The Place of Lead in an Egyptian Port City in the Late Period

A Thesis submitted for the Degree of Doctor of Philosophy

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VOLUME 1

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THE PLACE OF LEAD IN AN EGYPTIAN PORT CITY IN THE LATE PERIOD – ABSTRACT

Elsbeth van der Wilt – Archaeology – DPhil – MT 2013

This thesis analyses a range of lead objects discovered in Thonis-Heracleion, an Egyptian port city, and offers a new perspective on the use of metals in antiquity. It advances two central arguments: firstly, that the large quantity of lead artefacts in Thonis-Heracleion is not exceptional but rather a more accurate reflection of the metallisation of ancient societies and secondly, that the corpus of lead objects sheds light on aspects of ancient communities that normally remain invisible due to the ease of recycling and low cost of lead.

The first chapter reviews the presence of lead in the archaeological record in Egypt, the factors affecting its deposition and preservation, and the corpus as a whole from Thonis-Heracleion. A comparison between the two puts the lead from the site in a new Egyptian perspective. The second, third, and fourth chapters offer substantial analyses of lead ingots, weights, and containers found at Thonis-Heracleion with parallels from around the Mediterranean. The chapters show the potential of this corpus to shed light on activities in the Egyptian town despite the notable lack of direct parallels. It becomes clear for example that large lead objects appear earlier in the archaeological record and that the range of objects is wider than previously suspected. The analysis in these chapters offers a robust dating framework for lead objects previously unavailable.

Together the lead artefacts illustrate local mercantile activities, the economic role of the port city, and, through the identification of the first Athenian weights found in Egypt, trade connections between Egypt, Athens, and the rest of the Eastern Mediterranean. The result is an overview of lead in Egypt and its place in Thonis-Heracleion, demonstrating the significance of metals for understanding ancient societies.

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CHAPTER 1. INTRODUCTION: A SELECTION OF LEAD OBJECTS FROM THONIS-HERACLEION

This thesis utilises a selection of lead objects from Thonis-Heracleion to give an insight into activities in the harbour town and the use of this base metal in antiquity. Lead has an unglamorous image.[1] Dull and grey, it is known for its malleability and high mass density and it is used today for utilitarian purposes such as roof lining, pencils, bullets and batteries. Until the early 1900s it was also still used for water pipes.[2] This modern use of lead reflects the ancient practical uses.[3] Lead on its own, however, remains under studied and only a relatively small number of ancient lead artefacts are published. This thesis addresses this imbalance by dating and interpreting a significant assemblage of lead objects from underwater excavations in Aboukir Bay, Egypt, 20 km east of Alexandria.

More than 1,200 inventory numbers for lead objects have been recorded from Thonis-Heracleion since the start of work in the area in 1996. In view of the disparate nature of the corpus it was necessary to assess the various categories and make a selection for inclusion in this thesis. The selected artefacts are relatively large groups within the corpus and may be divided into three categories with broader themes such as trade mechanisms and exchange (weights), raw goods (ingots), and lead containers as objects that are only rarely preserved in the archaeological record. This selection allows the corpus to be contextualized within the broader Eastern Mediterranean world during the first millennium BC through the presence of trade networks and broader observations on the use of metals in ancient society.

The location of Thonis-Heracleion at the mouth of the Canopic branch of the Nile and the Mediterranean Sea plays an important role in the discussion of the objects. It was part of an extensive maritime network between Greece, the Levantine coast and

[1] As described by Nriagu 1983: vii; Eiseman 1980: 41.

[2] For a brief overview of Roman lead pipes, and their different sizes and production methods, see Adam 1994: 252–4.

[3] Lead was used as sling bullets and sheathing for ships in the Eastern Mediterranean (see **chapter 1**), and the Romans were the first to use lead to make water pipes

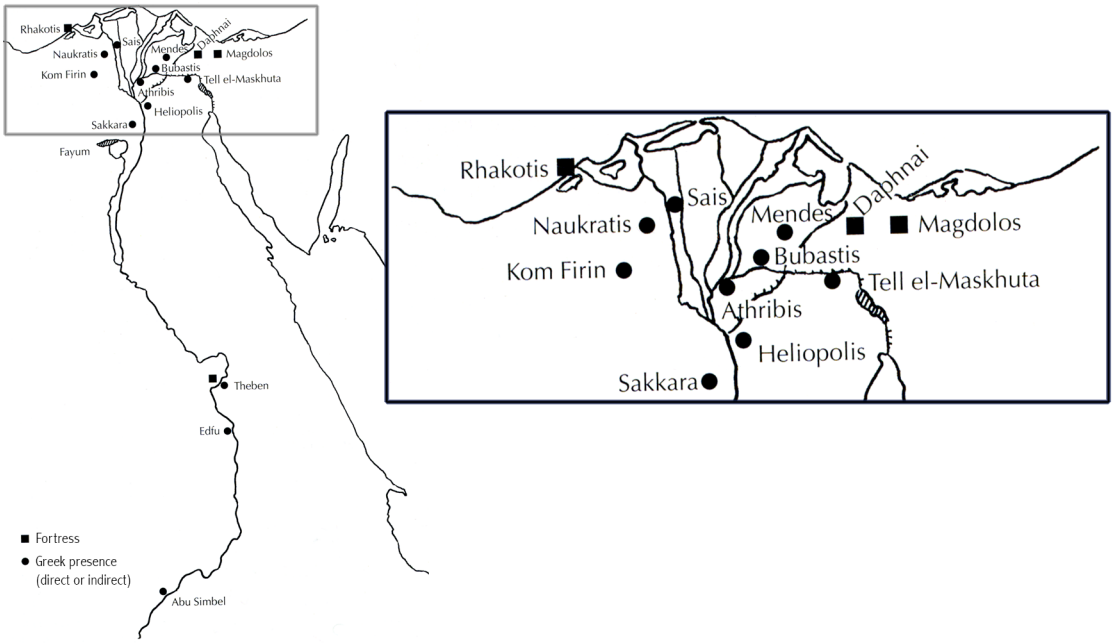


Figure 1.1 Map of Egypt indicating fortresses settlements with evidence for a Greek presence, with a detail of the delta, after Vittmann 2003: 198 fig. 99, adapted M. H. Jung.

Egypt. The analysis of the selection lead objects illustrates the influences from outside of Egypt on this harbour town. The presence of the large quantity of lead objects, their function, and deposition should be considered in view of its geographical location and its role as a customs-office during part of its occupation in the 5th and 4th centuries BC, as well as possible ritual activities.

This introductory chapter covers the site itself and its discovery, scholarship on Thonis-Heracleion and the wider implications for the role of Thonis-Heracleion with regard to Sais, Egypt's capital during the 26th dynasty, the Greek trading settlement of Naukratis further upstream, and the wider environment of the northwest delta (Figure 1.1).

1.1. Thonis-Heracleion

In 1996, the European Institute for Underwater Archaeology (IEASM) under the direction of Franck Goddio, alongside the Ministry of State for Antiquities (its former acronym SCA is used in the catalogue indicating object numbers in their holdings) started working in Aboukir Bay, Egypt.[4] The Oxford Centre for Maritime Archaeology (OCMA) has been collaborating with the IEASM since 2003. This research centre

[4] For a summary of the work from 1996 until 2005, see Goddio 2007.

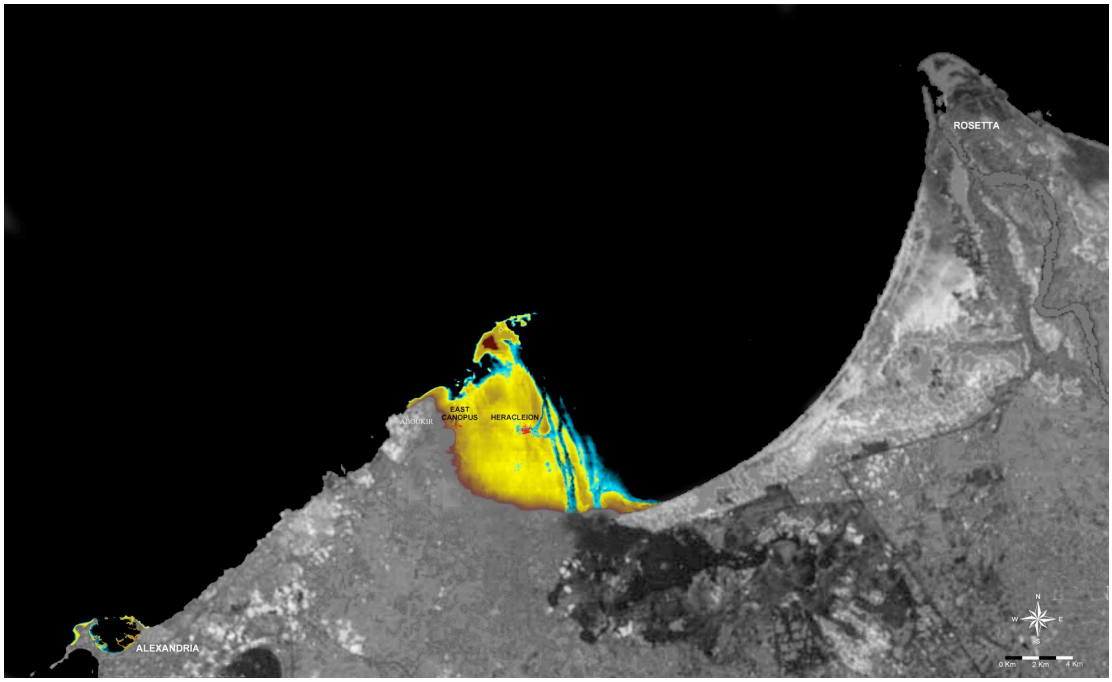


Figure 1.2 Bathymetric map of Aboukir Bay ©Franck Goddio/Hilti Foundation

within the Institute of Archaeology at the University of Oxford facilitates the study and publication of material from the excavations in Egypt as well as participating in the underwater excavations in Aboukir Bay since 2011. This thesis forms part of the programme of DPhil theses, supported by the Hilti Foundation, on the material culture from the excavations.

Aboukir Bay lies about approximately 30 km northeast of Alexandria. The western part of this bay is a currently submerged landscape (Figure 1.2), with the ancient Canopic branch of the Nile located to the east. The interest in this area was twofold: investigation of the archaeological remains and understanding the factors concerning the submersion of the ancient Canopic region.

Initial survey work identified two concentrations of archaeological remains, which were identified with Thonis-Heracleion[5] and East-Canopus on the basis of epigraphic evidence.[6] The sites of Thonis-Heracleion and East-Canopus currently lie at a depth of five to seven metres under sea level.[7] Drill cores taken show successively terrestrial, brackish, and fully marine molluscs indicating that this aspect of the sinking

[5] Cole gives an explanation of the naming of the site as 'Thonis-Heracleion', see Goddio 2007: xv. Goddio discusses the identification of the sites; see Goddio 2007: 18.

[6] Goddio 2007; von Bomhard 2008, 2012.

[7] Stanley et al. 2001, 2004: 6, 2007: 21.

of the site happened in stages, and not a single catastrophic event.[8] Eustatic sea level rise since the eighth century AD and the gradual subsidence of the Nile delta over time, on the basis of the time from the earliest presence at the site in the late 7th century BC, cannot account for the present depth of the city. Calculations of the natural subsidence of the Nile delta and the sea level rise falls short of the current depth by approximately three to five meters.[9] Evidence was found of one or several events leading to submersion of the landscape that were abrupt and dramatic.[10] Data from the soil samples showed that Thonis-Heracleion was built on top of water-saturated mud covered by a thin layer of sand.[11] This sediment does not provide stability for heavy stone buildings, such as temples, and this was a contributing factor to the subsidence of the sediment when the water is expelled abruptly.[12] As noted above, soil samples also provide evidence for a gradual process of subsidence as well as sudden failures, although it is difficult to date any of these changes with the present state of research.[13] Four reasons for rapid subsidence or substrate failure caused by the expulsion of the water in the sediment by applying pressure from above may be identified: Nile floods, tsunamis, the presence of large buildings[14], and lastly seismic activity that shakes sediments.[15] It is highly likely that a high Nile flood played a role due to water saturation and sediment loading, since this phenomenon is known from river deltas elsewhere in the world.[16] For Thonis-Heracleion, this may have caused riverbank failure, leading to a marshy environment and a shift in the river.[17] For East-Canopus submergence was likely later as suggested by the archaeological remains. A high flood, such as the one dated to 741/742 AD likely caused the final and complete submersion

[8] Stanley et.al. 2007: 85–6.

[9] Stanley et al. 2004: 6–7.

[10] Stanley et al. 2004: 7–10. Human remains were found underneath damaged structures in East-Canopus, see Stanley et al. 2007: 54–6.

[11] Stanley et al. 2007: 54–6.

[12] Stanley et al. 2007: 22, 57.

[13] Stanley et al. 2007: 84–5.

[14] Stanley et al. 2004: 9.

[15] Stanley et al. 2007: 21–2.

[16] Stanley et al. 2001: 294, Stanley et al. 2007: 56, 85.

[17] Stanley et al. 2001: 294.

of the landscape in Aboukir Bay.[18] At this time no earthquakes were recorded in Egypt.[19]

The IEASM led by Goddio undertook a geophysical survey to establish the contours of the ancient coastline and to establish the relief of the land prior to its submersion, in order to create a map of the region (Figure 1.2).[20] The aim of the geological survey was to define the landscapes through soil samples in order to understand how and when the land was submerged. After the survey, reconnaissance dives were made to investigate the results in archaeologically promising areas.

The identification of the ruins as those of Thonis-Heracleion was settled by the discovery of two monuments with inscriptions: the naos of the temple of Amun-Gereb and the Heracleion stela, both of which were found more or less *in situ*.[21] The naos identifies the god as Amun-Gereb.[22] The Canopus decree mentions Amun-Gereb in the Greek text where the deity is residing in a town called Heracleion, whereas the Egyptian uses the Egyptian *r3-ḥnt*, 'mouth of the lake'.[23] The Heracleion stela, an almost exact copy of the Naukratis stela[24] details the division of taxes levied at the Egyptian border during the reign of Nektanebo II (r. 360–342 BC). The text is identical except for the last part mentioning the city name, where it says it was erected at 'Thonis of Sais'.[25] Thonis is the Greek derivative of the Egyptian name *t-ḥnt*. Yoyotte argues that this toponym must refer to the large littoral lakes on the Mediterranean coast, or

[18] It is impossible to tell at this point how much of the area was (partially) submerged, and which areas where still above sea level. The presence of the late antique and early Islamic material just shows that at least some areas were still used, see Stanley et al. 2001, 2007: 56.

[19] Nur 2010: 134–5; Stanley et al. 2001: 294 n. 10.

[20] In general Goddio 2007: 10–5, specifically 8, 18.

[21] Although fallen over, Goddio 2007: 74.

[22] SCA 457; Goddio and Fabre 2008[2]: 309, no. 115; for an overview of the documents regarding Amun-Gereb, see Guermeur 2005: 140–2.

[23] For both the Greek and (a translation of both the) Demotic and hieroglyphic text of the Canopus decree side-by-side, see Spiegelberg 1922: 72–3, and 219 no. 468.

[24] For an overview of previous publications on the Naukratis stela, see Lichtheim 1976: 139 n. 1. Von Bomhard follows Lichtheim's interpretation of the text in terms of granting revenue to the temple of Neith "on the basis of a customs tax and trades tax, both taxes being levied at unspecified rates of taxation", i.e. a 10 % share of the tax revenue after collection, see von Bomhard 2012: 93–5, and fig. 4.10–4.11; and Lichtheim 1976: 141–2.

[25] SCA 277; Goddio and Fabre 2008[2]: 309, no. 116; von Bomhard 2012; Yoyotte 2001, 2004.

occasionally also to an inland lake.[26] Thus, combining the Canopus decree and the Heracleion stela it is clear that Thonis and Heracleion are the same city. The Greek name is due to the association of Herakles with Khonsu, son of Amun-Gereb in the triad common in Egyptian temples.[27] Herakles was a communal and binding factor in networks around the Mediterranean.[28]

The area of the city of Thonis-Heracleion is characterized by water: canals, harbours, the Nile in the east and a lake in the west connected this town to Canopus via a canal (Figure 1.3).[29] Significant remains were built on the central island: the temple of Amun-Gereb and his son Khonsu, perhaps a cultic platform, harbour and mooring areas. The naos and the stela discussed above were found here as well as colossal statuary associated with the temple: three statues of a king, a queen, and a Hapy figure.[30] The site was looted already in antiquity, and it was used as a stone quarry, since much construction material is missing.[31] The archaeological material shows the activities on the site dating from the last quarter of the seventh century BC[32] to the eighth century AD, with a notable lack of material from the Roman period and a small community of nuns in the Byzantine period.[33] It seems to experience its heyday during the 5th and 4th century BC as a frontier and customs town,[34] where products passed before travelling further upstream to Naukratis and beyond.

[26] Yoyotte 2001: 26, 28; Yoyotte 1958: 427–30.

[27] Yoyotte 2001: 31; Höckmann 2010.

[28] Chapter 4 in Malkin 2011: 87–141.

[29] Goddio 2010: 11–3.

[30] Goddio and Fabre 2008[2]: 100–5, 116–9, 306–7 nos. 102, 105, 106; Goddio 2007: 90 fig. 3.37.

[31] Goddio 2007: 77.

[32] Personal communication Catherine Grataloup.

[33] Grataloup 2010: 151; Goddio 2007: 75.

[34] Grataloup 2010: 156–8; for a discussion of a sample of pottery from this period, see Grataloup 2012.

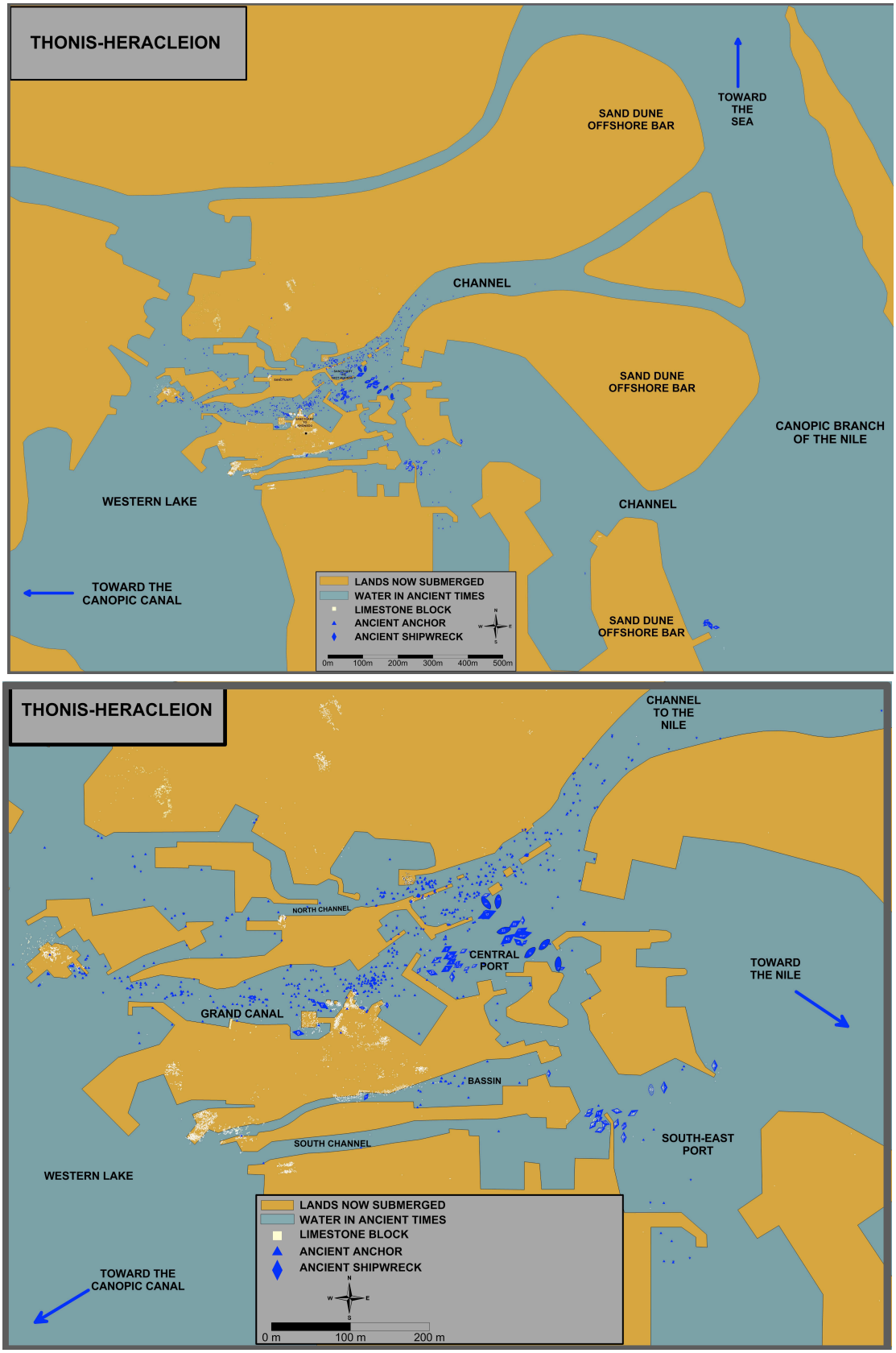


Figure 1.3 Map of the environs of Thonis-Heracleion at large (top) and the town of Thonis-Heracleion in more detail (bottom) ©Franck Goddio/Hilti Foundation

Its role as customs office and trade hub became obsolete when Alexandria developed as a major harbour during the course of the 3rd century BC.[35] Ceramic sherds are rare from the second half of the 2nd century BC. In the Byzantine period there is renewed activity, as shown by objects such as jewellery and coins, supported by literary evidence of a nunnery.[36] The latest datable object is an Abbasid gold dinar from the middle of the 8th century AD after which the region was finally submerged.[37]

The dating of the material changes across the site, which is perhaps caused by sea level rise combined with partial submergence in the northern areas.[38] In the area northeast of the site, north of the North passage there is a concentration of material from the 7th to early 6th century BC.[39] Numerous sunken ships and anchors can be found on the bottom of ancient waterways in the site dating to the 5th to 2nd centuries BC (Figure 1.4).[40] The temple area has material from the 4th to 2nd centuries BC.[41] In the south of the site, around the southern harbour of the temple island and the cluster of wrecks further south indicate a 2nd century BC date. One of the final activities at the site was the erection of a large stela during the joint reigns of Ptolemy VIII Euergetes II with Cleopatra II and III, probably around 118 BC, in the north of the site.[42]

1.1.1. Locating Thonis-Heracleion

Ancient authors mention various cities to the east of Alexandria, such as Canopus, Menouthis, Heracleion, and Thonis. A discussion of the references found in the ancient texts may be found in Goddio's monograph on the topography of Aboukir

[35] E.g. Yoyotte 2001: 27.

[36] Goddio 2011: 129, n. 42.

[37] From Thonis-Heracleion ca. 785 AD, SCA 319; Goddio and Fabre 2008[2]: 352, no. 432; Goddio 2007: 75. Two slightly earlier Umayyad gold dinars from East-Canopus, SCA 101 (ca. 729–30 AD) and SCA 100 (ca. 718–9 AD); Goddio and Fabre 2008[2]: 304, nos. 93 and 94.

[38] Personal communication F. Goddio.

[39] Area A, see Grataloup 2010: 151–2, and fig. 12.2.

[40] Fabre 2011.

[41] Area F, see Grataloup 2010: 152 fig. 12.2, and 155.

[42] SCA 529; Thiers 2009; Goddio and Fabre 2008[2]: 134–7, 310 no. 117.

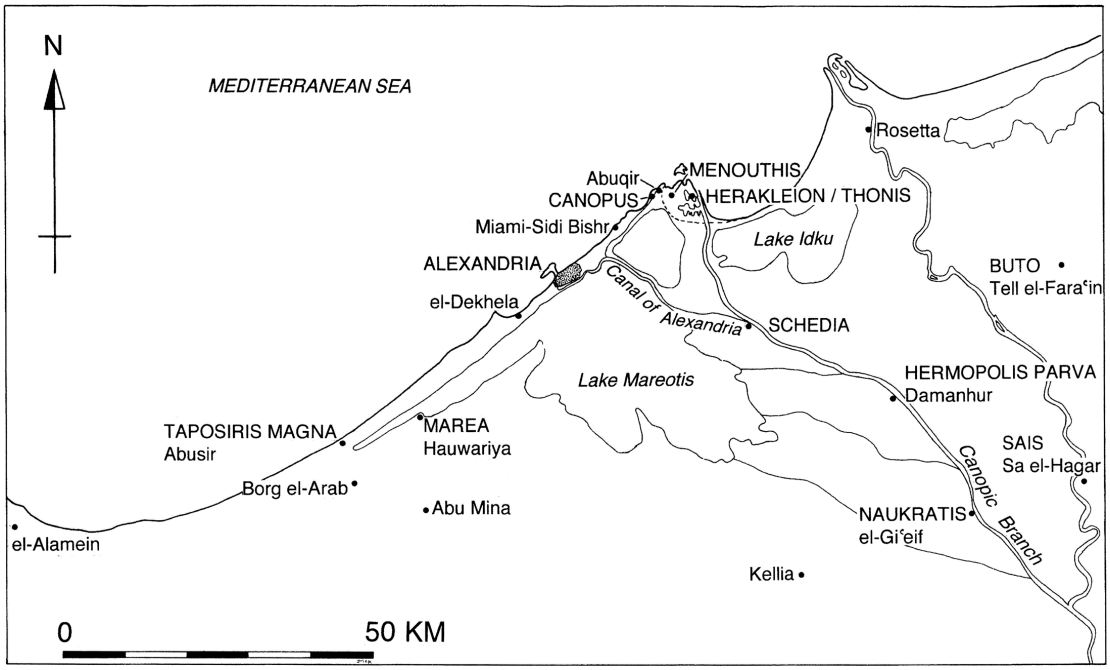


Figure 1.4 Map of the northwestern Delta, courtesy J. McKenzie.

Bay.[43] From the eighteenth century onwards, there has been much debate about their location. Tentative suggestions were made locating them on the modern shore of Aboukir Bay, on the basis of the distances in relation to Alexandria.[44]

In 1929, Daressy was the first scholar who suggested locating Menouthis and Thonis-Heracleion *in* Aboukir Bay.[45] In 1933, this hypothesis was confirmed when a RAF pilot flying over Aboukir Bay noticed ruins under the water. Prince Toussoun explored the area indicated by the pilot in May 1933,[46] together with Breccia and Adriani of the Greco-Roman Museum at Alexandria, Puy-Haubert, and a deep-sea diver, which resulted in the discovery of architectural elements and statuary.[47] Toussoun indicated the location of the ruins he found, which he associated with Menouthis,[48] and postulated the location of Heracleion on the basis of distances mentioned in the classical authors.[49] Not everyone, however, was convinced. Breccia, who was with him

[43] Goddio 2007: 1–3.

[44] Goddio 2007: 3, 4 figs. 1.1, 1.2.

[45] Daressy 1929: 20–51; for his map see Goddio 2007: 4 fig. 1.3.

[46] Alternatively, April 1934 as mentioned by Breccia, which is likely to be an error, see Breccia 1945: 82.

[47] Toussoun 1934.

[48] Toussoun 1934: 348–52, pl. VIII–IX.

[49] Toussoun 1934: 348.

on the boat in 1933, later downplayed the findings stating that in his opinion Toussoun had overstressed the importance of his discovery[50] and he cast doubt on the claim that any of the cities mentioned by the ancient authors had in fact been found.[51]

In between the activities of Toussoun in 1933 and the start of the work by Goddio in 1996 no archaeological research was undertaken at Aboukir Bay. Underwater visibility is poor, making effective visual surveys by divers largely impossible. Modern technology is indispensable in order to tackle the large survey area.[52] It would have been impossible to identify the archaeological remains without the help of ground penetrating techniques considering that a thick layer of sediment and concretions covered most objects.[53] With regard to the identification of the ruins, Goddio has reservations about the identification of Menouthis and proposes that the site discovered by Toussoun was part of the eastern suburbs of Canopus.[54] The new survey also proved that Toussoun's suggestion for Thonis-Heracleion was several kilometres off its actual location: it is located 6.5 km out of the coast from the harbour of El Maadiya and 3.9 km east of East-Canopus. [55]

1.1.2. East-Canopus

The second site with archaeological remains identified in Aboukir Bay is located 1.8 km out from the modern port of Aboukir and 3.3 km west of Thonis-Heracleion.[56] Goddio identifies the remains as part of the eastern suburbs of Canopus.[57] There are several areas with remains: site T in the east, a round structure, and an area with a

[50] Breccia 1945: 83 n. 1.

[51] Breccia 1945: 80; about the description of a large submerged city in Aboukir Bay with treasures to be recovered in European and American papers: "La realtà è assai più modesta. … Probabilmente si ha a che fare con piccoli isolotti su cui sorgevano o qualche villa o qualche tempio. … Le constatazioni fatte dai palombari confermarono che nel fondo della baia esistono più o meno estesi, *in nessun caso molto estesi*, resti di edifici…" my emphasis, see Breccia 1945: 81.

[52] Goddio 2007: 19.

[53] For a discussion of the geophysical prospection techniques, see Goddio 2007: 11–5, 19.

[54] About the identification of these ruins as East-Canopus, see Goddio 2007: 5, 18; see also n. 57 below.

[55] Goddio 2007: 69, 71.

[56] Goddio 2007: 29.

[57] Others have suggested Menouthis as another possibility; see Stolz 2007: 6; Stolz 2008; Toussoun 1934: 348–52, pl. VIII–IX.

collection of structures (TW) towards the west of site T.[58] Site T, extending over 150 m, is a narrow concentration or alignment of limestone and other objects with very few elements *in situ*, which was perhaps the site of a Christian settlement.[59] A concentration of lead artefacts was also recovered from this eastern extremity of site T, consisting of amulets of Ptolemaic date, as well as Byzantine jewellery and seals from the late 5th to early 7th century AD.[60] The two latest objects from this area are two Umayyad gold dinars.[61] The round structure has been interpreted as a *saqiya*.[62] An area west of site T contained an assemblage of many fragments of incomplete statues and architectural elements and consequently, it is suggested that this was a dump of pieces already broken in antiquity.[63]

There are several buildings at the western end of the concentration of archaeological material (TW0–6). On the basis of the construction of the walls, the masonry and the size of the walls of TW4 makes it clear that this building was pre-Ptolemaic, with ceramics indicating a 4th century BC to 4th century AD date,[64] as such it is the largest and oldest building at site T. The layout of the masonry, of which only the foundation courses were preserved, suggests it is the old temenos wall of a temple, perhaps that of Serapis at Canopus as mentioned by Strabo (*Geography* XVII.1.17).[65] To the south are three more probably Ptolemaic buildings, some with drainage channels (TW3, TW5, and TW 6), and to the south of these are two more buildings most likely

[58] Goddio 2007: 66 fig. 2.86, 67 fig. 2.87.

[59] Goddio 2007: 33–47.

[60] Goddio 2007: 39; the Byzantine gold and lead jewellery from site T was the topic of an unpublished DPhil thesis, see Stolz 2007.

[61] SCA 101 (ca. 729–30 AD) and SCA 100 (ca. 718–9 AD), see Goddio and Fabre 2008[2]: 304, nos. 93 and 94.

[62] Goddio 2007: 47–9.

[63] Libonati argues that the whole area T is a recycling area for architectural elements and statuary, see Libonati forthcoming; for the location of T and the statuary area to the west, see Goddio 2007: 50–1 fig. 2.45; for a study of the naos of the decades, of which fragments were recovered from site T, see von Bomhard 2012: esp. 2–5.

[64] Goddio 2007: 56–7.

[65] Goddio 2007: 50–7, esp. 54 fig. 2.57. Stolz points out that the identification of the temple as the temple of Serapis of Canopus is a hypothesis and not borne out by archaeological evidence, arguing that the Serapis head (SCA 165; Libonati 2010: 38–40 no. 5, 63) may have been brought there at a later date. Instead she favours the identification of the archaeological remains on land excavated by Breccia during the 1920s as Canopus, and the remains at site T as Menouthis, see Stolz 2008: 195–8.

Byzantine on the basis of the masonry and architectural elements (TW1 and TW2).[66] Perhaps they were part of the pilgrimage sanctuary of St John and St Cyrus known to have existed close to the Serapeum?[67]

1.1.3. Nelson's Island

Nelson's Island, located 4 km north of Thonis-Heracleion, is the only part of an original ancient promontory in the north of Aboukir Bay, which currently is above sea level.[68] The archaeological remains on the island are an integral part of the larger landscape containing Thonis-Heracleion and East-Canopus and thus relevant to the discussion here. From 1998, the Italian Archaeological Centre at Alexandria led excavations on the island directed by P. Gallo from Turin University.[69] Work revealed a Late Period cemetery under a later Greek settlement with a contemporaneous, i.e. early Ptolemaic, garrison installation. The cemetery dates from the end of the Third Intermediate Period to the 30th dynasty.[70] It is possible that it functioned as a cemetery of Thonis-Heracleion.[71] The settlement covering the cemetery was occupied between the last quarter of the 4th century and the early 3rd century BC.[72] It was probably abandoned by the start of the second quarter of the 3rd century BC after which it remained undisturbed leaving many objects *in situ*, perhaps due to its remote position on the coast.[73] The settlement contained a large building of limestone and baked bricks, which can be interpreted as fortifications, and many sling bullets were also found.[74] Gallo found small private and very large public cisterns, indicating the necessity of

[66] Stolz 2008: 194–5.

[67] Goddio 2007: 61–5, 67–8; for the pilgrimage sanctuary Goddio 2007: 67; also Stolz 2008: 196–8.

[68] Gallo 2011: 132–3, Taf. 1 a and b.

[69] For a summary of the work and accompanying bibliography, see Gallo 2011.

[70] Gallo 2009b: 118.

[71] No evidence for a funerary context has been found in Thonis-Heracleion, with the exception of one epitaph with a Greek inscription located in a canal in the western part of the site, SCA 382; Goddio and Fabre 2008[2]: 312 no. 131; Goddio 2007: 120, 121 figs. 3.95–6.

[72] Gallo 2012.

[73] Gallo 2009a: 110.

[74] Gallo 2009a: 112; Gallo 2011: 142, n. 27.

collecting fresh water in this part of Aboukir Bay.[75] He also found many small pieces of iron, bronze, and lead, indicating metallurgical activities, although he did not find the actual workshop. Ceramics associated with the metallic waste suggests a late 4th century BC date. Underwater excavations around the neighbourhood of the island revealed stone quarries and many ceramic sherds.

Nelson's Island is in a strategic location at the edge of the sea and the mouth of the Nile. Its location, the fortified buildings on the island, the large public cistern and high number of sling bullets suggest a military presence. Together with the cemetery found on the island, there are strong indicators of a close relationship with Thonis-Heracleion. Perhaps the cemetery on Nelson's Island also served as the necropolis for the population in Thonis-Heracleion, as no indicators of tombs (except one Greek epitaph) were found there.

1.2. The Egyptian Delta

> *No part of the world, so close to a large western population, and so essential to archaeology, is such unknown ground as the Delta of Egypt.*[76]
>
> *La connaissance insuffisante du Delta en face de tout qu'on sait de la Haute Égypte a des effects fâcheux pour l'Égyptologie parce qu'elle désaxe notre vision.*[77]

Thonis-Heracleion and its neighbouring towns in Aboukir Bay are part of the wider landscape of the Egyptian delta (Figure 1.1). Despite its political importance in the first millennium BC, our knowledge of this area is still relatively meagre compared to our understanding of Upper Egypt.[78] It is especially important for the historical narrative of the New Kingdom onward when both Egypt's political centre and economic heart was in the delta.

[75] Gallo 2009a: 110–1; Gallo 2011: 137. By contrast, Thonis-Heracleion has yielded only one roof tile, D. Fabre personal communication. For the large size of the public cistern, see Gallo 2010: 144–52.

[76] Petrie 1886: 1.

[77] Posener 1962: 639.

[78] For a discussion of the problems related to digging in the area, while stressing its importance, see Habachi 1943: 369–70.

