which pieces could be cut or broken as occasion arose" (Thomas 1938/39, 74; *cf.* also Powell 1978).

Gold coils from a Submycenaen tomb in Elateia, Greece, were considered by Dakoronia (2007, 62) not as ornaments but as depositions for their value. She further comments on the custom of accumulating bronze rings or spirals in the tombs of the area considering them as a possible Charon's fee for the deceased. Perhaps it is not irrelevant that during the 13th century onwards there were, according to written sources, three standards of value in Babylonia, simultaneously. Gold, silver and copper standards existed side by side (Kleber 2016, 43).

Payments in wool

In Ebla of Syria, the palace paid with wool to purchase goods, especially in fairs. Sometimes both wool and textiles were used to purchase other goods and wool was also used as payment for various workers *e. g.* carpenters and smiths working in the temple, and for services by functionaries and workers in the palace (Biga 2014, 144-145).

According to Old Assyrian texts, wool inside Anatolia was sold by colour and by quality (*e. g.* good, long, thick, soft) so the quantity of wool one could obtain against the price of 1 shekel silver varies from 2 to 10 minas. The average price was 6 minas for 1 shekel, as also in the Laws of Eshnunna, and the average production was 2 minas wool per sheep; for exceptional qualities the prices were higher, *e. g.* in one inscription we have an amount of "extra fine soft and long wool" valued in 2 shekels of silver (Lassen 2010, 167).

In intra Anatolia trade, the Assyrians exchanged wool for copper. The usual price in copper was 2 talents of wool for 1 talent of copper. Wool was first exchanged to copper, then copper was turned to silver. *e. g.* in an Old Assyrian text, 30 minas wool (15 kg, that is ½ talent) are to be sold to Anatolians for copper, at a ratio of 3:1 for copper ingots or 2:1 for ingot fragments, the latter case considered as a better bargain since the quality could be checked (Dercksen 1996, 58-59; Michailidou 2008a, 270). There were prices offered and prices per cost (Lassen 2010, 172) as prices in Old Assyrian transactions were based on supply and demand.

In general, prices along large geographical areas depend also on the accessibility to silver resources. The standard of value of silver had less buying power in Anatolia than in Mesopotamia. In Mari (Michel 2014, 244-245), the prices are 15, 17, 20 or 25 minas per shekel and the goat hair is cheaper, one could buy 30 minas with 1 shekel of silver. Wool rations were also given as compensation by the palace of Mari.

I have suggested that the measuring units used in recording wool were related to the process of estimating value. It is not irrelevant that 6 minas (a weight value equivalent to the Mycenaean LANA unit and also to the *nariu* unit at Nuzi) is the quantity of wool equivalent to the price of one shekel of silver in the Laws of Eshnunna. The phrase "*I will give you (for 1 shekel of silver) 6 minas of fine soft wool*" (Old Assyrian) quotes to the same price in the Laws of Eshnunna: 1 shekel of silver for 6 minas wool which is equivalent in the same code to 2 to 3 minas of copper (Postgate 1992, 193, text 10:2).

This idea (Michailidou 2008a, 271), that the six-minas wool-unit, was defined on grounds of its value (six minas wool for 1 shekel silver) is supported by the division of the official Linear B LANA unit in 3 parts (three *dimnaia*) and not in 4 parts (as expected in relation to the Mycenaean production ratio of 4 sheep to one wool unit). This division facilitated: a) the integration of an existing wool unit[4] in the bureaucratic Mycenaean system of weight measures based on the unit M (the double mina) and b) the connection of wool's value with copper measured in double minas (M).

Thus, a common concept on weight standards for the commodity of wool was based to the *mode of production* (when measured by the clip of either one or four sheep) and also connected to *the exchange value*, estimated in copper. As for the clip of one sheep, if we take as an example the owner of a balance weight of this weight-value, such as the specimen from Akrotiri (Fig. 5), if he happened to be a wool producer, he would have been in the position to check by weight his produce in connection with the number of sheep. If a textile producer, he would be able to instantly calculate the cost of raw material in numbers of sheep. If he was employing human labour, he could have used it to estimate standard rations on the size of the payment to be made in wool. For, in conclusion, wool was commonly used as part of the rations for dependent personnel, as transit goods and as means of payment.

