

A few notes on seven Greek lead weights in the Archaeological Museum in Split*

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The Archaeological Museum in Split holds seven square-shaped Greek lead weights which, based on the uniformity of their style, their symbols, legends and weights, undoubtedly belong to the Attic metrological system. These weights bear relief images of a shield, an amphora, a tortoise, and a crescent and half-crescent moon – the standard array of symbols in the Athenian usual weight system from the Late Archaic to the Late Hellenistic periods. Besides these symbols, three weights have legends designating a third and quarter stater (tritemorion and tetartemorion), and two examples are particularly notable: one bearing the symbol of a shield, and the other with a legend referring to a state guarantee (demosion) – both published here for the first time.

Key words: Greek lead weights, Archaeological Museum in Split, Attic metrological system, fractions of a stater

Scale weights are as old as scales themselves, and finds of them and depictions on wall paintings, relief sculpture, and papyruses have been known in ancient Mesopotamia and Egypt since the Bronze Age (Daremberg & Saglio <s. a.>: 548). In the poleis of ancient Greece and in the Roman Empire, scales (scales: Σταθμός or ζυγός / *libra* or *bilanx*), kantars (kantar: *καμπανός* / *stater*) and weights (weight: σταθμόν / *pondus*) were instruments from the public sphere (*instrumentum publicum*). Scale weights in Antiquity were generally made of bronze, stone and lead. Finds of bronze and stone weights are rather rare in the Greek city-states, possibly because they were more expensive to make due to the hardness of the material and their general durability. On the other hand, lead weights have survived in larger quantity, even though they were subject to wear, and were therefore less accurate. They were probably mould-made, although (judging by the way their edges are curved) they were presumably finished manually, and their weight was adjusted while they were still soft (Lang & Crosby 1964: 5). They are most often square-shaped or rectangular tiles, although triangular, discoid, rhomboid, hexagonal and octagonal examples are known. Sometimes they also have atypical shapes – such as three-pointed stars, truncated and stepped pyramids or astragaloi (Tekin 2016: 7). The front side of Greek lead weights normally bears symbols and inscriptions depicted in relief and tied to the units of weight and denominational labels, while the back side is plain. Some weights have on them an *episemon* (ἐπίσημον) or *parasemon* (παράσημον), i.e., a symbol or badge of a city-state, which is identical, in most cases, to that found on its coins.¹ In addition, some other inscriptions

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¹ Although the examples from Athens and Corinth impose a conclusion that every city-state could have arbitrarily selected its *parasemon* on its weights. Both cities had different *parasema* on their coins and on their weights: the owl may be interpreted as the *parasemon* of Athenian coins, and Pegasus of Corinthian coins, but both appeared on their weights only quite rarely (Tekin 2016: 10, 129).

can be seen on lead weights, which suggest an ethnic, or designation of the official state guarantee of their weight (*δεμόσιον*).

In general, Greek weights are rarely found in archaeological excavations, yet mostly in the context of excavations in public urban spaces, and it is noteworthy that most of the specimens on record come from excavations at Olympia and in the Athenian Agora. To be sure, they were used in marketplaces and bazaars in various commercial hubs of the Greek world across the Mediterranean, from the Archaic to the late Hellenistic periods. Under the Roman Empire they were integrated into, and adapted to the Roman weight system (*libra* = *λίτρα*; *uncia* = *ογγία*). However, many decontextualized finds of Greek weights have been neglected, and many of them are in museums and private collections. Moreover, Late Antique and Early Byzantine weights currently predominate in comparison to those from the pre-Roman era in the scholarly literature.²