Excavations in the region commenced in the late 19th century. The archaeological record is naturally incomplete due to destruction started in antiquity for example through warfare and purposeful removal of monuments to other cities within Egypt.[79] By the end of the 19th century archaeological reports document the demolition of ancient mounds or *tells* by *sebakhin* to serve as fertilizer. Surviving sites today are in danger due to rising water table, irrigation, and land reclamation.[80] On top of this, excavations in the delta were seen as unrewarding, because preservation is generally poor compared to the majestic temples and tombs in the Nile Valley, and difficult and costly due to the high water table.

Modern scientific techniques and renewed interest in the delta, however, have resulted in much progress, slowly redressing the imbalance of research between the Nile delta and Upper Egypt. Surveys using a range of scientific techniques such as geomagnetic surveys and drill coring are producing new maps of ancient landscapes and identifying new sites.[81] Old maps may be checked and corrected with the help of satellite imagery and new reconnaissance on the ground.[82] These developments have in turn influenced settlement archaeology in the delta. Intensive farming and population pressure in settlements and urban areas, which tend to remain in the same location in the landscape, make less land available for archaeological research as well as limiting the types of remains found: there are few excavated towns throughout Egypt, and most excavations have the character of rescue archaeology.[83] The on-going Austrian mission in Tell el-Dab'a in the eastern delta commenced in 1966 and combines survey work with targeted excavations.[84] It may be considered the beginning of a modern focus on settlement archaeology in Egypt. The work in Aboukir Bay and the discovery of East-Canopus and Thonis-Heracleion, also the product of a combination of scientific survey

[79] For the addition of older (Egyptian) material to younger structures, see Yoyotte 1998.

[80] These threats to monuments do not just occur in the delta, but are present throughout Egypt, see Stadelmann 2000: 13.

[81] E.g. P. Wilson 2006: 151-203; for an overview of general surveys in the delta, see P. Wilson and Grigoropoulos 2009: 1–5.

[82] Thomas and Villing 2013: 86–90.

[83] For an overview of Greco-Roman Egypt, see Müller 2010.

[84] For a diachronic overview of settlement archaeology in Egypt, see contributions in Bietak 1996a; and Bietak et al. 2010. For Tell el-Daba' in general, see Bietak 1996b.

work and targeted excavations, is an important addition to both the archaeology of the Nile delta and the understanding of the pattern of settlements and their role in the area.

Before a brief overview of several delta sites mentioned in the main body of this thesis, a short historical background is helpful in order to put Thonis-Heracleion into context. The Egyptian delta was already home to a culturally diverse society since at least the early second millennium BC.[85] The objects from Thonis-Heracleion are therefore unlikely to be purely Egyptian, nor is the appearance of Thonis-Heracleion to be interpreted as the start of a new era of exchange with the wider eastern Mediterranean.

1.2.1. Historical background

During the late Middle Kingdom (2008–1685 BC), the Hyksos, a people of Levantine origin, settled in the eastern delta[86] and created such a powerbase that in the Second Intermediate Period (1685–1550 BC) they founded their own dynasty at Tell el-Dab'a, ancient Avaris. During the New Kingdom (1550–1069 BC), extensive formalised contacts between the major powers in Egypt, Mesopotamia, and Anatolia are well documented.[87] A strong Libyan presence in the delta is evident at the end of the New Kingdom: numerous kings and chieftains with Libyan names and titles are attested in the north of Egypt throughout the Third Intermediate Period (1069–664 BC). This still continued at the beginning of the 25th dynasty, which originated in Kush, northern Sudan.[88] From around 750 BC the Kushite king Piye had brought Thebes under his control by the installation of his sister as the successor to the God's Wife of Amun following Libyan tradition.[89] The Nubian dynasty had to contend with the Assyrian

[85] The most important general book concentrating on foreign influence in Egypt during the 1st millennium BC, which is the relevant time period for this study, is Vittmann 2003.

[86] Grajetzki 2006: 133; for contacts between Egypt and other countries during this period, see Grajetzki 2006: 136–7.

[87] For translations and discussions of documents within the Amarna archive, see Moran 1992.

[88] E.g. Vittmann 2003: 1–20; contributions in Broekman et al. 2009; for the Piye Victory stela, see Grimal 1981; also Schäfer 1905: 4 ff; for a discussion of chronology and context of the stela, see Morkot 2000: 167–78.

[89] This God's Wife of Amun was the king's representative in Thebes, and a powerful position to control Upper Egypt when the royal residence was distant, either in the North, i.e. the Libyan powerbase, or in the south, i.e. the Kushite capital in Nubia, see Morkot 2000: 110, 185–6, 237–9. For Piye, see Kitchen 1986[2]: 369–71; and his successor Shabako, see Kitchen 1986[2]: 378–83.

threat at its northern border, which finally drove the last king of the dynasty Tantamani out of Egypt in 663 BC. The Assyrian king appointed vassals in the delta, who revolted against them quickly and successfully. Psamtik, foremost among the former Assyrian vassals, assumed kingship. Originating from Sais he established this city in the western part of the delta as the new capital. He proceeded to reunite Egypt under his rule through a combination of military superiority and diplomacy.[90] By 656 BC he had consolidated his rule throughout Egypt.

The Late Period is characterized by an increased integration of Egypt into the politics of the wider Mediterranean and a continuous threat of foreign invaders on Egypt's borders with periods where independence was lost. Greek mercenaries are hired for the Egyptian army and Naukratis is established as a Greek trading post at the beginning of the 26th dynasty (see 1.2.3), contemporaneous with Thonis-Heracleion.[91]

This integration intensifies from 525 BC onwards when Egypt becomes part of the Persian Empire and is integrated in the Persian administration. At first, the Persian administration seems careful to establish a good relationship with the priestly elite in order to ensure the acceptance of their rule over the country.[92] This picture may be nuanced, however, by a now lost decree of Cambyses. It is preserved only in short excerpts in demotic papyri, which concentrate on the exemption of specific temples in the Memphite region to a general reduction of royal offerings.[93] More detailed discussion of the economic development of Egypt during the Late Period follows in **Chapter 4**.

During the last period of indigenous rule foreign relations were designed to foster strategic allegiances with Sparta and Athens in order to help keep the Persians out of the country and to destabilize the western parts of the Persian Empire in the Levant as

[90] Lloyd 2000: 371–2, see also n. 79.

[91] Lloyd 2000: 374–6.

[92] Aided by Egyptians such as Udjahorresnet, who helped design Cambyses' pharaonic titulature and guided the Persian emperor towards favourable behaviour, see Holm-Rasmussen 1988; Baines 1996; Lloyd 1982: 169–73; Lloyd 1983: 294, 297; Vittmann 2003: 122–6.

[93] Agut-Labordère 2005: 50–2.

much as possible.[94] This was a continuation of a previous Saite policy to ward off the Neo-Assyrians and Neo-Babylonians.[95] Internally, Egypt was weakened by continuous dynastic turmoil.[96] Temple building activities and the quality of sculpture, however, reached new heights as many additions were made in hard stones such as granite.[97] As the major economic centres, this was not necessarily just a sign of piety, but also an investment in Egypt's domestic economy. At times warfare demanded much of the capital stowed away in temple reserves.[98] The policy of disrupting of active and passive meddling in the Eastern Mediterranean, however, did not prevent ongoing trade activities. In all likelihood they even strengthened the ties with the Aegean.[99] The strategy was ultimately doomed and after two previous unsuccessful attempts Artaxerxes III demolished the walls of the major cities in Egypt[100] and brought Egypt under Persian rule again in 343 BC. Classical sources are silent on Egyptian matters from this point until the conquest of Alexander the Great, but in Egyptian sources there are indicators of rebellion and unrest.[101] Alexander and the Ptolemies brought Egypt firmly into the Hellenistic world. The foundation and rise to prominence of Alexandria is likely to have influenced the amount of traffic down the Canopic branch of the Nile, as seems to be suggested by a majority of local pottery and corresponding decline of imported pottery at Thonis-Heracleion from the 3rd century BC onwards.[102]

A closer examination of objects found in Thonis-Heracleion will contribute significantly to the history of Nile delta and will elucidate some of the economic processes with regard to long-distance trade and other changes occurring during these tumultuous centuries. Thonis-Heracleion did not operate in vacuum, but was part of

[94] Ray 1987: 83; Ruzicka shows throughout his book how the continuously shifting Aegean allegiances with Egypt and Persia followed the ebb and flow of the Egyptian-Persian conflict and the resulting power balance in the Eastern Mediterranean, or 'middle territory', e.g. Ruzicka 2012: 44–8, 99–111, 164–76.

[95] Lloyd 1983: 287.

[96] Lloyd 1994: 337–41.

[97] Lloyd 1994: 353–5.

[98] Lloyd 1994: 343; Ray 1987: 85, n. 17 and 86.

[99] Lloyd 1994: 347–9.

[100] Diodorus Siculus 16.51.2; Lloyd 1994: 344; Lloyd 2000: 390.

[101] For an overview, see Ruzicka 2012: 199–209.

[102] Grataloup 2010: 155–6.

the larger landscape of the Egyptian delta alongside several other important sites (Figure 1.1). The following section discusses several sites that are chosen here because they played a significant role in the region or had a relationship with Thonis-Heracleion. Their excavation history and state of preservation are outlined.

1.2.2. Sa el-Hagar / Sais[103]

Today very little survives of the capital of the 26th dynasty described by Herodotus (*Hdt*. II.169–171). The modern site of Sa el-Hagar is located along the Rosetta branch of the Nile in the west of the delta and functioned as the capital of Egypt during the 26th Dynasty (Figure 1.4). P. Wilson of Durham University has been working here since 1997 surveying the site.[104] Results from drill augers at the site show evidence for Neolithic, predynastic, Old Kingdom, New Kingdom, Third Intermediate Period, 26th Dynasty, Ptolemaic, and Roman presence.[105] As in many other delta sites, the archaeological zone covers a large area: 3 km by 2 km; with clusters on areas of high ground elevated above the floodplain.[106] There are three main areas at Sais: the 'Great Pit', the Northern Enclosure and the Southern Enclosure.

The 'Great Pit' was already dug and disturbed before the 18th century as is clear from drill cores and test excavations.[107] It was completely demolished in the second half of the 19th century. At the northern enclosure high mudbrick walls were still visible in the nineteenth century, but have since gone.[108] The modern fields in the area still yield Attic black gloss sherds. The current top layers in the 'Great Pit' are near the level of prehistoric and predynastic remains.[109] At the western edge of the 'Great Pit' sections have been made and seem to point to the presence of disturbed Saite material in this

[103] Leclère 2008: viii–ix, 159–96.

[104] P. Wilson 2006.

[105] P. Wilson 2006: 147, 241. A toponym in Assyrian sources meaning "Harbour of the Lord of the (two?) Lands" is identified with Sais, see Kahn 2006: 254 n. 22.

[106] P. Wilson 2006: 241–2.

[107] P. Wilson 2006: 250; for ancient destruction layers from the Saite period and its use as a quarry for Alexandria, see P. Wilson 2006: 147, 243.

[108] P. Wilson 2006: 253–4.

[109] P. Wilson 2006: 251.

area.[110] Drill augers were also taken from the village of Sa el-Hagar itself, where Attic black gloss fragments were found in one of the cores.[111] The general lack of Saite material from this area is striking and it suggests a thorough removal of archaeological remains by *sebakh* diggers.[112] Much is known about the temples and other associated buildings from Herodotus' description, but the destruction of Sais has proceeded too far to create a map of Sais incorporating this information.[113] The Northern enclosure is perhaps the most likely location for the temple of Neith, the main goddess in the city.[114] The location of the temple of Osiris-Hemag is unknown, as is the location of the 26th dynasty royal necropolis.

The important role of Sais in determining the economic activities in Thonis-Heracleion is evident in the phrase 'Thonis of Sais' on the Heracleion stela.[115] Another important settlement for Thonis-Heracleion is the Greek settlement Naukratis.

1.2.3. Kom Geif / Naukratis[116]

Naukratis was on the same (Canopic) branch of the Nile around 100 km upstream from Thonis-Heracleion. Before the discovery of Thonis-Heracleion, it was considered the only Greek city and emporion in Egypt. A direct connection between Naukratis and Sais on the Rosetta branch of the Nile via a canal is presumed, but it has not been identified with certainty.[117]

W. M. Flinders Petrie of the Egypt Exploration Fund identified Naukratis with Kom Geif in 1884.[118] Two excavations seasons were undertaken at the site, the first in 1884–5 led by Petrie himself, and another led by E. Gardner on behalf of Petrie in 1885–6. Conditions were far from ideal. A high water table made work difficult and

[110] P. Wilson 2006: 243.

[111] P. Wilson 2006: 252.

[112] P. Wilson 2006: 254.

[113] P. Wilson 2006: 29.

[114] P. Wilson personal communication.

[115] See n. 25.

[116] Leclère 2008: viii, 113–57.

[117] P. Wilson 2010: 116.

[118] Petrie 1885.

the *sebakhin* continuously mined the mudbrick remains to use as fertilizer.[119] Work concentrated on the sacred areas such as the Great Temenos, sanctuaries of Apollo, Hera, Aphrodite, of the Dioskouroi and a scarab factory. D. Hogarth continued work on the site in 1899 and 1903, which he found much changed. He concentrated on the Great Temenos, which he was not able to retrace and subsequently concluded that it did not exist. [120] Both excavations were published promptly although not comprehensively.

W. Coulson and A. Leonard went to Naukratis with an American team to re-examine the site through survey in 1977–78 and excavations from 1980 to 1983,[121] shedding much light on the post-archaic site.[122] The central part of the site was by now flooded. Finally in 2012, the British Museum conducted a short season of 8 days in order to address inconsistencies and gaps in existing excavation reports and integrate the new fieldwork with the old.[123] One of several questions this fieldwork will address is whether Greek and Egyptian quarters may be identified, and if so, establishing their chronological development.[124]

A database with the location of the material from Naukratis is currently being compiled, first by the *Mainz Naukratis Projekt* and now continued with a large project at the British Museum, which holds approximately half of the total amount of material. This work is necessary because the material taken out of Egypt during the early excavations by Petrie and Hogarth was distributed among subscribers to the Egypt Exploration Fund, who had funded the initial two seasons.[125] Analysis of the material from the previous excavations is complicated by the dispersal of the artefacts over many different collections. It is also not clear how much material, local (Egyptian) coarse

[119] Petrie 1885; Petrie 1886; Gardner 1888.

[120] Hogarth et al. 1905: 107.

[121] Leonard 1998, Leonard 1997; Coulson 1996; Coulson and Leonard 1981.

[122] Villing and Schlotzhauer 2006a: 3.

[123] Thomas and Villing 2013: 82.

[124] Thomas and Villing 2013: 84.

[125] Villing and Schlotzhauer 2006a: 3.

wares for example, was discarded on site. Several important books and conference proceedings have appeared since 1999, and more are due to appear.[126]

The earliest archaeological evidence consists of Greek ceramics from the last quarter of the 7th century BC, or contemporaneous with Psamtik I.[127] This date indicates the earliest trading presence in Naukratis and contradicts Herodotus who attributes the foundation of Naukratis as a Greek trading post to Amasis (*Hdt*. II 178).[128] The last quarter of the 7th century BC is also the same date as the earliest Greek ceramics from Thonis-Heracleion.[129] Naukratis' status as a Greek trading settlement, i.e. port-of-trade, and / or polis, is subject of an on-going debate.[130] Naukratis was initially the *only* Greek polis in Egypt according to Herodotus (II,179). It is clear now that at least by the 4th century BC Thonis-Heracleion functioned as a customs office for traffic on this branch of the Nile.

The presence of Egyptians in Naukratis is also debated,[131] as Greek material dominates the modern collections. This picture is biased since most of the objects that were kept, including pottery, was found in the Greek sanctuaries. The Great Temenos was identified as the site of temple of Amun-Re Baded.[132] The epigraphic evidence for this deity dates from the reign of Apries,[133] increasing in number thereafter.[134]

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[126] For a broader perspective, see e.g. Boardman 1999[4]; Möller 2000; on pottery, see Villing and Schlotzhauer 2006b. Two workshops (December 2011 and June 2013) are due to be published; any unpublished material mentioned in the presentations at these is cited here as 'personal communication.'

[127] Villing and Schlotzhauer 2006a: 5 n. 16.

[128] On the discrepancy between Herodotus and the archaeological evidence, see Pfeiffer 2010; Snodgrass 2006: 7, 11-3.

[129] C. Grataloup, personal communication.

[130] See Pfeiffer 2010; Villing and Schlotzhauer 2006a: 5; Möller 2000; Bresson 1980.

[131] This is one of the research questions of the current Naukratis project in the British Museum, see Thomas and Villing 2013: 84; see the discussions on contacts between Greeks and Egyptians (in Naukratis) in Yoyotte 1991–1992, 1993–4; and in the past a significant Egyptian population was considered unlikely, see Möller 2000: 203, n 151; Villing and Schlotzhauer 2006a: 5–6.

[132] Thomas and Villing 2013: 97 ff.; Edgar 1922; and for a discussion of the Great Mound within the Great Temenos, see Muhs 1994: esp. 110–3.

[133] Leclère personal communication, stela Berlin 7780, now destroyed.

[134] Leclère personal communication; Yoyotte 1983; Guermeur 2005: 126–38.

Guermeur has also argued convincingly that Naukratis is the Greek version of an Egyptian name, and not the other way around.[135]

1.2.4. Tell Defenneh / Daphnai[136]

Turning to the eastern delta, Tell Defenneh lies on the one of two routes from Egypt to the Levant. The alternative route runs through the Wadi Tumilat and passing Tell Maskhuta. This fortress is situated in the desert and is nearly ten kilometres west of the Suez Canal.[137] It is unlikely that the site was occupied before the Saite dynasty.[138] Petrie started work here in order to find evidence for Carian and Ionian presence at Tell Defenneh, or Daphnae,[139] as known from Herodotus (I,154). Petrie interpreted the Greek pottery including examples with pottery marks as indicating Greek manufacture, and iron 'works and tools' abundantly present at the site as Greek presence, proving in his view that a garrison of Carians and Ionians was stationed here.[140]

These conclusions have subsequently been rejected and the area is now interpreted as an Egyptian temple.[141] Foundation deposits, similar to the ones from Tanis, Balamun and Naukratis indicate that it was founded by Psamtik I.[142] Many jar seals were found with the name of Psamtik II and Amasis, whereas of Apries just a single plaque and no seals were found.[143] Petrie erroneously dated the latest pottery fragments no later than the Persian period, whereas most is in fact from the reign of Amasis.[144] This has been re-evaluated recently.[145] After collecting material from Tell

[135] Guermeur personal communication.

[136] Leclère 2008: xiii, 507–40.

[137] Petrie 1888a: 47; Leclère 2007; Leclère 2008: xiii, 507–40.

[138] Leclère 2008: 510.

[139] Petrie 1888a: 47–8.

[140] Petrie 1888a: 48.

[141] Leclère 2007: 15; Leclère 2008: 519, 524–9.

[142] See the section on the Late Period in Section 2.2.2.7; Petrie 1888a: 48, 54–5. There were pieces or plaques of lead in the foundation deposits as well as copper and iron ore, Petrie speculates it was a reference to smelting works of Greeks or to the metal trade from Asia and the protection thereof, see Petrie 1888a: 55.

[143] Petrie 1888a: 51; Leclère 2008: 520 ff..

[144] Petrie 1888a: 52; Leclère 2008: 518.

[145] Leclère 2007: 15–6.

Defenneh in museum collections, Leclère concludes that the material is in fact predominantly Egyptian.[146] On the basis of satellite images Leclère proposes the presence of an Egyptian temple, although further research at the site would be needed to clarify the exact situation.[147] Egyptian rescue excavations are currently taking place.

The identification of Daphnae and Tell Defenneh as the site of the *stratopeda* mentioned by Herodotus has been rejected.[148] After the Persian invasion of 525 BC there is limited ceramic evidence of continuation at the site in the 5th century, after which there is a Greco-Roman and Byzantine occupation in a limited area.[149]

1.2.5. Tell el-Ruba' / Mendes[150]

Mendes is one of the largest and best preserved tells in the Egyptian delta, which was occupied since the Early Dynastic period.[151] The site is divided into two parts: one is the temple precinct with the naos of Amasis, the other a residential and industrial area.[152] From 1964 up until 1980, an American team undertook eight excavation seasons.[153] The first six seasons were spent on the temple area, the last two on filling the chronological gap of the New Kingdom and Third Intermediate Period in the excavated material. D. Redford continued work at the site from 1992 and has concentrated on the temple.[154]

Around a hundred pieces of Greek imported pottery the seventh to mid 4th centuries BC were excavated, although they are not from a primary context.[155] The earliest Greek pottery is almost exclusively East Greek area and can be dated to the last quarter of the 7th century BC, whereas later finds are consistently Attic.[156] Inscribed

[146] Leclère 2007: 16.

[147] Leclère 2007: 17.

[148] Leclère 2008: 518 n. 36.

[149] Leclère 2008: 29–30.

[150] Leclère 2008: x, 313–61.

[151] K. L. Wilson 1982: 1.

[152] K. L. Wilson 1982: 2.

[153] For excavation reports, see K. L. Wilson 1982: 2, n. 3.

[154] Redford 2004, 2009.

[155] K. L. Wilson 1982: 27.

[156] K. L. Wilson 1982: 27.

fragments from the temple also suggest much activity during the 26th, 29th, and 30th dynasties.[157] Artaxerxes III destroyed the city in 343 BC, Ptolemy II restored it, before the Nile arm silted up by the 1st century BC and the town dwindled.[158]

Wilson also comments on the presence of Greek pottery at Mendes:

> *Among the published sites, Mendes is fourth behind Naukratis, Defenneh, and Memphis in the number of fragments of Greek pottery excavated, yet at Mendes there is no independent evidence, whether archaeological, epigraphical, or textual, for Greek habitation. Since the corpus of this pottery from Mendes is relatively small and comes only from secondary context, it would be premature at this point to draw conclusions concerning the reasons for its presence at the site.*[159]

1.2.6. Tell Nabasha

Tell Nabasha is located 8 miles southeast of Tanis.[160] Petrie excavated at the site, as well as at Tell Defenneh in 1885–86. The granite shrine partly visible from the surface drew him to the site.[161] The remains of monuments in the temple area date to the later part of the 26th Dynasty, when Amasis undertook the rebuilding of the temple as demonstrated by the foundation deposits.[162] Traces of earlier phases of temple building from the Middle and New Kingdom[163] were also found, however, nothing remained *in situ*.[164] All that remains of the Saite temple is the foundation enclosure, a thick double pavement and the back of the granite shrine mentioned above, standing on a block of quartzite sandstone.[165] The shrine is inscribed with two damaged columns of hieroglyphs on both sides of the door. Petrie proposed to reconstruct the name of

[157] Redford 2009: 13 ff.

[158] Redford 2009: 19, 22–3.

[159] K.L. Wilson 1982: 29.

[160] Petrie 1888a: 4; the town is identified by four monuments: the table of offering, the statue of Merenptah, a fragment of a limestone statue and a fragment of a green basalt statuette all bear the name of the town, see p. 14.

[161] Petrie 1888a: 8.

[162] Petrie 1888a: 7, 14–5.

[163] Petrie 1888a: 9–12, 13, 15.

[164] Petrie 1888a: 11.

[165] Petrie 1888a: 12.

Amasis in the inscription, in accordance with the foundation deposits, which contained a plaque with this king's name.[166] Also in the deposits numerous items of pottery were found, representing 'ceremonial imitations' of larger vessels, to prevent reuse of these items that could possibly have been used during the foundation rite.[167] Multiple plaques were found in each corner, from 15 to 21 specimens, and they were made of different metals and stone. In each corner a single plaque made of lead, 'distinctly not inscribed', was also found.[168]

Petrie also worked in the cemetery of Tell Nabasha, identifying 'Cypriote' and 'Saite' burials.[169] He is convinced that these 'Cypriote' tombs belong to Cypriote mercenaries who came in the wake of the Carians and Ionians at Tell Defenneh during the reign of Psamtik I.[170]

1.2.7. Concluding remarks

The brief survey of Sais, Naukratis, Tell Defenneh, Mendes, and Tell Nebesheh shows the difficulties with the preserved archaeological material in the Nile delta and the difficult conditions it presents for archaeology. Important settlements are destroyed to the point that even reconstruction of a basic settlement layout is occasionally impossible. It demonstrates the importance of new fieldwork in the delta, especially with the help of modern techniques, to help fill the gaps and clarify inconsistencies in publications of older excavations. Work at Thonis-Heracleion has the potential to contribute significantly to a better understanding of settlements in the delta, and the nature and activities of its population. The preservation of metals in underwater location is also very good, which means that this object category will add another dimension unavailable at sites on land.

[166] Petrie 1888a: 13.

[167] Petrie 1888a: 15.

[168] Petrie 1888a: 14–5.

[169] Petrie 1888a: 17–25.

[170] Petrie 1888a: 21.

1.3. Aims

It is in this broader context of the Egyptian delta that Thonis-Heracleion needs to be placed. Through a selection of lead objects, this thesis concentrates on Thonis-Heracleion's position and role as an important node in trade networks in Egypt and the Eastern Mediterranean. Both the large number and the diversity of shapes and sizes of the lead objects make this corpus unique in antiquity. The present study contributes a new chapter to the study of ancient metallurgy, because a corpus of lead objects has not been studied systematically in its own right. The corpus from Thonis-Heracleion allows a new and different perspective on levels on metallisation, i.e. the use of metals in society, in antiquity.[171] **Chapter 2** has two parts. The first part presents an overview of the origins of lead metallurgy, lead objects from Egypt, and it has a brief description of literature on lead in antiquity. The second part discusses the whole corpus of lead objects, excluding the objects selected as case studies. This overview is new and it suggests that lead had a wider use than previously appreciated. It also demonstrates the exceptional nature of the corpus at Thonis-Heracleion.

The corpus as a whole is too large and diverse to receive a full and detailed treatment within the scope of this thesis. By focusing on the economic dimension of the town, other categories such as the oil lamps, pieces of lead sheathing, net sinkers, sounding weighs/leads, anchor stocks are not selected for detailed study, but discussed in **Chapter 2** only. The choice of objects is aimed at putting Thonis-Heracleion and its trade network into focus: lead containers, weights, and lead ingots as raw material for further use in the manufacturing process (**Chapters 3–5**). These chapters describe economic life and trade mechanisms on two levels. Firstly, lead is a trade commodity in itself, as the galena mines in the Eastern desert do not seem to be exploited on a significant scale during the first millennium BC. Secondly, the objects themselves by their nature as the weights and ingots, also contribute directly to our understanding of economic life in Thonis-Heracleion.

In **Chapters 3–5**, parallels for the lead objects from the underwater excavations are found around the Mediterranean. In general, parallels are few, however, and comparanda in other materials are necessary in order to establish or compare the dating.

[171] W.V. Harris coined the term 'metallisation', see Harris 2007: 532

They also help to build up a picture on the function and use of the lead object, and potentially its deposition. The general assemblage of **Chapter 2** is compared and contrasted with relevant assemblages from Egypt, Olynthus, and Pompeii. Combining this with the case studies, this thesis starts to build up a picture of lead in the ancient world that was previously uncharted.

Several questions are asked of the material. The most obvious question is regarding the size and diversity of the corpus. The corpus is exceptional in terms of sheer volume and the question is whether it was exceptional in antiquity and how this reflects the level of metallisation in this Egyptian port city?

Another important goal of this thesis is to provide a robust dating framework for the objects that are otherwise unique in the archaeological record. In view of the lack of direct parallels for the lead objects, comparison with objects of similar shape, but different composition, is necessary. A framework for dating is constructed through the study of the geographical distribution of individual groups across the site. These groups, and other significant clusters, are then compared to the datable ceramics and coins in the immediate vicinity. This leaves the immediate context of the objects at the site as the main reference in the discussion. Analysis of groups of material culture made of different material such as bronze and ceramic may serve as a conceptual model to explain the presence, dating, and role of the lead counterparts. Finally, the choice of material may have significance in terms of value and symbolism. Although the selection of objects is deliberately geared to a mundane, daily life role, the symbolic properties of lead must also be considered. This is especially necessary for areas where there is much ritual activity known from other well-established groups of material culture. Thus, the lead objects are used to see how and where the activity illustrated by the objects fit into the chronological development of trade between Egypt and 'abroad', as well as the relationship between Naukratis and Thonis-Heracleion.

1.4. Structure

The central part of this thesis focuses on three case studies that deal with the selected lead artefacts from Thonis-Heracleion. **Chapter 2** surveys the use of lead in antiquity from its first appearance during the 6th millennium BC until the Roman period in Egypt and discusses the corpus from Thonis-Heracleion as a whole. This

overview creates the background for the discussion of the corpus of lead objects from Thonis-Heracleion. In **Chapters 3–5** three relatively large and internally coherent groups were selected because of their unique size, quantity, and lack of parallels in the case of the lead containers. The selection of the objects from the larger corpus is discussed in **Chapter 2**.

Each chapter contains an introduction to the corpus, followed by a discussion of the archaeological context of significant spatial clusters of lead objects. In principle only objects that were personally recorded and photographed are present in this thesis. Groups are sorted in the typology according to size, i.e. on the basis of attributes. The clusters discussed in the chapters may contain objects across several different categories (see Section 5.3.7), as each group identified in the catalogue may not have a significant spatial distribution *per se*.

A few remarks on the spatial distribution of objects are necessary. The stratigraphy underwater contains a mobile upper layer in which objects may move around. On account of their high mass-density, the lead objects tend not to move around much. The horizontal distribution is considered a more or less accurate reflection of the deposition of the object. The vertical stratigraphy is not relevant or unknown in the case of prospection, but it will be discussed where present. Ceramics and coins may move around if they are from the upper mobile layer of sediment. Large numbers of coins are sometimes bagged under a single inventory number. The spatial distribution of these, therefore, is considered akin to a plough-soil assemblage, which has the potential of giving a general date range for the immediate environment, with the possibility that 'intrusive' items may be present.

The lead ingots of **Chapter 3** are an object category that is incontestably a trade commodity, i.e. raw material in bulk form in transit for further processing. I supplement the discussion of the lead ingots with the small number of silver ingots also from the site. The concept of an ingot as bulk transport of metal makes it interesting as one of the few identifiable trade goods in the archaeological record apart from ceramics. The grain trade between Egypt and Athens with grain leaving Egypt in return for silver, wine, oil, as well as lead (presumably) is well established from the 5th century onwards. Unfortunately, while it was not possible to do any lead isotope analysis or other chemical analysis on the ingots, it may be possible to suggest the original mine from

which the lead originates on the basis of a comparison of size, shape, and preserved weight of other lead ingots.

For the lead weights in **Chapter 4** a similar approach was taken. The group of weights from the site includes 9 inscribed Attic weights from Athens. The Athenian Attic weight standard is the weight standard that is best understood in the Aegean. The symbols and inscriptions correlate to their multiple or fraction of the weight standard, which in turn allows for cross-referencing and dating. The weights from Thonis-Heracleion are a very important addition to the study of weights in the Eastern Mediterranean. The preservation of lead and bronze underwater in a sediment layer, as opposed to exposed on the seabed, is much better and more stable than on land. I argue in **Chapter 4** that the correlation between the multiple and/or fraction indicated on the weight and the preserved mass is so accurate due to the underwater preservation. The degree of accuracy shown by the inscribed weights has repercussions for the analysis of weights in general, where inaccuracy levels up to 20% are accepted. Analysis of the weights with symbols and letters guides the study of the anepigraphic examples. The weights and ingots have a potential to shed light on the trade and trade goods present in Thonis-Heracleion. The weights make a relatively secure dating possible through cross-referencing with weights from the Greece.

The lead containers in **Chapter 5** form a large, internally coherent group of objects. Ranging from very large to very small, they may range in function from storage containers for commodities, to simple multipurpose dishes. This category is relatively unknown in the archaeological record on land occurring on shipwrecks instead. Consequently, lead containers are considered particularly suitable for maritime transport.[172] At Thonis-Heracleion, all containers with a diameter of more than 40 cm remain underwater, which is a significant portion of the corpus, and were not examined personally by the author. An exception was made for the largest containers for which an interpretation is presented on the basis of their functional aspects on a conceptual level (Figure 1.5). Different groups of containers are considered with regard to their spatial distribution around the site, the coins and ceramics in the vicinity, and parallels in different materials. This combination allows me to draw conclusions about

[172] Rosen and Galili 2007: 302. See **chapter 2**.



Figure 1.5 Lead container no. **190** (left) and no. **184** (right) ©Franck Goddio/Hilti Foundation.

the dating and function of the objects and to refute the idea that lead artefacts had a predominantly nautical original use.

Using these case studies, the presence of the large number of lead objects in Thonis-Heracleion is put into its direct archaeological context, as well as in a broader Mediterranean perspective. By taking three categories from the overall corpus, it shows the variety of the shapes and sizes, and different roles that they played in the life of the port.

The majority of the lead objects from Thonis-Heracleion may be dated to the late 5th to early 2nd century BC. This is corroborated with the picture emerging from the coins and ceramics from the site. Finally, the concluding chapter assesses the role of Thonis-Heracleion in the wider perspective of the dynamics of the Egyptian delta and trade activities.

1.5. Methodology — Selection of Objects

The backbone of this thesis is the catalogue of a selection of lead objects from Thonis-Heracleion. Data collection for the catalogue occurred during four seasons in the Maritime Museum in Alexandria, consisting of three weeks in May 2009, five weeks in April–May 2010, three weeks in October–November 2010, and a final two weeks in September 2011. The storerooms in the Maritime Museum contain a selection of ceramics, metal, and some stone objects. Objects of suitably small size are stored by inventory number, i.e. individually or as a group under one number, with their label in a plastic zip lock bag. Larger objects have a tag attached with the inventory number, and occasionally there is extra information such as an indicator of the provenance within



Figure 1.6 Scrap lead.

the site.[173] Groups of objects are then stored in larger plastic boxes and stacked on shelves in the storeroom. The work was carried out in the open air outside of the storeroom proper.

The first two seasons of data collection consisted of systematically describing all objects per box, as they were offered to me. This allowed me to come to terms with the large and disparate corpus. I used the last two seasons for a targeted approach trying to complete the documentation of several groups of objects, such as the weights, including stone and bronze examples, as well as the lead containers. In total, I documented around 600 objects. This does not include all the lead found from the site. Many unidentifiable lead pieces or scrap are collected during the dives, and these are not recorded (Figure 1.6). Very fragmentary but still identifiable objects are recorded, after which they are put into underwater storage. A large portion of lead objects identified as containers, mainly from the 2004 season, remains underwater. No photographs exist. When measurements of the diameter are present, they are listed in the catalogue and discussed briefly. When measurements are absent and no picture is present, they are not discussed.

Apart from concentrating on two large groups within the lead corpus, which sharpened the focus in the last two seasons, other practical constraints were applicable. Objects recovered during the 2010, 2011, and 2012 missions are not considered.

[173] There is a separate numbering system devised by the SCA inspectors taking care of the storerooms at the Maritime Museum, these numbers are not included here.

Following excavations, all objects remain on board of the research vessel for the duration of the excavation season. At the end of the mission they are transferred to the mainland, where they continue to undergo a desalination process. Where necessary, the conservators treat the objects by cleaning and removal of marine encrustations.[174] Occasionally, restoration work is also carried out.[175] Consequently, objects from these seasons could not be included in this thesis. A selection of well-preserved and interesting objects toured Europe and Japan with the exhibition 'Egypt's Sunken Treasures' from 2006 to 2011. It was only when the number of objects for the exhibitions in the United States was considerably reduced, that those objects returning to Egypt could be studied.

Nearly every object in the catalogue has an accompanying set of photographs.[176] The images were taken outside on a black velvet background in the shade and using a Nikon D90 camera. In later seasons a grey card was used to aid the colour correction in Adobe Bridge. Photographic documentation also takes place on board ship, with the objects still wet from the conservation tanks. These photographs do not appear here, with the exception of the photographs taken of the two large containers raised from the sea floor (Figure 1.5).

S. Heinz and I worked together in the storerooms. A degree of overlap exists between our work: the lead statuettes belong in the study of statuettes in general and Heinz recorded those. To aid this division, it was decided that I would concentrate on objects with a functional, more mundane role.

