

The Second International Suna & İnan Kırac Symposium on Mediterranean Civilizations

SHOPPING AND WEIGHING INSTRUMENTS IN THE MEDITERRANEAN WORLD AND BEYOND THROUGHOUT HISTORY

November 27-29, 2023 – AKMED / Antalya

PROCEEDINGS

Edited by

Oğuz TEKİN



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Research Center for
Mediterranean Civilizations

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PREFACE

Although studies and publications on weighing instruments have appeared sporadically from the late nineteenth century to the present, the project *Corpus Ponderum Antiquorum et Islamicorum* and the database titled *Pondera Online: An Online Database of Ancient and Byzantine Weights* have given new momentum to research in this field and led to a series of successive publications. Concurrent with these two innovative developments, annual workshops organized at the Université catholique de Louvain in the years following 2016 were followed by a symposium held in 2023 at Koç University AKMED (Antalya).

The present volume contains the papers presented at the 2023 symposium held at AKMED. With the inclusion of papers by two scholars who, despite being invited, were unable to attend the symposium due to illness, the book comprises a total of twenty-five contributions. The papers cover a long chronological span, beginning with Anatolia and Mesopotamia in the Bronze Age and extending to the Ottoman period. The main emphasis, however, lies on the Hellenistic, Roman, and Byzantine periods.

While one aim of organizing the symposium and subsequently publishing the proceedings volume was to contribute to scholarship, another was to draw attention to research in this field and to raise awareness.

While one aim of organizing the symposium and subsequently publishing the proceedings volume was to contribute to scholarship, another was to draw attention to research in this field and to raise awareness. On this occasion, I am indebted to Remziye Boyraz Seyhan for the proofreading of the book prior to publication. Last but not least, I would like to express my thanks to Dumbarton Oaks for its financial support of the symposium.

Oğuz Tekin

Made of Bronze and Lead, the So-called Standard Weights

Thomas LEBLANC*

Abstract

Weights are calibrated objects used every day in markets to weigh all kinds of goods. In the ancient Greek world, they regularly took the form of a metal plate decorated with an iconographic symbol and inscriptions. Until now, historiography has focus more on the visible aspects of these weights: iconographic type, inscription, intervention made on the weight after its production (abrogation, countermark, suspension hole, etc.). The metal required for their manufacture is one of the less studied subjects. However, the material study of these weights is not lacking in interest. Indeed, we can observe that two metals coexist in the composition of most of the Greek weights: lead and copper alloy. In this paper, we wish to question the reasons for this distinction based on the example of the cities of western Asia Minor during Hellenistic period. If copper alloy weights, much less numerous than those made of lead, could be interpreted as standard weights, it remains to define what the term “standard” covers and the precise role attributed to these instruments. As we shall see, the word “standard” covers several different realities and can distort the vision we have of these weights. Our objective is therefore to formulate hypotheses on the function of these singular instruments as close as possible to the actual stathmetical practices of the time.

Keywords: Standard, metals, historiography

This article results from a paper presented at the Symposium organized by AKMED. This presentation was part of my doctoral thesis. It aims to study around 600 weights of fifteen cities in north-western Asia Minor (current Türkiye) during the Hellenistic period, in three geographical areas: Propontis, Troas and Aeolis. Ancient commercial weights were used on a daily basis to weigh various commodities in markets, shops and workshops. In this sense, they constitute archaeological material of prime importance for understanding ancient metrological systems, and the mental categories and accounting logics behind these systems. As part of my research, I am studying weights from three main angles: typological, metrological, and anthropological. This article will focus on part of the first category of analysis. The typological study of the material must focus, among other things, on the metals used to produce them. The choice of producing a weight in one metal rather than another is significant and conceals a wish from civic authorities to endow an object with the status of a standard. The notion of “standard” is a recurring theme in the historiography of Greek stathmology. This term remains vague and general, so it deserves to be questioned.

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Of Bronze and Lead, the Distribution of Metals

During the Classical and Hellenistic periods, Greek cities mainly used two metals for their stathmic equipment: bronze and lead. A quick glance at the *corpora* of various cities in the *Pondera Online* database reveals, as does E. Pernice, that “*Das Material, aus welchem die Gewichte in Griechenland hergestellt wurden, ist überwiegend Blei*”.¹ Indeed, lead was the dominant material in many Greek cities, “ce qui semble caractéristique de l’ensemble du monde grec”,² as P.-L. Gatier states. However, some cities, such as Thasos and Corinth, are exceptions to the rule,³ which may indicate a deliberated choice or be due to the vagaries of conservation. Only bronze weights are known from Olympia, but this particular case will be developed later in the paper. The predominance of lead can also be observed among the 582 weights concerned by my thesis (see table 1). Indeed, most of the *corpus* studied includes lead weights (93.62%), while bronze ones represent only a small proportion (6.38%). This low survival rate for bronze objects could be partly due to the vagaries of archaeological discoveries, but it can also be explained by the regular practice of recycling. Indeed, we know that in Antiquity, metal objects, once discarded, generally end up going back into the crucible. This must have been a profitable operation, as there are examples of merchants specialized in the purchase and resale of metal objects destined for remelting. A wreck found in 1982 along the coast of Megadim in Israel bears witness to this practice. In the ship, dated to the second century BC, a Rhodian amphora was found probably ready to be recycled.⁴ This recycling is, of course, more profitable with bronze, which has a higher monetary value, as explained below. It is already worthwhile to remelt a small-module bronze weight. As for lead, its value is much lower, so we can assume that large modules are preferred for recasting. This explains why we do not know much about the multiples of the mina, even though the inscriptions mention it.⁵