Scholarly interest in Greek weights emerged sporadically in the 18th century, and gained momentum in the 19th century when German scholar Erich Pernice published a body of over 900 examples of Greek and Byzantine weights in his monograph *Griechische Gewichte* (Pernice 1894).³ A milestone for the study of the metrology of ancient Greece is certainly Mabel Lang's *Weights, Measures and Tokens*, in whose first chapter, dedicated to bronze and lead weights, a total of 153 examples of Greek weights were catalogued and analysed: 14 bronze, 111 lead and 28 stone (Lang & Crosby 1964: 25–33). But the most comprehensive work on Greek weights is *Die gewichte Griechischer zeit aus Olympia* (Hitzl 1996), which includes a total of 483 bronze and 1 silver weight from the systematic archaeological excavations conducted at Olympia for over a century. The textbook-style work *Balance weights in the Aegean World. Classical and Hellenistic Periods* (Tekin 2016) is a synthesis of Greek weights from 30 sites (city-states) throughout the Aegean world within the chronological framework of the Classical and Hellenistic eras. As to the lead weights from *Magna Graecia*, excavations on the acropolis of *Heraclea Lucaniae* yielded a square weight bearing graffiti that have been interpreted as the ethnic designation $\text{H}\text{P}\text{A}\text{K}\text{A}\text{H}\text{I}\text{O}\text{N}$, which is identical to that seen on the coins of this Greek city (Lo Porto 1961: 139). Additionally, three rectangular weights with incised symbols shaped like a triple and single X and E come from the site of contrada Mella (ancient *Mamertion*?) near Oppido Mamertina, in south-western Calabria; these symbols may have numerical significance (Costamagna & Visonà 1999: 369).⁴ A lead weight from Himera dated to the 4th century BC bears the designation of a hemilitra in relief (Campana & Santelli 2010: 3, 4).⁵ In the relevant Croatian literature, the first mention of weights from Greek Antiquity can be found in the guides for the Archaeological Museum in Split (Jelić *et al.* 1894: 165; Cambi *et al.* 1973: 37), where six Greek lead weights were exhibited. They are the only examples of these weights datable from the 5th to 2nd centuries BC from the western Mediterranean published thus far (Kirigin 2008: 41, 48–53).

Today metrology (*μέτρον*, measure; *λόγος*, science) is an auxiliary science of history that deals with the study of different measures and measuring systems in the past (Anić *et al.* 2002: 735), while in Antiquity *μετρολογία* referred to the theory of ratios (Liddell & Scott 1996: 1123).⁶ Moreover, besides weights and scales, ancient written documents are also an invaluable source of data on various weight systems, which are examined in comparison with other archaeological materials, primarily numismatic and epigraphic, as well as analyses of depictions, such as, for example, those seen on Greek vases, mosaics, etc. Nonetheless, when studying ancient metrology, one must be doubly cautious, particularly when making conversions to contemporary metrological systems which, to be sure, are far more complex and refined with their multiples and other increments than any ancient system of measurement. Moreover, it is also important to bear in mind the excess of theory over practice in the information provided by ancient writers. This (with a small

² For more on the trade-weights of Late Antiquity and the early Byzantine period in the territory of central Dalmatia held in the Archaeological Museum in Split, see Jovanović 2012 and the detailed bibliography therein.

³ For a thorough list of sources and research history on ancient Greek weights and metrology from the 18th to 20th centuries, see Tekin 2016: 2–5.

⁴ I would like to thank my dear colleague Paolo Visonà, Ph.D., for this information and for proof-reading this essay.

⁵ A bronze tetradrachm (?) weight bearing the designation Δ , dated to the 5th c. BC is known from Agrigento (De Waele & Amadasi Guzzo 1980: 442–443).

⁶ The word *μέτρον* had multiple meanings for a series of concepts: a rule, a measure of solid or liquid content, a weight for a single- or double-arm scale, etc. (Liddell & Scott 1996: 1123).

quantity of empirically obtained data on the precise measurements of specific items) inevitably leads to manipulated (approximate) figures when computing the convergences among standards (Lang & Crosby 1964: 1; Tekin 2016: 22). It was precisely the standard, the generally accepted, customary, and legally-guaranteed fixed value or unit that was one of the most important elements in the ancient Greek system of weights, the evaluation of which is a prerequisite for understanding and analysing ancient weights.

The foundation of the weight system in ancient Greece rested upon its correlation with the monetary system, and the ratio of 1 talent = 60 minae = 6000 drachms emerged from the Near East. When the minting of coins began, two weight systems functioned in Attica and neighbouring regions: the Aeginetic (at Aegina, in the Peloponnese, and in central Greece) and the Euboic (in Euboea, at Athens, and in Corinth). Athens had integrated the Aeginetic system from the time of King Pheidon (early 7th century BC), thereafter consolidating the Euboic system under Solon's reforms of the constitution and of the standard of weights and measures (594/93 BC). But these reforms were only thoroughly implemented under the rule of Pisistratus (561–527 BC). The Euboic-Attic (or simply Attic) system thus emerged, and it was accepted throughout Attica in the latter half of the 6th century BC (Tekin 2016: 35–36).