1.6. Perspective

The analysis of these more mundane objects will contribute to rewriting the narrative of the western delta. The reference work on archaic trade at Naukratis assessing its role as a Polanyian port-of-trade preceded the discovery of Thonis-Heracleion.[177] Naukratis, the famous Greek *emporion* further upstream on the same

[174] For a description of the restoration and conservation work, see Goddio and Fabre 2008[2]: 282–8.

[175] E.g. Robinson 2009: 147–8 no. 101.

[176] I took all images, with the exception of small number of objects, for which individual photographers are credited.

[177] Möller 2000.

branch of the Nile, must have had a close, and dynamic, relationship with Thonis-Heracleion at the mouth of this branch of the river. The earliest pottery from both sites is dated from the last quarter of the 7th century. Thus, the archaeological record commences at both sites at the same time, but Naukratis continues into the Roman period long after activity in Thonis-Heracleion ceases. It calls into question how the relationship between the two towns along the Nile developed over time, both internally in Egypt as well as externally in terms of long-distance trade.[178] From at least the 4th century the Heracleion stela makes it clear that the town functioned as a customs office.[179] There also seems to be a garrison installation at Nelson's island at this time.

For our purposes, four spheres of activities in Thonis-Heracleion may be identified: military, economic, nautical, and religious. Trading of basic commodities from ships reaching their first harbour after a sea voyage, taxation of imported goods, and religious activities, both in the temple and in a less formal environment, all took place. Another significant presence at the site is the large number of ships and boats: lead objects are considered a significant part of the equipment, e.g. anchor stocks and lead sheathing.[180] The lead objects should therefore be understood in this broader maritime environment.

The details of the material are treated separately in the catalogue. The archaeological context is discussed in the text of the chapters. All dates in the text are BC, unless indicated otherwise. For the absolute dates in this thesis see the table n I. Shaw (ed.) 2000, The Oxford History of Ancient Egypt. Oxford, Oxford University Press. P. 479–83.

[178] Pfeiffer 2010.

[179] Von Bomhard 2012.

[180] For a basic discussion of lead on ships, see Rosen and Galili 2007.

CHAPTER 2. LEAD IN THE ARCHAEOLOGICAL RECORD IN EGYPT

In this chapter I present a survey of the appearance of lead in pharaonic Egypt, both in textual sources and in objects. Lead is little studied in Egyptology and only marginally better studied in classical archaeology.[181] The discrepancy between the abundance found in Thonis-Heracleion and the scarcity of material from the rest of Egypt requires explanation. This brings up the question of survival and metallisation of society in antiquity. I will argue that the metal assemblage from the site is a more accurate reflection of the level of metallisation than is normally envisaged.

This survey starts with a brief discussion of the beginning of metalworking in the Near East from 8th millennium to the late 3rd millennium BC. An overview of sources of lead such as galena ore illustrates the distribution of the metal in the Eastern Mediterranean. Finally the discussion concentrates on lead from Egypt. Literature on lead in Egypt is reviewed, followed by a survey of objects made of lead with a known Egyptian provenance. I have chosen to conclude the survey when Egypt becomes a Roman province in 30 BC for two reasons. The first is that the occupation at Thonis-Heracleion ceased at some point during the second century BC, before a limited resumption of activity in the Byzantine period.[182] Secondly, the Roman period also sees an exponential growth in the mining and use of lead.[183] These two considerations, the end of the town and the different nature of the lead 'industry' associated with the Roman empire, make the start of Roman rule in Egypt a natural end to this overview.

[181] For general overviews for Egypt: e.g. Helck 1975a, 1975b; Ogden 2000; Lucas and Harris 1962: 243–4; for classical archaeology: e.g. Nriagu 1983, Eiseman 1980. See also the literature review below in Section 2.2.3.

[182] Dating for the shipwrecks found in the area, see Goddio 2007: 75; and for complementary dating from the ceramics from Thonis-Heracleion, see Grataloup 2010.

[183] Evidence from Sweden suggests a peak in lead production in the 1st century BC, see Renberg et al. 1994: 324; Nriagu 1998: 1622.

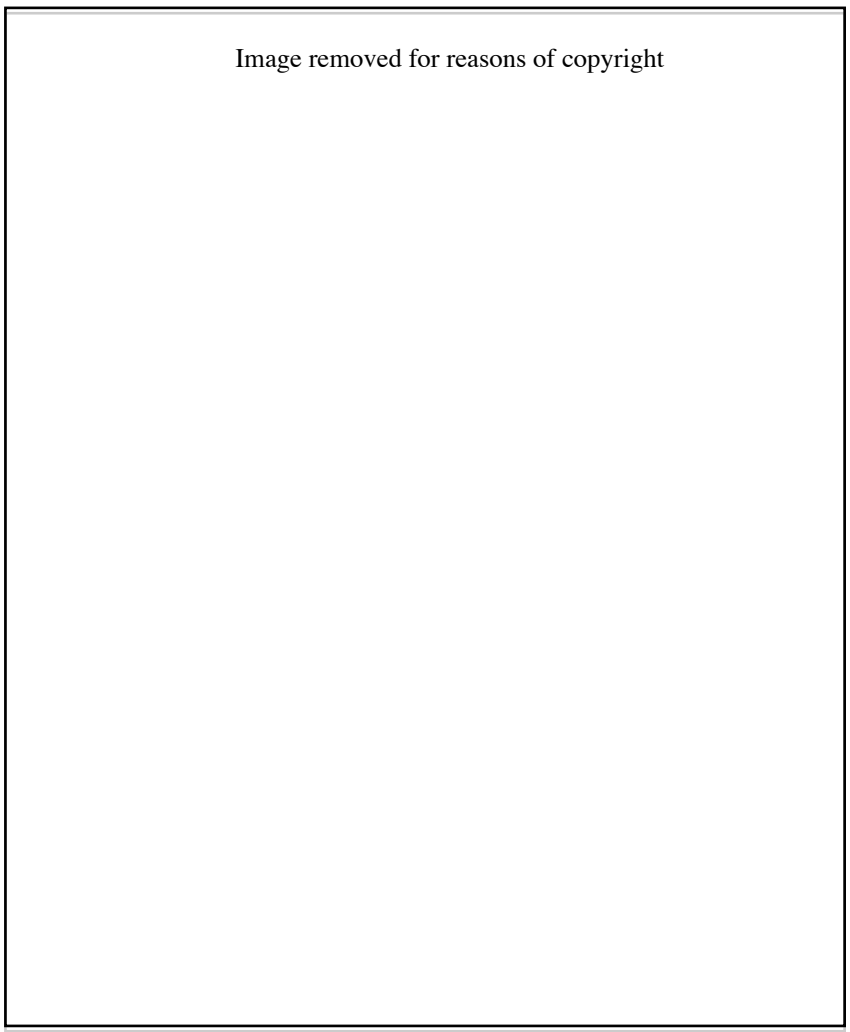


Figure 2.1 Map of Egypt and the Near East showing the areas where metals are found, including lead, after Wengrow 2006: 15 fig. 1.1.

2.1. Outline of the beginnings of metallurgy

The earliest evidence for the working of metals comes from the region stretching from central Anatolia to northern Mesopotamia.[184] (Figure 2.1) The appearance of objects made of native copper, mainly small trinkets, coincides with the appearance of the first farming communities in the Near East in the 8th millennium BC.[185] The 'invention' of metallurgy most likely did not diffuse from the Near East, but developed independently in the Balkans and the Iberian Peninsula.[186] Gold, silver, lead, and

[184] For a good general overview of the development of the field of archaeometallurgy within archaeological sciences, see Killick 2001. For Çayönü Tepesi, see Muhly 1988b: 5–9.

[185] Craddock 1995: 97–8; 122–6; Tylecote 1991[2]: 1 nos. 4–5; Muhly 1988a: 4–6.

[186] Killick 2001: 485, 490; Muhly 1988b: 5–8.

copper are the first metals used and exploited.[187] The low melting temperature of lead would have encouraged early metallurgists to use this metal for beads and small objects.

The earliest appearance of objects made of hammered native copper ore, the most common native metal, is from Çayönü Tepesi in southeast Anatolia.[188] Dating to the 8th to 7th millennium, more than 50 small objects of native copper were found, albeit as a local phenomenon.[189] Wertime suggests that metal was first appreciated and used as attractive stones — native copper appears on the surface in shades of bright blue and green for example — before actual metallurgy developed.[190] It was not just copper and lead that was utilised. Gold objects of a very high purity were found in the cemeteries at Varna, Bulgaria.[191] More than 3000 objects, weighing more than 6 kilos in total, can be dated to the 5th millennium BC.[192] The purity of the gold suggests that refining was taking place. Copper slag was found in Çatalhöyük dating to the 6th millennium BC and contemporaneous copper pieces from Yarim Tepe are also suggestive of smelting.[193] It is only from the fourth millennium, however, that there is clear evidence for the smelting of copper.[194]

The earliest attestation of smelted lead in the archaeological record is from Anatolia and northern Mesopotamia.[195] There is a lead bracelet from Yarim Tepe I from the 6th millennium BC[196] and a roughly contemporary lead bead from Jarmo, a

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[187] For a summary, see Killick 2001: 487–8, fig. 39.1.

[188] Muhly 1988a: 5–6; for a general discussion of the site with only a single mention of the copper objects, see Braidwood et al. 1981: esp. 250; for a map of the sites with the earliest copper metallurgy, including Çayönü Tepesi, and the regions where early copper and lead were mined, see Wertime 1973: 879 fig. 3.

[189] For an overview of early copper artefacts, see Gale et al. 1991: 50–1, table 1. The presence of copper objects at Çayönü Tepesi is restricted to certain archaeological strata, and the technology also does not seem to spread, but the latter may perhaps be due to lack of evidence/excavation elsewhere, see Muhly 1988b: 6.

[190] Wertime 1973: 876, 878.

[191] Eluère 1989: 61–2.

[192] Ivanov 1991: 9.

[193] Vitrified copper dating to 7000–6000 BC, see Tylecote 1991[2]: 7 n. 4; also Gale et al. 1991: 50–1 for further references for both examples. Muhly disagrees, and thinks it is crucible or melting slag, Muhly 1988a: 7.

[194] Craddock 1995:126–7, also Tylecote 1991[2]: 7 n. 7.

[195] Muhly 1988a: 7. For a map of the Mesopotamian sites mentioned here, see Muhly 1988b: 2 fig. 1.2.

[196] Found on virgin soil under a corner of house 345, perhaps as a deposit, see Merpert and Munchaev 1987: 17, pl. Vb; Merpert et al 1977: 82, 84 pl. XII no. 2; see also Craddock 1995: 125.

village in the Chemchemal valley of North Eastern Iraq.[197] The (year-round) occupation of this village dates to between 9000–6500 BC.[198] Another early appearance of lead is in Çatalhöyük in central Anatolia, where beads were found, made of lead ore (PbS) instead of the smelted metal.[199] Since it is lead ore, and not refined pure lead, no metallurgical process was needed.

The earliest evidence from Egypt for copper smelting may come from Buhen in northern Sudan and was reported by Emery in 1963, who found objects made of arsenical copper.[200] The site was occupied from the early third millennium BC.[201] In the same period, between 3000–2500 BC, the very first bronze objects were found in the city-states in Mesopotamia.[202] It is only from around 2000 BC that copper alloy or bronze objects only start to appear in greater numbers in Egypt.

To summarize, although the earliest worked metal objects appear as early as the 8th millennium BC there was only a slow development of metallurgy. Evidence for metalworking *before* 3500 BC is scarce in all regions, but objects made of lead appear at its onset.

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[197] Braidwood et al. 1983: 1,10.

[198] Braidwood et al. 1983: 15. The excavators are inclined to be cautious and do not want to use this bead to suggest that lead was used by the people of Jarmo, instead that it might be an isolated incident. After testing the lead they (unsurprisingly) concluded that it was different to modern American manufactured lead, see Braidwood et al. 1983: 542, fig. 136: 19.

[199] Craddock 1995: 125. Muhly mentions "reports that the Çatalhöyük beads actually are made of galena but pending publication, nothing can be made of such information", see Muhly 1988b: 4; but Nriagu for example still listed these beads as an early occurence of lead Nriagu 1983: 67, following older publications. For the beads, see Mellaart 1967: pl. 140.

[200] Preliminary excavations, see Emery 1963; El Gayar and Jones 1989; also Craddock 1995: 130–1. An axe made of impure copper was found in Assiut, possibly earlier in date than Buhen, see Carpenter 1931: 589.

[201] Only pottery of the Old Kingdom was found, see Emery 1963: 116.

[202] Lucas and Harris 1962: 218 n. 2.

2.2. Lead in Egypt

The following section presents a summary of lead objects discussed both in the literature on ancient metallurgy and in Egyptology.

2.2.1. Egyptian sources of lead

There are several sources of galena (PbS) in the Eastern desert of Egypt and it occurs in small quantities near Aswan.[203] Gebel el-Zeit is the main area where galena was mined.[204] Running parallel to the coast for 30 km, the area is approximately 80 km north of Hurghada and 50 km to the south of Ras Gharib. A French team worked here on two separate areas for 5 seasons from 1982 to 1986. They date the mining activity to the second millennium BC and conclude that the site was abandoned, and presumably exhausted towards the end of the New Kingdom. There is inscribed material from the 12th dynasty to the 19th dynasty.[205] Galena was mined at four other sites: Gebel Abu Kherfan (no. 13) is the most important,[206] Zog el-Bohar (no. 22), Umm Gheig (no. 23), Bir Ranga and Wadi Rusas (no. 39).[207] This first site is known under several toponyms and was mined during the 26th dynasty, dated by Vikantieff on the basis of the inscriptional evidence.[208] Castel gives an overview of all these sites in the Eastern desert and points out the persistent confusion between Gebel Abu Kherfan and Wadi Rusas, which is a term Vikentieff used inaccurately for the former site, not the latter, but which stuck in the literature.[209] At Wadi Rusas Castel only found scant traces of ancient mining.

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[203] Castel et al 1989: 11–12; Stos-Gale and Gale 1981: 286 fig. 1; also Helck 1975b: 704; Lucas and Harris 1962: 205 (Um Semiuki, copper deposits including lead ore), 243 and n. 6 and 7. For the lead in Aswan, see Hume 1912: 38–9; Hume 1937: 856; n.b. there is mention of galena in the Eastern desert, Umm Gheig etc., but not near Aswan or Gebel Zeit in Said 1962: 264, 269.

[204] See Castel et al. 1989 and Régen and Soukiassian 2008; Helck 1992; for maps, see Castel et al. 1989: 6–7; also Castel and Pouit 1997: 101–2, and fig. 1; Said 1962: 157 fig. 22, 158; Harris 1961: 175–6.

[205] Régen and Soukiassian 2008; for the New Kingdom depot of stelae dating to 18th and 19th dynasties, see Castel and Soukiassian 1985.

[206] Said 1962: 114 fig. 17.

[207] Numbers given are found on the map in Castel et al. 1989: 10.

[208] Three inscriptions from the Late Period: see Vikentieff 1957.

[209] Castel et al. 1989: 14.

Petrie stated — without reference — that lead would have been imported from Near East from early Dynastic times.[210] The belief that the Egyptians imported lead from elsewhere from the start and only used their own resources of galena for making kohl, is persistent.[211] This picture is reinforced by the images of generic foreigners bringing presumed lead ingots to the tomb owners in the Theban tombs during the 18th dynasty, where the discussion focuses on the 'nationality' of the generic foreigner, be they of Syrian or Aegean origin.[212] It is nevertheless possible that Egypt could have sustained its demand for lead until the New Kingdom, a period for which there is clear evidence of lead being imported (see Section 2.2.2.5). The following overview of lead objects serves to assess the number and use of lead objects in Egypt and considers whether the assumption of the importation is warranted.[213]

2.2.2. Lead objects from Egypt

2.2.2.1. Predynastic Egypt

As shown above, lead was available from at least the 6th millennium BC and it was increasingly used during the end of the 4th and into early 3rd millennia BC.[214] It would have been available during the late 4th and 3rd millennium in Egypt.[215]

There are four lead objects from Egypt from this early date. The earliest object made of lead found in Egypt is a falcon made of lead sheeting held together with copper pins,[216] originally perhaps covering a limestone model of a falcon.[217] It was

[210] Petrie 1909 b: 103.

[211] The galena (PbS) used as an unrefined ore material for kohl, see Lucas and Harris 1962: 80–4; Harris 1961: 174–6; Walter et al. 2003. The concern for galena (*msdmt*) intended for use as kohl or eye paint is illustrated by a group of papyri from the 20th dynasty, containing complaints about the poor quality of the galena intended for pharaoh, see Helck 1967: 137–140 (text B) and 144–5 (text E).

[212] Wachsmann 1987: 50–4. See Section 2.2.2.5.

[213] The use of lead for glass, (faience) glazing, lead-tin solder and as addition to bronze to increase fluidity is beyond the scope of this thesis, which concentrates specifically on lead objects.

[214] See n. 9 above; there is not much evidence of metals and metal casting dating to before 3500 BC, as noted by Tylecote 1991[2]: 7–8. For studies specifically on early metallurgy mentioning lead in the Aegean, see Renfrew 1967: 4–6; and Gale and Stos-Gale 1981b.

[215] Predynastic lead objects are listed below. Silver has also been found in late predynastic contexts, the silver perhaps originating from Northern Syria, see Gale and Stos-Gale 1981a: 104. For the occurrence of silver in the 4th millennium in the Levant, see Prag 1978: 36–8.

[216] Ashmolean Museum inv. no. 1895.137; see Payne 1993: 14 no. 6, fig. 3.

found by Petrie in grave 721 at Naqada and dated to Naqada IIc (3650–3400 BC).[218] Analysis has shown that it is made of 99,9 % lead, which is a remarkable purity.[219] It is debated whether or not the lead is from a non-Egyptian source and therefore imported.[220]

There are not one but two lead female figurines from predynastic Egypt. In the collection of the Petrie Museum there is a damaged lead female figurine of 7cm high; no further details about its provenance are known.[221] The more famous example, often mentioned as the earliest human figure in lead, is also held in London.[222] In 1899 the British Museum purchased a lead statuette of a standing female figure.[223] Like the hawk sheeting found by Petrie, this figurine is also of a remarkably pure lead.[224] It is 5.9 cm high and the head is proportionally large compared to the body. The face and hair are carved in detail. Stylistically it compares well to another female ivory statuette of a woman named Benerib found in the tomb of king Aha at Abydos.[225] The provenance of the lead statuette may consequently be attributed to Abydos, but this remains a hypothesis as it was acquired as part of a miscellaneous group of objects. Patch argues persuasively that the lead statuette should be dated to the 1st dynasty (3100–2900 BC).

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[217] Limestone model Ashmolean Museum inv. no. 1985.136, see Payne 1993: 16 no. 17, fig. 4.

[218] Petrie and Quibell 1896: 26, 46, pl. LX no. 14; also Petrie 1920: 12, 27; and Partington 1935: 81 n. 18. Prag thought it was made of silver, see Prag 1978: 38, n. 38. The relative dating (IIc) is according to Payne 1993: 4–9, and it also correlates with the chronology proposed in Wengrow 2006: 273 table 2. Petrie dated grave 721 to SD 44–64.

[219] Petrie identified the object on visual inspection as made of lead, other scholars since stated it was made of silver. XRF analysis, however has shown that it is indeed made of lead, see Gale and Stos-Gale 1981a: 115. Hendrickx and Bavay (2002: 66) call it lead "with a very high silver content."

[220] See Stos-Gale and Gale 1981: 289, 292 table 5, 294; this is contested as local galena sources such as Bir Ranga, show a wide range of lead isotope signatures, see Hassan and Hassan 1981. For a concise summary of the discussion of the import of lead and silver in this early period, see Hendrickx and Bavay 2002: 66.

[221] UC15125, Petrie 1920: 9, pl. ii no. 7; Ucko 1968: 147 no. 189.

[222] Patch 2012: 176; also mentioned, for example, on the International Lead Association website under 'lead facts', accessed December 8, 2013, see http://www.ldaint.org/lead-facts/history-of-lead.

[223] Inv. no. 1899,1016.1151, and BM no. 32138; Krysko 1986; Patch 2012: 173, 176–7 (incl. images), 259 cat no. 157; its authenticity has been questioned; see Prag 1978: 40 n. 80.

[224] Krysko 1986.

[225] Krysko 1986: 109; Patch 2012: 176–7, 259 cat. no. 158.

Partington had the only mention of an earring of the Protodynastic period.[226] Galena was also used as black eye paint from at least the Naqada II period,[227] and galena clumps have been found in graves.[228]

2.2.2.2. Old Kingdom

From the Old Kingdom there was a lead plug from the drainage system in the temple of Sahure[229] and a grey cup with a surface patina containing lead, which might indicate the beginning of lead used for glazing.[230] ***Msdmt***[231] as black kohl, perhaps galena, appears in the Pyramid Texts of Unas and Pepi II.[232]

2.2.2.3. Middle Kingdom

Apart from *msdmt*, another Egyptian word for lead ***ḏḥty***[233] appears for the first time on a Middle Kingdom relief as a caption for ingots.[234] The first attestation of the inclusion of lead (ore) in a foundation deposit is found in the valley temple of Senwosret II, which contained among other items 4 pieces of lead ore.[235] Adding samples of the materials used in the construction of the building in the deposit is part of a tradition starting in the Middle Kingdom and lasts until the Ptolemaic period.[236]

The Annals of Amenemhet II, a large fragment of which was found in Mit Rahina on the lower side of the pink granite plinth of a colossus of Ramses II, mention amounts of lead in three different instances.[237] The text is an account of events at court for the end of one year and the start of another in the reign of Amenemhet II and

[226] Partington 1935: 81, n. 21.

[227] Lucas and Harris 1962: 80–4; Brunton 1927: 43, 62; Petrie 1892: 41; also Prag 1978: 285 n. 2; also Partington 1935: 23.

[228] UC 5084, 5115, and 5125, see Fuchs 1984: 942 n. 16.

[229] A lead plug of 99% lead, with a ring for a chain, see Borchardt 1910: 76–7, fig. 102–3.

[230] Partington 1935: 82, n. 20.

[231] Erman and Grapow 1928: 153; Erman and Grapow 1940: 224–5.

[232] Sethe 1908: 30, 54 d; for a discussion of the identification of the word, see Harris 1961: 174–6.

[233] Erman and Grapow 1931: 606; on the identification of the word as lead and/or tin, see Harris 1961: 67–8.

[234] Cairo Museum, see Wachsmann 1987: pl. LII A; Evans 1928 ii: 176–7, fig. 90; Müller 1906 i: 5–8, pl. I; Müller 1910 ii: 183; also Pendlebury 1930: 76 n.1.

[235] Petrie 1890: 22, pl. XIV–XV; further references, see Weinstein 1973: 78–9 (entry no. 17).

[236] Weinstein 1973: 436.

[237] Farag 1980; Posener 1982; Altenmüller and Moussa 1991: 10; Malek and Quirke 1992.

contains long lists of items brought to Egypt, which are listed with their quantity, provenance and destination. All mentions of lead are in fragment M of the inscription:

[col. x+13] 6 deben of lead, and 55 deben of 'lead minerals' (*sšw*) is brought as tribute by children of the chiefs of Asia/Levant, together with Asiatics, animals, and silver,

[col. x+15] 238 1/4 deben of lead is brought by people from Tjempau,[238]

[col. x+18] 58 deben of lead in a list of objects mentioned in association with Asiatics and a military expedition returning to Egypt,[239]

[col. x+19] 1410 deben of 'lead minerals' (*sšw*), as part of a list containing metals, minerals, and stones.[240]

2.2.2.4. Second Intermediate Period

No lead objects survive that may be attributed to the Second Intermediate Period. Stelae from this period found in a depot near the sanctuary at Gebel Zeit suggest activity at this time in the galena mines.[241] The sanctuary was dedicated to Hathor 'lady of galena', Horus, and Min of Coptos, the main deities of the desert.

2.2.2.5. New Kingdom

From the New Kingdom there are multiple examples of lead objects and references in written sources. Papyrus Ebers (ca. 1500 BC) contains 45 medicinal recipes including ***msdmt***, black eye kohl made of lead ore.[242] Two tombs in Thebes from the 18th Dynasty have depictions of lead (?) ingots of a distinctive shape.[243] The first example is from the tomb of Rekhmire (TT 100)[244] dated to the reigns of Thutmosis III and Amenhotep II and it shows Syrian tribute including two rectangular ingots.[245] Parts

[238] A *hapax legomenon*, this locality is thought to be somewhere in Syria/Levant, see Altenmüller and Moussa 1991: 12, 34 n. 22.

[239] Altenmüller and Moussa 1991: 14.

[240] Altenmüller and Moussa 1991: 14.

[241] Castel and Soukiassian 1985: 290–3, stela nos. 557, 549, 559; a summary in Helck 1992.

[242] For an overview, see Györy 2002: 51 n. 28–9b; for the underlying biochemical reasons for the use of lead in medicinal recipes, see Weser 2005: 121; Walter et al. 2003: 125–6; for translations and analysis, see Bardinet 1995.

[243] Wachsmann 1987: 50–54.

[244] Porter & Moss 1960: 206–14.

[245] Wachsmann 1987: pl. XLIV.

of actual ingots of this shape were found in Ha-Hotrim near Haifa on the Levantine coast and were identified as lead ingots.[246] The ingots in the tomb of Rekhmire are captioned with *ḏḥ* and not *ḏḥty*.[247] There is a debate what metal this word identifies, as it occurs in only a few instances. It should be distinct from the word for lead and has been suggested to mean tin, since the words *ḏḥ* and *ḏḥty* are clearly distinguished in papyrus Harris (see Section 2.2.2.5). Harris rejects this translation for several reasons; instead he suggests it is more likely to refer to an ore, possibly lead ore.[248] *ḏḥty* itself might also be confused with tin, since this confusion seems to have been prevalent throughout antiquity.[249] Testing of the remains of the Ha-Hotrim ingot for its chemical composition might shed light on this question. The second example is from the tomb of Amenemopet (TT 276)[250] from the reign of Thutmosis IV and shows 'hybrid' porters carrying two lead ingots.[251]

The first relevant textual evidence dates to the reign of Thutmosis III. The annals of this king, a long and historically important document, list the military accomplishments of Thutmosis III abroad, with an emphasis on the mention of tribute from subjected areas.[252] The tribute mentioned from four campaigns includes lead. During the fifth campaign in year 29 the king secures the Levantine coast and sails back to Egypt for the first time, capturing (Syrian) ships with cargoes of — amongst other things — lead.[253] In campaign 9 in year 34, the lead comes from lands called 'Isy' and 'Retenu'.[254] Generally these countries have been identified in northern Syria,[255] but

[246] Wachsmann & Raveh 1984; see also Section 3.2.1.

[247] Sethe 1909: 1101.

[248] For a discussion of both words, see Harris 1961: 66–8.

[249] Aufrère 1991: 453 n. 58; Harris 1961: 67–8; and also Partington 1935: 80–1.

[250] Porter & Moss 1960: 352–3.

[251] Hybrid is a term Wachsmann uses to indicate indeterminate non-Egyptians, people that combine elements of different groups originally, see Wachsmann 1987: 4–9; for the scene see Wachsmann 1987: pl. LII B.

[252] Breasted 1906 II: 163–217.

[253] Breasted 1906 II: 196–7, §460, 462.

[254] Breasted 1906 II: 206, §491 (Retenu, 11 blocks), 493. (Isy, 5 + blocks).

[255] Lucas and Harris 1962: 244; the broader region seems to provide lead for the important players in the LBA. Southern Anatolia is where the Assyrian kings from Tikulti-Ninurta I collected lead as tribute, see Jankowska 1969: 264–5, also map 1. Jankowska marks out the area of Bīt-Zamāni as containing reserves of tin or lead, an area in the region of Çayönü Tepesi mentioned above. For maps of lead deposits and workings in including those in this region

Quack identifies 'Isy' with Cyprus.[256] In year 38, during the 13th campaign there is the mention of 2 lead blocks;[257] in year 39 during the 14th campaign Isy presents 1 brick of lead.[258] In the 17th and final campaign in year 42 'Tunip' gives 1100 deben of lead.[259]

From the later 19th dynasty, dated to the reign of Merenptah or Seti II, there is a letter from Deir el-Medina requesting items to be collected as taxes for temple of Amun-Re, king of the gods, among which is the mention of lead.[260]

Papyrus Harris I lists all the temple donations made by Ramses III, compiled on the event of his death.[261] Found in 1855 in Luxor, it is now in the British Museum and at a total length of 42 meters, the largest document known from ancient Egypt.[262] There are three different parts, one Theban, one Heliopolitan, and one Memphite. Each part sums up the donations by the king to the relevant temple estate. In the summary of the Theban part Ramses III donated different types of material to make statues with, with lead explicitly mentioned.[263] In the Heliopolitan part a lead figurine of the Nile god is mentioned, as well as one made of galena.[264] Inscriptions at Medinet Habu in the temple of Ramses III also mention *ḏḥty*.[265]

On a different scale there is the mention of a mass of lead in BM ostracon 5637.[266] It is dated to before 4th regnal year of Ramses IV, if the identification of the figure of Nekhemmut is correct. Nekhemmut robbed a trader with a warehouse on the

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of southeast Anatolia, as well as concentrations halfway between Antalya and Adana, and lead on the Black Sea coast near Giresun, see de Jesus 1980: 63–81, 195 Appendix II, and maps 12–13. For an overview of lead sources for Mesopotamia (Anatolia, but also potentially Iran and Afghanistan) see Moorey 1994: 293. A large number of lead objects of diverse nature were found in Assur, from large circular plates as the basis of stone pivots and inscribed plaques to much smaller objects; see Moorey 1994: 295–6.

[256] Quack 1996.

[257] Breasted 1906 II: 210, §509.

[258] Breasted 1906 II: 212, §521.

[259] Breasted 1906 II: 216, §534.

[260] pChester Beatty V = pBM EA 10685, Rto. 7,12–8,6 and 8,6–8,14; Gardiner 1935: 48–9, pls. 25–6.

[261] BM 9999; see Grandet 1994:

[262] Grandet 1994 i: 3–4.

[263] Grandet 1994 i: 75.

[264] Aufrère 1991 i: 182, 186 n. 91.

[265] Nriagu 1983: 127.

[266] Blackman 1926: 183.

quay of Western Thebes during the festival of Amenhotep I. Among the stolen goods was this unspecified mass of lead.

Lead objects dating to the New Kingdom are again scarce. Lead ore was present in the foundation deposit of the temple of Hatshepsut at Deir el-Bahri excavated by Winlock in 1924.[267] A ceramic saucer with lead ore was found in a deposit in the temple of Thutmosis III in Coptos.[268]

In the main city of Amarna three lead objects were found together with three exquisite glass vases under a double plaster floor in one of the houses.[269] They are now housed in the British Museum:[270] a lead wine strainer from a siphon with a ridged neck and a pointed perforated body, a lead jug, and an angular portion of a lead type of drinking tube with a lily in the angle. Catalogued at the same time was a plaque in the shape of a goddess, but Peet does not mention this object together with the other three objects in his report.[271] Another lead wine strainer of unknown (Egyptian) provenance is also housed in the British Museum.[272] A similar drinking tube is depicted on a stela now in the Berlin Museum showing a man, Tarura, using such a straw to drink from a ceramic vessel.[273] Acquired in 1898, the stela's provenance is unknown, but the style and genre suggest strongly that it is from Amarna. The man drinking from the straw has been identified as a solder from the Levant on the basis of the distinctive hairstyle, the beard, his un-Egyptian name, and the spear depicted behind him. Although the stela and the lead drinking tube are not from the same context, as it is unlikely that this stela was erected in a house, the link of the lead drinking tube to the Levant is significant for the question of imports of lead from the Near East.

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[267] For further references Weinstein 1973: 152 fig. 15 deposit C, for which see p. 158 (entry no. 30).

[268] Deposit 7, see Petrie and Hogarth 1896: 14, pl. I, XVI; for further references Weinstein 1973: 180 (entry no. 40).

[269] House N.49.21 (1921), see Peet et al. 1923: 23–4, pl. 1; for the three lead objects, Peet et al. 1923: 24 fig. 5; for the glass vases, Peet et al. 1923: 24, pl. XII no. 3 and 7.

[270] Wine strainer: inv. no. 1921,1008.82, EA 55148; jug: inv. no. 1921,1008.81, EA 55147; drinking tube: inv. no. 1921,1008.83, BM 55149, see Freed et al. 1999: 239, no. 115.

[271] Inv. no. 1921,1008.80, EA 55146.

[272] Inv. no. 1929,0601.3, EA 59269.

[273] Berlin inv. no. 14122; Priese 1991: 129–30 cat no. 80; Freed et al. 1999: 161 fig. 121, 239 no. 114 = Freed et al. 2000: 239, no. 114.

There are some lead net sinkers from Amarna, which Petrie dates to the 18th dynasty.[274] Net sinkers from the same period were also found at Gurob.[275] Tutankhamun also had small lumps of galena among the objects deposited in his tomb.[276]

2.2.2.6. Third Intermediate Period

The amount of lead objects and the use of lead increase during the 1st millennium BC. There are several falcon plaques found on mummies from the Third Intermediate Period in the Rijksmuseum van Oudheden in Leiden, the Netherlands, as well as two lead earrings also possibly dating from this period[277] and an udjat eye plaque.[278]

A foundation deposit of Osorkon II from the pylon of the Great Temple in Tanis contained two lead plaques.[279] From the 25th dynasty there was perhaps a (now lost) lead plaque and some lead ore in a foundation deposit of Taharqa in the temple in Sanam, Nubia.[280] Similar lead tablets were found in foundation deposits of royal pyramids nearby in Nuri.[281] From the beginning of the 1st millennium onwards lead was added in larger quantities to bronze statues, increasing the fluidity of the metal when casting.[282]

2.2.2.7. Late Period

More lead objects are preserved from the Late Period (664–332 BC), which coincided with the start of a global increase in lead production around 600 BC,

[274] Petrie 1927: 49 no. 2, pl. XLIII.

[275] Not illustrated, see Petrie 1927: 149 nos. 10–2.

[276] Murray and Nuttall 1963: 15 no. 456 b (no photograph was taken by Carter); see also Lucas 1927: 175.

[277] Inv. no. AB 160 a+b; Leemans 1846: 24 no. G 292, pl. XLI.

[278] Inv. no. AB 159; Leemans 1846: 26 no. G 505, pl. XLIII.

[279] Montet 1947: 257; for further references Weinstein 1973: 319 (entry no. 122).

[280] The identification of lead is uncertain, see Griffth 1922: 81, 90–2, pls. VII, XXI no. 12; for further references Weinstein 1973: 322 (entry no. 125)

[281] As excavated by Reisner in Nuri, now in the British Museum inv. no. 1922,0513.283, EA 55572, and EA 55562–3 Anlamani, see Dunham 1955: 56, 61 fig. 39; and EA 55564 perhaps Aspelta (?), although it is not mentioned in the catalogue of the contents of the foundation deposit of the tomb, see Dunham 1955: 78–102, esp. 78 and 96 fig. 69; and also Budge 1925^{2}: 451.

[282] Hill 2007: 191, n. 17.

reaching its maximum around 2,000 BP as evidenced by increased presence of lead in Swedish lake sediments (see infra).[283] The start of this increase may perhaps be linked to the increase in silver mining for coinage, as lead was a by-product of silver production, for example in Laurion (see Chapter 3).[284]

One lead plaque was present in three out of four foundation deposits in Defenneh that contained the name of Psamtik I of the 26th dynasty.[285] One deposit also contained pieces of lead ore. Three lead plaques were recovered from Nebesheh from the reign of Amasis[286] and of unknown date in Gemaiyemi.[287] Petrie reports a lead tank that was found in the Palace of Apries and went to the Cairo Museum.[288] It seems that lead was rarely used for amulets.[289] A stone dice filled with lead, possibly from Naukratis but of unknown date, is in the collection of the British Museum.[290]

Several lead objects including three lead vessels were found in the area of the animal necropoleis at North Saqqara. The sanctuaries are dated from the 26th dynasty onwards and are thus a very interesting corpus of material to compare with the containers from Thonis-Heracleion. Excavations in block 4 near the falcon galleries revealed mainly bronze objects such as statuettes, coins, a fishhook, as well as a number of ostraca, two limestone plaques and three limestone dice. Among these objects was a small, badly crushed lead vessel.[291] In the west dump there were several lead objects: a lead vessel with lightly incised decoration, a plumb bob, and a walnut sized lump of

[283] Renberg et al. 1994.