TABLE 1. Distribution by city of weights according to their metal.

Cities	Lead weights	Bronze weights
Abydos	10	6
Ainos	0	2
Alexandria Troas	30	3
Assos	3	0
Bisanthe	2	0
Byzance	12	2
Chalcedon	0	1
Kyzikos	206	10
Gryneion	2	0
Ilion	5	0
Kyme	13	2
Lampsacos	32	1
Lysimacheia	94	7
Myrina	34	0
Skepsis	1	0
Tenedos	5	2
Unknown cities	95	2
Total	544	38

¹ Pernice 1894, 5. Translation: “The material from which the weights were made in Greece is predominantly lead”.

² Gatier 2014 133.

³ Only two bronze weights are known from Thasos, while Corinth has six lead weights and nine bronze weights.

⁴ Treister 1996, 358.

⁵ At Assos (I.Assos, no. 3), weights of one talent and one pentamine are listed. At Athens (IG II-III² 1013), weights of one talent and one decamine are also mentioned.

Characteristics of Lead and Bronze

Lead's preponderance can be explained by the fact that it is easy to work with because of its low melting point and offers a whole series of advantages, all at a modest cost. After tin,⁶ lead is one of the metal that reaches its melting point the fastest, at 327,4° C.⁷ As temperature is easily reached, the melting process can be carried out in rudimentary furnaces.⁸ In addition, lead is a material that is relatively resistant to various forms of corrosion. It resists water well, and is only attacked by soft water or water containing organic acids or nitrates.⁹ Lead is also resistant to most mineral acids, except for nitric acid, and to various forms of corrosion, unless it meets lime, iron oxide or certain organic materials.¹⁰ All these advantages are offset by the fact that lead is “un métal peu résistant et très malléable”,¹¹ which makes it sensitive to regular and repeated use, as with market weights, which had to be used every day in the marketplace. This disadvantage is reduced as weights were probably renewed regularly.

If we look at bronze's characteristics, we see that it is a more resistant metal than lead, much less ductile and sensitive to friction, making it a much more durable material; and that furnaces capable of reaching at least 1083°C are needed to produce it.¹²

However, lead has one significant advantage which explains easily why it has been chosen to produce most of the weights: its price. The Pseudo-Aristotle gives us an estimation of the metal's price:

Πυθοκλῆς Ἀθηναῖος Ἀθηναίοις συνεβούλευσε τὸν μόλυβδον τὸν ἐκ τῶν Λαυρείων παραλαμβάνειν παρὰ τῶν ιδιωτῶν τὴν πόλιν, ὥσπερ ἐπώλουν, δίδραχμον, εἴτα τάξαντας αὐτοὺς τιμὴν ἐξαδράχμου οὕτω πωλεῖν.¹³

*Pythocles the Athenian recommended his fellow countrymen that the State should take over from private citizens the lead obtained from the mines of Laurium at the price of two drachmae which they were asking and should itself sell it at the fixed price of six drachmae.*¹⁴

As metals were regularly sold by talent, the price of lead would be between two and six drachmas per talent. The text suggests that the price of six drachmas proposed by Pythocles would enable the city to triple its capital by obtaining a monopoly on lead, allowing it to sell this metal at any price. Hence, the ordinary and recurring price was more likely to be around two drachmas. This low estimation of the price of lead is reinforced by A. Bresson, who indicates that in Epidaurus, a talent of lead was worth two drachmas and five obols.¹⁵ In comparison, bronze, which is an alloy of copper and tin with an average tin content of around 10%¹⁶, is sold at a high price. A. Bresson and A. Rangabé give their price per talent, in Athens in the 5th century BC (see table 2):¹⁷

⁶ For comparison, tin reaches its melting point at 232°C, silver at 961°C and copper at 1083°C.

⁷ Gatier 2014, 133.

⁸ Gaiu 2016, 56.

⁹ Cochet 2000, 3-4.

¹⁰ Cochet 2000, 4.

¹¹ Cochet 2000, 3.

¹² Gatier 2014, 135.

¹³ Arist., *Oec.*, 2.37.

¹⁴ Armstrong 1947, 395.

¹⁵ Bresson 2008, 47.

¹⁶ Descamps-Lequime 2010, 117.