The Athenian system had two main standards (the stater and mina), which were expressed in two variants (the coin stater/mina and the trade stater/mina), depending on whether the weight of a coin, or precious metals, or the weight of goods was being measured. The stater was the basic unit of weight in Solon's time (Lang & Crosby 1964: 3, 4).⁷ In the Classical and Hellenistic periods, however, the basic unit of weight was the mina – although its weight and the number of drachms into which it was divided varied from region to region, depending on the monetary system that was in use (Tekin 2016: 126). Yet, regardless of their regional variations, the fractions of staters and minae were fixed, just like the units on weights, and they were divided by 4, 8, 16 and 3, 6 and 12 (Tekin 2016: 37). Changes in the number of drachms in a mina and differing standards are indicated by ancient written and epigraphic sources. In the *Athenian Constitution* of the 4th century BC, Pseudo-Aristotle stated that Solon had increased the coin mina from a weight of 70 Aeginetic drachms to 100 Attic drachms, while the trade talent was increased by 3 minae in relation to the coin talent, proportionally dividing the difference into fractions (*Pseudo Aristotle* 2013: 13). Accordingly, the trade talent thus became 5% heavier than the coin talent, and the trade mina was increased from 73 Aeginetic drachms to 105 Attic drachms, which was the metrological beginning of the dual weight system in Athens.⁸ That Solon's 105-system was not continually in use in Athens was suggested by Andocides in his subversive text *On the Mysteries*⁹ (403 BC), which advocated that the decree of Teisamenus whereby Solon's laws for weights and measures had to be reactivated (Canevaro & Harris 2017: 36–37). Further, a fragment of a decree from the late 2nd century BC testifies to the introduction of a new mina consisting of 150 coin drachmae, which was based on the preceding mina of 138 coin drachmae (I. G., II 29, 1013. 2–37; Meritt 1938: 130). We may therefore conclude that the weight standard in Athens was amended, i.e., increased, on multiple occasions – at least four times in the period from ca. 500 to 100 BC. This conclusion is accepted by most scholars (Kroll 2013: 111). The reasons for the increased standards are potentially multiple: they range from economic and political crises to the adoption of simple weights for greater mercantile efficiency (Tekin 2016: 20).

After all, concrete evidence for the existence of different standards in Athens is provided by the finds of bronze and lead weights from the Agora, among which the variability and (dis)continuity among the symbols in comparison to their value marks has been noted (Lang & Crosby 1964: 18–20). The symbols on weights generally facilitated their identification and use (particularly for the illiterate) in the course of trade. Even though they changed over time, some symbols nonetheless suggest a certain denomination. Symbols of a wheel, astragalos, dolphin (half, quarter-) amphora, (half-) tortoise and half-crescent moon belonged to the Athenian regular weight system based on the 105/110-drachm standard (Lang & Crosby 1964: 6; Hitzl 1996: 108–109).

⁷ According to Lang, the stater was the main unit of weight, because it probably expressed the ratio between bronze and silver in Solon's time (105:1), so that the bronze stater represented the quantity of bronze required to purchase one silver stater.

⁸ For a consideration and philological interpretation of Chapter 10 of Aristotle's *Athenian Constitution*, see Chambers 1973.

⁹ Regarding Andocides' credibility, see the recent articles by Hansen 2016 and Canevaro & Harris 2017.



Fig. 1. Square lead weights from the Greco-Hellenistic collection of the Archaeological Museum in Split (photograph: Tonći Seser).