[284] From 2,600 BP there is a marked increase in lead deposits in lake sediments from Sweden with a peak around 2,000 BP, see Renberg et al. 1994: 324; for the link to coinage, see Nriagu 1998: 1622.

[285] Petrie 1888a: 55, pls. XXII–III; for further references, see Weinstein 1973: 326–7 (entry 128). For foundation deposits in general, see Letellier 1977: 909. This is a phenomenon also known in Mesopotamia, e.g. in Khorsabad and in the temple of Ishtar in Assur, see Partington 1935: 278–9.

[286] In the British Museum, 5 x 8 cm, inv. no. 1887, 0101.1339–49, EA 23503; Petrie 1888a: 15, pls. V–VI, XIV.

[287] Petrie 1888a: 40, pls. XIX; for further references, see Weinstein 1973: 341 (entry no. 147).

[288] Petrie 1909a: 2, pl. XIII.

[289] One example is the two-finger amulet from the collection of Rev. G. J. Chester, inv. no. 1886,1009.198, EA 21548; Müller-Winkler does not list lead among the metals used for amulets, see Müller-Winkler 1987: 490.

[290] Inv. no. 1886,0401.1719, EA 11619; Petrie started excavations in Naukratis in 1885 and the Egypt Exploration Fund donated the object in 1886, hence Naukratis is suggested as the provenance. A similar die with lead in the holes in its sides is in the Ashmolean, AN1896-1908-E.3744.

[291] 8.4 cm high, see Martin 1981: 32–3 no. 332, pl. 39.

lead.[292] The documents in this dump date from between the end of the 26th dynasty to the start of the Ptolemaic period. Other lead objects were found on the surface in sector 7; these are a lead vessel, a plumb bob, a disc, and a curved fragment.[293] A hollow-cast lead figurine of a (human-headed) Ba-bird, with protruding tangs at its feet to allow it to be mounted on a base, was excavated in Saqqara, and is held in the British Museum.[294]

A lead vessel was recovered from a grave (details unknown) in Naukratis.[295] Von Bissing describes four lead containers in his catalogue of the Cairo Museum metalware: one from Qaw el-Kebir and three from Saqqara, which according to the description are perhaps slightly later in date.[296]

One of the most intriguing objects in this survey is a wooden statue of a 4th century BC king, presumably Nektanebo II.[297] The pose of this statue is unusual with one arm raised, and its construction in wood with several different parts is elaborate. The wood is makore.[298] A photograph of the statue from 1922 shows it complete with its metal sheeting, which was removed at some point after the photograph was taken and has subsequently disappeared. Recent analysis of the surface of the wood showed 41% lead, indicating that it was lead sheeting, or possibly heavily leaded silver.[299]

A solid-cast copper-alloy statue of Thoth with a lunar disc headdress and a base of lead is also dated to the Late Period and currently in the collection of the British Museum.[300] The British Museum acquired a collection from Miss Selima Harris, who had inherited her father's collection of antiquities.[301] Among this collection was

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[292] Exterior surface decoration of 2 incised lotus flowers and a chequer design, H. 7.9 cm, diameter top 14.2 cm, base 9.5 cm, see Martin 1981: 64, no. 758, pl. 39, two other lead objects are also listed here: lead plumb bob (H. 2.3 cm) no. 759, pl. 6, and lump of lead no. 760.

[293] Martin 1981: 94, nos. 1149–52, and see pl. 6 for no. 1150.

[294] H5–2740; inv. no. 1975,726.9, EA 68299.

[295] Gardner 1888: 29.

[296] Von Bissing 1901: 57 CG 3546, and 64 CG 3556–8; see **chapter 4**.

[297] Josephson 1997: 33–9, pls. 12a + b, for a photograph of the statue with the cladding still in place, see 12d; also Hill 2007: 160–4.

[298] Josephson 1997: 37.

[299] Josephson 1997: 38–9.

[300] Inv. no. 1875,0810.98, EA 11056 (H. 13.3 cm).

[301] Bierbrier 2012[4]: 244.

another statue with a lead base, this example being a solid-cast ibis.[302] A separate lead-filled plinth, presumably a base for a statue since it has traces of a hieroglyphic inscription, is also in the British Museum. Its provenance may be Tanis, as the Egypt Exploration Fund donated it in 1885 and Petrie first started work (i.e. excavations) in Tanis in 1884.[303]

In Tell el-Herr, a votive deposit dating either to the last quarter of the 4th century or to the first half of the Ptolemaic period yielded a long lead rod of unknown dimensions, square in section and blunt at the narrow ends.[304] The deposit also contained faience cylinders, glass paste inlays and gold leaf, a bronze uraeus, bronze fixating elements of a chest (?), iron, lead tools, and other raw materials.[305]

2.2.2.8. Ptolemaic Period

Lead is mentioned in 10 papyri from the Ptolemaic period. There are several mentions of lead vessels and lead workers in the archive of Zenon, private secretary to Apollonius, an important advisor to Ptolemy II. One letter dating to 257 BC mentions receiving Mendesian myrrh in small lead vessels, alabastra, from Zenon.[306] Lead also appears in an unknown quantity in a document that was perhaps an account,[307] a letter to Zenon requesting that he send some lead (256 BC),[308] and a mention in what was probably a report.[309] Also from the Zenon archive, now housed in the British Museum, is an account addressed to Zenon mentioning lead for melting, wood, and other necessities for the lead-workers.[310] A letter from same archive now in the University of

[302] Inv. no. 1875,0810.116, EA 11619 (H. 12.1 cm, image present in online database).

[303] Inv. no. 1885,1110.73, EA 27630; for an overview of Petrie's work in Egypt, see Drower 1985: 472 appendix B.

[304] Valbelle and Marchi 2012: 1031, 1037.

[305] Valbelle and Marchi 2012: 1032, see also pls. XIII–XVIc.

[306] pCair.Zen.59089, Edgar 1925: 109–10, JdE 48537; Edgar also mentions a lead vessel JdE 48823 "lately" from Mendes in the commentary to the text, but I have not encountered this in any catalogue.

[307] pCair.Zen 3.59386 ro, Edgar 1928: 127–8, JdE 48913.

[308] pCair.Zen 4.59553, Edgar 1931a: 19, JdE 51539.

[309] pCair.Zen 4.59633, Edgar 1931a: 77–9, JdE 51585.

[310] pLond 7.2176, Skeat 1974: 263, inv. no. 2325; Rostovtzeff linked this document to pottery repairs but as Skeat points out there is no mention of pottery in this document, nor of lead in a document concerning a number of pots (pLond.7.2049, Skeat 1974: 196–7), see Rostovtzeff 1922: 181.

Michigan lists among other things 25 talents of lead entrusted to Kriton (257 BC?).[311] Another papyrus in Michigan, again from the Zenon archive, is the authorisation for the purchase of lead for 'the coppers of the baths, likewise for those of the boiling-house' (245 or 244 BC).[312]

There are only three known instances where lead is mentioned *outside* of the Zenon archive. The revenue laws of Ptolemy Philadelphus, a long papyrus dated to 259/8 BC, contains one mention of lead in column 75, line 8.[313] Columns 73–78 are a section by themselves, but preservation is fragmentary and the immediate context of the reference to lead is lost.[314] Finally, two lead cups are mentioned in two documents in the archive of Ptolemaios son of Glaukis from the Memphite necropolis.[315] The two documents deal with the same incident and are complaints about other priests forcing their way into the temple building and venturing into the shrine of Astarte in Saqqara, near Memphis. Among the items mentioned in the sanctuary are two lead cups.

A lead foundation plaque was found in Naukratis under the pylon of Ptolemy II,[316] with others in the foundation deposit of Ptolemy IV in Tanis[317] and in the Min temple in Coptos.[318] There is also a painted (white with brown and black details) lead giraffe in The Brooklyn Museum, said to be from the Egyptian delta near the city of Benha (ancient Athribis).[319] The classical modelling indeed suggests a Hellenistic date.[320] It is the only giraffe statuette known from antiquity and the catalogue entry bases the Ptolemaic dating on an attestation of a live giraffe during the reign of Ptolemy

[311] pMich 1.9 ro, Edgar 1931b: 67–9, pl. II, inv. no. 3200.

[312] pMich 1.65, Edgar 1931b: 140–1, inv. no. 3194.

[313] pRev 75 l.8, Grenfell 1896: 55.

[314] Grenfell 1896: 54–6, 173–4.

[315] UPZ 1.5 l.38–9 and l. 44, Wilcken 1927:128–9; upz 1.6 l. 28, Wilcken 1927: 129–33.

[316] The lead plaque in the British Museum should probably be identified as coming from the foundation deposit in Tanis, as Petrie started work there in 1884. This plaque was donated by the Egypt Exploration Fund in 1885: inv. no. 1885,0101.18, EA 22026; Petrie 1886: 30–1 no. 24, pls. XXV–I, XLII; Petrie 1893: 43, fig. 29; for further references Weinstein 1973: 377 (entry 158).

[317] For further references Weinstein 1973: 388 (entry 168).

[318] Petrie and Hogarth 1896: 19, pls. XVI, XXIII; for further references Weinstein 1973: 394 (entry 173).

[319] Inv. no. 55.181, H. 3.5cm, L. 6.4 cm, see Brooklyn 1956: 48 no. 55, pl. 78.

[320] Giraffes, however, are known from earlier tomb scenes, e.g. Rekhmire (TT100), thus the uniqueness of this statuette is somewhat overstated in the catalogue.

II. The Karnak cachette yielded three lead Osiris figurines that cannot be dated more specifically than to the Late or Ptolemaic period.[321] There is also a group of 20 lead crowns, or head decorations that are presumed to be Ptolemaic in the Egyptian Museum in Cairo.[322]

A large volume of lead was excavated in a Ptolemaic trench (BE96–11) in Berenike, making up 75% of total volume excavated metals in the location.[323] There was a notable absence of the metal in other trenches; lead comprised only 5.4% of total volume of metals (180 cm^3) from the 1996 season.[324] It is suggested that this trench was possibly an industrial dumping ground.[325] Several objects were also found in this trench, including fragments of seal rings.[326] In the following 1997 season lead comprised only 0.5% of the total recovered metal fragments.[327] Small quantities were found in trench 95/96/97–5 in the first 2 phases: 19% in phase I (late 1st century BC to early 1st century AD) and very little in phase II (1st century AD – 2nd century AD). No objects have been described, however, so presumably these consist of unidentified fragments of lead. Seasons 1999 and 2000 saw a large amount of lead recovered, 52.3% of the total volume of metals.[328] Nearly all this lead, 95kg, was excavated in trench BE00–36 from Ptolemaic loci, consisting mostly of fragments of lead sheets.[329] The excavation report in the same volume, however, seemingly contradicts this and mentions large quantities of lead waste and only "a few flat pieces were also found" in an area described as a dump from phase II (= post-Ptolemaic a).[330] Hense suggests the sheets may have served as

[321] Legrain just mentions three statuettes, Legrain 1905: 67; a search in the Karnak Cachette Database of the IFAO (http://ifao.egnet.net/bases/cachette/) shows 4 statuettes: CK 854, JdE 36761 (probably to be associated with the cachette); CK 902, JdE 37059 (A); CK 903, JdE 37059 (B); CK 904, JdE 37059 (C).

[322] Garland and Bannister 1927: 30–1, fig. 4; nos. JdE 31589 to JE 31608 as given by Lucas and Harris 1962: 244.

[323] Hense 1998: 200 fig. 9.1.

[324] Hense 1998: 199.

[325] Hense 1998: 210.

[326] Hense 1998: 213, fig. 9.17 no. 3637-D-3508.

[327] Hense 1999: 219–20, fig. 10–1.

[328] Hense 2007: 211.

[329] Hense 2007: 216–7.

[330] Sidebotham 2007: 34–5.

lining for water tanks, a possible hydraulic structure that was found in an earlier phase in the trench, or as sheathing for ships.[331]

The large amount of lead from Berenike demonstrates the scale of lead use in areas of society other than temples, which constitute all of the other examples of lead in the Ptolemaic period. The occurrence of lead clearly also depends on the excavation of specific contexts, as well as on the circumstance of object being taken out of the normal process of recycling of objects by placing it in a (temple) deposit.

2.2.2.9. Roman Period[332]

At the very end of the period covered in this thesis, I would like to indicate several instances of lead in Roman Egypt. There is a lack of references to lead in written sources, with just two ostraca, possibly from Thebes, mentioning lead and lead-workers from the first centuries AD.[333] In Oxyrhynchus lead tokens or tesserae made of lead were used for the grain dole.[334] There are 8 further references to lead and lead-workers in papyri from the 5th–7th centuries AD.[335]

In terms of the archaeological record, the discovery of three large lead objects cannot be neglected. In 1990, two rectangular lidded lead coffins and one coffin of a different shape with remains of a wood casing were excavated in the Roman cemetery at Marina el-Alamein.[336] The cemetery is dated to the second half of the 1st century BC to the middle of the 1st century AD.

A statuette was discovered in March 1989 by the French team excavating the temple and 'fort' of ancient Kysis, modern Douch. The excavation revealed a treasure of 1.2kg of gold in a globular ceramic vase identified as 4th–5th century AD.[337] The

[331] Hense 2007: 217; and Sidebotham 2007: 31.

[332] Apart from the volumes on lead mentioned in section 2.2.3, for more on the lead industry in the Roman period especially, see Besnier 1920, 1921a, 1921b; Gowland 1901; Davies 1935; and, less reliable in the details, Boulakia 1972.

[333] o.Wilck 1188 (1–400 AD); o.Wilck 1485 (201–300 AD); p.Erl 100 (101–300 AD); p.Oxy 64.4441 (315–316 AD); p.Ross.Georg 5.61 (351–400 AD).

[334] Rea 1972: 12–3; I thank B. P. Muhs for bringing this to my attention.

[335] P.Muench.1.4–5v; p.Oxy 6.915; p.Turner 51; p.Turner 52; p.Turner 53; sb 6.9368; sb 20.14076; stud.pal 8.852.

[336] Zych 2003: 81–3, figs. 9 and 10; cf. Daszewski 1991: 34–5 for an unreferenced mention of lead coffins from the Hellenistic necropolis of Hadra.

[337] Reddé 1992: 1.

treasure consists of two crowns, bracelets, plaquettes, a pectoral, silver plaquettes, and a few miscellaneous pieces, which have been dated to the beginning of the 2nd century AD.[338] Near to this another three objects were found, one bronze Osiris, one bronze Horus as a soldier, and a gilded lead figure of Isis,[339] enveloped in 'bandelettes' to be dated to the early Christian period. The treasure is in the Egyptian Museum in Cairo, while the lead statuette remains in the Khargeh Museum.[340] It shows that lead continued to be in use in Egypt, as is known from elsewhere in the Roman Empire.

2.2.2.10. Conclusions

This survey of the use of lead in Egypt illustrates that although objects made of the metal are relatively scarce in Egypt, their range is diverse. They appear sporadically in the predynastic period and during the Old Kingdom. The presence of galena in a foundation deposit of the Middle Kingdom suggests that its qualities as a building material were already recognized. Texts from the Middle Kingdom also mention large quantities of the metal in royal possession. By the New Kingdom the mention of lead in written sources increases significantly. It is associated with imports in the royal annals, where it is brought to Egypt in large quantities. The connection between the lead drinking tube from Amarna and the depiction of a similar drinking tube on a contemporaneous stela of a Levantine soldier is interesting in this respect.

Lead objects from the New Kingdom are rare. More objects appear in the Third Intermediate Period and Late Period. There is a surprising proportion of mundane use of lead, e.g. the lead tank in the Palace of Apries or the plumb bob, but the range is very diverse and extends to the lead containers in Saqqara and the lead sheathing of the Nektanebo statue. Although it remains relatively scarce, this does suggest a familiarity with the metal and a normality surrounding its use.

This relative scarcity must be explained by recycling processes even though lead was a cheap metal.[341] Unlike broken ceramics, sherds of which could only be recycled for ostraca, lead was easy to re-melt and it had many applications. From 2600 BP there

[338] Reddé 1990: 290–1 fig. 8.

[339] Inv. no. 89-125; SAE 1079; see Reddé 1989: 130–1; Reddé 1992: 1.

[340] O.E. Kaper, personal communication.

[341] Lead does not survive well anywhere, e.g. in Britain, see Needham and Hook 1988: 259.

is a clear increase of atmospheric lead (deposition) visible in lake cores in Sweden, culminating into values 5 times higher at its peak than normal, or natural, background measurements before the peak in the 1st centuries BC and AD.[342] This information demonstrates the increased production of lead, initially as a by-product of silver production, from the 6th century BC onward. If the material is scarce in the archaeological record, whereas there is evidence for increased production, then the most obvious explanation is reuse.

The suggestion that reuse of lead has played a significant role in the absence of lead objects from antiquity is strengthened by the range of lead objects known in Egypt from the Third Intermediate Period onwards. A range of objects speaks of a familiarity with the metal and its properties. The containers from Thonis-Heracleion, for example, are remarkable for their large number as well as their range of size, which is greater than known from anywhere else in the ancient world. The lack of diversity and numbers of objects made of lead created a situation where they are generally discussed as a small part in a larger theme, or the chronology and geographical scope is very large.

2.2.3. Overview of scholarship on lead

The goal of this section is firstly to demonstrate the scarcity of literature on the topic of lead in Egypt and secondly to illustrate the broad perspectives taken when discussing the role of metals. General overviews of the use of metals and other materials in the ancient world are plentiful and frequently contain much information. The information, however, is not usually arranged chronologically and, since the authors cover such large topics, the overviews range in quality and utility from surprisingly well referenced to the cursory, with confusions or contradictions apparent on closer inspection. The discussion below, of publications in chronological order, serves to illustrate the frustration of dealing with a large corpus of lead material from Thonis-Heracleion, while comparable material is not available, either not published or not the focus of these publications.

[342] Renberg et al. 1994.

Partington produced an impressive tome on the origins of chemistry in the entire ancient world.[343] It was a 'systematic account of the sources, production, and uses of materials,' where he sees the Greek and Roman worlds inheriting 'the knowledge of the use of materials' from older cultures. He discusses Egypt, Babylonia and Assyria, the Greek world, Asia Minor, Persia, Phoenicia, and Palestine. He starts with textual references to lead and the provenance of the lead in Egypt, followed by an extensive list of lead objects with a mention of lead alloys.

Lucas and Harris have a short overview with a relatively extensive bibliography to the mining of lead in Egypt.[344] Their list of objects made of lead is extensive, but it gives the impression of multiple objects in each of the categories, which is not always borne out by the references.[345] Lucas and Harris also mention that there "can be little doubt" that lead and lead objects until the New Kingdom had an Egyptian origin and after that a foreign, Syrian provenance.[346]

In 1983 Nriagu wrote the most comprehensive overview of lead and its mining and use in antiquity and medieval times.[347] A voluminous tome, it brings together most aspects of the metal: from a chapter on attestations from secondary sources to more technical sections on the prospection, mining, and refining of the metal. Its scope is large, dealing with lead sources throughout the world and chronologically it starts with the earliest attestations to an unclear cut-off point in mediaeval times. The author is a geochemist; this quickly becomes clear in the assured treatment of the more technical topics in the book. The historical parts are wide in scope and exhaustive; the resulting encyclopaedia of information lacks, however, a focus on any contextual interpretation. The wealth of information contained within makes it the most important book published on lead in antiquity.

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[343] Except India and China, see Partington 1935: v–vi.

[344] Lucas and Harris 1962: 243–4.

[345] E.g. there is mention of "small human and animal figures", whereas only one example of each is referred to, see Lucas and Harris 1962: 244. It is clear there were lead human and animal figures, however, as they appear in the collection of the British Museum and in Thonis-Heracleion, see below.

[346] Lucas and Harris 1962: 244 n. 13, referring to Petrie: he stated that lead would have come from Syria, however without any refereces to substantiate this assertion, see Petrie 1909 b: 103.

[347] Nriagu 1983.

The two volumes on Gebel el-Zeit have already been discussed (see Section 2.2.1). The first volume on the mines and mine technology is especially important, concentrating on the archaeology and mining techniques. Aufrère has a small section on lead in his book on minerals in Egyptian thought where he is mainly concerned, naturally given the scope of the book, with the linguistic dimension and literary connections of the Egyptian word *ḏḥty*.[348] Finally, Ogden discusses lead in Egypt in a chapter on metals in a handbook on Ancient Egyptian materials and technology.[349] It is a relatively short and incomplete description of the occurrence of lead mines and objects made of lead in Egypt.

To summarize, there are several broad and expansive works on metals in antiquity. They contain many references to lead objects and references to lead in texts, but they lack a narrative on the use of lead in ancient societies. The large number of lead objects from Thonis-Heracleion demands a reassessment of lead in antiquity, in light of its absence in the archaeological record at sites elsewhere. Before presenting detailed studies of three categories of lead objects from Thonis-Heracleion, it is necessary to take stock of the whole assemblage.

2.3. Lead in Thonis-Heracleion

To date, Thonis-Heracleion has yielded more than a thousand lead objects and many more unidentifiable pieces of scrap lead. The groups consist of diverse types from anchor stocks to miniature vessels and lead statuettes and amulets.[350] Geophysical survey work started in Thonis-Heracleion in 1996 with targeted diver survey and prospection and stratigraphic excavation commencing in 2001. Survey work included a metal detector, which may perhaps have led to an overrepresentation of metal objects in the corpus. Excavations, however, also yield a proportionately large number of metal finds, suggesting that the large number of metal objects is not a bias of the work undertaken so far but a characteristic feature of the site.

Three large categories from the corpus (Table 2.1) are selected for more detailed discussion in subsequent chapters of this thesis. First there is a chapter on lead ingots,

[348] Aufrère 1991: 453–4.

[349] Ogden 2000.

[350] For the lead statuettes and amulets, see Heinz 2013.

as well as a small number of silver ingots (see **Chapter 3**). An ingot is a trade commodity, a raw product to be used for manufacture at the final destination, and as such it is illustrative of trade networks. The second main group is the lead weights, which is perhaps one of the most interesting groups of objects made of lead (see **Chapter 4**). A small number of these have symbols on them and/or are inscribed. These allow the identification of a specific weight standard, which in turn gives a specific dating. Together with the lead ingots they shed light on the trade activities taking place in the harbour town. Finally, the 131 (apart from those remaining underwater) lead containers from Thonis-Heracleion are a large group of objects with a great variety in size and lacking any previous study (see **Chapter 5**).

Category	Comparable objects in Egypt	Actual numbers (A) / Inventory numbers (I)
Weights	Yes	153 (A)
Containers	Yes	131 (A) +
Anchor stocks	No	105 (I)
Statuettes	Yes	90 (A)
Miniature vessels	Yes	62 (A)
Fishing weights	No	36 (I)
Tokens	No	25 (I)
Oil lamps	Yes	14 (A)
Ingots	No	20 (A)
Ladles	No	7 (I)
Clamps	No	2 (I)
Keys	Yes	2 (I)
Buttons	No	7 (I)
Dice	Yes	1 (A)
Knuckle bones	No	2 (A)
Sheathing	No	10 (A)
Rings	Yes	28 (A)
Sounding leads	No	7 (A)

Table 2.1 List of all categories of objects made of lead found in Thonis-Heracleion. A distinction is made between inventory numbers (assigned at excavation) (I) and actual numbers (A). 'I' indicates uncertainty about actual numbers, as individual inventory numbers may contain a group of several different objects.

The remaining smaller groups are diverse in nature (Table 2.1). The numbers here are provisional: they are based on identifications during four seasons of fieldwork. During these seasons, less than half of the inventory numbers containing lead were studied due to limited time in the field combined with underwater storage for a number of objects, e.g. (fragmentary) lead containers. Objects not studied are not included in this table, because of the significant risk of misidentification in the case of little-known lead objects. The exception to this rule is the lead anchor stocks, which are easily identifiable, but will be studied separately alongside other anchors from the site. The table does show the general ratios of categories within the corpus. Although this thesis deals with a selection of lead objects, it is important to canvas the whole corpus for a sense of the diversity and wide applicability of lead.

2.3.1. Nautical objects

The presence of lead anchor stocks is unsurprising in a harbour town with 64 shipwrecks in the ancient waterways (Table 2.1). As a component part of an anchor, the stocks should be discussed in conjunction with the other anchors from the site for a full treatment. Other nautical items are brailing rings, which elsewhere in the Mediterranean date from at least the 6th century BC,[351] and pieces of lead sheathing for hulls. Lead patching of the hull is known from the Porticello wreck,[352] whereas the earliest complete sheathing of a hull dates to the mid 4th century BC.[353] Lead rings with a flange,[354] and D-rings with perforations[355] were also found at the site.

There are at least seven sounding leads. One, for example, is hemispherical, with the remains of a plug at the top. The base has only a very shallow hollow, with its surface roughened with tool marks and little incisions. There are three, possible four indents in a concentrical circle on top of the hemispherical surface. It weighs 1,300g.

[351] For example, the 6th century BC Giglio wreck yielded lead brailing rings, see Bound 1991: 27 and fig. 60; for brailing rings in general, see Casson 1995[2]: 68–70. Lead rings were also found in Roman contexts in Berenike on the Red Sea coast, see Hense 1998: 213, fig. 9.17 no. 3637-D-3508.

[352] Eiseman and Ridgway 1987: 16, figs. 2–8 and 2.9.

[353] Kahanov 1999: 219 n. 2; for rolls of lead sheathing and lead sheathing still attached to the planking on the Kyrenia wreck, see Katzev 1969: 58.

[354] With further references, Eiseman and Ridgway 1987: 23 V45, and 24 figs. 2–23 and 2–24.

[355] In both bronze and lead from Olynthus, see Robinson 1941: nos. 1341–46, pl. XC.

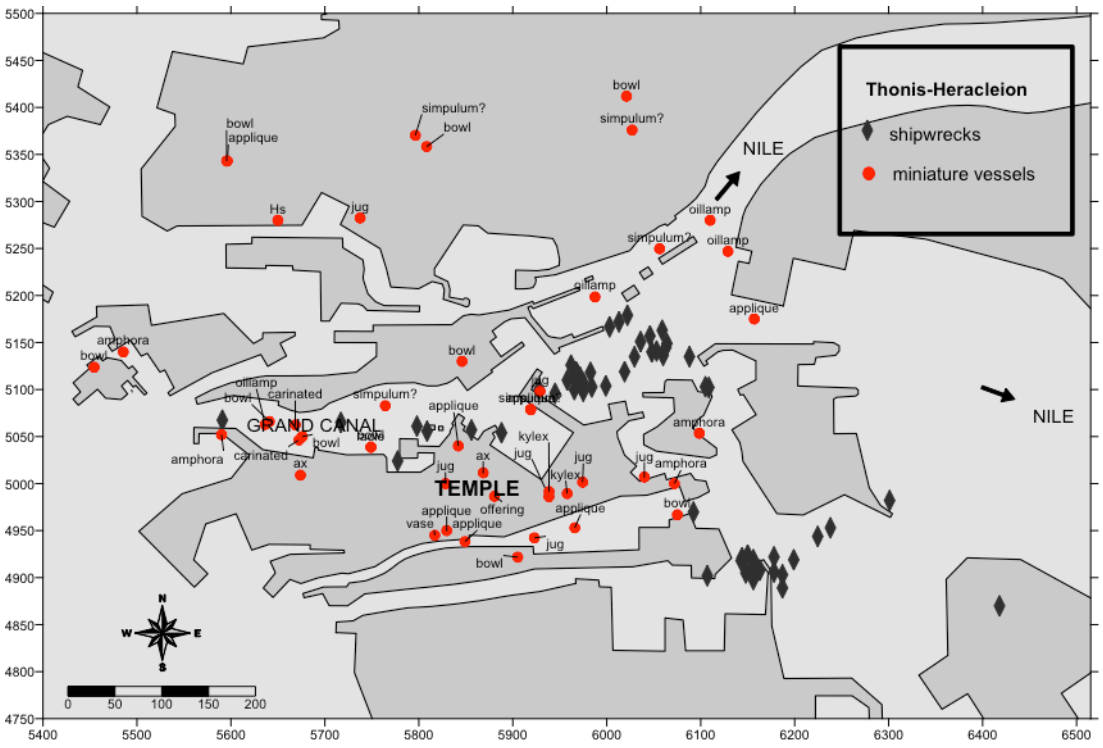


Figure 2.2 Distribution map of lead miniature vessels from Thonis-Heracleion.

The second one is conical, with a non-circular base with an inward tapering depression. Two square holes are drilled in the top to attach a rope. It weighs 4,200g. A preliminary assessment of the sounding leads suggests that they fit into an existing chronological framework spanning several centuries, but they require further study.[356]

2.3.2. Miniature and ritual objects

Sixty-two miniature lead vessels have been recovered from the site (Figure 2.2). Another group of lead miniature vessels in the Greco-Roman Museum, Alexandria, was published in 2009.[357] Some objects have a known provenance, e.g. from the Hadra necropolis in Alexandria[358] and references to many parallels around the Mediterranean may be found here. These miniatures are a Hellenistic phenomenon. Their distribution is not concentrated in one area of Thonis-Heracleion, reflecting the widespread distribution of votive and sacred objects around the port and city.

[356] E.g. Oleson 2008: 120–22 figs. 1–4.

[357] Boussac and Seif el-Din 2009.

[358] Boussac and Seif el-Din 2009: 237 n. 70, cat. nos. 70–71, 73.

Fourteen lead oil lamps were found in Thonis-Heracleion.[359] There are also 12 ceramic and 6 bronze oil lamps, but only one of the bronze examples has a similar shape to those in lead.[360] This type is a simple shape: an open bowl-shaped receptacle with a pinched area for the floating wick,[361] which is a type of lamp is known from around the Mediterranean from the Late Bronze Age onwards into the Hellenistic period. Many examples are known in terracotta.[362] Two types are present in the corpus, ones with and without a rim. One lead oil lamp was found in Olynthus.[363] It is an open bowl, but the rim is not pinched as in the examples from Thonis-Heracleion. Two ceramic examples both with a slightly elevated pinched area for the wick are in the collection of the British Museum, one from Naukratis (more pronounced elevation)[364] and another possibly from Tanis.[365]

Both bronze and lead ladles are present, always at the edge of water and land (Figure 2.3). Bronze ladles are far more numerous, at 110 in total, than the 7 ladles made of lead. There is a surprising lack of situlae at Thonis-Heracleion, with only two

[359] Robinson (under votive practices) mentions 18 lead lamps, see Robinson 2009: 275, this goes unmentioned in the discussion of lamps in Robinson 2009: 199–204.

[360] H.2003.XX.6915; Robinson 2008: 202, no. 160.

[361] Form no. 11, in Walters 1914: xviii, pl. XXXIX. Robins suggests this shape of lamp, resembling a sea-shell, which was used as a lamp in Ur for example, may be an import in Egypt, see Robins 1939b: 184. For a discussion on (the different shape of) Greco-Roman lamps from Egypt, see Robins 1939a.

[362] This overview is not exhaustive, but it gives a general indication of contemporaneous oil lamps elsewhere in the Mediterranean: see Djuric 1995: 11–3, nos. C1–9; Bailey 1975: for Cyprus see p. 214, no. Q479 (reg. no. 1880.7-10.16), pl. 90–1 (dat. 825–750 BC); p. 221–25, nos. Q488–Q493, pl. 96–7, pl. 142 (Q488 (1960.3-2.1) 650–550 BC from Tomb 146 at Amathus, Q489 (1880.7-10.101) idem, no provenance but perhaps Amathus (p. 209), Q490 (1966.2-16.2) late 5th–early 4th c Marion tomb 66, Q491 (1883.1-6.117) 4th–3rd c Achna, Q492 (1883.1-6.116) 250–200 Achna, Q493 (1883.1-6.118) prob. 3rd c Achna) no exact provenance for Q491–3; for Al Mina see p. 231, 232, pl. 100-1, pl. 145; p. 232, Q504 (local, 700–600 BC, but perhaps confusion over provenance, then 4th c BC), p. 233 Q506 (poss. Cypriote, confusion about exact provenance).

[363] From the North Hill, lamp possibly with handle, L. 9.5 cm, W. 7.0 cm; see Robinson 1941: 200, no. 629 (inv. no. 34.553), pl. LII.

[364] Walters 1914: 26 no. 144; Bailey 1975: 244 no. Q515 (reg. no. 1886.4-1.1353) Naukratis, late 4th or early 3rd century, dating is based on comparanda from Alexandria mainly, pls. 102–3, see also p. 240.

[365] Walters 1914: 26 no. 143; Bailey 1975: 244 Q516 EA (EA 22251, reg. no. 1885.11-1.357) Tanis (?), pl. 102–3, see also p. 240.

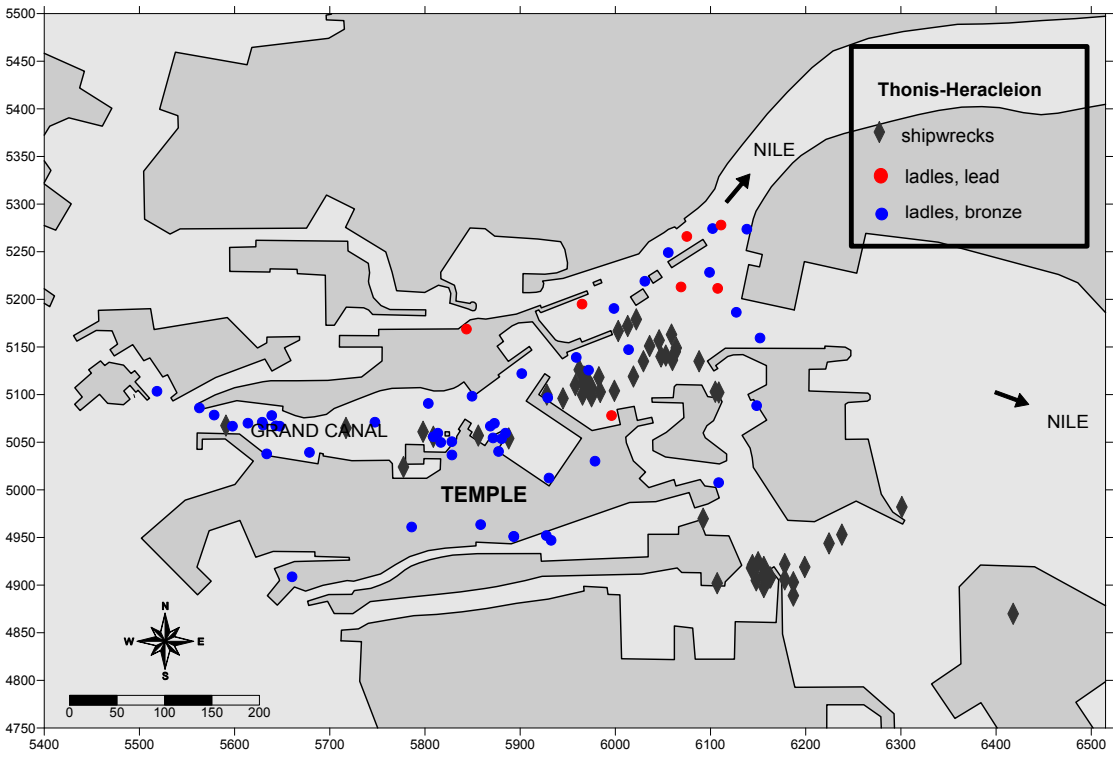


Figure 2.3 Distribution map of bronze and lead ladles in Thonis-Heracleion.

bronze examples found so far.[366] By contrast, there are numerous examples from Saqqara, where much ritual equipment was found in association with the animal necropoleis in Saqqara. Caches of bronzes from Saqqara supply many parallels for individual pieces and for the corpus as a whole.

A small number of lead barks have been recovered at Thonis-Heracleion (Figure 2.4, Figure 2.5). As with the ladles (and oil lamps) they were all from underwater contexts, that is, from the bottom of ancient waterways. The proximity of these objects, especially the lead barks which have no obvious practical purpose, in the Grand Canal and elsewhere is one of the main reasons for arguing for a votive deposition of the Athenian weights found in the Grand Canal (see Section 4.3.1.1).