¹⁷ See Bresson 2008, 47 (the inscription mentioned is *IG I³ 472*) and Rangabé 1864, 264-65.

TABLE 2. Price for the talent of the metals of bronze alloy.

Metal	Talent value in Bresson	Talent value in Rangabé	Average talent value
Tin	233 dr.	230 dr.	231 dr. 3 ob.
Copper	35 dr. 1 ob.	45 dr.	40 dr.

If we take average price between the two values and consider that tin is present at around 10% in the bronze alloy, we can estimate tin's cost at 23 drachmas and one obol, while copper would cost 36 drachmas, for a total of 59 drachmas and one obol per talent of bronze. The price ratio between lead and bronze is, therefore, around 1:30. The scientific value of this demonstration is slight because it is based on just two Athenian attestations from the fifth century, but it gives an idea of the magnitude of price disparity between the two metals used to create the weights.

Considering the advantages of lead and its low cost, it is easy to understand why the civic authorities favoured it for producing most objects used everyday within the agora. At the same time, the choice of bronze for certain objects reveals a genuine choice to enhance their value. Otherwise it is hard to understand why the cities would have paid more for a more expensive metal.

Bronze: A Revealing Marker?

The much higher price of bronze compared with lead, and the rarity of objects made of this metal (only 7% of weights found are made of it), suggest that these objects were different from those in lead. It is for this reason that historiography has considered copper alloy weights as "standard" weights, enabling magistrates to control lead weights used everyday by merchants.¹⁸ Historiography, therefore, tells us that magistrates had the resistant bronze weights and merchants the fragile lead ones. However, objections have recently been raised against this systematic association between bronze and standard. This is notably the case of S. Killen,¹⁹ who develops an argumentation to show that bronze is not always the sign of a particular status of the object.

But how can the use of a different and much more expensive metal be explained, if not to indicate a desire to give a special status to the object? Indeed, any element that helps distinguish a weight from another, can only provide "*des indices sur la façon dont on les perçoit et dont on les considère*".²⁰ If a meaning has to be given to these objects, already set apart by their own material, it is the theory of the standard that proves the most seductive, for as A. Testart recalls: "*Il n'est pas de mesure sans étalon*".²¹ This tradition of using bronze for standards can still be seen more than a thousand years after the period studied. In Albi, in 1288, the pound standard was created in bronze, as W. Kula points out.²² By producing a standard in an expensive metal, Albi's authorities were able to drastically reduce the risk of counterfeiting weights, as few people could afford to produce a fake. What is more, the counterfeit would yield only a small profit at the cost of a high-risk.²³

¹⁸ Killen 2020, 1.

¹⁹ See Killen 2020.

²⁰ Charrey 2020a, 200.

²¹ Testart 2004, 10.

²² Kula 1984, 85.

²³ Kula 1984, 85.

Colourimetric Differentiation

Besides price and rarity, another factor that distinguishes bronze weights is colour. Lead weights are usually silverish / greyish in colour, while bronze weights are either reddish or goldish, depending on the alloy's tin content.

Today, bronze objects are dark, sometimes tending towards a brownish colour due to the “phénomènes de corrosion naturelle, liés à leur exposition durant l'Antiquité, aux traitements superficiels auxquels ils ont pu être soumis et aux conditions de leur enfouissement durant des siècles”.²⁴ However, in ancient times, if the tin content was less than 10%, the colour of the bronze fluctuated between reddish yellow and red.²⁵ If tin content was between 10 and 15%, it had a yellowish or even golden colour. C. Grandjean, based on analyses of bronze coinage carried out at CEB-IRAMAT laboratory, states that Greeks appreciated the light and golden-coloured bronze with a high tin content for their coins.²⁶

Nevertheless, we must check whether this observation is similar for the weights analysed in this paper. To produce the colourimetric weight distribution graph²⁷ (see fig. 1), weights were observed as closely as possible based on photographs available or, where possible, by autoptic examination, but it is certain that results are only indicative. Indeed, the original colour of the bronze is difficult to restore because it has been altered by corrosion and by any treatments the object has undergone in museums (brushing, cleaning). Moreover, as O. Mecking has shown by measuring the wavelength of light reflected on bronze objects, a slight difference in colour between two objects may be due to the manufacturing process, even if the alloy is similar.²⁸ It is clear from visual inspection that red bronze is in the majority. However, it is impossible to determine whether this predominance of bronze with a low tin content reflects an economic or stylistic choice, or a difficulty in sourcing tin.