Payments in lead?

Weighing is an act related to the abstract idea of measuring, by the invention of a unit, also related to the actual materialization of *value*, by introducing 'metal value'. It is significant that the only problem referring to weighing in the Egyptian Rhind Mathematical Papyrus, asks for the value of precious metals, including lead (Robins/Shute 1987). Since metal value was a monetary concept in 'money barter', a question arises: were standards of lead also connected with the role of money? After all, Powell (1996, 227-228; 1999, 14-15) defines lead as a cheaper form of money, along with copper/bronze and barley (and tin as a mid-range money).

Rings made of lead, as those from Kültepe (Özgüç 1986), are regarded by Dayton (1974, 50-51 with references) not merely as ornaments but also as a form of pre-coinage money, by following the concept applied to rings and coils made of precious metals, due to their precise value (in standard weight) and to the possibility of fractioning (Peyronel 2010, 933 citing Dayton 1974; also Powell 1978). "If the rings represent money it is interesting that examples of such rings of an overlapping type occur both in copper and in lead, as well as in silver..." (Dayton 1974, 51).

The discussion at the end of this paper will concentrate on a possible multiple function of *the weight regulated discs made of lead, commonly identified as balance weights*.

The connection of the lead discs to metrology is evident, but Powell argues that "minas and shekels themselves were monetary terms in ancient Mesopotamia, as is evidenced not only by internal Meso-

4 In Younger's view, both in earlier Cretan Hieroglyphic and Linear A scripts, wool is recorded in units equivalent to LANA and sub units equivalent to the double mina (Younger 2005).

▲*Fig. 8. A lead balance weight, of half the Minoan standard, may easily have functioned on the smallest balance pan (of diam. of 5.8 cm) from Akrotiri.*

potamian usage but also by the fact that they turn up as words for monetary units in other languages" (Powell 1996, 228). Words are always indicative[5]; the balance weight was in essence the *stone* that measures (*abnu* in Akkadian and *ỉnr* in Egyptian). In Deir el-Medina, a fragment of stone, whose function was to serve as a witness of the total mass of the yarn measured on scales with the help of two stone balance weights, bears the following inscription:

12 deben, with the weight of two stones, the weight of the yarn of PN

(Valbelle 1977, 3-4)

The main question arising, is why in Minoan and Mycenaean economies, the items identified as balance weights are not made only of stone but also of lead. Lead was certainly "valued for its own qualities, particularly that of high density and hence heavy weight per unit of mass" (Mossman 2000, 105), so this was one of the advantages (Fig. 8) pointed out by Petruso (1992). The disadvantage was the minor accuracy as compared to stone weights, therefore there was some range of weight values among balance weights constructed around the same unit. I suggest that while the stone weights are closer to the idea of official weights (Fig. 9), the lead discoid weights, easy to reproduce (Michailidou 1990), are close to the idea of the Standard Average Quantity (*cf.* last paragraph of this paper).

To date only texts from Mari (Joannès 1989) mention the use of lead balance weights (unspecified in shape) by the palace administration for weighing heavier masses, along with lead ingots in two different types, *kubdu* and *lê'u*. But, there is as yet no physical representation of lead weights in Mesopotamia. Lead discs, more or less similar to the Aegean balance weights, are identified in the archaeological record of central Anatolian sites (as already Buchholz 1980, 231-232, n. 43). Whatever the origin of concept, they are thicker than the Aegean, more close to the idea of ingots (Michailidou 2015). Peyronel (2016), in his important article on lead ingots, emphasizes that a precise functional distinction between ingots and weights is not always possible but tends to believe that those from Kültepe are balance weights, since their masses are related to weight units (Peyronel 2016, 107-109 with references; *cf.* also more references to these lead discs in Michailidou 2015).