The lead barks and 90 lead statuettes are excluded here, as they are already included in the corpus of a different DPhil thesis by Sanda Heinz, which treats all statuettes and amulets.[367] One of the important conclusions from her work is that the

[366] Two bronze situlae from Thonis-Heracleion: H6939 and H8276; for examples from Saqqara in the Petrie Museum: UC 30809, with parallels in collections in Boston, Philadelphia, and Durham; as well as a small situla UC 30810; also Martin 1981: 25 no. 221 (H. 6.3 cm), 28 no. 296 (H. 6.4 cm), 106 no. 1500 (H. 6.8 cm); Insley Green 1987: 105–15.

[367] Heinz 2013; for some preliminary observations, see Heinz 2011.

use of lead at the site seems to be determined by the size, subject, and setting of the statuette, and not by cost of the material.[368]

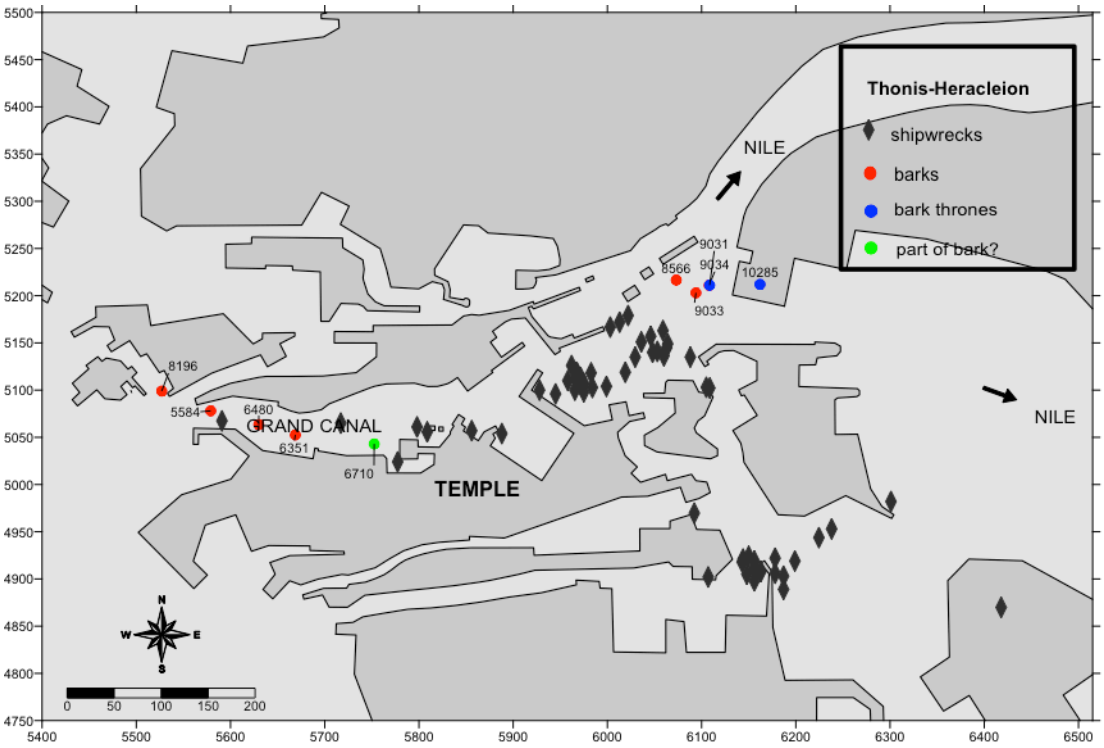


Figure 2.4 Distribution map of lead barks in Thonis-Heracleion.

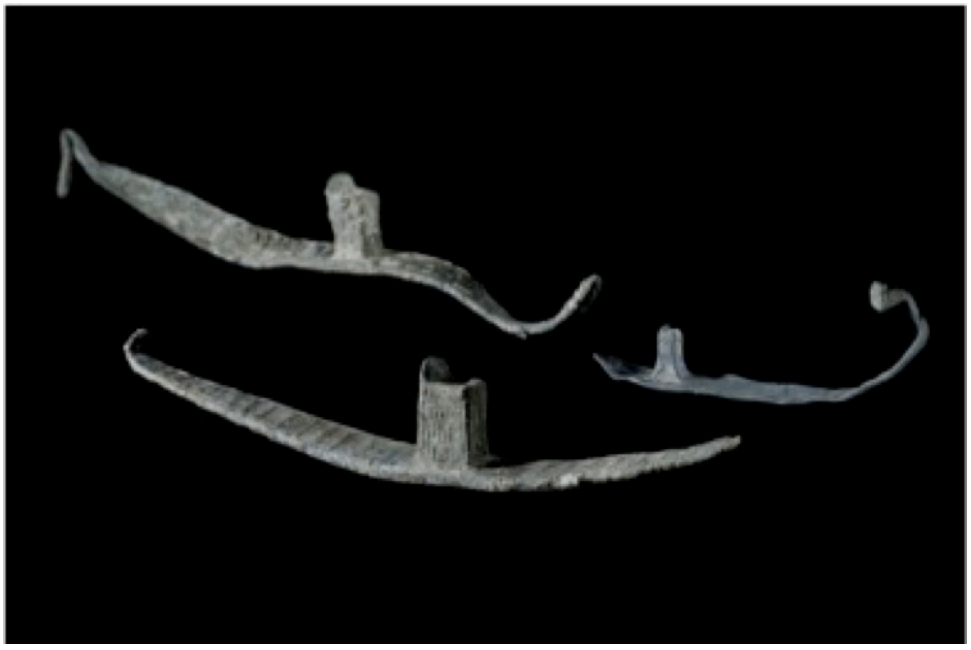


Figure 2.5 Lead barks from Thonis-Heracleion.

[368] Heinz 2011: 224.

2.3.3. Others

A small number of items may be related to games: a single lead dice and several lead knucklebones (Figure 2.6). For the lead dice there are parallels in other materials such as bone, stone, and bronze, but no other purely lead examples.[369] Knucklebones from Egypt made of other materials than lead are known from the New Kingdom.[370] Bone astragali are common in Olynthus, where they occur in large numbers, as well as two bronze examples.[371] This settlement also yielded 5 lead astragali that were unparalleled at their time of their publication.[372]

Worth mentioning are also two lead keys found in the northern part of the site, in what has been identified as a sanctuary.[373] Consequently, the keys should perhaps be interpreted as votives, as it is unlikely that lead keys could function as a real key. A 'curse tablet' was also found, but it should probably be identified as a rolled up piece of lead sheathing as no writing is visible. It is larger than other pieces of sheathing found at the site.

Lead was also used in connection with architecture, both for building and for repairing: five lead dovetail masonry clamps were found.[374] Three plumb bobs were identified from the site.[375] Other practical applications are the repair of broken ceramics with lead clamps, which are well known from elsewhere in the

[369] Petrie lists 58 dice in the collection of the Petrie Museum, see Petrie 1927: 57, pl. XLIX; from Olynthus one ivory die is known, see Robinson 1941: 504, no. 2570, and n. 78 for further references (L. 2.3 cm; W. 2.5 cm; H. 1.8 cm 10.8g; probably with a hole for a lead plug), pl. CLIV, exact provenance unknown.

[370] All three in grey steatite, see Petrie 1927: 57 nos. 227 (large faces with figures), 228–9, pl. XLIX.

[371] Robinson 1941: 503, n. 75

[372] Robinson 1941: 502–4, nos. 2563–7, pl. CLXIV; esp. no. 2563 for measurements, from section T, trial trench on E.S.H.

[373] For similar iron keys from Olynthus, see Robinson 1941: 508–9, nos. 2577–8, pl. CLXV; also see Petrie 1917: 59 §175, e.g. nos. 193–4, pl. LXXVI.

[374] Similar to those from Olynthus, Robinson 1941, 332 no. 1566, pl. XCVIII.

[375] Weighing 519g and 37.3g respectively; for parallels see Martin 1981: 64 no. 759 (H. 2.3 cm), 94 no. 1150 (H. 1.4 cm); also see Petrie 1917: 42 §118 nos. 82–4, pl. 47. Plumb bobs may have been involved in weighing, see Petruso 1981: 45 n. 4 fig. 1; for an example of a balance from Defenneh with a light, small plumb bob, see Skinner 1967: pl. 8.

Mediterranean.[376] Another type of lead object associated with pottery was probably used to stabilize pots instead of repairing them (Figure 2.7).[377] A series of flat discs of lead with one or two perforations at or near the centre have been recovered from the site. Small bronze discs with perforations in the centre and around the edge were recovered in Olynthus. Robinson suggested they may have functioned as reinforcements for furniture (for handle mounts) and in the construction of buildings.[378]

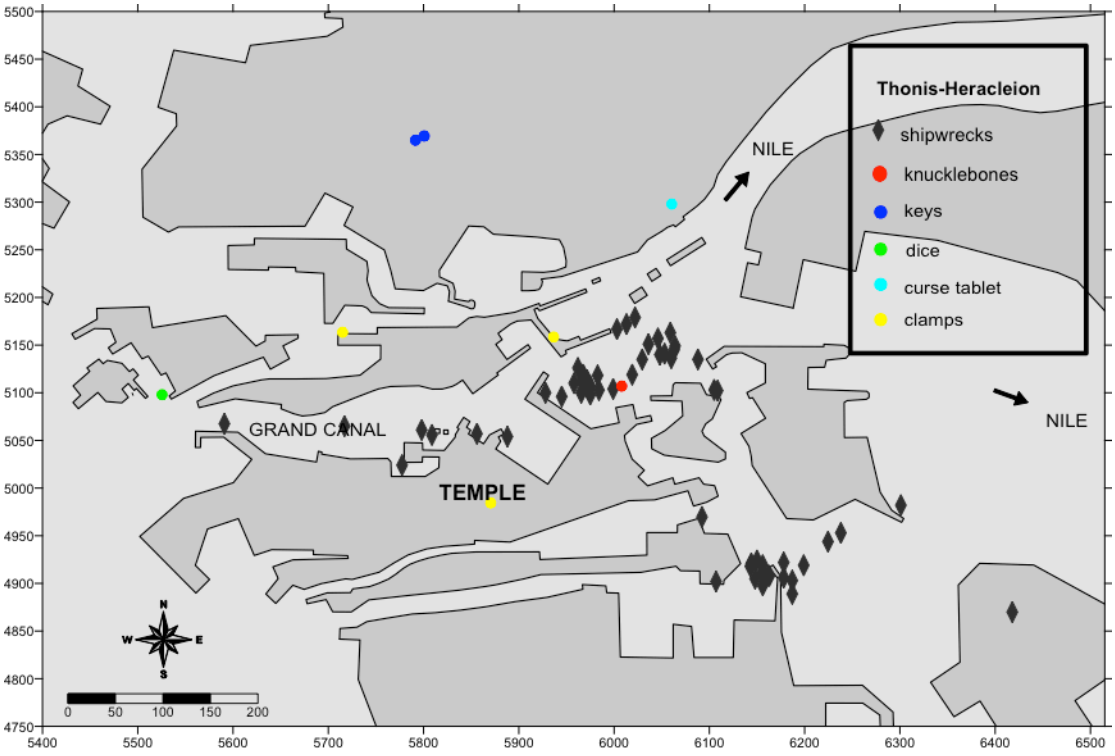


Figure 2.6 Distribution map of several categories of lead objects in Thonis-Heracleion

[376] E.g. Robinson 1941: 332–3, nos. 1567–1582, pls. XCVIII–IX.

[377] Grataloup 2010: 153 fig. 12.4.9, 154.

[378] Robinson 1941: 278–83 nos. 1206–30, pls. LXXVII–VIII.



Figure 2.7 Two types of ceramic 'repairs' made of lead. The example on the left is always found in the centre of the base of the ceramic vessel, whereas the the clamp on the right is found in the body of the container to secure a break.

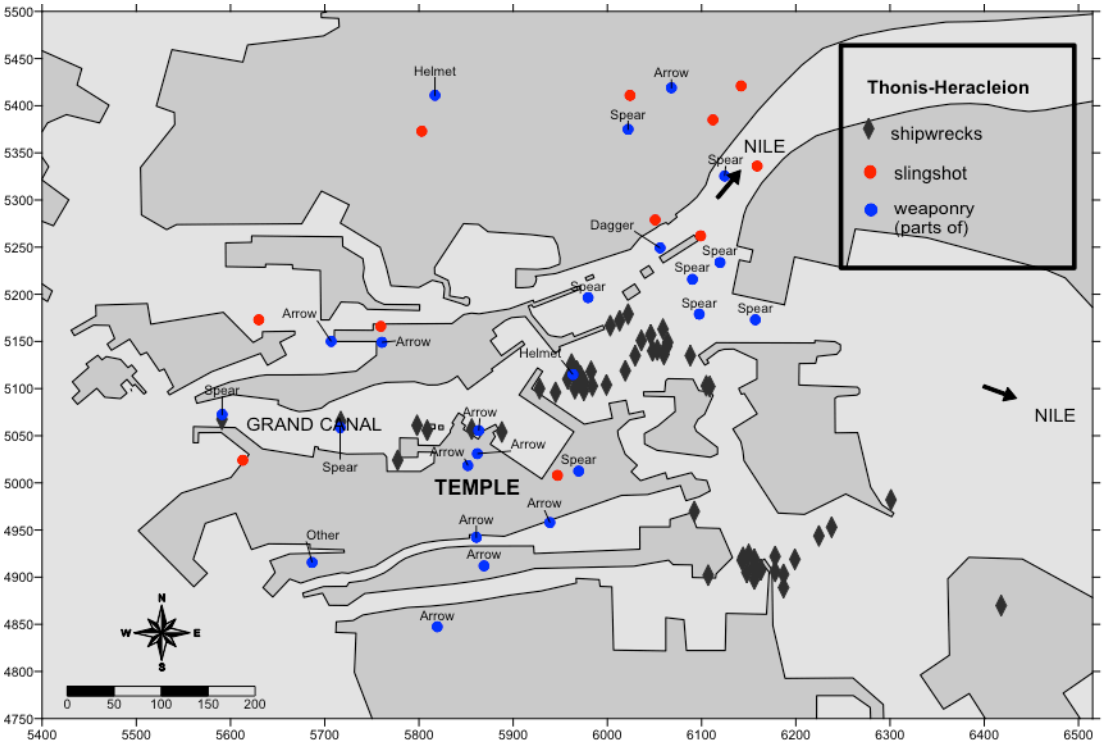


Figure 2.8 Distribution map of lead slingshot and other weaponry in Thonis-Heracleion.

Finally, a number of lead slingshot bullets were found across the site, as well as other objects associated with fighting and weapons, perhaps to be connected to the politically volatile 4th century BC (Figure 2.8). The distribution map of these objects shows less deposition in the water.

2.3.4. Scrap lead

In addition to this list of categories, it is necessary to mention the large volume of small pieces of scrap lead found across the site.[379] This consists of amorphous objects and broken pieces, which are considered scrap residual items and not recorded (Table 2.1). It is also important to point out that there is at present *no* evidence for lead smelting or a metallurgy workshop in Thonis-Heracleion, although it is very likely that this activity took place.

2.4. Conclusions

In short, the broader functional categories of objects for which lead was used are nautical, ritual, buildings and domestic life, and warfare. The preceding assessment of the lead assemblage in Thonis-Heracleion (Table 2.1) has also illustrated that it stands in marked contrast to the lead known from elsewhere in Egypt in terms of size and diversity. The survey of lead objects and written sources mentioning lead from Egypt shows that lead was used from predynastic times until the Roman period. From the Third Intermediate Period onwards, however, there is an increase and diversification that suggests a familiarity not previously acknowledged in scholarship.

Many object categories from Thonis-Heracleion have comparable examples from Egypt, e.g. some lead containers, weights, plumb bobs, oil lamps, and miniature vessels, but in much smaller numbers. This discrepancy may be due to a difference in the location of the site and modern fieldwork. Thonis-Heracleion is a settlement with mundane activities, and many harbour facilities, as well as a temple. Archaeological work in Egypt is concentrated in desert areas, as settlement sites are normally located on levees in order to maximise the available space on the floodplain for agriculture. This also causes modern settlements to be built on top of the remains of the older settlement, making the archaeological remains difficult to access. Consequently, archaeological work is conducted elsewhere. This results in different ranges of material, simply because the different contexts have different ranges of associated material culture. There are a few notable exceptions for settlement archaeology, for example

[379] The volume is not quantified as it is impossible to weigh items on board ship and the scrap metal is never brought on land.

Amarna, and it is precisely in a house from this city that a few lead objects were found. The majority of the small lead containers from Egypt were found in the area of the animal necropoleis in Saqqara (where there was also a settlement in the necropolis), and in **chapter 4** a hypothesis is advanced that at least some of the lead containers were deposited in a ritual context.

Apart from the location of fieldwork, a second important factor explaining the discrepancy in numbers of lead objects is the depositional context. Thonis-Heracleion was surrounded by water: the river and the sea to the east and northeast, basins and lakes to the west, and many interconnecting canals in the centre. Many objects were recovered from areas that would have been underwater in antiquity, or were near the water and collapsed and spilled into waterways at some point.[380] An underwater location has a better rate of preservation because objects are effectively put out of circulation, and outside of normal processes of discard and recycling. Was this a convenient place to throw rubbish? Or is it part of a ritual, for the safe return after a voyage for example?[381] The following three chapters look at distribution plots of object categories in detail to ascertain if there are any identifiable patterns.

Finally, the number of metal artefacts from the site is reminiscent of other large assemblages of metal artefacts from Olynthus and Pompeii. After Philip II sacked Olynthus the settlement lay in ruin, but not out of reach of plunderers and scavengers. Pompeii was dramatically taken out the normal cycle of daily life, and although there was some time to prepare for evacuation and it is clear objects also were retrieved after the eruption, the material culture preserved at Pompeii remains exceptional.[382] The metal artefacts from Olynthus are plentiful in number, but small and of little monetary value. Thonis-Heracleion also shows signs of plundering and reuse: although some precious metal objects were recovered, as well as several courses of stone work in the temple, it needs to be assumed there was originally much more.[383] The special character of the assemblage in Thonis-Heracleion is largely due to the deposition of many artefacts underwater.

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[380] Meadows 2011.

[381] E.g. votive anchors, see Goddio and Fabre 2008[2]: 310–1 cat. no. 127.

[382] For the assemblage of a metalworker's shop, see Section 5.4.4.

[383] Some walls are at an angle, possibly in association with a landslide, e.g. Goddio 2007: 79–82 and figs. 3.14–3.19.

2.4.1. Three case-studies

The preceding overview of lead in Egypt and the broader discussion of the lead corpus from Thonis-Heracleion have established that the role of lead in ancient Egyptian society is rarely examined in detail. The lead corpus from Thonis-Heracleion will address this lacuna by providing a robust dating framework. For this, the assemblage from Thonis-Heracleion is broken in to three functional categories, two focussing on trade and one on the little-known containers. Through a detailed analysis of these three categories, it is possible to gain a new perspective on levels of the metallisation of society in antiquity. Pompeii and Olynthus, with their large quantities of metal, were considered exceptions to the norm, but it is becoming increasingly clear, not just from the discoveries at Thonis-Heracleion, that this pattern may reflect metal in society more accurately than previously thought.[384]

Another point raised by the discussion on the lead objects from Thonis-Heracleion is the numerous parallels found outside of Egypt. The following chapters may also be used to help elucidate the role of Thonis-Heracleion both within a local network relating to Naukratis and Sais and within international trade routes and contacts.

The geographical position of the town at the mouth of the Canopic branch of the Nile implies a mixed population of both Egyptians and others. The Egyptian and Greek names of the site, Thonis-Heracleion, are symbolic of a world where close economic and military ties existed between Egypt and Greece. The corpus of lead casts a new light on Greek-Egyptian relations. Some of the lead objects from Thonis-Heracleion have an Athenian provenance and may be dated to 4th century BC when the grain trade with Athens was in full swing **(Chapter 3)**.

Previously, Greek presence overseas tended to be identified by or extrapolated from the presence of imported Greek pottery. There are clear methodological problems with equating pots to people.[385] Other markers of Greeks in Egypt include gravestones

[384] I am not suggesting that the assemblage at Pompeii is an accurate reflection of life in this town, rather that the volume of metal objects should be interpreted as more ordinary than exceptional. See also Harris 2007: 532.

[385] As summarized by Gill 1994.

with Greek and Carian inscriptions in Saqqara.[386] Greeks seem to have adopted an Egyptian identity quickly. If one disregards the presence of Greek pots and the literary evidence, they are difficult to identify as a distinct group in the archaeological record.[387] The delta is where many foreigners such as Greeks would have lived and settled. How can they be detected in the archaeological record? The following three chapters analysing three different categories of material culture in lead from Thonis-Heracleion contribute to this broader narrative of Greek ties to Egypt.

[386] E.g. Masson 1978.

[387] For example the sarcophagus of Wahibre-em-achet in the National Museum of Antiquities, Leiden, the Netherlands, see Vittmann 2003: 203, and pl. 22.

CHAPTER 3. INGOTS

This first of three case studies concerning the corpus of lead from Thonis-Heracleion treats the lead ingots. An ingot is defined here as a mass of metal, typically oblong in shape, which is well suited for the handling, storage, and transportation of the metal as a raw material. It represents a transitional phase between the extraction of the metal at the mine and possible refining process on site and the moment when it reaches its 'final' destination where the ingot is processed further. The most common archaeological location to find metal ingots is on shipwrecks (see below). The ingots from Thonis-Heracleion discussed in this chapter, however, were recovered during general survey and excavation work, and are not directly associated with cargoes of the numerous shipwrecks at the site.

Many trade goods were of perishable nature, such as grain, papyrus, and natron and consequently they do not leave traces in the archaeological record. The comparatively rare finds of raw material, such as metal ingots, provide more information on this type of trade. The preceding chapter showed that Egypt had no significant lead resources and associated production apart from limited galena sources in the Eastern desert that were worked during the Middle and the New Kingdom. Epigraphic evidence from tribute lists and tomb scenes supports the idea that by the New Kingdom lead was imported in large quantities into Egypt from the Near East and perhaps the Aegean. The first half of this chapter discusses the ingots from Thonis-Heracleion. In the second half, the chapter builds on the picture of lead trade deduced in **chapter 1** by contrasting and comparing the ingots from Thonis-Heracleion with pre-Roman ingots known from Egypt and the rest of the Mediterranean. The result is a broad framework for dating the examples from Thonis-Heracleion. A discussion of the lead ingots from the Mediterranean combined with the group of lead ingots from Thonis-Heracleion also sheds light on the hypothesis of lead imports in Egypt from the New Kingdom into the first millennium BC. The absence of signs of metalworking at Thonis-Heracleion is also addressed briefly.

The scope of this chapter is extended to include ingots of different materials from Thonis-Heracleion (a small number of plano-convex, or cake-shaped ingots in both lead

and silver, as well as bronze, tin, and iron ingots) because they are few in number and may potentially give information that reflects back on the lead ingots. The material of a number of plano-convex ingots is tentatively identified as silver on the basis of visual inspection.[388] In Laurion, Attica, silver was extracted from argentiferous galena for the production of Athenian coinage, with lead as the by-product of the more desirable silver.[389] For this reason, and because of the much-debated role of silver in the economic processes of exchange, notably weighed silver as payment eventually developing into coinage, it is a logical step to include the silver ingots in the scope of the present chapter. As will become clear, the location of the silver ingots is clearly demarcated and contrasts markedly with the distribution of the lead ingots.

3.1. Ingots from Thonis-Heracleion

The discussions of the three different categories or shapes of ingots have two components each: first come the numbers, weights, and shapes of the individual ingots, followed by the discussion of the distribution and context of the ingots. The loaf-shaped ingot is the first group, which is clearly an ingot intended for bulk transport. The second is a much thinner ingot, bar- or stick-shaped, and much lighter than the previous category. The third and final category is the plano-convex ingot.

> *Nous appelons lingot une masse de métal obtenue à partir d'une certaine quantité de minerai en fusion, coulée dans une moule de forme variable. L'objet n'a d'autre destination que de permettre un transport commode du métal. Il convient de négliger les morceaux de minerais non traités et tous les déchets de fabrication informes, parfois appelés improprement lingots: le lingot se définit comme une matière élaborée et il porte, le plus souvent, une inscription.*[390]

[388] Verification of the chemical composition is an avenue of future research.

[389] This is not always the case: lead was also extracted from oxidized ores such as cerussite (lead carbonate) and jarosite, e.g. Rio Tinto, Spain, and the mines in southeastern Turkey.

[390] Laubenheimer-Leenhardt 1973: 1; "We call an ingot a mass of metal obtained through extraction from a specific mass of fused minerals, poured into a mould of variable form. The object has no other purpose but permitting the ease of transport of the metal. Untreated pieces of minerals and all shapeless waste from the fabrication process, sometimes inappropriately called ingots, should be omitted from this definition: an ingot is defined as processed material and, most often, carries an inscription." This translation is by the author.

Laubenheimer-Leenhardt's definition of an ingot is useful for the understanding and classification of the numerous small pieces of 'scrap' lead that were found distributed across the site of Thonis-Heracleion. They can appear as amorphous lumps or mangled objects that were seemingly discarded or lost. Such objects were consequently not described as ingots, because their primary purpose was not for the bulk transportation of the metal. The discussion does, however, include smaller, deliberately made bars or sticks of metal as it would appear that they were specifically manufactured for the transportation of the raw metal rather than being a manufactured commodity in their own right.

The archaeological evidence would tend to suggest that pre-Roman lead ingots are relatively uncommon, in contrast to the large numbers known from the Roman period.[391] Based on the premise that the ingots are not later than the end of activity at the town in the mid-2nd century BC, this group from Thonis-Heracleion considerably expands the existing corpus of pre-Roman ingots.

3.1.1. Loaf-shaped lead ingots

Loaf-shaped ingots are large and oblong in shape, half-cylindrical in section, with rounded short ends (Figure 3.1 and Figure 3.2). Table 3.1 contains the details of 11 loaf-shaped ingots from Thonis-Heracleion, as well as the details of two more, possibly originally loaf-shaped, ingots. Two are well preserved, including one with multiple stamps on its flat base (**no. 1** 5943). In others large chunks of the original ingot are missing or they are covered in marine encrustations obscuring any marks, making it impossible to establish the original weight. The ingots heavier than 5kg were weighed on suitable scales in the laboratory in the Maritime Museum, Alexandria. Ingots lighter than 5kg were weighed on a normal kitchen scale (with a limit at 5kg).

[391] Muhly 1988b; Eiseman 1980: 43.

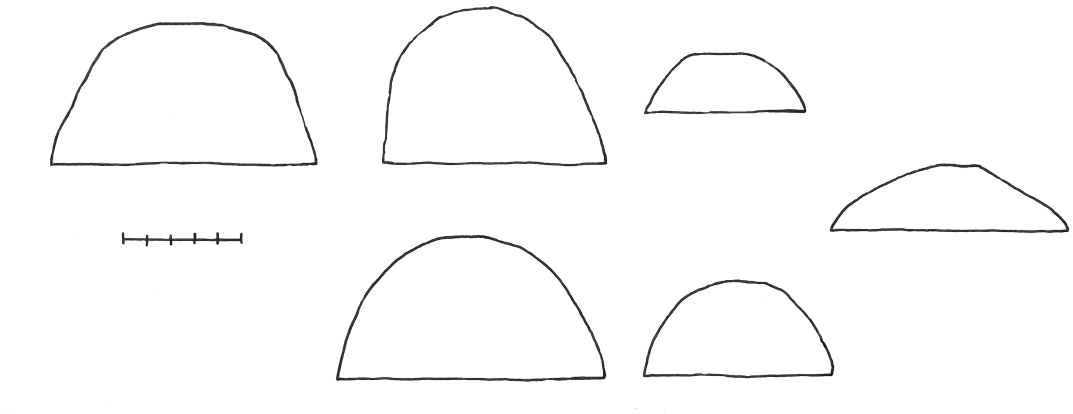


Figure 3.1 Ingots from top to bottom: no. **2** (top and section) and **7** (top, side and section).

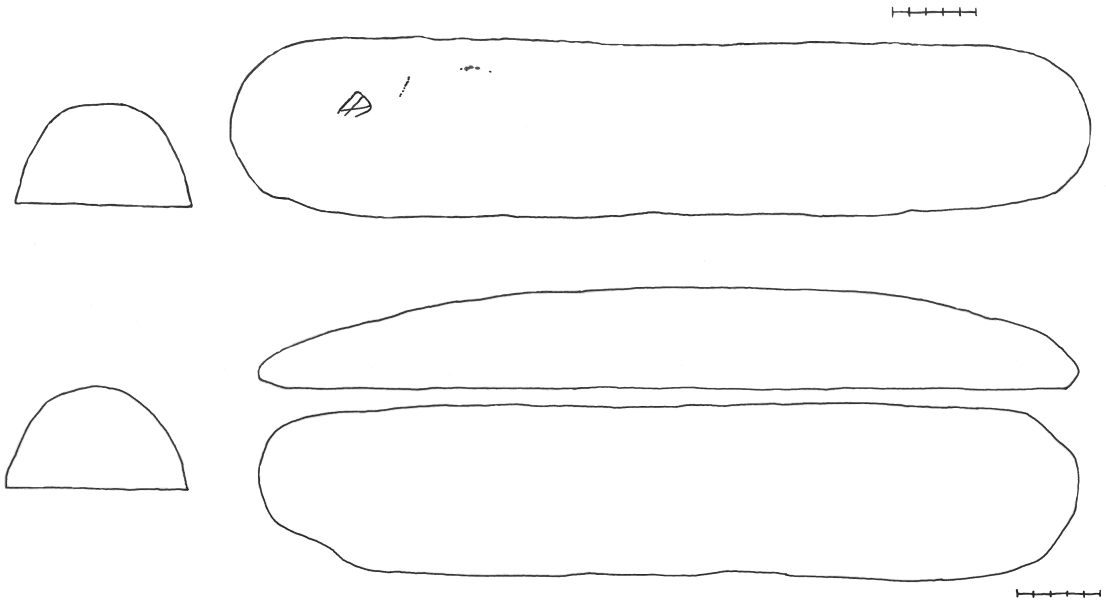


Figure 3.2 Sections of selected ingots, from left to right, top: no. **4**, **8**, **11** middle: **10**; bottom: **6**, and **9**.

No.	Dimensions (cm)	Weight (g)	Stamps	Preservation	Comment
1	46.9 x 11.0 x 6.5	23,000	7 stamps, 3 in pairs of 2: 'T' as a single stamp, and 'IA' in ligature, representations of flute player and acrobat[392]	Very good, complete	Egypt's Sunken Treasures cat. no. 357 Multiple striations
2	51.0 x 10.5 x 6.0	23,000	Partial stamp	Very good, complete	No coordinates
3	48.2 x 12.0 x 6.0	22,000	–	Severely corroded, with many shells	No original surface visible
4	48.1 x 11.2 x 6.0	20,900	Chiseling, and pi-shape?	Smooth surface, complete	
5	47.1 x 11.9 x 6.7	20,100	–	Severely corroded, with many shells and 1 ceramic fragment embedded	
6	46.2 x 11.3 x 6.0	17,470	–	Smooth surface, complete, cleaned	
7	48.7 x 11.0 x 6.0	17,230	–	Smooth surface, complete	Striations present
8	53.0 x 9.5 x 6.5	16,800	–	Complete, but corroded rough surface	
9	57.0 x 8.0 x 4.0	13,129	–	Remains of marine encrustations, complete	
10	46.2 x 9.9 x 3.0	5,990	–	Eroded remains of ingot, incomplete	
11	43.0 x 7.0 x 2.5	3,630g	–	Very worn and very rough, incomplete	
12		1,386	–	Incomplete, fragmentary, ragged edges, with pottery	Lead slag?
13	21.2 x 2.3 x 1.1	247	–	Rough surface, remains of marine encrustations	Flat backed, semi-circular section "stick"

Table 3.1 Loaf-shaped ingots from Thonis-Heracleion

[392] No photograph is available, for description see Goddio and Fabre 2008[2]: 342.

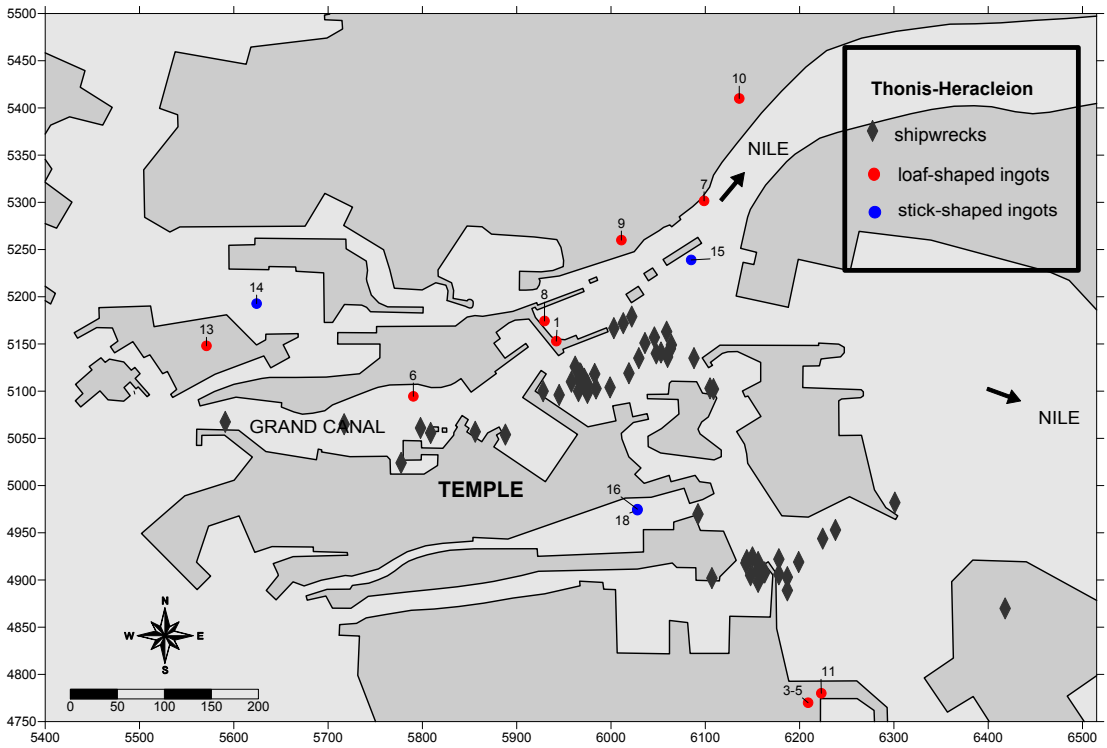


Figure 3.3 Distribution map of loaf-shaped and stick-shaped ingots ©Franck Goddio/Hilti Foundation.

Apart from shape, the location, metrology, and the presence of stamps are the significant features of this group of ingots. A discussion of the shape is more meaningful in the context of parallels, so this is treated in section 3.2. The majority of loaf-shaped ingots are found on land or at the edge of land and water (Figure 3.3).[393] It is also apparent from the spatial distribution that there is no obvious connection between the known submerged vessels in Thonis-Heracleion and the ingots, suggesting that they were not recovered as part of a cargo of raw material or used as ballast on the sunken vessels.

3.1.1.1. Spatial distribution

This discussion starts with the location of the ingots (no. **6**) recovered in the middle of the Grand Canal, which was a focal point of religious rituals.[394] Many of the objects found at the bottom of this canal have known religious connotations, e.g. bronze ladles used in libation offerings. In the absence of large quantities of transport

[393] Nos. **2** and **17** do not appear on the distribution map as they do not have coordinates registered for them in the database.

[394] The Canopic decree mentions nautical processions from the temple at Canopus to Thonis-Heracleion during the Khoiak festival, see Pfeiffer 2004: 144–8, 155–7.

amphoras and other such 'trade waste', it seems unlikely that the banks of this canal were used as a commercial *entrepot* where ingots would be offloaded. There is also no indication of metalworking taking place in the area of the site. Moreover, there is no shipwreck identified in this part of the Grand Canal. The find location in the water of the Grand Canal does not necessarily suggest that this ingot was found in an area originally underwater. In the immediate vicinity of the ingot there is a group of very large lead containers. In **chapter 4** I argue that this group indicates the presence a small island or wooden mooring area in the canal to support the containers (see Section 5.3.1.2).