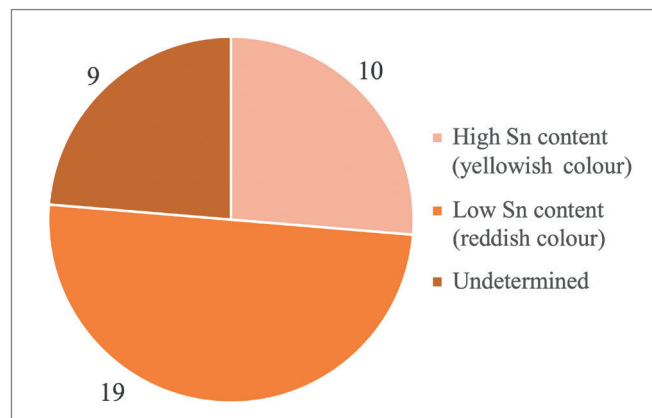


FIG. 1 Colour distribution of copper alloy weights.

Some weights from the same city resemble each other in every way, differing only in the metal of which they are made. This is precisely the case at Kyzikos, where two distaters²⁹ appear to have been casted in the same mould, as they have many similar details, but are made from different

²⁴ Deschamps-Lequime 2019, 76.

²⁵ Deschamps-Lequime 2019, 154.

²⁶ Grandjean 2020, 175-76.

²⁷ The weights and their identifiers are as follows Pondera: **Abydos**, reddish weights: #11835; yellowish weights: #11837, 12473, 15514, 16907; weight of indeterminate colour: #13411. **Ainos**, reddish weights: #13327; yellowish weight: #3150. **Alexandria Troas**, reddish weights: #1381, 13180; weight of indeterminate colour: #3172. **Byzance**, reddish weight: #13168; weight of indeterminate colour: #1716. **Chalcedon**, reddish weight: #536. **Kyzikos**, reddish weights: #1523, 11513, 11838, 12705, 12811, 14580, 17092; yellowish weight: #12058; weights of indeterminate colour: #3366, 12053. **Kyme**, reddish weight: #13274; yellowish weight: #1829. **Lampsacos**, reddish weight: #1284. **Lysimacheia**, reddish weights: #1522, 3152, 13026, 16958; yellowish weights: #12809, 16957; weight of indeterminate colour: #13209. **Tenedos**, yellowish weight: #12484; weight of indeterminate colour: #13241. **Unknown cities**, weights of indeterminate colour: #3221, 12067.

²⁸ Mecking 2020, 8.

²⁹ See numbers #13534 (for the lead specimen) and #1523 (for the bronze specimen) on Pondera.

metals. The simple use of different metals, and therefore different colours, is enough to show a difference in status between two objects from the same mould.

Olbia and Olympia, Examples Against Standard Weights?

An argument against the association between bronze and standard weights is put forward by S. Killen, who uses the cases of Olympia and Olbia as examples. However, it should be remembered that the case of Olympia is a special one, as these were almost certainly ancient offerings, cast in the form of standardised weights³⁰ that could be offered to the venerated divinity, as their archaeological context seems to confirm.³¹ As far as Olbia is concerned, the scholar states in her article that there are no known lead weights from the city. However, an article by O.G. Chekhovych,³² published in 2019 provides information on 76 lead weights that could belong to Olbia. Furthermore, two lead weights bearing the city's *ethnicon* are known to be in the National Library of France and in the Coin Cabinet of the National Bank of Romania.³³ The arguments put forward by S. Killen against the association between bronze weights and standard weights, based on the Olympian and Olbian cases, have proved invalid.

Assos' Inscription

At Assos, an inscription from the fourth century BC, discovered in 1982 on the acropolis, mentions bronze weights used as public instruments.

- [τ]ὰ σκεύεά ἐσσι δαμόσια ἐπὶ
 2 ἀγορανόμῳ Μεγιστίᾳ Σωγενεΐ-
 ω. ἡμιμέδιμνοι χάλκιοι τρεῖς,
 4 ἡμίεκτα ἔννεα, διχοίνικα δέ-
 [κ]α, χοίνικες ἑπτα, τρίχοα
 6 [χ]άλκια τέσσαρα, ἡμίχοον, ἄλ-
 [λο ἡμ]ίχοον χώναν ἔχον. στά-
 8 [θμα χά]λκι[α.] τάλαντα τρί[α]
 π]εντάμναον[
 10]τε[³⁴.

*Here are the utensils for public use, under agoranomos Megistias son of Sogenes: three bronze vessels with a (capacity of taking) half a medimnos; nine with half a sixth [i.e. a twelfth of a medimnos]; ten with two choinikes; seven choinikes; four bronze with three choes; one with half a chous; another with half a chous having a funnel; bronze weights: three of a talanton; [- - -] one of five minas; [- - -].*³⁵

³⁰ Siewert 1996, 145.

³¹ Hitzl 1996, 95; 102.

³² See Chekhovych 2019.

³³ See #12650 for the French weight and #14341 for the Romanian weight.

³⁴ I.Assos, no. 3, 3-5.

³⁵ Translation of I.Assos, no. 3.