Seven square lead weights (pl. 1) are preserved in the Greco-Hellenistic collection of the Archaeological Museum in Split. Even though five of them are already known (Fig. 1: 1–5), two additional weights were found during a reexamination of the collection and are published here for the first time (cat. no. 1 and 2, Fig. 2 and 3).¹⁰ Based on the uniformity of the style, symbols, legends and weight standards, all of them undoubtedly belong to the Athenian metrological system. Unfortunately, they lack any data on the context of their discovery, and on the time and circumstances of their acquisition by the Museum. Therefore, whether the weights were found individually or as a group, remains unknown.¹¹ The earliest among them is certainly the weight bearing an image of an oval shield in relief (cat. no. 1, Fig. 2). This type of weight is exceptionally rare and it is linked typologically to an example in bronze from the earliest set of official weights held in the Tholos in the Athenian Agora, which has been dated to ca. 500 BC (Lang & Crosby 1964: 25, cat. no. 2, Pl. 1: 2). Yet, in contrast with the Athenian example, our specimen does not bear a designation for the state guarantee nor a denominational value, although it may be concluded (on account of its weight) that it is also a quarter-stater (*tetartemorion*). The shield symbol was originally ascribed to the 6th century BC, because it is associated with the symbols of the wheel, astragalos, boukranion, and amphora, that are found on the earliest Athenian weights, and which can also be seen on the *Wappenmünzen*, the earliest Athenian coinage (Tekin 2016: 45). Significantly, the shield was also the symbol of the island of Salamis, which the Athenians had annexed in the first half of the 6th century BC. Therefore, it is possible that its adoption on the earliest weights actually reflected the Athenians' desire to represent the different parts of their city-state (Lang & Crosby 1964: 12). Our weight, based on its preserved weight, belongs to the 105-drachm standard, with a deviation of approximately 6% from the assumed weight of Solon's standard stater (915.6 g). It is believed that, after the reactivation of Solon's system in 403 BC, the shield symbol was discarded and replaced with the symbol of a tortoise for the quarter-stater (Lang & Crosby 1964: 20).

¹⁰ I would like to thank my museum colleagues: senior conservator Borko Vješnica for the conservation of the weights, senior photographer Tonći Seser for the photographs in this essay, and senior preparator Ika Prpa-Stojanac for her practical remarks on the production of lead weights.

¹¹ Even though in all publications of weights (including the most recent one by Kirigin 2008: 48–53), Salona has been referred to as their likely findspot, and although they are said to have been acquired possibly after the 1930s, this cannot be established with any certainty based on the museum's documentation and inventory logs. Therefore it seems safer to conclude that the provenance of all of the weights featured in this essay is unknown.

Depictions of (sea) turtles and tortoises can be seen on the earliest Athenian 1/6 stater weights, and they are tied to the Aeginetic (Pheidon's) weight system which Solon adapted and introduced into the Euboic-Attic system (Lang & Crosby 1964: 9). The sea turtle is the *parasemon* of the earliest coinage of Aegina, and its replacement on coins by the tortoise (probably *Testudo graeca*) occurred ca. 445 BC (Lewis & Llewellyn-Jones 2018: 651–685). Such a change prompted not only the parallel change of the tortoise symbol on Athenian weights, but also the change of fractions, so that the tortoise began to appear on 1/4 stater weights, which had until then carried the shield symbol (Lang & Crosby 1964: 8–10). Both our examples (Fig. 1: 2, 3)¹² bear relief designations of the quarter-stater (*tetartemorion*), which are harder to discern on the second weight, because the rounded edges have crossed over the letters in the corners. Identical analogies can be found on the weights from the Athenian Agora which belong to the 105-drachm standard, and they appear in dated contexts from the 4th century BC, the late 4th/early 3rd century BC, and the late Hellenistic period (Lang & Crosby 1964: Pl. 7, no. 34, 38, 40, 42). Although the preserved weight of both weights is less than the weight of the assumed stater of the 105-drachm system (variation of 12% for the first weight, and 4.3% for the second), it is unlikely that these weights are linked to some other standard. Instead, it is more likely that their weight decreased over time due to chemical processes, and it is possible that they were used rather extensively and became worn.

The 1/3 stater weight, bearing a depiction of an amphora with the legend *tritemorion* in relief (Fig. 1: 1), may be interpreted in a similar way. Weights with depictions of the early Panathenaic amphorae of types I–III appeared on examples from the Athenian Agora already in the 4th century BC, and most of them were found in a Hellenistic context. These images are followed by those of late Panathenaic amphorae, of which the earliest depictions appeared on New Style coins of the 2nd century BC (Thompson 1962: 301–333). The amphora shown on this weight may have belonged to type II, given that its handles are attached to the vessel below its lip, and not directly to the lip as was the case for the early Panathenaic type III amphorae. Weights with depictions of early Panathenaic amphorae of types I and II are based on the 105-drachm standard (Lang & Crosby 1964: 25), which is also the case in our example, with a preserved weight that varies 11.5% from the weight of the 105 system stater.