A well-preserved ingot with stamps (**no. 1**) was recovered with another group of medium-sized lead containers, from a part of harbour infrastructure to the northeast of the Grand Canal *en route* from this canal to the North passage. A lead clamp used in architectural construction and a lead container (no. **246**) were also found in this area. It is possible that this is simply an ingot lost in transit. Another large ingot (no. **8**) was found at some distance to the North, associated with the same harbour infrastructure. It is not clear what, if anything, the presence of the ingots near large containers may indicate. There are no coordinates registered for ingot no. **2** with the partial stamp.

Three more loaf-shaped ingots (nos. **7, 9, 10**) were found in a northwestern direction concentrating on the north bank of the North passage, but in isolation from each other. The distribution of these ingots in the North passage and around the harbour infrastructure suggests a relatively early date of the 5th to 4th centuries BC in view of the ceramic record from the site and the absence of coins in the North passage.[395] Ingot no. **6** is perhaps slightly later, in view of the well-attested 4th and 3rd century BC activity in the Grand Canal.

Four ingots (nos. **3–5** and **11,** Figure 3.3) are from the southwest of the site and therefore outliers. Their findspot was on land around another harbour basin. In general, ceramics in this area suggest activity during the final Hellenistic phase of the site.[396] These ingots are badly corroded, but the impression of the shape of these ingots is not half-cylinder, rather a truncated half-cylindrical, or in other words a rectangular parallelepiped (Figure 3.1 and Figure 3.2). Although the sample size is small, it is

[395] A. Meadows, personal communication.

[396] Area G, see Grataloup 2010: 156.

tempting to speculate that the shape of the ingots could be taken as a visual clue of a later date for these ingots.

To conclude, the loaf-shaped ingots mostly appear in the northern areas of the site, typically in the waterways, with only one in the Grand Canal and more surrounding the North Passage. There is no relationship with any identified sunken vessels, nor is there any apparent clustering in the spatial distribution or context of the ingots with the exception of the slightly flattened ingots in the southeast.

3.1.1.2. Metrology

Turning to the metrology of the ingots, the two best-preserved ingots weigh 23,000g. This is considerably lighter than the weight of the closest parallel from the Porticello wreck (see Section 3.2.3). For this ingot it is suggested on the basis of its current weight of 25,950g that it was intended to weigh 1 Attic talent of 26,160g or 6,000 drachma.[397] This is not readily applicable to the ingots from Thonis-Heracleion. Even the best-preserved examples at 23kg (nos. **1** and **2**) weigh considerably less than 1 Attic talent of 26,160g. This amount of weight loss is unlikely in view of their good state of preservation. Moreover, the other 6 loaf-shaped ingots (nos. **3–9**) are reasonably well preserved and weigh even less. This suggests that an Attic talent of 26,160g, or a fraction thereof, was not the intended weight of the ingots.

Nos. **10** and **11** are damaged and fragmentary, and no. **3** has a rough surface. Thus, it is likely that the recorded weight is not the original weight, due to post-depositional factors of marine encrustation and the erosion of metal, as well as the cleaning (or not) of the ingots after excavation. No. **4** seems clean (unfortunately no photograph is available) and thus here too there seems to be no scope for a significant amount of weight loss. No. **5** has only a third of the original lead surface visible, and the same is true of ingot no. **3**.

The other ingots (nos. **6–9**) seem to agree with being measured as a fraction of the Attic talent. Ingots nos. **6–8** are close to 2/3 of a talent and ingot no. **9** seems attractively close to half a talent at 13,129g. These suggestions, however, remain

[397] Eiseman and Ridgway 1987: 57–8.

speculative as the corpus is limited, both in Thonis-Heracleion and elsewhere in the Mediterranean, and no firm conclusions can be drawn from the available material.

3.1.1.3. Stamps

The presence of stamps on some of the ingots needs to be considered in more detail. Ingot no. **1** has stamps on its flat side of the ingot that were probably impressed while the lead was still in the mould. The second example (no. **2**) has a (partial) stamp impressed on the convex side of the ingot, and thus probably applied at a different stage of the production process than no. **1,** when the ingot had already been removed from the mould. In their discussion of the Porticello lead ingot, Eiseman and Ridgway call the former stamp primary, and the latter secondary in order to distinguish between the two.[398] It is clear that fresh lead would be soft enough for a secondary impression on the convex side after the initial casting and cooling.

Several possibilities concerning the meaning of stamps on lead ingots have been put forward. The stamps on the Porticello ingot are square with rounded corners, and impressed in ligature are the sigma, iota and eta. The same stamp is impressed 6 times at irregular intervals along the longitudinal axis of the convex side of the ingot. In their discussion Eiseman and Ridgway suggest that they may signify ownership of the ingot or, more specifically, the lessee of the mine, the mine's name and/or place, the value or weight of the ingot, and the sign of the *metronomos*, an official in charge of checking the quality, weight and general production.[399] The following ideas for the interpretation of the stamps on the loaf-shaped ingot from Thonis-Heracleion (no. **1**) are based on these assumptions:

1. No. **1** is similar enough in shape to the Porticello ingot to use this as parallel,
2. that the Greek-style stamps on the ingot from Thonis-Heracleion indicate a Greek provenance, and

[398] Eiseman and Ridgway 1987: 57 n. 73.

[399] Eiseman and Ridgway 1987: 57, and n. 86; in a 'shrewd study of ingot-stamps', see Boardman 1988. The link Eiseman and Ridgway establish to the typical 4th century lease contract of the Laurion mine is very helpful. These lease contracts contain the name of the lessee, the price, sometimes the name of the registrar of the mine, the name, place and classification, and the four boundaries of the mine, see Crosby 1951: 192; Parker 1992: 333.

3. that it is plausible that the ingot from Thonis-Heracleion may also be a Laurion ingot as the lead isotope analysis from the Porticello ingot suggests that it was sourced in Laurion.

The first two assumptions are fairly straightforward; the final one is more tenuous, but not crucial. Based on these, I look towards Greece and Laurion specifically for clues as to the meaning of the stamps on the ingots from Thonis-Heracleion. There are 4 different stamps on the ingot, 7 in total. All stamps have an irregular hexagonal shape. Four stamps have *interior decoration* in raised relief, meaning the stamp or die used to make the impression had decoration on it in intaglio. The effect is similar to a seal impression. The three other stamps were made with stamps or dies in raised relief. Consequently, the stamps may be divided into two separate groups on the basis of their technique. Furthermore, this division is echoed in the imagery on the stamps. Both the figurative stamps have their interior figure in raised relief, one with a figure of a flute player, the other of perhaps a male athlete, whereas the two stamps with letters are in bas-relief.

This visual distinction between the two groups of stamps may represent a different meaning or category of meaning. Starting with the stamps in bas-relief, individual letters in Greek notation may be equated to numbers, or they may be used as an acronym, an idea also put forward for the Porticello ingot, albeit unsuccessfully.[400] The obvious suggestion is that the letter T indicates 'talent', i.e. an Attic talent of 6,000 drachmas.[401] If, however, lead in the shape of these ingots *always* weighed a talent, by default, then one wonders why it was necessary to confirm this by means of a the stamp. Furthermore, the ingot does not, in fact, weigh one talent. The other solution may be that the T was stamped by a *metronomos*, after confirming or controlling its weight. Perhaps one may speculate the other stamp in bas-relief may perhaps identify the official in question further. The other stamp read IA in ligature. The shape of the lettering, however, is reminiscent of a different stamp on a lead weight (no. **47**), *if* one

[400] Eiseman and Ridgway 1987: 57; the following discussion of the stamps on this ingot as they relate to the Attic weight system should be disregarded, since it conflates the different concepts of a coin stater (2x drachma of 4.35g) and a weight stater (2x mina of between 105–150 drachma (the mina increases in weight over time), see **chapter 3**). If the stamps indicate 101 (coin) stater, this works out to 101 x 8.7g = 878.7g.

[401] For references, see Eiseman and Ridgway 1987: 58 n. 85.

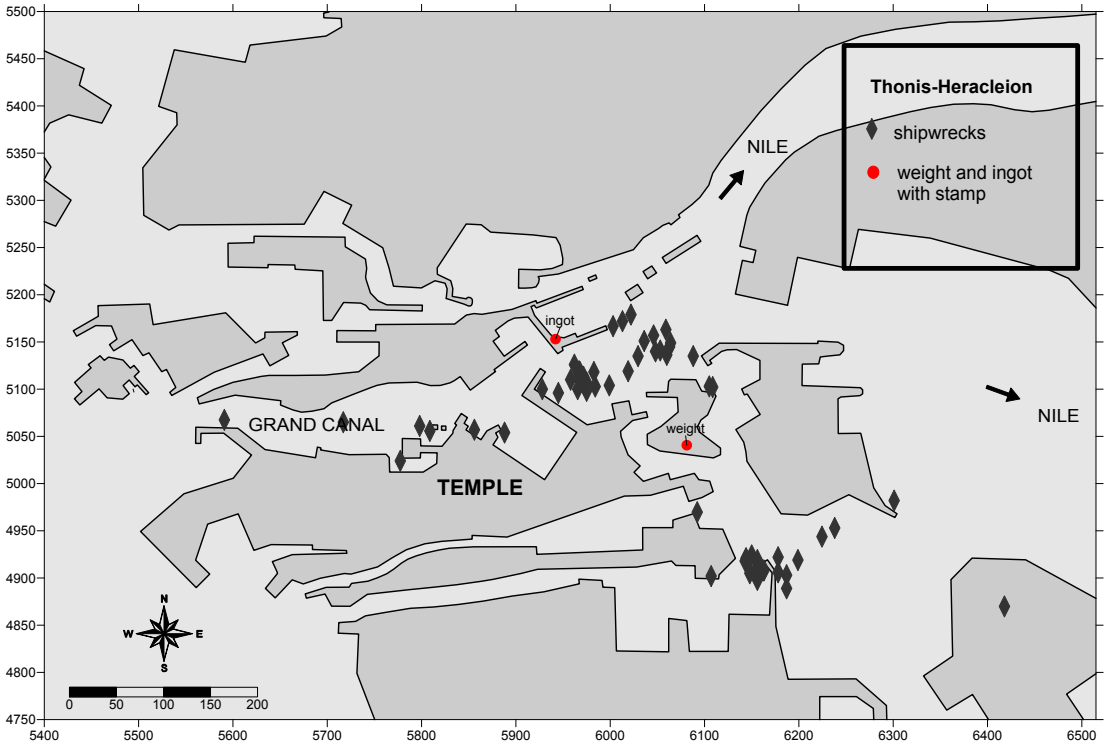


Figure 3.4 Distribution map of weight no. 47 and ingot no. 1 with stamp ©Franck Goddio/Hilti

is interpreted as the negative of the other. Apart from the reversal, they are also not identical in shape either. The stamp on the weight is round with a frame in relief around it, whereas the stamp on the ingot is hexagonal. The reversal also means that is possible that the stamp could be read differently as NA or AN as a monogram. It is impossible at present to answer this question with any certainty. The weight and the ingot were found at a considerable distance to each other (Figure 3.4) and their association is thus on the basis of the similarity of stamps only. The appearance on the weight does favour the hypothesis that this was an owner's mark or identification of a person. As the multiple/fraction of a value, unit or measurement, in line with other legends and symbols on weights, it makes little sense to appear on both a small weight and a large ingot. In view of the lack of parallels, it is impossible to be more precise, or more certain, other than suggesting possibilities.

Turning to the group of figurative stamps in raised (interior) decoration from a die in intaglio, the flute-player and the athlete, perhaps these may be taken as visual indicators of provenance. Eiseman and Ridgway suggested several options for the interpretation of the stamps on the Porticello wreck: one was for an equation to numbers, and another option used 4th century lease contracts of mines in Laurion from the Athenian agora for the identifying 'tags' for mines and by extension the

products from the mines. These contracts contain several key components: the name of the lessee and the name and borders of the mine are the most important. Many villages, hamlets, and/or natural features mentioned in the contracts are very local and difficult to identify.

In Crosby's article on the contracts, one of the contracts makes mention of Aulon, a village or region in the Sounion deme of southern Attica as well as two others referring to roads leading to Aulon.[402] On the basis of the lettering and formulas in the text, chronologically the contract is placed just after 367/6 BC. The fact that Aulon was the site of a mine is confirmed by a reference in a speech by Aeschines (I.101) from 343 BC. Here he mentions a workshop at the silver mines in Aulon.[403] It is possible that the figurative stamps on the ingot refer to the mine or locality where the ingot was produced. I would like to speculate that the stamp with the flute player (*auletes*) may be interpreted a visual reference, a pun, to the mine at Aulon. Although this link is speculative, it must be noted that the reference in Aeschines from the middle of the fourth century and the ingot from Porticello are roughly contemporaneous, making the link more compelling. The other figurative stamp shows a male athlete, perhaps a *diskoboulos*, with one leg outstretched in front of the body and the other leg bent with the heel touching the buttock. This stance is reminiscent of images of athletes on Greek vases. [404] Without more evidence for a more definitive analysis, however, the interpretation of the stamps from the Thonis-Heracleion ingot will remain elusive. The parallel with the Porticello wreck and the stamps (see below), combined with the established trade connections with Athens in the 4th century BC, clearly point a Greek provenance for the stamped ingot from Thonis-Heracleion. The link to Laurion is tempting, but cannot be proved.

In conclusion, the stamps with letters may relate to people controlling or overseeing production in some way; the stamps with pictures may refer to the particular mine or a geographic location. Although still speculative, it would seem more certain that the loaf-shaped ingots had a provenance in the Greek world. Other indications of

[402] Crosby 1950: 194, 207 doc. 2 (367/6 BC or slightly later) line 8 with further references to Aulon in docs. 8 and 10, pl. 83 no. 2.

[403] Adams 1968: 82–3; Fisher 2001: 238–9.

[404] E.g. image on kylix Louvre G111 by the painter Kleomelos, see Beazley archive, ARV2 118,1; Add2 174.

this Egyptian-Greek trade network are the Attic pottery and the Athenian weights found at the site (see **Chapter 4**).

3.1.2. Stick-shaped lead ingots

No.	Dimensions (cm)	Weight (g)	Stamps	Preservation	Comment
14	42.5 x 1.7 x 1.5	702	-		
15	32.7 x 1.5 x 1.1	336	-		
16	15.8 x 3.3 x 3.4 section 0.7 x 0.55	44.9	-		One short end at near 90 angle
17	15.6 x 2.1 x 1.7 semi-circ. section, one end flattened	249	-		No coordinates
18	13.3 x 0.9 x 1.2 semi-circ. section	34.3	-	Complete	Rectangular section, one short end at 45 angle

Table 3.2 Stick ingots from Thonis-Heracleion

There are also 5 objects, perhaps ingots, which are very different in their appearance compared to the previous loaf shaped ingots (Table 3.2).[405] They are like rods or sticks in shape and much lighter than the loaf-shaped ingots. They are rectangular (nos. **14**, **17**), square (no. **16**) or hemispherical in section (nos. **15**, **18**). The diameter of the ingot is not more than a few centimetres. This type of lead object was also found at Olynthus, where they are called bars.[406] A total of 16 bars are catalogued from Olynthus, of which 6 are cross-shaped in section.[407] Leaving these to one side, the remaining 10 bars are smaller than the ingots from Thonis-Heracleion, measuring 7.7–19.3 cm in length. Their weights are not recorded. Four of the bars from Olynthus have inscriptions interpreted as personal names. The provenance is unknown in 6 instances; the remaining 4 bars were found in houses.

The distribution of the Thonis-Heracleion example shows two (nos. **16** and **18**) found in the harbour south of the temple island. Another (no. **14**) was recovered from the northwest of the site, also in an area that would have been underwater. The location of no. **17** is unknown as no coordinates are recorded. There are no

[405] They are also different from lead anchor stocks, which are more sickle-shaped.

[406] Their diameter is similar, though much shorter in length than the examples from Thonis-Heracleion, see Robinson 1941: 477–80, nos. 2514–2529 and pls CLV and CLVII.

[407] Robinson 1941: 478, nos. 2518–23.



Figure 3.5 Striations visible on the short end of a loaf-shaped ingot.

inscriptions or stamps on any of these ingots. The simple explanation would be that these are ingots, shapes of metal intended for ease of transport and use. The varying length of the ingots may be interpreted as the result of the objects having parts removed for use, e.g. mending and repairing activities, such as maintenance of lead sheathing of boats, other equipment on board ship, or the ceramic repairs. This is a plausible interpretation both for the ingots from Thonis-Heracleion and for the bars in the houses in Olynthus. The inscribed examples may simply be indicators of ownership.

3.1.3. Casting and production

The loaf-shaped ingots were cast in clay moulds, and the less regular ones perhaps even in the sand.[408] The loaf-shaped ingots show striations of the lead on the short ends of the oblong shape. This brings up the question of the production of the ingots. Whittick showed that the striations on lead ingots are the result of a single continuous pour.[409] The striations (Figure 3.5) are the result of the surface cooling rapidly after coming into contact with the surface of the mould and not the result of intermittent pouring.

It is likely that the ingots were produced at the mining site, rather than at Thonis-Heracleion where there are no clear indications for the location of a metallurgy workshop (Figure 3.6).[410] Nevertheless, it is highly unlikely that there was no metallurgical activity at the site: a great deal of circumstantial information would

[408] Nriagu 1987: 107.

[409] Whittick 1961.

[410] For a map map of silver/lead mines in the Eastern Mediterranean, see Eiseman 1980: 42.

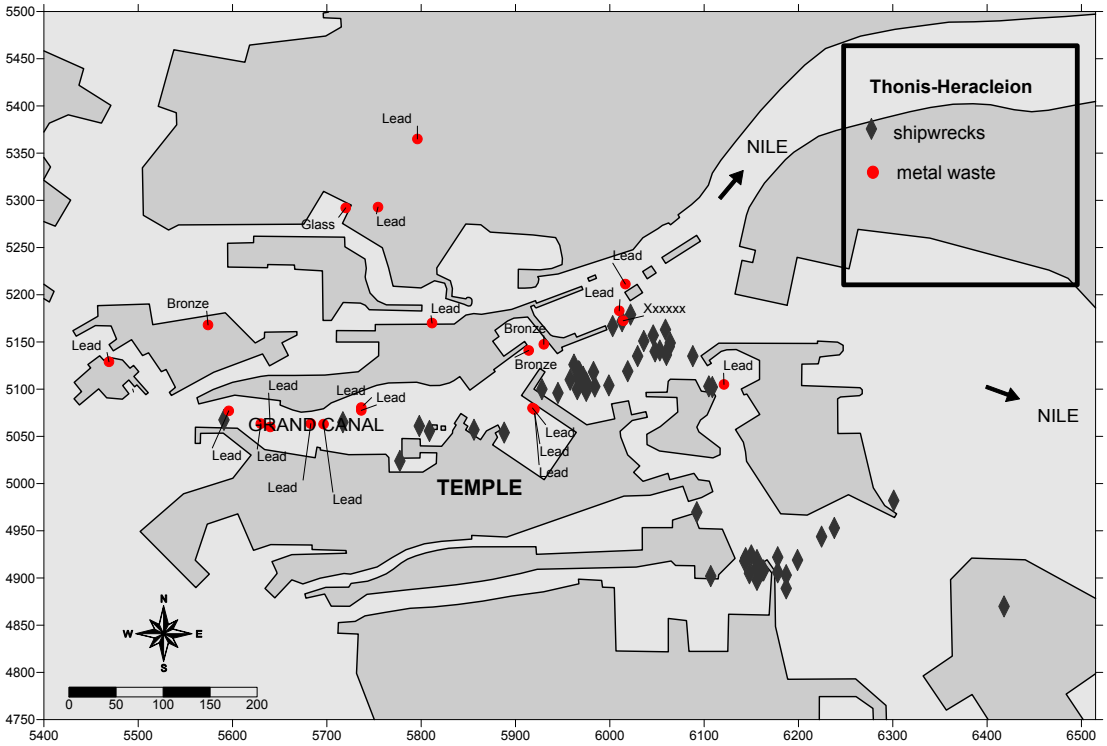


Figure 3.6 Distribution map of metal waste ©Franck Goddio/Hilti Foundation.

indicate that such a workshop(s) existed.[411] There are objects identified as metal waste, which are mostly found in the ancient waterways, with a significant proportion in the Grand Canal and in the general direction of the North Passage. Some bronze waste was also found near the well-preserved ingot (no. **1**). A coarse-ware pot containing lead residue was also found.[412]

3.1.4. Plano-convex (silver?) ingots

The excavators identified a small number of plano-convex ingots as made of silver. These nine objects were found in the southwest of the site during a single season in 2007 (Figure 3.7). After handling a large number of metal objects from Thonis-Heracleion and on the basis of visual inspection, I think that these ingots are probably silver, not lead. The patina on the 'silver' is different to the patina on the lead objects: it is blacker, with white metallic flecks that do not dull.

[411] Identical flaws in small falcon amulets suggests a production centre at the site, see Heinz 2013.

[412] H.2001.H1.26.

No.	Measurements (cm)	Weight (g)	Stamps	Preservation	Comment
19	10.9 max. x 2.9	830			Silver/ lead?
20 (A)	L. 9.9; W. 7.3; H. 2.9 *for the conglomerate*	687 (with B)			Stuck together with B
20 (B)	L. 9.9; W. 7.3; H. 2.9 *for the conglomerate*	687 (with A)			Stuck together with A
21	7.0 max. x 1.9	358.7			
22	7.8 max. x 1.5	346.1		Many marine encrustations	
23	6.0 x 5.4 x 3.3	253.1			Little kernels, conglomerate
24	7.9 x 7.6 x 1.5	250.1			Lead?
25	8.0 x 5.0 x 2.8	227.0			Shape unrecognizable
26	max. Ø 5.1; min. Ø 4.6; H. 1.0	108.0			
27	4.7 x 4.1 x 1.1	56.0			Lead?
28	4.2 max. x 0.8	28.2			Half a ingot, cut

Table 3.3 Plano-convex ingots, nos. H9954 and H9974 were not available for study.

As is clear from Table 3.3, these plano-convex ingots are considerably smaller and lighter than the lead ingots. Weighing a few hundred grams at most, they resemble silver ingots, as known examples tend to weigh up to a maximum of 500g.[413]

The distribution map (Figure 3.7) shows that all silver ingots were found in the southeast of the site. This concentration in this part of Thonis-Heracleion is remarkable, as is the observation that they occur in proximity to groups of statuettes.[414] In the vicinity three statuettes in the shape of a lion were found made of the same material.[415] Before further observations can be made, the immediate context of in this area requires further investigation to see, for example whether this is an area of silver production.

[413] Kroll 2008b: fig. 1.1.

[414] See general distribution map in Heinz forthcoming.

[415] Nos. H.2007.XX.9938, H.2007.XX.9939, H.2007.XX.9940; see Heinz 2013.

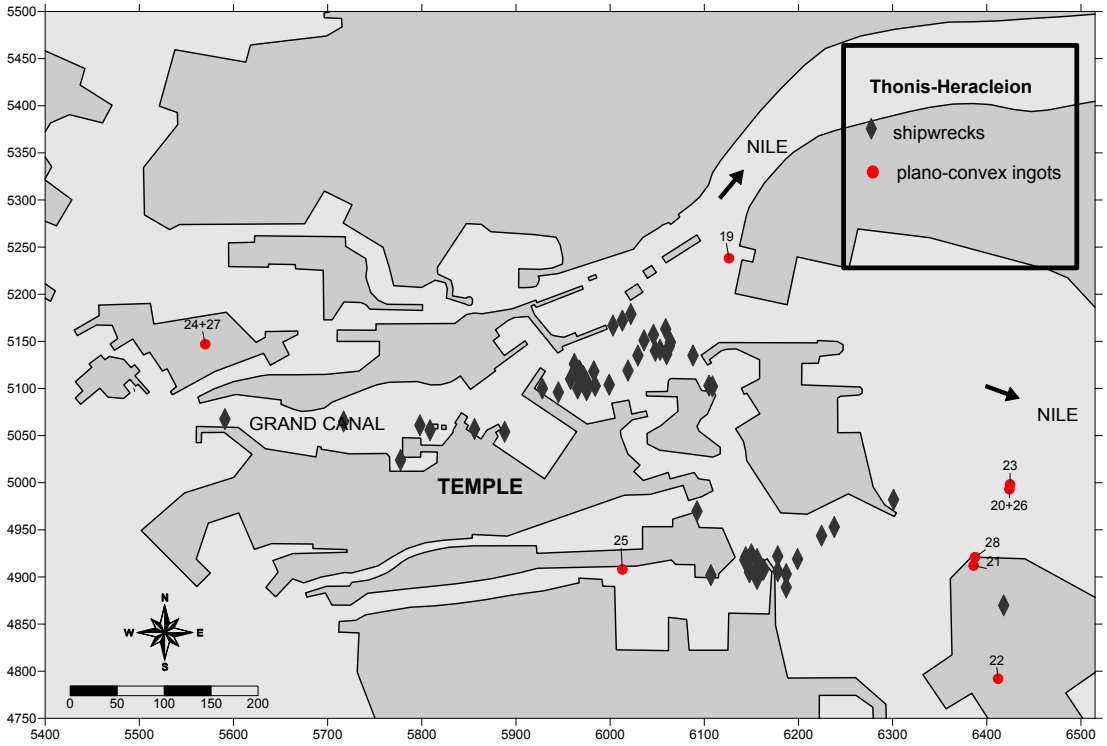


Figure 3.7 Distribution map of plano-convex ingots ©Franck Goddio/Hilti Foundation.

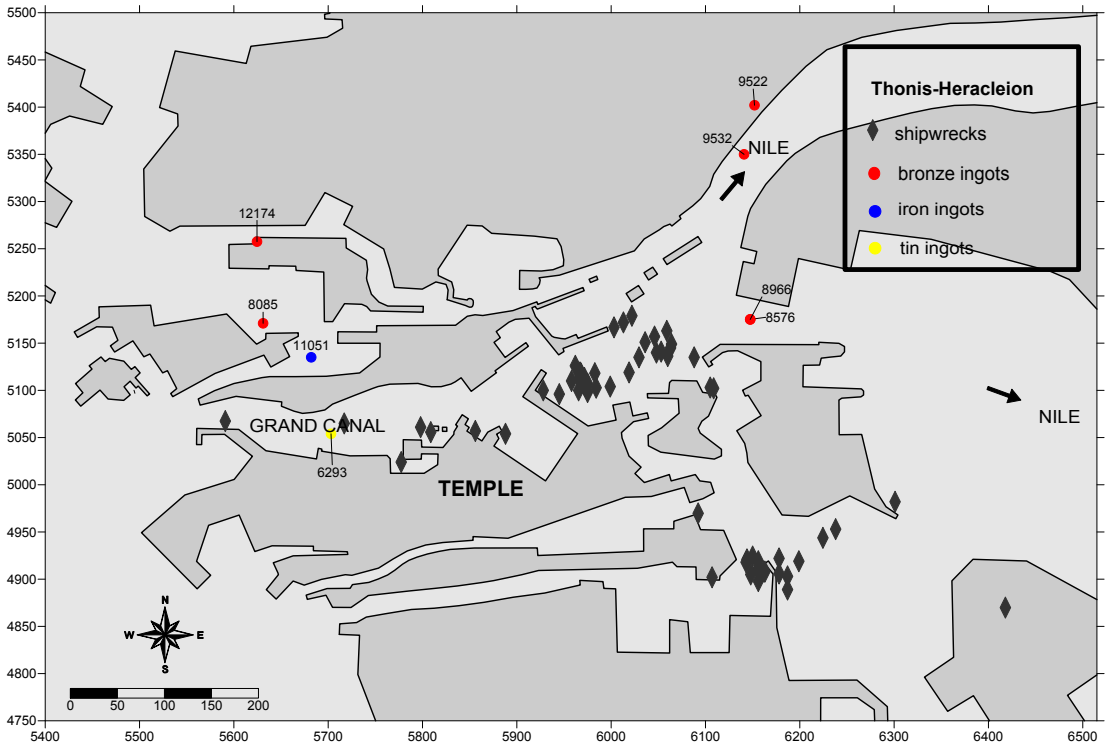


Figure 3.8 Distribution map of ingots made of other materials ©Franck Goddio/Hilti Foundation.

3.1.5. Ingots of other materials

There are several objects in the database of the excavation that have been identified as ingots of different materials (Figure 3.8). There are 5 (pieces of) iron ingots,[416] one ingot tentatively identified as tin,[417] and several bronze ingots.[418] The distribution map shows a general scatter of the ingots across the site. The small number of ingots of other materials is surprising and it demonstrates the importance of lead at the site. No production sites can be identified, nor is there a connection with the sunken ships.

3.2. Lead ingots in the Mediterranean

The second part of this chapter surveys comparative material found around the Mediterranean, both on shipwrecks and occasionally on land, which will provide a general framework for dating the lead ingots from Thonis-Heracleion. Lead ingots from *before* the Roman period are relatively uncommon, in contrast to the large numbers known from the later period.[419] As the pottery and numismatic evidence indicates that activity at Thonis-Heracleion ceased around the 2nd century BC,[420] it is logical to presume that the ingots found here are pre-Roman in date. The best-studied pre-Roman lead ingots come from the Porticello wreck near Sicily. In the publication of the wreck the authors remark that:

> *The Porticello ship serves as a reminder that greater vigilance is needed in seeking evidence for trade in items other than durable, easily recognizable Attic pottery. Admittedly, bronze statuary cannot be expected to turn up at land sites. Lead in ingot form is virtually unknown, but small quantities enjoying everyday use can be tested for their isotope make-up, and eventually a large enough body of data will be*

[416] H.2008.XX.11051 (12 x 2cm); H.2008.XX.11096 (40 x 17 x 17cm) 4x.

[417] H.2003.XX.6293 (30 x 3.8 x 0.8cm) no image present.

[418] H.2004.XX.8085 (6.5 x 5.5) image present, H.2004.XX.8576 (19 x 1.1 ?) image present, H.2004.XX.8966 no image, H.2006.XX.9522 (3.5 x 3.1 x 2.7) image present, H.2006.XX.9532 (4.4 x 1.2 x 1.2) image present, H.2010.XX.12174 (10.5 x 1.5) too recent, excluded, H.2006.XX.9716 (4.3 x 1.7 x 1.2 cm, 53.2g trapezoidal section).

[419] Eiseman 1980: 43.

[420] For a discussion on the pottery, see Grataloup 2010.

available to permit a better understanding of the lead trade: uses include rivets in pottery mends; roof tiles, floors, cistern and vat linings, iron clamp fixtures; sling bullets; lamps, pots, cinerary urns and sarcophagi; statuettes and as an alloy with bronze; traces in silver coins and other silver objects; solder; seals, stamps, tablets, tokens, and tickets; white and red coloring agents, and weights; on ships, hull sheathing and patches, anchor parts, fishing weights, brailing rings and scuppers.[421]

The isotope make-up mentioned by Eiseman and Ridgeway refers to stable lead isotope analysis. The goal of this type of research is to retrieve the lead isotope ratio of the object, which remains stable throughout any processing. This ratio may then be matched to known isotope ratios from mines and a connection between object and mine may be made, although this is not as straightforward a comparison in practice.[422] Results obtained with lead isotope analysis from the ingots from Thonis-Heracleion would be very interesting. Unfortunately, this was outside of the scope of the present study.

The following overview starts with the earliest pictorial and archaeological attestations of lead ingots, before discussing the small number of parallels found on shipwrecks in the Mediterranean. At the end of this part, a broad framework for the dating of the ingots from Thonis-Heracleion is suggested.

3.2.1. Lead ingots from the Late Bronze Age onwards

This discussion of lead ingots starts from the Late Bronze Age, although the evidence of occupation from Thonis-Heracleion only starts in the late 7th century BC. This is for two reasons. Firstly, the number of ingots is small but increases over time, which puts the ingots from Thonis-Heracleion in a wider perspective. Secondly and related to this, the shape and stamps on two examples from the site are used to argue for a provenance in the Aegean.

[421] Eiseman and Ridgway 1987: 112.

[422] One of the first volumes of the *Journal of Archaeological and Anthropological Sciences* is a special volume on lead isotope analysis and archaeometallurgy, and the editorial discusses some of its difficulties in terms of the ancient metal sample (exploitation of resources and technology involved) and modern analysis (analytical tools and databases), see Cattin et al 2009: 137–9. In the same volume Hauptmann gives an overview of the controversies in research lead isotope analysis and ways to move forward, see Hauptman 2009.

As noted in **chapter 1**, temple inscriptions in Egypt mention an increase in the amounts of lead in tribute lists. In several Theban tombs there are depictions of Syrian traders,[423] people from the Aegean,[424] and Nubians bringing goods. The examples of Aegean traders date from the reigns of Hatshepsut and Thutmosis III.[425] In the tomb scenes these envoys are always shown bringing goods that are received by the Egyptians, as if all the goods were tribute to pharaoh. In the case of Greeks, however, it is clear that they were never subject to Egypt, and consequently there can be no question of bringing 'tribute'. The reality was likely more complex than just exacting tribute and mixed with other economic processes such as trade.

Raw metals were among the goods imported from the Near East. Syrian traders are shown bringing copper, silver, and lead ingots.[426] Copper and silver were important as measures of value, but they were not native to Egypt and had to be imported. Bronze was commonly used for weights during transactions and (weighed) silver could be used as a form of proto-currency, as perhaps the rings of silver brought by Syrians in the tomb of Rekhmire (TT 100).[427]

A small number of lead ingots in the eastern Mediterranean may be dated to the Late Bronze Age, and these have been compared to the Egyptian reliefs.[428] Off the Israeli coast, two assemblages have been found, probably the remains of wrecks. The first is Kefar Shamir, which dates to the 14th and 13th centuries BC.[429] This site yielded tin and lead ingots, both rectangular and round plano-convex, as well as five stone anchors (typical examples of Syrian or Cypriot stone anchors of the Late Bronze Age). An Egyptian bronze sickle sword was found at a small distance from one of the anchors.[430] Previously other Egyptian bronze objects were salvaged in the area. On the

[423] Davies and Faulkner 1947.

[424] Identified as Minoans, see Wachsmann 1987: 108.

[425] Wachsmann 1987: 27–40, 103–5; see Section 2.2.2.5.

[426] For examples of mostly Syrians carrying ox-hide ingots from the Theban Tombs, see Wachsmann 1987: 50–5.

[427] Davies 1943 (I): 21. Wachsmann lists more instances of silver rings, for example appearing in the annals of Thutmosis III, see Wachsmann 1987: 53, and pl. XLIV (Rekhmire). In general, see Castle 1992: 263.

[428] Overviews are found in Buchholz 1972, 1973; some qualifications of ingot identifications in these publications may be found in Muhly 1988b.

[429] Parker 1992: 225, no. 540, see also map 14; Misch-Brandl 1985: 5, see map.

[430] Raban and Galili 1985: 326–8, figs. 5–9.

basis of the presence of the Egyptian sickle sword and the other Egyptian bronzes, Raban and Galili propose the Nile Valley as a 'most likely' provenance for the metal objects. They all, however, have a single perforation and incised signs that are identified as Cypro-Minoan.[431] The lack of lead mines in Egypt also makes the suggested Egyptian provenance of the lead ingots unlikely. This does not preclude that the ship may have been Egyptian, even if the cargo of the original ship was of mixed composition.

To the south of Kefar Shamir on the Israeli coast another assemblage, Ha-Hotrim A, was discovered in 1980.[432] The ingots recovered are of a type depicted on the walls of Egyptian tombs as representations of foreign tribute. The ingot fragments from Ha-Hotrim are just a part of the complete ingots shown in the reliefs. Like the five lead ingots from Kefar Shamir, the ingots from Ha-Hotrim are smaller in scale than the ingots shown in the reliefs in the tomb of Amenemopet (TT276), where the ingots are significant in size compared to the human figure carrying them.[433] Perhaps the ingots depicted in the tomb of Rekhmire are also of a smaller scale.[434]

Sixteen lead ingots in total were found in the North Palace of the Late Bronze Age at Ras Ibn Hani, on the coast of northern Syria. Only 6 ingots were found in a group together, the others were found scattered over the site.[435] The excavators suggest the lead may have been used for the purifying of copper.[436] They are between 530g and 40kg each, and in total weigh approximately 280kg.