It states that “Megistias son of Sogenes”, *agoranomos* in office is equipped with “public instruments” (σκευέα ἐσσι δαμοσία), enabling him to perform his duties. These include vessels for liquid measurements, but also a set of weights, some of which we do not know about because of the lacuna. The instruments used by the magistrate in charge of monitoring market transactions were all made of bronze. Thus, the vessels are said to be “χάλκιοι”, while the weights are also made of bronze: “στά[θμα χάλ]κια”. Why would the authorities have taken the trouble to have a lapicide engraving a list of the *agoranomos*’ official instruments, specifying that these tools are made of bronze, if not to indicate that these objects are the ones used for reference? No mention is made of lead objects. It could be argued that the inscription is fragmentary and that these were perhaps mentioned in the missing part. However, if we compare it to what is written for liquid measurements, we notice that no mention is made of everyday objects and that only bronze instruments are described. And there is a good reason for this: bronze tools were the city’s privilege, and an ordinary merchant had to use lead weights or vessels made of terracotta or some other material.

The Notion of “Standard”

Can we still say that bronze weights do not have a special status? Their rarity, price, and colour, as well as their use as instruments of official magistrates, suggest the contrary. The real historiographical problem with bronze weights is that the term “standard” has been used indiscriminately by scholars since the 19th century. Several works recognised the special role played by bronze weights, but generally limit it to the sole function of controlling everyday lead weights. This vague and reductive term prevents us from grasping these bronze weights’ complex and polymorphic nature. This has led some scholars to question the status of bronze weights. However, in my opinion, the debate regarding whether bronze weights are standard weights has not been approached from the right angle. Instead, the question that needs to be asked is: what does “standard” means? What are the various realities behind this generic and reductive term? But before answering these questions, we need to look at the origins of this interpretation.

A long-standing historiographical tradition

This notion of “standard” weights appeared in stathmological research as early as the 19th century, as it was already mentioned by E. Pernice in 1894 in his work entitled *Griechische Gewichte*. The German scholar explains that bronze was reserved for standard weights.³⁶ P. Charrey, speaking of Byzantine weights, explains why these objects were probably recognised as “standards”: “À l’origine de cette quête du poids officiel byzantin, se trouve sans nul doute la perplexité toute naturelle du chercheur devant le nombre important de poids qui se distinguent du reste d’une production normalisée par des caractéristiques singulières et ostentatoires”.³⁷ Strictly speaking, “standardised production” weights did not exist in the ancient Greek world. But we can easily draw a parallel with lead weights, the most common ones. Admittedly, they were not standardised, as they did not have a common producer and had different iconographic types and shapes depending on the city. However, in practice, the production process remained the same: a lead plate on which an iconographic type is placed, usually with a caption. Following the example of the Byzantine world, where decorative “singular and ostentatious features” were used to differentiate weights, the ancient Greek world would have used another metal, such as bronze, to mark

³⁶ Pernice 1894, 5.

³⁷ Charrey 2020b, 108.

a difference in status.³⁸ This distinction would therefore have been translated by the researchers as a desire to distinguish usual weights from “standard” weights. But this term “mobilis[e] le plus souvent un imaginaire métrologique contemporain qui, par anachronisme, masque presque systématiquement à l’historien la diversité des pratiques de contrôle et de normalisation des instruments qu’il étudie”³⁹ as P. Charrey reminds us. Some researchers, as A.M. Riggsby, are not convinced by this term and are aware of its problem, but do not question it, preferring to speak about “the existence of several standards under the same name”.⁴⁰

Using an inscription from a city that is not the primary focus of my research, and which moreover is limited in time to the second century BC, presents risks of extrapolation. Nevertheless, the metrological system of Athens likely spread to the cities studied, as was probably already the case in Kyzikos, and the inscription comes from a period within the one analysed.⁴¹

The terms of the game: stathma, symbola and sekomata

The Athenian inscription is an agoranomic decree from the second century BC, translated by Ch. Doyen, which is particularly interesting for the point that concerns us, and which will accompany a large part of this section dedicated to the notion of “standard”.

(7) Let the magistracies which the laws prescribe to do so make metrological instruments (σηκώματα) in reference to the standards (σύμβολα) which have been established - that is, with reference to liquid measures (ύργα), dry measures (ξηρά) and weights (σταθμά) - and oblige every vendor in the agora, in workshops, in shops, in cabarets or in warehouses, to have recourse to these measures (μέτρα) and weights (σταθμά) and to measure (μετρέω) all liquids (ύργα) by means of the same measure (μέτρον), and that no magistracy be permitted any longer to make either measures (μέτρα) or weights (σταθμά) which are [larger] or smaller than these. [...]