In one of the Old Assyrian texts where straw is given against copper items, we read (Dercksen 1996, 80): '*...5 bundles: I am holding as pledge 2 su'u* (discs of metal)'. It is interesting that the metal mentioned here as pledge is defined in the form of discs. We have already discussed that the discoid shape was favorable for ingots of precious metal, *cf.* gold ones from the Uluburun wreck (Pulak 2005), and flat discoid silver ingots from Ebla (Peyronel 2010, 944, fig. 4). In order to consider the possibility that also lead discs, as ingots of special shape, may function as currency, we must face the subject of *the value of lead*.

Peyronel (2016, 104) emphasizes the widespread class of lead figurines produced during the Middle Bronze Age in Anatolia. Lead figurines were also found in Mycenaean contexts. Lead vessels were found in numbers at the main Mycenaean sites (see Mossman 2000, 90-94, 102, fig. 5-6), and bun ingots were also found in domestic and workshop contexts (Mossman 2000, 98). Mossman (2000, 102-103) notes that we do not have documentary evidence for the value of Mycenaean lead, and if we take the example from the Rhind Mathematical Papyrus, where lead is half as valuable as silver, we should take into account that value may change with time and geographical area. To my view, local availability of the metal is not a crucial parameter for lower value, since interregional demand may increase its exchange value. I am not sure if the deposition of six huge lead vessels in the Shaft Graves of Mycenae, along with many vases of precious metal, points only to the availability of lead. Very indicative for the accumulation of lead in palatial contexts is the large amount of lead in ingots, with a total weight of more than 500 kg, stored in the Northern palace in Ugarit (Peyronel 2016, 110). The ingots are of various dimensions and shapes (mainly disc- or oval shaped). If we turn to the oldest – Early Bronze Age – lead ingot from Ebla, again from a palatial context (Royal Palace G), this is a very interesting example of a weight regulated ingot: made of pure lead and cast in plano-convex shape in an open mould, it corresponds to *six western minas* of 470 g (Peyronel 2016, 105). Converted to Aegean wool units, it represents a standard similar in weight with the 3 double minas of the later, Mycenaean, LANA unit.

5 Powell also concludes that the Sumerian sign for "shekel" actually seems to be the stylized picture of an axe and moreover, the Sumerian word "gin" not only means shekel but also axe.

The same quantity of lead (3 kg) is recorded in the single Aegean textual evidence of lead (*mo-ri-wo-do* = Gk. *moliwdos*), from the Knossos palatial context (*CoMIK* II):

KN Og 1527

1.	]	mo-ri-wo-do M 3
2.	]2	mo-ri-wo-do M 3
3.	]N 2	mo-ri-wo-do M 3
4.		mo-ri-] wo-do M I[

I quote DEL FREO's (2014, 23) description in his article on the tablet KN Og 1527: "On the first three lines, *mo-ri-wo-do* is always followed by the weighed quantity M3 (*ca.* 3 kg); on line 4 it is followed by M I[but, considering the position of the figure and the size of the lacuna, the amount is probably incomplete and can be restored as M 3. On lines 2 and 3, immediately right of the break, the amounts]2 and]N 2 (*ca.* 0.5 kg) are still visible. Finally, given the physical characteristics of Og 1527, it is likely that the tablet was originally twice as wide as the present fragment and that it contained a list of commodities arranged in two parallel columns". He suggests that the preceding commodities may be all of metal, but in the Og series there are also records of M 30 of ivory, M 1[of ri-no, RO 2 (of saffron?). According to DEL FREO (2014, 24), the missing part may contain the names of commodities or the names of individuals followed by the ideograms of the commodities. He suggests that the tablet registered distribution of lead (and perhaps of other metals too) for the production of lead balance weights, and he further mentions the comment (by MICHAILIDOU 2001b, 105) on the consistency of the quantity M 3 of lead to the LANA wool unit and to the actual lead discoid balance weights weighing 3 kg from Akrotiri and Thebes.