The above examples represent the entire extent of the currently available evidence for lead ingots in the Mediterranean from the Late Bronze Age. The overview shows that *all* the ingots were in fact found on the coast of Syria and Israel. This dominance of lead ingots in the region is reflected in the picture gleaned from the Egyptian tomb

[431] Misch-Brandl 1985: 9 nos. 1.3–7, and a plate (unnumbered). The largest ingot weighs 6,938g (18–20 x 0.7–6.0 cm), the lightest 680g (12 x 7x 1 cm); for Cypro-Minoan in general, see Ferrara 2012, 2013.

[432] Parker 1992: 209, no. 494, see also map 14; Wachsmann and Raveh 1984; Misch-Brandl 1985: 7–9.

[433] A fact remarked upon before, see Brown 2011: 198; measurements of two of the Ha-Hotrum ingots are published, see Misch-Brandl 1985: 9 nos. 1.1 (13.5/15.5 x 1.0/1.5 cm, 995g) and 1.2 (12.5 x 5.2–7.8 x 1.5 cm, 803.4g); cf. Wachsmann 1987: pl. LII B.

[434] Cf. Wachsmann 1987: pl. XLIV.

[435] Lagarce et al. 1987: 279, fig. 3, 282–3 figs. 6–7; lead was abundant in the palace, see Bordreuil et al. 1984: 405–6 n. 7.

[436] Lagarce et al. 1987: 283.

scenes, and the inscriptions of Thutmosis III discussed in **chapter 1**, that suggest that lead was a product associated with the area encompassing the modern Syrian and Israeli coast. The large quantity of lead found in the North Palace of Ras Ibn Hani also shows that the large quantities mentioned in the Annals of Thutmosis III are likely to be an accurate reflection of actual quantities circulating at this time.[437]

3.2.2. Lead ingots from the first millennium BC, from shipwrecks

As the ingot is a transitory object by nature, it comes as no surprise that they are most often found on shipwreck sites and only rarely on land. Several factors should be considered when dealing with publications of wrecks. The field of underwater archaeology developed rapidly with the increased accessibility and development of scuba diving, allowing dives at greater depth and for a longer period of time. Although much progress has been made in recent years, still a relatively small number of shipwrecks have been scientifically excavated compared to known wreck sites.[438] Moreover, the distribution of wrecks is distorted, because divers visit some areas more frequently than others in the Mediterranean. This causes a higher density of (known) wrecks, for example in southern France, compared to those on the coast of northern Africa, and this is unlikely to reflect the real distribution. For example, sixty-four ancient vessels have been identified since work started in Thonis-Heracleion, demonstrating substantial nautical activity at the site and suggesting that it is the lack of work along the north African coast, rather than the lack of potential find-sites, that is the most significant factor in the current distribution pattern of shipwrecks. These were first mapped by Parker as part of the publication of his 1992 catalogue of 1189 wrecks, which aimed at giving a general, standardized overview of the whole assemblage of known ancient shipwrecks from the Mediterranean. Some wrecks in Parker's catalogue are well documented, whereas others are only known from short communications or hearsay. For a quarter of all shipwrecks mentioned in this publication so little information is available that only an extremely brief description is possible, with basic data such as condition and depth unknown.

[437] The Uluburun wreck contained large quantities of metal, see Pulak 2010.

[438] The following discussion is a summary from Parker, see Parker 1992: 3–6.

Sites are often discovered through the remains of the cargo lying visible on the floor of the sea. Unlike wood and other organic material, ceramics, stone, and metal do not disintegrate underwater. Thus, if the ship's cargo consisted of mainly organic material such as sacks of commodities such as grain, the wreck will be difficult, if not impossible, to locate. The hull, or parts of it, only survives *under* items that do not decompose — such as a mound of amphora sherds — or when it settles in anaerobic conditions, either under a dense layer of clay or at considerable depth, where there is less oxygen. Lead objects survive well under water with only the surface layer oxidizing. [439] Apart from chemical reactions, there is a possibility of marine encrustations growing on the surface of the ingot if it settles in the upper sand layers at the site.

Two factors influence the visibility and/or presence of lead ingots on the sea floor. The first is the distribution/location of wrecks with lead ingots as cargo and their state of publication, as is applicable to all shipwrecks. The other is the looting of the lead objects before systematic excavations. Lead ingots are found as portions of the cargo on 55 wrecks as documented by Parker.[440] Lead or galena ingots are only found on 7 shipwrecks between the Late Bronze Age and the Porticello wreck (415–385 BC), which contains a parallel for the ingots from Thonis-Heracleion, with the great majority of the wrecks dating to the Roman period. The wrecks are found in Spain, southern France, and off the Italian coast, showing a very different distribution than the ingots from the Late Bronze Age with their Israel-Syrian distribution.

The wreck at Dómu de S'Órku, near western Sardinia, is unpublished but metal ingots including lead in different shapes were reported.[441] A small number of ceramics was used to date the wreck to 700–400 BC. Off the coast of southern Spain near Cartagena, Murcia, lead or litharge ingots were among the cargo of two wrecks: the Mazarrón 2 (ca. 650–600 BC)[442] and the Bajo de la Campana A (ca. 625–575 BC). The Mazarrón 2 carried 2,800kg of lead litharge, fashioned into (currently) very fragmentary

[439] Cronyn 1990: 207; also Tylecote 1983.

[440] Parker 1992: 18; increased to 68 wrecks as collected by Brown 2011: appendix A.

[441] Parker 1992: 164 no. 365; Agus 1990: 448–9.

[442] For radiocarbon dates, see Negueruela 2004: 237–9.

round, plano-convex lead ingots.[443] No lead isotope analysis on the ingots is published and there is no other cargo preserved except for a single fragment of an amphora. The ship is reminiscent of the Phoenician tradition of shipbuilding with pegged mortices and tenons, but it is not a straightforward Phoenician ship, as there is also evidence for local techniques. Moreover, the ship is small at 8.15m, making it unlikely to do well on open sea. Local Iberian manufacture of the ship is more likely.[444] The site of the Mazarrón also yielded 7 lead plano-convex ingots of 90% purity.[445] No other information is available, apart from the fact that their context is unclear and that they are not directly connected with either shipwreck. Therefore the attribution to the 7th century BC is weak.

The Bajo de la Campana carried a diverse cargo of western Mediterranean origin, including ivory, tin, ceramics, and galena.[446] The tin ingots are hemispherical in section and oblong, and in shape and appearance (their rough surface is due to being produced in sand moulds) they are reminiscent of the smaller loaf-shaped lead ingots from Thonis-Heracleion.[447] The galena is preserved in granules and perhaps comes from Murcia.

The Giglio Campese A (600–590 BC) off the coast of Tuscany had a mixed cargo of Corinthian finewares and Etruscan amphorae as well as raw metals.[448] The origin of the boat is unclear. The hull and cargo perhaps indicate a Greek origin, although Etruscan has also been suggested. The site was looted before official excavation. The raw metal in the cargo consists of iron bars, lead ingots, and copper.[449] Bound and Vallentine make mention of 'one, perhaps two, metal ingot(s)' from this wreck.[450]

Three other wrecks from the second half of the 6th century BC should also be discussed: the wrecks at Rochelongue (*ca.* 550 BC) and Cala Sant Vincenç (520–500

[443] Negueruela 2004: 235 n. 12, 278 fig. 35; Mederos Martín and Ruiz Cabrero 2004: 269.

[444] I am grateful to Carlos Cabrera Tejedor, DPhil candidate in maritime archaeology at Oxford University, for supplying me with hardcopies of the references and discussing them with me.

[445] Mederos Martín and Ruiz Cabrero 2004: 269.

[446] Mederos Martín and Ruiz Cabrero 2004: 269–70.

[447] Mederos Martín and Ruiz Cabrero 2004: 269 fig. 7.

[448] Parker 1992: 192, no. 451, see also map 7.

[449] Bound and Vallintine 1983: 119 n. 11.

[450] Bound 1991: fig. 53.

BC). The Rochelongue wreck, near Cap d'Agde, consists of a large metal cargo of 1,700 objects, among which were approx. 800kg of copper ingots of 6kg each, 32 tin ingots, sheets of tin and lead, and granules of galena.[451] The origin of the metal and the boat are unknown, and the diverse cargo is likely to have had different origins. The cargo has been interpreted as a hoard ready for recycling.[452] The Cala Sant Vincenç had a similarly diverse cargo as the previous wrecks, containing amphorae, fineware and tableware, and items made of tin, as well as a partial ingot of lead ore.[453] Lead isotope analysis indicates that the origin of the ore is likely Cartagena, near Murcia.

The Bon Porte A wreck, dated to the 6th century (550–525 BC) produced one ingot, which may perhaps be an anchor stock.[454] Chemical analysis determined it was made of 99% lead. No isotope analysis was performed, however, so the source of the lead is unknown. The shape of the ingot, being rectangular and pointed, is not similar to the rounded loaf shape found in Thonis-Heracleion.

The preceding discussion gives an overview of all instances of lead ingots until the start of the 4th century BC. All examples are from the western Mediterranean. The wrecks demonstrate a very limited corpus of lead ingots, although the quantities of lead and lead ore that are transported are significant. Lead (ore) is transported in granules or in plano-convex ingots. One more rectangular object from the Bon Porte A has not been positively identified as an ingot and may be an anchor stock instead.

3.2.3. The Early Hellenistic period

The best parallel for the ingots from Thonis-Heracleion comes from a ship wrecked near Sicily. The Porticello wreck carried a cargo of bronze statuary when it sank.[455] Unfortunately when the site was discovered in 1969, its discoverer and other

[451] Long 2004: 129; Parker 1992: 369–70 no. 993; Brown 2011: 200 no. 7 (appendix A); Penhallurick for example comments on the "Iberian character" of the cargo, see Penhallurick 1986: 106.

[452] Long 2004: 129; Huth 2000: 187.

[453] For further references, see Brown 2011: 200 no. 8 (appendix A).

[454] Jongcheray 1974: 88 fig. 3; Jongcheray 1976: 21, photographs **no**. 2–3, 22–3; Parker 1992: 74–5, no. 106; Long 2004: 133.

[455] Parker 1992: 332–4, no. 879, who tentatively dates it to 425–400 BC on the basis of stylistic analysis of the statue cargo. The wreck and its contents were published in 1987, see Eiseman and Ridgway 1987. For a discussion on the parallels for the ingots from Porticello, see Eiseman and Ridgway 1987: 55-7.

locals looted it before this came to the attention of the police later the same year. In 1970 the excavation of wreck began by a team from the University of Pennsylvania. The date of the wreck is not wholly fixed: the excavators themselves argue for a date between 415 and 385 BC, while Parker dates it slightly earlier.[456] The lead anchor stocks found by the looters were sold as scrap and all but two of the fifteen lead ingots were destroyed. They are said to have contained stamps and they would have provided much information on the metal trade at this time.[457] One partial ingot was found *in situ*; another complete ingot was collected from the looters on the boat when they were arrested.[458] Unfortunately, no original surface from the partial ingot is preserved. The complete ingot is a loaf-shaped ingot with six stamps on its back.[459] Of these six stamps only two are 'clear and complete, and these were made from the same matrix.'[460] Isotope analysis has shown that these two ingots from the Porticello wreck fit in the ratios known from Laurion.[461] In the 19th century, mineworkers in Laurion found an ingot allegedly of the same shape.[462] Unfortunately, no picture of it survives. The Porticello ingot is a good match with the ingots from Thonis-Heracleion, in terms both of shape and of stamps.[463]

The only example of a lead ingot from an excavation on land comes from Olynthus. A lead ingot (?) of similar shape and roughly similar dimensions to the loaf-shaped ingots from Thonis-Heracleion and the Porticello ingot was found in a trial trench in a house,[464] which Robinson interpreted as a bar of lead to be used for repairs. I am not aware of any analysis performed on this ingot and no stamps are visible or mentioned in the description. The presence of galena mines in the region around

[456] Parker 1992: 333; see also Gill 1987: 31–3; see esp. 31.

[457] As is emphasised by Eiseman, see Eiseman 1980: 41–7.

[458] Eiseman and Ridgway 1987: 53.

[459] Eiseman and Ridgway 1987: 54–60, C35.

[460] Eiseman and Ridgway 1987: 57.

[461] Eiseman and Ridgway 1987: 57, 107; also Eiseman 1980: 42.

[462] Eiseman 1980: 43; Eiseman and Ridgway 1987: 55 n. 59.

[463] For a description of the stamps, see Eiseman and Ridgway 1987: 54; 57–8.

[464] Although it is not clear from which room, Robinson 1941: 480–1 no. 2530 (inv. no. 34.473), pl. CLVII; the length measurement of this ingot must surely read 0.56m, as noted by Eiseman and Ridgway 1987: 55 n. 61.

Olynthus suggests the lead may be local, although it does not exclude a different provenance either.

Lead isotope analysis was performed on multiple lead artefacts from the Ma'agan Mikhael ship. This wreck is dated to around 400 BC on the basis of the ceramics, was built in an Eastern Greek tradition, and sailed between Greece, Cyprus and the Levantine coast.[465] The results of the analysis of metal artefacts and sludge on board, including an unspecified "massive" lead ingot,[466] show that the isotope signature matches the values from Laurion.[467] It has been speculated that the lead sludge was perhaps part of an earlier cargo offloaded (in Cyprus?).

In 2008, 4 ingots were found near Cala d'en Ferrer, off the north coast of Ibiza.[468] They are round to slightly oblong in shape, irregular due to casting in sand, and hemispherical in section. They weigh 42, 30, 25 and 12kg respectively. Lead isotope analysis suggests a provenance from Sierra Morena, near Cartagena, Spain.

From the same area at Rochelongue/Cap d'Agde near a site designated 'E' (mentioned above), 8 plano-convex lead ingots were recovered from a very mixed context, weighing between 66 and 33kg, and one poorly preserved example of 15kg.[469] Ceramics found nearby may not necessarily be associated and thus cannot be used for dating. Parker speculates a 3rd century date on the basis of a comparison with the Cabrera B ingots. The ingots were analyzed and found to be within the isotope values known from Cartagena.[470] A shell Pinna nobilis was used as a mould. A sign resembling a Greek *pi* appears on all ingots, but its meaning is unclear.

[465] Kahanov and Linder 2004: 243 ff; Parker 1992: 247–8 no. 612.

[466] Shimron and Avigad 2003: 177, n. 36; the discussion of the isotopic material promised in this n. 36 to appear in volume II is not actually present there, see Kahanov et al. 2004. For a personal communication from Kahanov that the ingot weighed 9.85kg, see Brown 2011: 201–2 no. 10 (Appendix A).

[467] Shimron and Avigad 2003: 177–8, fig. 11.

[468] Hermanns 2010: 187-193.

[469] Parker 1992: 46 no. 17; Eiseman and Ridgway 1987: 56 n. 66; Laubenheimer-Leenhardt 1973: 146–61 nos. 26–33 (with further references); Gallet de Santerre 1962: 622.

[470] Trincherini et al. 2009: 132–3, table 2, Graph 1

From the same site there is another area designated Agde G, which yielded a large cargo of 100 tons of lead litharge in tablet form.[471] There are no other dating criteria, and the pre-Roman date is consequently far from secure.

In short, the Porticello wreck produced the only good comparison for the ingots from Thonis-Heracleion. The late 5th to early 4th century BC date of this wreck, and therefore this ingot, also works very well in relation to the other datable lead objects that are examined in the following two chapters.

3.3. Trade goods and long-distance trade networks

Egypt begins to look westwards with the growth of the Greek world. The dynasty at Sais wanted access to this world for troops and prestige goods like silver, grain was an export commodity for this. Silver was also needed to pay the troops. The presence of Greek pottery was often used to argue for the presence of Greeks in Egypt, although such simplistic interpretations are no longer regarded as so straightforward.[472] It is striking that foreigners seem to disappear in the Egyptian archaeological record almost immediately, and this is especially true of Greeks.[473] The Carians, on the other hand, left some distinctive monuments in Saqqara among other places.[474] The material from Heracleion-Thonis has the potential to redefine these views. Why did the Greeks migrate to and trade with Egypt in the first place? They were migrating from their homelands in the Aegean from the 9th and 8th centuries onwards, looking for new fertile areas to settle and found colonies. At a later stage, it became necessary to import grain into Greece from the Black Sea and Egypt.[475] The inability of city-states to sustain their own population in the Aegean was an important development in the 6th

[471] Parker 1992: 45 no. 14.

[472] Gill 1994; Möller 2000: 43 and n. 31, 44–5; Vittmann 2003: 233; P. Wilson and Gilbert 2007: 259, 261.

[473] An example of the rapid assimilation of Greeks into the archaeological record is the black sarcophagus of Wah-em-ib-re in the National Museum of Antiquities at Leiden. The sarcophagus is one that seamlessly fits into the Egyptian tradition, completely with its genealogy. It was recognized later that the names of the father and mother of the owner of the sarcophagus are Egyptianized forms of Greek names; so that the owner is the son of two Greeks, possibly immigrants; for a discussion see Vittmann 2003: 203, and pl. 22.

[474] Höckmann 2001: 217–232; see in the same volume also Kammerzell 2001: 233–55; Vittmann 2003: 155–79.

[475] Moreno argues that Athens and many other poleis depended on the import of grain from possibly the sixth century onwards; see Moreno 2007: 309–15.

century.[476] Although the chronology and the size of the grain imports are debated,[477] it is beyond doubt that by the fourth century there were grain transports from Egypt to Athens. Other Egyptian exports would have been papyrus and linen.[478] Papyrus especially grew abundantly in Egypt and was exported throughout the ancient world as the ancient equivalent for paper. In return it has been suggested that wine and olive oil were the most important products destined for import to Egypt.[479] The question remains how much this new interaction with the Greek world left traces in the administration of Egypt at this time, or if this influenced its perspective on international trade?

There is other evidence for economic relations between the Aegean and Egypt through the grain import to Athens. There is also epigraphic evidence in the form of an inscription dated to 333/2 BC that mentions a sanctuary for the worship of Isis in Piraeus founded there by the Egyptian merchants.[480] This is interpreted as a privilege granted to Egyptian traders directly related to the Egyptian supply of grain to Athens.[481] In return for the export of grain, Athens was able to supply Egypt with silver, which was sought after but not present in large quantities in Egypt.[482] It is worth noting that silver and lead are often found together in galena ores and consequently that the mining of silver is closely related to the mining of lead.[483] To sum up, it is highly likely that Heracleion-Thonis played a role in the grain trade since it is located so strategically on the coast.

A few remarks from an economic perspective should be made about lead as a raw material. Since there is no evidence in Egypt of large-scale exploitation of lead we must

[476] Sherratt and Sherratt 1993: 374.

[477] For a minimalist approach with regard to the dependence of Athens on imported grain, see Garnsey 1988.

[478] Austin 1970: 35–6.

[479] Austin 1970: 36–7; these goods also appear in the Aramaic customs document discussed below, see Briant and Descat 1998: 69–73.

[480] Rhodes and Osborne 2003: no. 91, esp. p. 465.

[481] Rhodes and Osborne 2003: 465.

[482] Milne describes the grain for silver pattern, although his article is in general outdated; see Milne 1939: 178–9. Although galena ores are present in the Eastern Desert (see Ogden 2000: 168–9), it is generally thought that most of the silver found is imported when its use increases in the New Kingdom, see Hill 2007: 23, n.2.

[483] Eiseman 1980: 41.

presume it was imported,[484] although this is not archaeologically proven. Although ingots from pre-Roman times are rare compared to Roman ingots, it is possible to identify several shipwrecks with similar ingots to the ones found in Egypt. It is also possible to make some tentative suggestions about the original mine the ingots were coming from.

3.4. Concluding remarks

Evidence for galena mining activities in Egypt is absent for the first millennium BC. The frequency of lead objects from Egypt increases at this time (see **Chapter 1**) and the lead corpus from Thonis-Heracleion is remarkably rich. The idea that lead was imported into Egypt throughout the first millennium BC is tested in this chapter by collecting all instances of lead ingots from the Late Bronze Age around the (eastern) Mediterranean, the distribution of the lead ingots in the Mediterranean, any information on their provenance, and the comparison with the group from Thonis-Heracleion.

The first part of this chapter described the (potential) specimens of lead ingots from Thonis-Heracleion. The second part gives an overview of lead ingots in the Mediterranean until the first century BC. It demonstrates their novelty in Egypt and their relative rareness in the archaeological record in general. The overview also clearly shows –in snapshots - the large quantities of lead shipped around the Mediterranean. It lends credibility to the theory of (large) quantities of lead imported into Egypt.

The overview also suggests that the likely chronological place of the ingots from Thonis-Heracleion is in the late 5th and 4th century BC. The presence of stamps with Greek letters on two ingots supports a non-Egyptian origin. The lead ingots are associated with the nautical aspect of the harbour town. Similarly shaped ingots were recovered from a mining site, Laurion, and on a shipwreck near Sicily. Neither context is applicable to Thonis-Heracleion. This town was not a mining settlement, but a customs office and marketplace. Nor were the ingots found in association with shipwrecks. If they were not found at the place of production, and an accidental find in transit also seems unlikely, then which options remain? Had they reached their final

[484] Ogden 2000: 148-76, for lead specifically see 168–9.

destination? The relative isolation of these ingots from each other, i.e. the absence of clusters of ingots, leaves drawing conclusions difficult. This pattern may, however, illustrate the relatively frequent occurrence of lead ingots at the site, as opposed to a single archaeological context containing a large number of ingots.

Combining these lines of evidence, I suggest the possibility that the ingots from Thonis-Heracleion also came from Laurion. The analysis of the stamps on one ingot suggests a Greek origin, and tentatively a link to the mines at Laurion. The lead isotope analysis of the ingot from Porticello, the best parallel to the discussed ingots from Thonis-Heracleion, shows that it was made from lead from Laurion. As Eiseman notes "there is no way to know how typical the Porticello examples are."[485] The loaf-shaped ingots are a substantial expansion of this type of lead ingot, as well as an enlargement of the pre-Roman lead ingots in general.

[485] Eiseman 1980: 43.

CHAPTER 4. WEIGHTS

The corpus of metal weights from Thonis-Heracleion, in lead and bronze, consists of 156 examples.[486] They are divided here into groups and discussed according to shape. A small number of weights in other materials than lead were recovered. There are 6 stone weights, of which only 2 were available for study. A larger number of 11 bronze weights were found, which are all included in this chapter as well. There are perhaps more weights in the remaining unseen storage boxes in the Maritime Museum as well as the weights that were found in 2011 and later, which are not included here.

This chapter starts with a survey of lead weights and weight standards in Egypt in order to establish a background in Egyptian metrology. A perspective on the metrology in the Eastern Mediterranean discussing weight standards from the Aegean and the Near East is also required, as they are likely to be present among the corpus from Thonis-Heracleion.

The weights are divided into several categories based on their shape: square, plinth-shaped or cubic Aegean examples and Egyptian domed cupcake or domed shapes (see table 3.1). The relatively large number of 14 Attic weights with Athenian symbols and letters in Thonis-Heracleion is an important discovery for the study of ancient trade and metrology. Sufficient scholarship is available on the topic of ancient weights in the Aegean and the Near East to provide the necessary comparanda for the material from Thonis-Heracleion. In this way, through the different weight systems, the lead weights can indicate evidence for trade networks separate from ceramic evidence. The analysis will refine the date of a few that were already published,[487] as well as the remaining unpublished epigraphic weights from the site up to 2010.

The majority of the weights include all of the Egyptian weights, which are anepigraphic, i.e. without symbols, letters, or markings. This group was challenging because of the lack of markings. The group of lead weights from Thonis-Heracleion is

[486] I am grateful to J.H. Kroll for the discussions (at length) of the weights and weight systems in Thonis-Heracleion and for his many helpful suggestions for this chapter.

[487] Goddio and Fabre 2008[2]: 342–343, cat nos. 358–364, and 367. For a preliminary analysis and dating of a selection of the weights already published in the catalogue, see Van der Wilt 2010.

compared with the collection of lead weights in the Petrie Museum, part of the large collection of Egyptian weights housed in that museum. The present discussion excludes fishing weights, as they serve a different purpose than playing a role in the exchange of goods.

Finally, I discuss the composition of the corpus of weights in Thonis-Heracleion, including the ratio of Greek-style to Egyptian-style weights. A comparison between Thonis-Heracleion and other sites in Egypt and around the Eastern Mediterranean brings some striking differences to light, e.g. the small number (6) of stone weights, and the corresponding minority of Egyptian-style weights. A re-analysis of the body of lead weights discussed in Petrie's 1926 volume on ancient weights is offered as a comparison to the corpus of weights from Thonis-Heracleion.

The weights offer a glimpse into trade activities and mechanisms, as "Two problems were of constant concern to governments: to safeguard the proper manufacture and use of weights and measures, and to urge uniformity of standards...".[488] At the end of this chapter, I consider what kind of trade activities are reflected in this corpus of weights. Table 4.1 shows the numbers of different types of weights identified. Closer inspection of the numbers in the table shows that weights lighter than 50g are in the majority with 88 examples, as opposed to 71 weighing more than 50g. These small and light weights are not likely to play a role in the large-scale shipping activities in a port city at the border of a nation, involving as taxation and the bulk transport of commodities. Their geographical distribution within Thonis-Heracleion may provide clues as to their final deposition.

Some inscribed weights are in locations with significant ritual activity. Their location at the bottom of the ancient waterways plays a role as it is a favourable circumstance for their preservation, and it is imperative to address the question of accuracy and underwater preservation. The small (and light) weights have the Attic drachma as their unit. The occurrence of small weights, their location, and the usually problematic preservation of metals on land is also considered in order to come to conclusions about the role of the weights in Thonis-Heracleion.

[488] Kisch 1965: 4.

156 weights: 154 metal + 2 stone weights in total		
26 Aegean style weights – inscribed weights	14 with Athenian symbols	*all >50g*
	2 with symbols, not identifiably Athenian	*all >50g*
	10 weights with signs (incl. coin weight)	*all >50g except 1*
92 Aegean style weights - inscribed weights	14 market weights	*35 x >50g* 41 pre-hellenistic/Attic 18 hellenistic/Ptolemaic 20 unclear
(total: 116 lead + 2 bronze)	78 weights, based on a multiple or fraction of a drachma	
38 Egyptian style weights	16 cupcake incl. 2 stone	Mainly bronze, only few lead (only *5 >100g* in total, only *6 >50g* in total) (unknown lead? 1x; stone 2x; lead? 7x; lead 19x; bronze? 3x; bronze 6x; + 3x)
	22 cylindrical/round	
Total: 156		

Table 4.1 Overview per category of the weights found at Thonis-Heracleion

A discussion of the scholarship on lead weights and weight systems found in Egypt is a useful starting point, focusing on the metal weights from Egypt. There is a small number of catalogues with weights, which are discussed briefly. This is followed by an overview of the weight standards occurring in the Eastern Mediterranean. Considering the location of Thonis-Heracleion at the border of Egypt, it is only reasonable to expect that the cosmopolitan nature of a harbour town on the Mediterranean coast is reflected in the objects present at the site.

4.1. Weights in Egypt: metrology and catalogues

4.1.1. Metrology

Egyptian metrology is relevant to the discussion as the corpus of weights was found in Egypt. It is, however, not a topic that has attracted much scholarly interest.[489]

[489] Overviews in the standard reference works are often superficial, e.g. Grandet devotes just four sentences to 'weight' in the larger lemma on 'Weights and measures' see Grandet 2001. He refers the reader to Gardiner's Egyptian grammar for "The classic presentation of the ancient Egyptian system of weights and measures" (p. 495), which consists of one paragraph detailing the 10 kite per deben ratio, see Gardiner 1957[3]: 200; the LÄ is no exception, with a concise overview in one paragraph of both documentation and artifacts from the Old Kingdom to

The following overview relies heavily on the work of M.-A. Cour-Marty, who published several articles and her PhD thesis on weights throughout pharaonic history.

There were three weight systems in use in ancient Egypt, and these remained relatively stable throughout Egyptian history up until the Ptolemaic Period. The earliest weights appear in prehistory.[490] During the Old Kingdom the standard weight unit was 13g, the 'gold' deben, also called the *beqa*, and this reconstruction is based on four stone weights with different royal names.[491] There is another weight from the First Intermediate period, and 6 examples from the Middle Kingdom on the same standard. Perhaps this weight standard is associated with the trade in gold, on the basis of the sign on the weights and their provenance for example from Middle Kingdom forts in Nubia.[492]

During the Middle Kingdom there also seems to be a 'copper' deben at around 90g in use, with two weights with the name of Amenemhet I weighing 17.5g and 89.4g.[493] It is clear that towards the end of the Middle Kingdom the 'gold' standard had lost its importance in favour of the 'copper' deben.[494] Grandet mentions the change from the dominant 'gold' standard to the newer standard of 91g briefly, and seems to suggests a development between the two when he points out the conversion between the two standards, as 7 x 13g making the equivalent of 91g.[495] This observation probably reflects a conversion practice when dealing with two weight systems, and not any direct relationship between the two systems. As a prime number 7 is too inconvenient to be a multiple or fraction in a system, as it does not readily divide into smaller units.[496] The most popular shape during the Old and Middle Kingdom is a

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the New Kingdom, see Helck 1980: 1202 followed by a short overview of weights and measures in demotic sources, see Vleeming 1980: 1211; see also Cour-Marty 1989 I: 2.

[490] Skinner 1967: 3, pl. I.

[491] Cour-Marty 1990: 22 n. 7.

[492] Petruso 1981: 45–7, fig. 2; Skinner 1967: 30–1.

[493] Cour-Marty 1990: 23 n. 10.

[494] The latest weight on the 'gold' standard has the name of Thutmosis I, see Cour-Marty 1990: 23 n. 11.

[495] Grandet 2001: 495.

[496] For a discussion of 'practical factors' concerning weight systems, see Petruso 1992: 10–1.

square or rectangular shape, whereas in the Predynastic period a higher, more pyramidal shaped weight was preferred.[497]

This new deben was the only Egyptian weight standard in use during the New Kingdom. Weighing around 91g, it was divided into 10 units called kite (*qedet*) of 9.1g each.[498] The *sep* is a multiple of 10 deben. The Egyptian weight standard thus multiplies by and divides the unit by ten,[499] whereas the kite is divided binarily with fractions such as ½ kite.[500] The deben in the New Kingdom was used as a standard measure for exchange in transactions, facilitating the exchange and acting as a proto-currency.[501] The shapes of weights become more diverse in the New Kingdom.[502] A particular feature of the New Kingdom and the Late Bronze Age more broadly, is the occurrence of bronze weights in the shape of animals or animal heads.[503]The most common shapes, however, are almond shapes, also called barrel shapes or sphendonoids, and oval shapes.[504] This type is also frequently found in the Levant at this time. Throughout Egyptian history until the Late Period, the preferred material for weights is stone. Hematite was especially preferred for the almond shaped weights.

During the Late Period there is a shift in preference to metal, mainly bronze, for weights. Stone weights still occur, and in larger numbers than before. Proportionately, however, they are less significant.[505] The 'copper' deben standard remains unchanged at 91g and is attested in several weights with royal names of the 25th and 26th dynasties.[506] The predominant shapes during the Late Period are the cupcake and

[497] Cour-Marty 1990: 54 fig. 26.

[498] Grandet 2001: 495; Hendin 2007: 78–9.

[499] Heltzer and before him by other scholars, mention the exception to this rule, presumably implemented to facilitate trade: in the foreign trade of the Ramesside Period, there was a unit called *šḥ't, šḥ'*, or *snỉw* that measured 1/12 of a deben, see Heltzer 1996: 31, and n. 1.

[500] Other weight systems in the Eastern Mediterranean by contrast, such as the Babylonian, Phoenician, and (later) Greek weight systems, are sexagesimal, see Powell 1979: 106; Hendin 2007: 86, 93.

[501] Bleiberg 2007: 181; Zingarelli 2010; for a group of inscribed weights from Deir el-Medina, see Valbelle 1977.

[502] Cour-Marty 1990: 23, 54 fig. 26.

[503] Cour-Marty 1990: 23, 42 fig. 14; for examples in the Egyptian Museum, see Hafford 2002: 505, 509–10; Skinner 1967: pl. 5.

[504] Hafford 2002: 506–8.

[505] Cour-Marty 1990: 54 fig. 26.

[506] Cour-Marty 1990: 24.

domed shapes, which also occur in Thonis-Heracleion.[507] The majority of weights from this period are from the delta, and specifically from Petrie's excavations at Naukratis and Defenneh. They are light weights and were found in urban areas. The predominance of weights lighter than 100g suggests that commodities of high value were measured. Cour-Marty links the proportion of weights from other urban areas, Amarna (more than 25% of the total number of weights in the New Kingdom) and Thebes, to the presence and importance of craftsmen and the working of precious metals.[508] It is, however, only natural that weights would be found in places such as houses, shops, workshops, where they would have been used.[509] It does not necessitate an exclusive relationship between precious metals and the presence of weights, as other contexts such as pharmacies, people selling expensive herbs and medicaments, would require precise weights as well.

A problematic point for the analysis of the weights from Thonis-Heracleion is the difficulty in identifying Ptolemaic weights. By contrast, Seleucid weights are well known with their distinctive symbols, e.g. anchors.[510] It is unlikely that there are no Ptolemaic weights preserved, therefore this lack of examples may in fact be a problem of a difficulty in distinguishing between those from the Late Period and Ptolemaic period.[511] Evidence for the presence of 3rd century BC weights in Thonis-Heracleion comes from Greek-style weights, not from Egyptian-style weights (see Section 4.3.3).

4.1.2. Previous catalogues

The main collections of Egyptian weights in the world are in the Cairo Museum (2,600 examples), the Petrie Museum in London (4,000+ examples), and in the

[507] Cour-Marty 1990: 32–3 figs. 4–5, 54 fig. 26; for an image of a contemporaneous set of weights with a balance, Skinner 1967: pl. 8.

[508] Cour-Marty 1990: 23.

[509] For example, the occurrence of a number of stone weights, as well as "rare metal weights", in fill layers of floors in a building from the First Persian Period in Elephantine discovered in Area 15 of the Austrian excavations in Aswan, perhaps associated with the military garrison stationed there at this time, see Müller 2008: 326 n. 32.

[510] E.g. Rostovtzeff 1941: 451–5 pl. LIV–V; at auction, see Christie's 1989: 73 no. 240; and Elayi and Elayi 1997: 32-4.

[511] Rostovtzeff already remarked that there seems to be no change in the metrological system in the Ptolemaic period, see Rostovtzeff 1941: 1299.

Oriental Institute in Chicago (700+ examples). Cour-Marty estimates that there are perhaps in total in the region of 8,000 ancient Egyptian weights preserved in collections.[512]

In the late 19th century W. M. Flinders Petrie started to publish the first lists of weights from his excavations at several sites in the Egyptian delta together with catalogues of other categories of objects.[513] He identified himself as an empiricist working solely on the actual objects, as opposed to "speculative metrologists" working on theories as to the exact mass of a specific weight unit.[514] Petrie listed stone and some metal weights, but a particularly large number of metal weights from Defenneh — 1,600 in total — were excluded from the analysis.[515] He details his approach to weighing the objects and establishing the original weight standard on the basis of the object's current weight and weight loss by assessing its damage, chemical composition, and corrosion. He only published the metal weights from Defenneh, which thus require careful consideration, in 1926.[516] Already in 1888 Petrie had set out to reconstruct the weight standards present in the corpus of stone weights on the basis of the substantial body of material already available at the time. Subsequently, Griffith published some thoughts on Egyptian metrology in two articles. He combined textual evidence and weights in museum collections, for example on individual pieces from the Petrie collection in London, in order to establish weight standards.[517]

In 1908 A. E. P. Weigall published the weights housed in the Cairo Museum.[518] The majority of the weights are made of stone, with only 40 bronze examples. The catalogue contains no lead examples. It describes the classification applied and surveys the literature at the time, avoiding references to other weights as much as possible in

[512] Cour-Marty 1990: 17.

[513] Petrie 1886: 69–87; 1888: 80–94.