(40) Let these preserve them and give metrological instruments (σηκώματα) of measures (μέτρα) and weights (σταθμά) to the magistracies and any others who need them, without being authorised either to modify [the standards (σύμβολα)] or to take them outside the premises which have been established, with the exception of metrological instruments (σηκώματα) which will have been created in lead, [marked] [—].⁴²

From the very first lines of the inscription, the words distinguishing different roles of weights are mentioned. Indeed, we read that magistrates should have “*metrological instruments (σηκώματα) constructed with reference to the standards (σύμβολα) that have been established – that is, with reference [...] to the weights (σταθμά)*”. Thus, in the second century BC, in Athens, a distinction was made between weights in the general sense of the term, which were called *stathma* (σταθμά), and *sekomata* (σηκώματα), which were weights (*stathma*) created and based on the standards that were the *symbola* (σύμβολα). The inscription shows that we have objects with a special status that makes it possible to serve as a model for manufacturing other objects. How, then, can we fail to see a parallel between bronze weights and *symbola* on the one hand, and lead weights and *sekomata* on the other? Indeed, it is when *sekomata* are mentioned that reference is made to lead: “*metrological*

³⁸ Charrey 2020b, 108.

³⁹ Charrey 2020b, 107.

⁴⁰ Riggsby 2019, 92.

⁴¹ See Leblanc 2021a; 2021b.

⁴² IG II-III² 1013. All the following translations of this decree are based on a personal English translation of Doyen 2016.

instruments (sekomata) of measures and weights (stathma) [...] without having permission to either modify [the standards (σύμβολα)] or take them outside the premises that have been established, with the exception of metrological instruments (σηκώματα) that will have been created in lead". The fact that the decree specifies that only lead weights may leave the place of production suggests that another material was used to produce some of these objects, otherwise the precision would be superfluous. Bronze weights immediately come to mind. Indeed, the decree states that the public slaves must provide *sekomata*, without specifying the material, to anyone who might need them, including magistrates. However, if we go back to the inscription at Assos, the magistrate in charge of controlling the agora, namely the *agoranomos*, is provided with bronze weights.⁴³ Nevertheless, it should be borne in mind that the Assos inscription does not use any of the terms mentioned above to refer to these bronze weights, referring simply to "tools/utensils for public use".⁴⁴ Therefore, this Athenian decree cannot be used to generalize a case to the whole of the ancient Greek world. As we can see in Assos, the terms used are not the same. However, the Athenian case, with its rich vocabulary, can serve as a reference point for identifying the different realities that lie behind the generic term "standard". Among the passages already mentioned, we can already underline two of them: the role of control and the role of production model. To these, we must add the fiscal role and the role of account unit.

Controls

Bronze weights have always been attributed with the role of controlling the usual market weights, which is the first reality contained in the generic term "standard". However, contrary to what has previously been suggested, this control is exercised at several levels.

The use of bronze weights to check lead weights has been the first form of control. The Athenian decree informs us about the users of the usual lead weights: "*sellers in the agora, in workshops, in shops, in cabarets or in warehouses*".⁴⁵ The identification of these sellers is supported after the Hellenistic period by Philo of Alexandria, who identifies the "*weight, scale and measure handlers*" as "*merchants (emporoi), shopkeepers (kapeloi), small merchants (agoraiotai) and all other merchants of solid or liquid foodstuffs*" and specifies that they are "*placed under the dependence of agoranomoi*".⁴⁶

The weights used by these vendors are made of lead, as the decree implies. They used them daily to weigh the food products they sell to buyers, but sometimes a dispute arises between the two parties over measurements' validity. They are, therefore, obliged to go and visit the *agoranomos*, who has the task to settle disputes of that kind. To do this, buyer and seller may take the offending measure to the *agoranomos* at its premise, the *agoranomion*, near the marketplace. This process was repeated later, in Roman times, when buyers and sellers went to the *ponderarium* to settle a dispute.⁴⁷ In the *agoranomion*, lead is measured using the bronze weight of the *agoranomos*. If the scales are in balance, then the measure is in order. If this is not the case, in Athens "*the owner of the [fraudulent] measure is arrested [...] [and] the magistrates [take] to the public bank the list of goods to be auctioned; if he is a slave, let him receive these [fifty lashes]*".⁴⁸ The user who uses a fraudulent measurement or weight is therefore subject to an economic penalty. If the offender was a slave,

⁴³ See I.Assos, no. 3.

⁴⁴ I.Assos, no. 3.

⁴⁵ IG II-III² 1013, l. 8-10.

⁴⁶ Philo Alex., *Spec. laws* 4.193-94. Translation of Roubineau 2012, 58.

⁴⁷ Berrendonner 2009, 366.

⁴⁸ IG II-III² 1013, l. 2-6.

fifty lashes were inflicted. These penalties were specific to Athens, but there is every reason to believe that they must have been similar in other cities. A punishment common to all cities must have been the destruction of the fraudulent weight. This was probably followed by the levying of an economic compensation for the citizens or corporal punishment for the slaves, as was also the case in other cities.⁴⁹

A second, rarer form of control can be considered. This involves checking the measures used by magistrates, even though doubts about their instruments should not have been recurrent. However, some magistrates have had to be investigated for dubious behaviour. Indeed, the decree sets out the penalties for failure to comply with the injunctions concerning weights and measures: “*If any magistrate makes weights and measures or does not oblige them to sell by means of them, he shall be liable to pay a thousand drachmas consecrated to Demeter and Kore*”.⁵⁰ This desire to avoid fraud by magistrate is so strong that an examination of the wealth of candidates for this office is taken in account to ensure that they are in a position to pay the fine: “*and that there be [in this regard] a declaration of wealth up to the amount of this money for whoever would like, among the Athenians, to authorize, calibrate and verify measures (μέτρα) and weights (σταθμά), for the future as well*”.⁵¹ This form of control is probably carried out using model weights, the equivalent of the Athenian *symbola*.