The fact that the same quantity of lead is repeated four times (?) perhaps has its parallel in the allocations of copper/bronze in some Jn tablets, but may have another meaning *in combination with the different quantities registered in the unpreserved column*. This repetition of the M 3 lead quantity in the second column recalls the repetition of shekel 1 silver quantity, again in the second column, of the text of the Eshnunna Law Code (YARON 1988, 44-45) with the following prices of commodities:

6 minas wool for 1 shekel of silver
3 minas copper for 1 shekel of silver
2 minas wrought copper for 1 shekel of silver, etc.

In accordance with the above, we may suggest a very daring restoration, only as an alternative working hypothesis[6]:

6 With an arbitrary, though indicative, selection of the commodities for the first column.

▲*Fig. 9. A marble discoid balance weight from Akrotiri, inscribed with a circle and representing the Minoan standard of 62 g, tested inside the same smallest balance pan.*

1.	LANA 1] mo-ri-wo-do M 3	1:1	(6 minas wool: 6 minas lead)
2.	ri-no M]2 mo-ri-wo-do M 3	⅔ :1	(4 minas linen: 6 minas lead)
3.	AES M 1]N 2 mo-ri-wo-do M 3	½ :1	(3 minas copper: 6 minas lead)
4.	ka-ko M 1 mo-ri-] wo-do M I[	⅓: 1	(2 minas copper: 6 minas lead)

If tablet Og 1527 preserves a unique indication of lead functioning as a unit of account, we should take into account that no similar text is as yet preserved. However, this tablet is both contextually and paleographically isolated (DEL FREO 2014, 26). We will not proceed further, for the time being, and only face the obvious question: was lead used for payments? In the best archaeological documentation available, that is, the distribution of lead discs among houses in Late Bronze Age Akrotiri, it is evident that whole clusters of lead discs, found in some houses, are connected with the metrological tables for this period, therefore their function as balance weights is more probable than as merely weight regulated items. However, there are houses revealing only one or just a few (MICHAILIDOU 2008a, 59-100), how useful these might be for weighing? The discoid lead ingots/ weights from Middle Bronze Age Kültepe, found in houses, workshops and rarely in burials, are mostly *isolated finds*, according to the published information on contexts (as supports PEYRONEL 2016, 108). For Mycenaean period, MOSSMAN (2000, 102) argues that the weights *found singly*, may have a different function from those sets of weights used for measuring.

▶*Fig. 10. Intact or deliberately fragmented lead discs. The stone disc in the middle of the last row, was found in Akrotiri together with a lead weight and two balance pans.*

▲*Fig. 11. The three heaviest lead discs from the cluster of 27 weights found in the West House at Akrotiri, possibly a weaving workshop. The smallest on the right, is equivalent to the wool unit.*

There follows the next question: why a few balance weights at Akrotiri were deliberately cut? (Fig. 10). Even small ingots stored in palatial context at Ugarit, had been deliberately cut into pieces (Peyronel 2016, fig. 6) some are comparable to fragmented lead weights at Akrotiri. And I quote recent words on the practice of *weighing money* in the ancient Near East, even in the period when coins were elsewhere counted: "it is well known that money, whether coins or scrap silver, was weighed until the end of cuneiform documentation. Coins were considered bullion and were weighed on a balance. *If a weight smaller than the coins was needed, the coins were cut into pieces without hesitation*" (Vargyas 2002, 113).

In conclusion, the Aegean lead discs, along with their function as balance weights, they represented formalized metal bullion accepted by their society as *customary standards* (Fig. 11), in contrast to the *official standards* represented by well worked stone balance weights[7] (as Fig. 9). The customary standard was brilliantly named (in Ialongo *et al.* 2015) as representing the Standard Average Quantity – SAQ – a convenient tradable quantity of mass, in fact a very practical unity. When materialized in metal (of whatever form) it also functions as currency in pre-coinage economies.

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7 It is significant that in Akrotiri, many stone weights were also customary standards, *cf.* Michailidou 2006.

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