Weights bearing a depiction of a crescent moon and a half-crescent moon in relief are also held in Split's Museum. Although they have no legends indicating their weight, the weight with the crescent moon also bears a relief image of a stylized five-pointed star (Fig. 1: 4), while the weight with the half-crescent moon has a visible perforation, which suggests that its weight was adjusted during production, while the metal was still soft (Fig. 1: 5). It is believed that the crescent and half-crescent moon symbols on weights were derived from the Athenian obol, examples of which feature four crescent moons. This leads to the conclusion that the crescent moon symbolized a quarter, and the half-crescent moon an eighth of a given unit, probably a mina. Weights with depictions of the crescent moon have a broad weight range, so they have been divided into two groups: the first encompasses those which in terms of their weight correspond to the quarter mina of the 105-drachm standard, whereas the second group contains several examples with depictions of the crescent moon accompanied by the legend *ἕξμη(όριον)* meaning 1/6 of a mina (Lang & Crosby 1964: 12). Insofar as our weight (Fig. 1: 4) denoted a quarter mina of the 105-drachm standard, its preserved weight would suggest a stater of 655.82 g, which is a deviation over 28% of what would be expected. If so, the weight may have been invalid or potentially falsified even in Antiquity. On the other hand, if it denoted 1/6 of a mina, then the preserved weight would suggest a mina of the 138-drachm standard (491.94 g), with a somewhat smaller deviation of approximately 18%. Thus, weights with depictions of a half-crescent moon are linked to the eighth portion of a mina, and sometimes they also bear a legend *ογδο(ον)*. Since they are closely associated with weights which (besides the aforementioned legend) also bear the image of a cornucopia, it is difficult to tell them apart, particularly if they are heavily worn.¹³ In terms of its heaviness, dimensions and type, our weight (Fig. 1: 5) bearing a depiction of a half-crescent moon, although weight-adjusted during its production process, corresponds to weights of the late 5th to 4th

¹² After examining the depictions of tortoises on the weights (Fig. 1: 2 and 3), the senior curator of the Natural History Museum in Split, Dalibor Vladović, M.S., believes that the first weight shows the image of a sea turtle and points out the animal's body structure: its head thrusts far forward in comparison to the legs, while the forelegs resemble fins (Jovanović & Vladović 2015: 55). He believes that the second weight depicts a Hermann's tortoise (*Testudo hermani*) which he explains by the appearance of the forelegs, the position of the head and shell, and the prominent plates on the shell. I am grateful to my colleague for his comments.

¹³ This erroneous interpretation of our weight was made by Kirigin 2008: 52: 25.

centuries, which continued to be used into the Hellenistic period, naturally with the higher weight of the mina (Lang & Crosby 1964: 30, no. 54, 55, 57).

This essay is the first publication of the weight bearing the designation *ΔΕΜΟ(σιον)* in relief, but its surface is rather worn, so what is within the small circular stamp (9 mm) in the middle (cat. 2, Fig. 3) cannot be discerned. Based on its weight, it may have corresponded to 1/16 of a stater, just like an example from the Athenian Agora with a virtually identical weight which bears the designation *ἡμισυνημιτετ(αρτον)* and has been dated to the late 5th and early 4th century BC (Lang & Crosby 1964: 30, no. 56). It should be emphasized that the stamps of diverse motifs (Dionysus seated on a throne, an owl, amphora, olive branch with kalathos, rosette, cornucopia, thyrsos, etc.) appear on different types of Athenian weights, and they have been associated with the *metronomoi*, the officials whose task was to certify the propriety of weights (Lang & Crosby 1964: 22). The agorae were simultaneously coordinated by the *agoranomoi*, the magistrates charged with maintaining the general order and the maintenance of structures in the marketplaces (Tekin 2016: 31, 32), and the *metronomoi*, who were responsible for the certification of scales and weights. This was in fact a council of ten men, selected by lot, of whom five were in Athens, and five in Piraeus (Vanderpool 1968: 73). Their responsibility was to maintain accurate measures and weights, which facilitated lawful and fair trade. Thus the *metronomoi* checked the weight used by merchants in advance and compared them to official weights on which the designation *δεμόσιον*, just like that on our weight, indicated the legality and state guarantee of their property.