Finally, it should be noted that these two forms of control mentioned above, which concern commercial weights, also had to be applied to monetary weights. These weights are based on the immutable monetary standard, which is used together with the weight standard, for weighing the most precious commodities “*which it is intended to sell with reference to (the standard of) silver*”.⁵² The Athenian inscription provides information on their existence, as it specifies that the tare of the new mina should be weighed “*in reference to the weights found in the monetary workshop*”.⁵³ These monetary standard weights, the metal of which is unknown, were probably used to weigh coins in the mint where they were kept. They must also have had bronze or lead counterparts that enabled sellers of precious commodities to carry out their commercial transactions with buyers. A lack of information means that we cannot say much more about their material.

To conclude, on the one hand, if we use the Athenian lexicon, there were lead *sekomata* produced for “*garantir l’exactitude des quantités vendues et donc l’équité des transactions commerciales sur le marché*”.⁵⁴ On the other hand, there were bronze weights for controlling the lead ones in order to prevent a seller from using an *asymbleton* weight (ἀσύβλητον), i.e. contrary to the *symbola* that serve as model weights.

Model weights

The second role played by “standard” weights was that of a model. These model weights are called *symbola* in Athens, but their names are unknown elsewhere. It is therefore impossible to determine if they were called in the same way in the cities studied. In Athens, the creation of model weights was entrusted to an “*official responsible for establishing measures and weights*”.⁵⁵ It is very likely that these model weights were made of bronze, as this material is more durable and

⁴⁹ Roubineau 2012, 51.

⁵⁰ IG II-III² 1013, l. 12-16.

⁵¹ IG II-III² 1013, l. 12-16.

⁵² IG II-III² 1013, l. 31-32.

⁵³ IG II-III² 1013, l. 29-30.

⁵⁴ Charrey 2020b, 113.

⁵⁵ For this extract and the previous one, IG II-III² 1013, l. 38-39.

less sensitive to handling. Once established, these *symbola* were transmitted “to the public slave in charge of the Skias [Agora], to the one in Piraeus associated with the [epimeletes] and to the one in Eleusis”.⁵⁶ The *symbola* were used as models by the slaves charged to make all the other weights. The ones which were made of lead, as explicitly mentioned in the decree.⁵⁷ Should we imagine that in case of a dispute over *agoranomoi* measurements, these were the model weights to be used? Unluckily, there is no source to confirm this hypothesis.

This pattern of production is not unique to weights, which are not the only objects to have models for calibrating them. Bricks and tiles were also standardised⁵⁸ based on a model. In Athens, the model of the tiles is in marble and provides their dimensions.⁵⁹ Weights for weaving looms, fishing sinkers and amphorae also seem to have been calibrated based on a model.⁶⁰

The pattern of production known in Athens was probably not applied in all the cities. However, although the terms and the various stages cannot be transposed, it is logical to think that the studied cities of Propontis, Troas and Aolis also had “model” weights equivalent to the *symbola* to enable craftsmen/slaves to create weights for the market.

The fiscal instrument

A third function could be attested for the weights known as “standards”, but our only mention is in a specific and localised context. An Athenian law of 374/373 BC states that the 50th tax levied on grain from the islands of Imbros, Lemnos and Skyros must be collected in grain. This inscription attests to the fact that in certain cases, grain was weighed.⁶¹ It is argued that this levy of the fiftieth tax in the form of grain was introduced to meet a shortage of grain in the city. The inscription indicates this when it states that this law was introduced “so that the people could publicly dispose of grain”. Concerning the subject of this paper, the most enlightening part of the inscription is the reference to the weighing of the grain:

- [...] τοὺς πυροὺς ἄ[πο]-
 22 στήσει ὁ πριάμενος ἔλκοντας πέντε ἑ[κ]-
 τέ<α> τὸ τάλαντον, τὰς δὲ κρι<θ>ὰς ἐλκο[ύσ]-
 24 <α> τὸν μέδιμνον τάλαντον ξηρὰς ἀπροσ[τ]-
 ῆσει καθαρὰς αἰρῶν, τὸ σ<ή>κωμα ἐπὶ ΤΗ[. .]-
 26 ΩΝ<Η>Ι σηκώσας, καθάπερ οἱ ἄλλοι ἔμ[π]ορ[ο]-
 ι· [...].⁶²

*The buyer shall weigh the grain by weighing (= holding out the scales) one talent for five sixths (the ἑκτέας), he shall weigh the barley by having divided it clean and dry by weighing (= holding out the scales) one talent for one medimnos, weighing the standard weight on [...], as [do] other merchants.*⁶³

⁵⁶ IG II-III² 1013, l. 38-39.

⁵⁷ See IG II-III² 1013, l. 40-43.

⁵⁸ Johnstone 2011, 36.

⁵⁹ Bresson 2008, 26.

⁶⁰ Bresson 2008, 26.

⁶¹ Johnstone 2011, 55.

⁶² Rhodes and Osborne 2003, no. 26, l. 21-27, 118-22.

⁶³ Translation courtesy of my colleague Emma Pavan to whom I extend my warmest thanks.

The inscription mentions the grain's weighing using a *sekoma* placed on an instrument, which we can easily assume to be a scale, as the inscription specifies "*as [do] the other merchants*". It is difficult to determine whether this weight is made of bronze or lead. However, the fact that we are in a context of taxation by and for the city suggests that the weights used were those of magistrates, and therefore made of bronze.

This record of the use of weights in a tax roll is set in a specific context that cannot be taken as everyday practice. The fact that it is mentioned in an inscription for a law clearly shows that the practice of weighing grain was exceptional. Although this taxation role must be treated with great caution, it cannot be totally ruled out that weights played a more extensive fiscal role. This tradition of using weights for tax purposes can still be found in Byzantine times, as evidenced by Novella 128 of the Justinian Code, which stipulates that "*those who collect public taxes must use just weights and measures so that they do not harm our tributaries*".⁶⁴ This diachronic comparison shows that the use of weights in taxation is not surprising. This may lead us to think that sometimes, in ancient Greek world, weights could also be used as instruments to guarantee fair taxation by the city. Although uncertain, this fiscal role of weights must be considered when we think of them as city's instruments, namely as "standards".

An accounting unit?

A last role can be attributed to weights called "standards", from which the other roles derive. This original function stems from the adoption of money. The ancients realized that when a transaction between buyer and seller took place, it was unequal. The seller received one or more coins whose mass and value are guaranteed by the city by means of the imprint (χαράκτηρ) affixed to them, as Aristotle reminds.⁶⁵ The buyer did not know whether the goods were of good quality, nor exactly how much he would receive.⁶⁶ All in a world where goods were not standardised as today. To solve the first problem, the authorities introduced laws aimed at guaranteeing a certain quality of the goods offered for sale by merchants. Another solution was to use weight units which enable the buyer to know exactly how much of the product he is receiving. In this way, the combination of these solutions helps to redress the balance between the seller, who receives a currency guaranteed by the city, and the buyer, for whom the weight units and laws of the city guarantee the quantity and quality of the goods.⁶⁷

However, these weight units are imaginary accounting quantities and had to be given some substance. "Standard" weights come into play because they serve to materialize the weight unit. The existence of these weights is essential because "actual individuals can only compare two existing weights, not a weight and the imaginary standard".⁶⁸ In a way, these model weights are comparable to what was, until 2019, the "big K", which embodied the reference mass of the kilo. However, unlike the "big K", which was placed under a glass bubble and made so "sacred" that it could no longer be touched, the model weights probably embodying these accounting units were used to create the other weights. Therefore, when a merchant defrauds by using an altered lead weight, he is not defrauding the bronze control weight, but the accounting quantities represented by model weights.

⁶⁴ Translation in Charrey 2020b, 109.

⁶⁵ Arist, *Pol.* 1.3.12-16.

⁶⁶ Johnstone 2011, 53.

⁶⁷ Berrendonner 2009, 367.

⁶⁸ Riggsby 2019, 103.

Conclusion

The ancient Greek cities used bronze and lead to create the weights used on the markets. Lead weights were the majority and seemed to be the everyday objects used by merchants. The bronze ones belong to the magistrates. The use of a more expensive metal in a different colour indicates a desire to give the objects a different status. Until now, these bronze objects have been known as “standards”. This vague term has led some researchers to question the link between bronze and a different status from lead objects. This article aimed to show that these bronze weights do indeed had a special status. Rather, it is the use of the term “standard” that is wrong and should be avoided. This term is too simplistic and prevents us from understanding all its nuances. We have seen that these bronze weights could have played a role at different levels. They could have been used to check everyday objects made of lead, while at the same time they had to be checked too. It was possible to carry out this verification with the model weights used to create other weights. The cities may have used bronze weights as a fiscal instrument, but the lack of sources makes it impossible to state it with certainty. The last role cited in this paper, but first in their conception, was to materialise an accounting unit to balance transactions between buyers and sellers.

Obviously, one type of weight could play different roles. For instance, model weights also embody the accounting unit and could be used to control the magistrates’ weight. These latter were probably those used if there was a taxation carried out with a weighing process. Aware that categories are not frozen, and that weights could be used for several purposes, even if speaking of “standard” is convenient, it would be more appropriate to distinguish between control weights, model weights and tax weights.

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