In ending, we may conclude that the group of Greek lead weights from the Archaeological Museum in Split undoubtedly belong to the Attic metrological system, for which there are direct typological/stylistic and weight parallels in the examples from the Athenian Agora. Following an overview of the legends and symbols on the existing weights, a cautious attempt has been made to ascertain certain general criteria for a relative chronology which – based on known changes in weight standards and on a small number of finds from well-defined contexts – may point to an absolute dating. Given that these are decontextualized finds whose symbols are a standard component of the repertoire on Attic weights from the late Archaic period until the Hellenistic era, we may only speculate on how they even came to the Museum. If indeed they were found in the territory of present-day central Dalmatia, either together or separately, this would certainly underscore the Greeks' mercantile interest in the eastern Adriatic seaboard already since the late Archaic period. By this time, regular maritime trade between the northern Adriatic and Greece, which was largely conducted by the Ionian Greeks (Athenians, Aeginians and the Greeks of Asia Minor) had become the norm (Šešelj 2009: 438).

CAT. NO. / INV. NO.	SYMBOL IN RELIEF	LEGEND	WEIGHT OF WEIGHT IN INVENTORY LOG	WEIGHT OF WEIGHT Kirigin 2008	WEIGHT OF WEIGHT IN 2019	WEIGHT OF STATER/ MINA	DATING
Cat. no. 1, H-5667	Shield		216 g		215.46 g	861.84 g	End of 6 th – end of 5 th c. BC
Cat. no. 2, H-5668		<i>ΔΕΜΟ(σιον)</i>	56.37 g		55.94 g	895.04 g	Late 5 th – beginning of 4 th c. BC
Fig. 1: 1, H-5661	Amphora	<i>ΤΡΙΤΗ(μόριον)</i>	273.9 g	276 g	270.21 g	810.63 g	4 th c. BC
Fig. 1: 2, H-5663	Tortoise	<i>ΤΕΤΑΡΤ(ημόριον)</i>	204.8 g	206 g	201.52 g	806.08 g	4 th – beginning of 3 rd c. BC
Fig. 1: 3, H-5664	Tortoise	<i>ΤΕΤΑ(ρτημόριον)</i>	222.4 g	222 g	219.13 g	876.52 g	4 th – beginning of 3 rd c. BC
Fig. 1: 4, H-5659	Crescent moon		93.06 g	84 g	81.99 g	/ 491.94 g	Hellenistic era
Fig. 1: 5 H-5662	Half-crescent moon		58.29 g	56 g	55.5 g	/ 444 g	Late 5 th /early 4 th c. BC

Table. 1. Greek lead weights from the Archaeological Museum in Split with designations of symbols, legends, weights and proposed dating

Catalogue

1. Square lead weight with rounded edges bearing the image of a shield in relief. Inv. no. H-5667 (Fig. 2). Length: 3.9 cm, width: 3.7 cm, thickness: 1.5 cm, weight: 215.46 g (equivalent to a stater of 861.84 g) Analogies: Lang & Crosby 1964: 25, cat. no. 2. Dating: end of the 6th c. – end of the 5th c. BC



Fig. 2. Square lead weight bearing the image of a shield in relief. Obverse & reverse (photograph: Tonći Seser).

2. Square lead weight with rounded edges on which each of the corners contains a Greek letter in relief forming the word $\Delta EMO(\sigma\iota\omicron\nu)$ counter-clockwise. Inv. no. H-5668 (Fig. 3). Length: 2.8 cm, width: 2.8 cm, thickness: 0.8 cm, weight: 55.94 g (equivalent to a stater of 895.04 g) Analogy: Lang & Crosby 1964: 30, no. 56. Dating: late 5th – beginning of the 4th c. BC



Fig. 3. Square lead weight with the inscription $\Delta EMO(\sigma\iota\omicron\nu)$. Obverse & reverse (photograph: Tonći Seser).

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