[514] Petrie 1926: vi, 20–1; Petrie's role is often mentioned in discussions of the development of scholarship on Mediterranean metrology, e.g. Petruso 1992: 5; Hitzl 1996: 5 and n. 39.

[515] Petrie 1888a: 81.

[516] Initially, they were put aside for "special research", see Petrie 1888a: 81; later the very small bronze weights from Defenneh, those under 50 grains, are kept separate, see Petrie 1926: 22 §53.

[517] Griffith 1892: 435–49, 1893: 307–15.

[518] Weigall 1908.

order to keep the focus on the corpus in Cairo.[519] He favours a simpler organisation of the weight standards in use in Egypt than Petrie, arguing for wider margins in less numerous standards.

After publishing numerous smaller contributions in other volumes, Petrie produced a more definitive analysis of Egyptian weights and weight systems in 1926.[520] This remains the standard reference work Egyptologists turn to regarding weights and metrology as the author is so well known and the volume easily accessible. As such, it requires review here.

Collecting all the data on weights from Egypt, the majority of which Petrie had excavated and published previously himself, the volume attempts to provide a comprehensive overview of ancient Egyptian weights. He discusses the process of establishment of a typology: the motions of searching, listing, and tabulating remain much the same today, apart from the modern methods of computerized statistical analysis. He proceeds to discuss shape and the system of division of weights into multiples and fractions. The dating parameters he established for the shapes of Egyptian weights are still accurate, as becomes clear in the corpus from Thonis-Heracleion for the Late Period, i.e. the cube and domed shapes.[521]

Petrie identified eight different weight standards, reconstructing an interconnected but tangled account of weight standards with an extremely long lifespan.[522] In his discussion of the stater standard for example, he suggests the earliest examples of the standard are from the 1st dynasty in Egypt.[523] The designation 'stater' for an Egyptian weight system implies a relationship with the later Greek coinage, and thus the connection of weights nearly 2,500 years older than the appearance of the first stater in the Aegean is anachronistic. For the Egyptian 'copper' standard on the other hand, the division of the fractional system remains unaltered.

Nevertheless, if the issue of terminology is disregarded, the identification of weight standards in fact still stands. Statistical analysis of the corpus of weights in the

[519] Weigall 1908: i–iii.

[520] Petrie 1926: 1; see also Cour-Marty 1991: 138, and n. 3.

[521] Petrie 1926: 7.

[522] Petrie 1926: 1, 8–21; for an argument for a minimal number of systems, see Petruso 1992: 9; Hitzl 1996: 5 n. 38.

[523] Petrie 1926: 13.

Petrie Museum published by Hemmy[524] verified the standards Petrie had identified in 1926. Cour-Marty suggests a renaming or re–identification of Petrie's weight standards.[525] The new naming of the weight standards clarifies the origin of the systems and explains their multitude. The first two are the indigenous Egyptian standards, of which the first (gold-copper) deben ceases to play a role during the New Kingdom. The following two are Near Eastern shekels, in use since the Late Bronze Age/New Kingdom. The Hebraic systems are from the Levantine region, while the final three are Greek in origin, based on a coin as unit. The standards from the Eastern Mediterranean are discussed in more detail in the following Section 4.2.

Petrie 1926	Cour–Marty 1990	Unit (g)
Pym/peyem	Royal Hebraic shekel	7.5–7.75
Sela	Phoenician standard	7–7.9
Daric	Sumero–Babylonian shekel	7.9–8.8
Stater	Euboeic–Attic drachma	8.7 (2x 4.35)
Qedet	"Kedet" deben	8.8–9.8
Necef	Commercial Hebraic standard	9.8–10.9
Khoirine	Royal Hebraic shekel[526]	11.5–12.25
Beqa	"Gold–copper" deben	12.2–14
Sela[527] / Palestinian shekel?		14.1

Table 4.2 Terminology for weight standards appearing in Egypt with their respective units, adapted from Cour-Marty 1990: 45 fig. 17; and Skinner 1967: 38–9.

Returning to Petrie's 1926 volume, the metal weights discussed there are of particular interest to the corpus of lead weights from Thonis-Heracleion. He excavated these weights himself in the Egyptian delta and they are, as he observes, a phenomenon of the 'Greek period.' Although not explicit in his text, it is clear that he interprets this as from the Archaic period onwards, i.e. the earliest Greek presence in Egypt.[528] Actual examples, however, of metal weights from the Aegean of this shape do not predate the late 6th century BC, even from the Aegean.[529] He discusses the problems of the

[524] Hemmy 1937.

[525] Cour-Marty 1990: 45 fig. 17.

[526] For the Hebraic shekel, the nesep, and the *pym*, see Elayi and Elayi 1997: 21–2.

[527] Skinner 1967: 28.

[528] Petrie 1926: 22–7.

[529] From a well in the Athenian agora, Lang and Crosby 1964: 25–6, BW1–3, pl. 1.

preservation of metals such as bronze and lead with their tendency to gain or lose weight according to their environment. Here he has a tendency to (over-) emphasise the difficulties posed by the material for establishing the weight standard. This is especially true in the case of the "little square leaden weights", which he correctly connects with the Greek coin drachma.[530] These show a range of 57–74 grains, which equals 3.7–4.8g, leading Petrie to remark that a 'much wider range' of error must be applied.

There are two other practical issues related to this volume. In hindsight it is unfortunate that Petrie chose to record the mass of the weights in grains instead of grams. He felt it would ease the comparison between corpora of weights if he used grains, since the majority of weights at the time were published in this unit.[531] Convention has changed in over time, and it complicates the comparison with weights in grams. The other practical issue is the fact that the numbering system employed by Petrie in his publications does not correspond to the current numbering system in place in the Petrie Museum in London. The numbers cannot always be matched on a one-to-one basis based on weight, but in most cases significant smaller groups of several weights may be identified that match each other.

In 1989 Cour-Marty published her PhD thesis, which had a similar scope to Petrie's study and aimed for a comprehensive overview of weights found in Egypt. At first she estimated the total number of weights found in Egypt at 6000.[532] By the time she finished her thesis, however, the number had increased to 7314 weights ranging from the Predynastic to the Ptolemaic period.[533] She touches on the problems related to the assemblage of weights: in a quarter of the cases the provenance of the weight is unknown, which consequently obscures the dating.[534] More than 95% of the weights are uninscribed.[535] The shapes are very diverse, as can be seen in the plates illustrating her corpus. Dome- or cupcake shapes are typically Egyptian,[536] although they were

[530] Petrie 1926: 22.

[531] Petrie 1926: 3.

[532] Cour-Marty 1991: 139.

[533] Cour-Marty 1989 I: 2.

[534] Cour-Marty 1989 I: 64.

[535] Cour-Marty 1991: 142.

[536] Weigall 1908, types I, J, K, L, M, and N; the term is not a modern invention, as it was used already in 1965, see Kisch 1965: 2; also Petruso 1992: 3.

evidently not the only shapes. Most Egyptian weights were made of different varieties of stone. In the case of weights made of metal, there is a preference for bronze.[537]

The number of metal weights in Cour-Marty's corpus is 1863, approximately a quarter of her total. There are 1801 weights of bronze, 60 of lead, and 2 of iron.[538] After checking and counting in the corpus printed at the end of her PhD thesis, I surprisingly counted 166 lead weights.[539] The majority of these, namely 156, are in the collection of the Petrie Museum of University College London. The collection of the Oriental Institute in Chicago houses 9 lead weights.[540] Cour-Marty also lists one lead weight of which the location is unknown, but supposed to be Amarna.[541]

The numbers of the lead weights in the Petrie Museum in Cour-Marty's thesis are taken directly from Petrie's 1926 publication on weights. She assumes that all weights have an Egyptian provenance, although for the majority of the weights in Petrie's catalogue the provenance is left unspecified. When a provenance is indicated, it is mixed and does not suggest any geographical ordering or Egyptian bias.[542] In fact, Petrie states that the collection of weights in the Petrie Museum is not from his excavations, but from the collection of the Rev. Greville Chester.[543] It is likely that a large number of the weights are Egyptian, as Egypt was a favourite travel destination of Chester, but it was clearly not the only destination. After working with the weights, it seems likely on the basis of markings on the weights that the corpus includes later, Byzantine specimens. On the whole, this is a more complex picture than Cour-Marty presents. Nonetheless, the collection in the Petrie Museum remains the single largest collection of lead weights from antiquity and as such an important body of material as comparison for the present corpus from Thonis-Heracleion.

Only 38 weights in the Petrie collection have an explicitly stated Egyptian provenance: the majority, 28 weights, is from Alexandria, 6 are from a Roman set of

[537] Cour-Marty 1990: 41 fig. 13.

[538] Cour-Marty 1989 I: 60–1.

[539] See Appendix I with a list of the lead weights in the Petrie Museum taken from Cour-Marty 1989 III.

[540] A large collection of weights have recently been found in the depot of the Oriental Museum in Chicago, where they will be photographed for the British Museum project *Naukratis: Greeks in Egypt*.

[541] See Cour-Marty 1989 III: 101, no. 8006.

[542] He mentions the presence of 'many' weights from Syria and Asia Minor in this section, see Petrie 1926: 22.

[543] Petrie 1926: 22 §53, for the Reverend Greville John Chester, see Bierbrier 2012[4]: 119–20.

weights found in Amarna, and the remaining 4 are from Memphis, Riqqeh, Gurob and Qus.[544] Of the weights in Chicago, seven are from Naukratis, one from Nebesheh, and one of unknown provenance.[545] Furthermore, Cour-Marty notes that most of these weights are small denominations: only 14 weigh more than 200g, 83.18% of the total of metal weights weigh less than 20g, 76.91% less than 10g, and 60.76% less than 3g.[546] Except for lead weights from the Roman and Coptic periods, lead is mainly used as a material for filling and adjusting a (bronze) weight.[547]

Cour-Marty's most accessible article, however, is a guide to Egyptian weights for archaeologists published in 1990. It is a concise summary of Egyptian metrology aimed to guide Egyptologists and archaeologists dealing with Egyptian weights through the complexity of metrology (see Section 4.1.1 and Table 4.2).

This overview of weight catalogues demonstrates that the present analysis of a corpus of weights from a single site is a novelty. Petrie compiled the main collection of weights from sites in the Egyptian delta and most studies, including Cour-Marty's, concentrate on museum collections. There are no site-specific or regional studies from sites in Egypt. The collection in the Petrie Museum is not purely Egyptian, as the weights are in part excavated, in part bought locally, and in part bought from other collectors. On the other hand, several important metrological studies may be found for the rest of the Mediterranean, which are discussed next.

4.2. The Eastern Mediterranean: metrology and catalogues

Apart from the Egyptian weight standard, the location Thonis-Heracleion on the Mediterranean coast makes the presence of other weight systems in use in the countries from the shores of Aegean to the Near East inevitable. This section presents the general development and relationships between different weight systems from the Late Bronze Age to the Hellenistic period. It aims to reflect the current state of scholarship in the field, which is changing continuously especially the case of Greek metrology with the

[544] Cour-Marty 1989: Appendix I p. 47–55.

[545] Cour-Marty 1989: Appendix I p. 61–2, 67–8, 79–80.

[546] Percentages taken from Cour-Marty 1989 I: 60–1.

[547] Cour-Marty 1989 II: 24, no. 38; Cour-Marty 1991: 140.

appearance of new material. The development of the Attic weight system and the exact weight of the Attic drachma are still topics of debate. This section does not give a historical overview of scholarship on metrology.

Several different systems were in use in the Near East and by the Late Bronze Age it is clear that there was a level of coordination between them.[548] Alberti and Parise demonstrate that the individual weight systems in both the Aegean and the rest of the Eastern Mediterranean were easily convertible, which would have facilitated exchange and the trade in bulk goods.[549] These larger units were divided according to different fractions.[550] The talent would be divided into a number of minas (1 mina is approx. 470–480g), which would then be divided into 60, 50 or 40 shekels depending on the region.[551] The Egyptian kite (9.1g) corresponded to the shekel of Ugarit (1 mina/50). This shekel is found throughout the region as well as three other shekel standards: the shekel 'of Khatti' weighing 11.4g, the shekel of 'Karkemish' at 7.8g, and the common Mesopotamian shekel of 8.4g (see Table 4.2 for a list of weight standards).[552]

During the 9th to 7th centuries BC, animal shapes such as lions and ducks occur as metal weights in Late Assyrian contexts.[553] Other shapes are spherical bronze weights flattened on one side, or flattened on opposite sides. Two bronze cubes with gold inlay have also been found in Nimrud as well as a small bronze pyramid shaped weight.[554] Weights are typically spherical and made of stone in Levantine region at this time,[555] e.g. in the corpus of 58 weights from Lachish, halfway between Gaza and Jerusalem.[556] All weights from Lachish were made of stone with one exception made of lead, which is

[548] Alberti and Parise 2005: 381–2, 387–8.

[549] Alberti and Parise 2005: 383.

[550] Heltzer 1996: 31.

[551] Alberti and Parise 2005: 382.

[552] Alberti and Parise 2005: 384–5; Heltzer 1996.

[553] Curtis 2013: 74–6, 173–4 cat. nos. 533–569, and pls. XLII–III; Skinner 1967: 36–7; Elayi and Elayi 1997: 24 n. 26.

[554] For a discussion and further references, see Curtis 2013: 74–6.

[555] Elayi and Elayi 1997: 20.

[556] The script on the weights suggests a 7th to 6th century BC date, see Diringer 1953: 348–56, pls. 50–1; a similar weight with a shekel sign as identified on the weights from Lachish is found in Defenneh, see Petrie 1888a: pl. XLVII no. 119; for further references on the shekel sign and its interpretation, see Scott 1964: 56 n. 12.

thought to be of a later date.[557] There are three standards identified by inscriptions on these weights, the *nesef*, *pim*, and *beqa*.[558] Overall, there is a continuation of Late Bronze Age standards into the first millennium.[559]

By contrast, there is very little evidence for the development of weights from the Aegean. The only surviving weights of the early Early Iron Age were found in tomb no. 79 in the Toumba cemetery in Lefkandi, Euboea.[560] Sixteen nearly complete hematite weights, as well as fragments were found, the only weights surviving from Greece from 12th to the 6th century.[561] They represent a direct continuation of Late Bronze Age practices of making weights of hematite.[562] Another development at the end of this period is the emergence of metal as material for weights replacing stone. Especially the use of lead for weights becomes dominant in the Aegean, as it was cheap and plentiful.[563] Bronze on the other hand was also used when accuracy was required, such as for official weights. From the Aegean this spread across the Mediterranean, for example four lead weights from this early period were found in the Phoenician emporion of Huelva, Spain.[564]

The weights from the Athenian agora were published in 1964.[565] M. Lang worked on the 14 bronze and 61 lead weights from Athens.[566] Her catalogue remains one of the most important for Greek metrology and it contains several parallels for the material from Thonis-Heracleion. Her analysis and chronological ordering, however, is now out-dated. The context of the weights found in the agora spans a period of 500 years.

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[557] Diringer 1953: 354 no. 58, and 355.

[558] Elayi and Elayi 1997: 21–2; for a 'high' and 'low' mina in the Neo-Assyrian weight system, see Curtis 2013: 74–6; and Elayi and Elayi 1997: 25.

[559] Based on a study on Phoenician weights, see Kroll 2008a: 39.

[560] Kroll 2008a: 38.

[561] Kroll 2008a: 39, table 1 and 40, fig. 1.

[562] See especially Kroll 2008a: 44.

[563] Pernice 1894: 5; Petruso 1992: 2, n, 2.

[564] Gonzales de Canales et al 2006: 23, fig. 36.

[565] Lang and Crosby 1964.

[566] Lang and Crosby 1964: 25–31.

In 1996 K. Hitzl published his work on a large group of weights from Olympia.[567] Using the mainly bronze weights in the catalogue as a point of departure he gives a comprehensive overview of past scholarship on Greek weights and metrology from the classical period onwards. The most important part of this work is the re-assessment of the Attic weight system as proposed by Lang. Hitzl restructures the system and achieves a new dating through cross-referencing to archaeological data. His new proposals have been generally accepted (for more details see Section 0).

Hitzl also provides a brief survey of weights found at other Greek sites.[568] From Delphi 17 Roman and Byzantine lead weights were recovered.[569] Corinth yielded just 3 early lead weights.[570] All weights, including the lead, from the site have their denominational value inscribed on them, making it possible to reconstruct to some extent the Corinthian weight system.[571] On the basis of the lead weights there seems to have been a mina of approximately 415g, divided into 50 staters of three drachma each.[572] In the Hellenistic period there seems to have been a mina of around 600g based on 200 drachma.[573] From Kyzikos on the shores of the Black Sea, there are Hellenistic lead weights.[574] One of the reforms of the Attic weight standard (see Section 0) is connected to the increasing political interest in and (grain) trade with the Black Sea. In order to facilitate trade, the Attic mina of 456.75g was raised to the Kyzikene mina around 480–483g.[575]

Some of the weights from other sites, such as Olynthus, must represent other weight systems, which are less well understood. It becomes clear, however, that the Attic weight standard was the dominant one, the commercial koinè,[576] in the Aegean.

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[567] Hitzl 1996.

[568] Hitzl 1996: 121–9.

[569] Hitzl miscounted, see Hitzl 1996: 122; Perdrizet lists 17 examples, not 14, see Perdrizet 1908: 209 nos. 713 (3x), 714 (2x), 714, 715 (9x), 716, 717, and 718.

[570] Davidson 1952: 204, 208 nos. 1580–82, pl. 94.

[571] Kroll 2012; Hitzl 1996: 123–5.

[572] Kroll 2012: 114 n. 19.

[573] Hitzl 1996: 125.

[574] Hitzl 1996: 127–9; Weiß 1990.

[575] Hitzl 1996: 129; and for a similar development in the 2nd century BC, see Kroll 2012: 115.

[576] For the expression 'commercial koinè', see Meyer and Moreno 2004: 213–4.

Finally, the Persian weight system was based on the Babylonian shekel of 8.4g, which was also the weight of a Persian gold Daric.[577] The Persian mina is reconstructed as 504g, or 60 Darics.[578] The Aramaic papyri from the Jewish garrison in Elephantine show that transactions were made in shekel and kharsh, i.e. a unit of 10 shekels. This was probably a weighed amount of silver.[579] In a later development in the archive, amounts defined in shekels are equated to the stater.[580]

The overview shows that there are several important metrological works on Greek material, and more studies based on individual sites compared to Egyptian weights.[581] The most likely weight systems to be encountered in Thonis-Heracleion are the Egyptian deben standard and any of the other standards listed in Table 4.2. Merchants would have carried their own sets with them, so the presence of different weight systems in the assemblage from Thonis-Heracleion would be not be surprising.[582]

Excursus: An update to the Attic weight system — changes to Hitzl's proposals

As will become clear below, the Attic weight system plays an important role in the corpus of weights from Thonis-Heracleion. The weights with signs and symbols clearly belong in this Attic system. In order to clarify the discussion and elucidate the proposed dating of the individual weights, it is necessary to describe the Attic weight standard in some detail.

[577] Kroll 2008a: 45; Hitzl 1996: 129–32; Van den Hout 1990: 551.

[578] Hitzl 1996: 132.

[579] Naster 1970, Porten 1968: 63–4; see also the discussion in section 4.3.1.5 below.

[580] The equations in the texts – 2 shekels for 1 stater – show that for 'a stater' a tetradrachm seems to have been understood, with a shekel of 8.7g, see Naster 1970: 34–5; Porten 1968: 64–5; Kroll 2001: 14–5. This explanation seems very likely in an Egyptian context. It does not, however, work seamlessly with other 4th century Palestinian shekel weights, see Tal 2007.

[581] For an excellent example of a study of Cypriote Late Bronze Age weights not previously mentioned, see Petruso 1984, 1992.

[582] Several sets of weights have been identified on the Uluburun shipwreck, probably belonging to different merchants, see Pulak 2000: 264; see also Hafford 2002: 503 n. 2.

In Athens there was a bi-stathmic system of two co-existing standards.[583] One was the market weight standard based on a market stater, that is, a double mina, which was raised several times (see Table 4.2). The market weight system is based on the Attic drachma (4.35g), which may be multiplied out to determine the mass of the mina (i.e. half a stater) and the market stater (two mina, as distinct from the coin stater at 8.7g) as the defining units.[584] Hitzl has an excellent overview of the symbols of the multiples and fractions of the weights in the successive weight systems.[585] The number of drachmas per mina gradually increases over time as a process of standardization to facilitate conversion between different weight standards. The shifts in weight are pinpointed according to textual sources and archaeological context, which in turn allow unprovenanced or otherwise undatable specimens to be dated.

The second system was a silver-coin standard based on the Euboeic mina of 435g, i.e. a drachma of 4.35g x 100. This was the standard applied to Athenian coins, which were favoured internationally, and consequently the standard remained stable down to Roman times.

The present analysis of the weights from Thonis-Heracleion takes into account several changes compared to Hitzl's reconstruction of the Attic market weight system, changes reflect the current state of scholarship since publication of his book in 1996. The Attic weight system is the best understood system in the Aegean, but this does not mean that it is fully understood. Crucially, the mass of a drachma has not been fixed, nor is the chronological progression of the shifts in weight fixed. The relationship with other weight systems in the Aegean is also unclear.

The first change with the system as proposed by Hitzl concerns adjusting the drachma weight from 4.366g in Hitzl to 4.35g.[586] Although this is a small change in absolute terms, it has a knock-on effect for larger units such as the mina. Table 4.3 lists the increasing weight of the mina and the corresponding dating.

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[583] Kroll 2012: 114–5, n. 22. This exposé owes much to J. H. Kroll for his guidance throughout this chapter, but in particular for discussing the Athenian weight system — as presented here — with me at length and for making his unpublished notes available to me.

[584] Hitzl 1996: 111–20.

[585] Hitzl 1996: 105–6, 111–5.

[586] Using Doyen 2012, see Kroll 2013, on the basis of Lang and Crosby 1964: 37 SW16, pl. 12; for 4.366g drachma, see Hitzl 1996: 53.

Number of drachmas (at 4.35g) per mina	Dating	Gram
105	Second half of the 6th century – end of the 5th century BC	456.75
110	Beginning of the 4th century – beginning of 3rd century BC	478.5 (480.26 in Hitzl 1996)
112		487.2
138	Beginning of 3rd century – mid-2nd century BC	600.3
150	mid-2nd century BC – 86 BC	652.5

Table 4.3 Dating of the Attic weight systems

The steady progression of the system from 105, 112, 138, to 150 drachmas per mina remains the same as Hitzl.[587] Hitzl proposes a Late Classical system ("C") of 110 drachmas per mina instead of Lang's 112 drachmas per mina.[588] The 112 drachmas per mina is preferred here as it fits the data from Thonis-Heracleion much better. The dating of the change from 105 to 112 drachmas per mina was changed slightly in a review of Hitzl's work, suggesting an early 4th century BC start date instead of 420 BC, and this is applied here.[589]

The pattern of the stater (market) weight system becoming progressively heavier makes it possible to sort and date the weights with Attic symbols, including those from Thonis-Heracleion. The denominational symbols (dolphin, amphora etc.) on the weights allow for the reconstruction of the original stater (or mina) weight that formed the basic foundation for the weight, from which the number of drachmas per mina may be deduced. The first weights of this kind appear in the archaeological record from the late 6th century BC; before that time the analysis is based on documentary sources.[590] As a general rule, weights with letters in raised relief are 4th century BC, whereas weights with letters incised on the edges may be dated to the 5th century BC.[591] The increasing weights of the mina are connected to changes in trade networks. The 105 to

[587] Contra Lang, Hitzl 1996: 106–11.

[588] Hitzl 1996: 113–5.

[589] I thank J.H. Kroll for drawing my attention to this review, see Johnston 1998: 253.

[590] From a well in the Athenian agora, Lang and Crosby 1964: 25–6, BW1–3, pl. 1; 6 small square lead weights were reported on the Pointe Lequin 1A ship wreck, which has been suggested to come from Greece or cities in Asia Minor, and it has been dated 530–510 BC, see Long 2004: 135; they are minute (0.45 x 1 cm), see Long and Sourisseau 2002: 54.

[591] Pers. comm. J.H. Kroll.

112 drachma per mina is associated with the increased trade interaction with the Black Sea.[592] The change to 150 drachmas towards the end of the Hellenistic period is prompted by the desire to equate to the Roman libra.[593]

Apart from the reforms in the Attic system, there are the local and less well understood weight systems in the Aegean that make the study of ancient weights frustrating.[594]

4.3. Weights from Thonis-Heracleion

Before progressing to the discussion of the weights, some general remarks about the typology are helpful. The presentation is arranged principally on the basis of shape: first the square plinth shapes, then the domed shapes. A subdivision within these categories follows on the presence (or absence) of symbols, markings, and/or inscriptions. If they are absent, the identification of an object as a weight is based purely on its shape. Any doubt about the identification is stated explicitly.

In this corpus from Thonis-Heracleion, the shape is an indicator of provenance. Weights with a square plinth shape are indicative of a Greek origin, especially since there are examples of the square plinth shapes with typical Attic symbols and legends on them. The traditional Egyptian shape for weights in the Late Period can be described as domed, or a 'cupcake' shape.[595]

The subdivision in this catalogue between weights with and without markings, symbols, or inscriptions is only relevant in the case of the square plinth-shaped weights associated with a Greek origin. The weights in the other categories are all unmarked. This distinction is relevant, as the symbols are usually an indicator of the fraction or multiple of the weight standard. To establish the weight standard in unmarked specimens, scholars have turned to statistical analysis.[596] An algorithm designed by Kendall in 1974 is applied to the values of the mass of the weights in order to give the

[592] Meyer and Moreno 2004: 213.

[593] Hitzl 1996: 117–8.

[594] For similar sentiments, see Kroll 2012: 112; Davidson 1952: 203–4.

[595] The term 'cupcake' is regularly used to describe this shape and appears in the literature as early as Kisch 1965: 2.

[596] For an analysis of Cypriote weights using statistical methods, see Petruso 1984, 1992; for other case–studies see Hafford 2005; Pakkanen 2011.

smallest significant value (quantum) that would indicate the weight standards involved.[597] After discussions with statisticians in the Department of Statistics at Oxford University who questioned the applicability of this algorithm to the data, I decided not to pursue this avenue of research in this thesis.

It is also important to stress the tendency of metal to gain or lose weight over time according to its use and (post-) depositional circumstances.[598] Weights may chip during their lifetime in circulation, the chemical composition may change after deposition, and after excavation weight loss may be incurred during cleaning.[599] It is necessary to estimate the percentage of weight loss or gain experienced by the object after manufacture. As the tables on the inscribed weights will show, however, the weight loss seems to be minimal.

4.3.1. Weights in a plinth shape

In total there are 118 square plinth-shaped weights from Thonis-Heracleion. Multiple weights under one excavation number are counted separately. An overview of the numbers of weights in each category is given above in Table 4.1. Some of the weights are already published in the catalogue accompanying the exhibition *Egypt's Sunken Treasures*.[600]

The present analysis starts with the 26 weights that have markings, symbols, and/or a legend.[601] They are all square plinth-shaped weights made of lead. The symbols are denominational symbols and the legend identifies them as Athenian. Using these as a point of departure, I turn to the weights with symbols, other markings, and finally the uninscribed examples within the corpus of square, plinth-shaped weights.

[597] Petruso 1992: 69–75.

[598] Petrie 1926: 3 §7, 22–3 §54.

[599] For example, occasionally mechanical removal of marine encrustations during the early seasons at Thonis-Heracleion was used with the weights, which may have resulted in some additional weight loss.

[600] Goddio and Fabre 2008[2]: 342–3, nos. 358–364, 367.

[601] Cat. no. 25, see Goddio and Fabre 2008[2]: 343, no. 367.

4.3.1.1. Weights with Attic symbols and an Athenian legend

The catalogue starts with six weights on the Athenian standard, an identification secured by the legend accompanying the symbols on the weights.[602] The two heaviest weights (nos **29** and **30**) are the heaviest *metal* weights in the whole corpus from Thonis-Heracleion.[603] Both have the wheel symbol indicating the stater, i.e. double mina, of the market weight in the Attic weight system.[604] The Greek legend ΔΕΜΟ in raised relief in the corners on the face containing the wheel symbol implies an official guarantee or control and the concept of ΔΕΜΟ or ΔΗΜΟ, 'public', which is closely associated with Athens.[605] Theoretically, both weights should be equally heavy. Only one, however, is the expected double stater (no. **30**); the other is a triple stater (no. **29**) and as such it is unique.[606]

The dolphin is a denominational symbol for a half-stater, or mina, and it appears on a worn weight with faint traces of ΔΗΜΟ in raised relief (no. **31**). Another worn weight with a full amphora (no. **32**) also has faint traces of letters. The final two weights, one with a full (no. **33**) and one with half a tortoise (no. **34**), are also inscribed with Greek letters in raised relief. Apart from weight no. **29**, the masses of all the weights and their symbols match in terms of the fraction of a stater indicated by the symbol.

[602] Petrie lists more weights with Athenian symbols, see Petrie 1926: plates L and LI.

[603] Two *stone* weights are the heaviest of the whole corpus at 28 and 46.5kg (nos. **147** and **148**).

[604] Hitzl 1996: 105.

[605] Lang and Crosby 1964: 6.

[606] For parallels for the double stater, see Empereur 1981: fig. 7; also Lang and Crosby 1964: LW 1–2.

Cat. no. (symbol)	Weight (g) (reconstructed mina in g)	% deviation (no. of dr/mina)	Multiple/fraction
29 (wheel + ΔHMO)	2920 (486.7)	-0.1% (112)	Triple stater
30 (wheel + ΔHMO)	1920 (480)	-1.5% (112)	Double stater[607]
31 (dolphin + ΔHMO)	398.8 (398.8)	-18.1% (112)	Half stater
32 (amphora ΔHMO)	287.9 (431.9)	-11.4% (112)	Third stater
33 (tortoise + ΔHMO)	238.2 (476.4)	-2.2% (112)	Quarter stater[608]
34 (half tortoise ΔEMO and HMITE[609]	119 (476)	-2.3% (112)	Eighth stater[610]

Table 4.4 Weights with Attic symbols and an Athenian legend

On the basis of these symbols the original stater weight unit and the weight system may be reconstructed. These six weights with Athenian symbols fit into the Late Classical system of 112 drachmas per mina (112 x 4.35g).[611] The back of weight no. **29**, and to a lesser extent no. **30,** has traces of tool marks suggesting the mass of the object was closely adjusted. On the basis of their reconstructed mina weight, interpreting weight no. 1 as a triple stater weight and considering the adjustment signs on the back of both weights, they show a very close fit on the 112 drachmas per mina system. Weights nos. **31** and **32** have lost 18.1% and 11.4% respectively in weight, large losses that one might expect from their poor condition. Attribution to the earlier 'Solonic' system would mean a smaller weight loss of 12.7 % (no. **31**) and 5.5 % (no. **32**).[612] That system, however, is reconstructed on the basis of textual references and there are very few examples of weights on this system preserved from Athens.[613] This fact, combined with the worn state of the weights from Thonis-Heracleion, makes me hesitant to attribute a weight to this early system. Weights nos. **33** and **34** also fit comfortably on the 112 drachma per mina system.

[607] Parallel: Lang and Crosby 1964: LW 1, pl. 2; for all other known comparanda, see Empereur 1981: 540 no. 5, fig. 5 and n. 6.

[608] Parallel: Lang and Crosby 1964: LW 34–44, pl. 7.

[609] Lang and Crosby 1964: 6.

[610] Parallel: Lang and Crosby 1964: LW 45–8, pl. 8.

[611] Contra Hitzl 1996: 109; as Lang already suspected, which has now been argued by Doyen 2012, see the review by Kroll 2013.

[612] Hitzl 1996: 112–3.

[613] Kroll 1971.

On the 110 drachmas per mina standard as proposed by Hitzl,[614] there would no room for some weight loss expected during use, deposition and post-depositional processes, such as cleaning.[615] Weight gain is unlikely, and the fit for weights nos. **33** and **34** is perhaps too tight on this standard (no. **31** -16.6%, no. **32** -9.7%, no. **33** -0.4%, no. **34** -0.5%).

The close relationship between the current mass and reconstructed ideal weight of these six weights signals the high level of accuracy achieved in these lead weights. The idea that the ancient Greeks or Egyptians were incapable of achieving a high level of accuracy in their measurements is untenable,[616] considering for example the fractions of a drachma in circulation as low-value coinage.[617] The accuracy demonstrated by the weights nos. **29**, **30, 33**, and **34**, as well as the large number of very small lead weights (see Section 4.3.1.5), show the ability and the necessity to control the accuracy of weights in the marketplace. This level of accuracy in the lead weights also does away with the assumption that they were less accurate by definition than bronze (or silver) ones.[618] Bronze weights may retain their mass better than their lead counterparts, as bronze is inherently more resistant to chipping and degradation. It does not, however, follow that the degree of accuracy at the point of manufacture was different due to incapability.[619]

[614] 110 x 4.37g = 480.26g, see Hitzl 1996: 113. All calculations here use the new drachma weight, i.e. 110 x 4.35g = 478.5g for the mina.

[615] As aptly described by Hitzl, see Hitzl 1996: 47–8.

[616] E.g. Grayson 1974.

[617] Kim 1994; for a similar, general point of accuracy in weighing, see Bresson 2000: 214–5.

[618] For the higher degree of accuracy for silver weights, see Hitzl 1996: 92; also Bresson 2000: 230.

[619] Also, different situations may demand different levels of accuracy, i.e. buying jewellery vs. food, see Bresson 2000: 217.

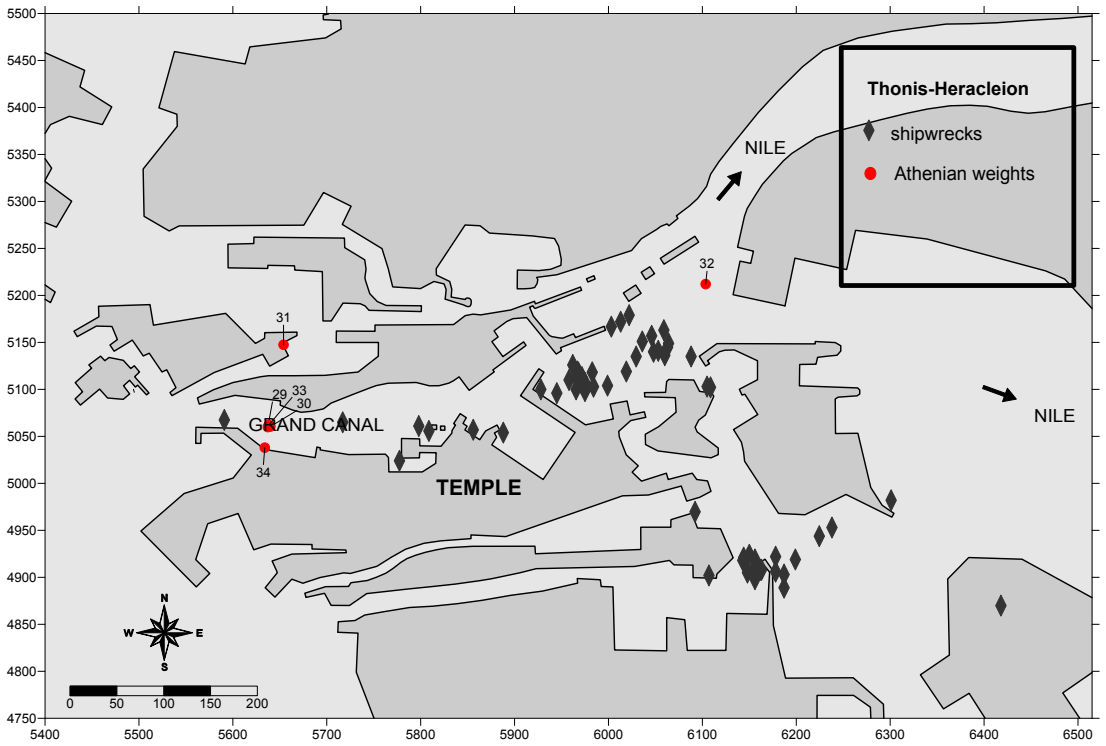


Figure 4.1 Distribution map of weights with Attic symbols and an Athenian legend ©Franck Goddio/Hilti Foundation.

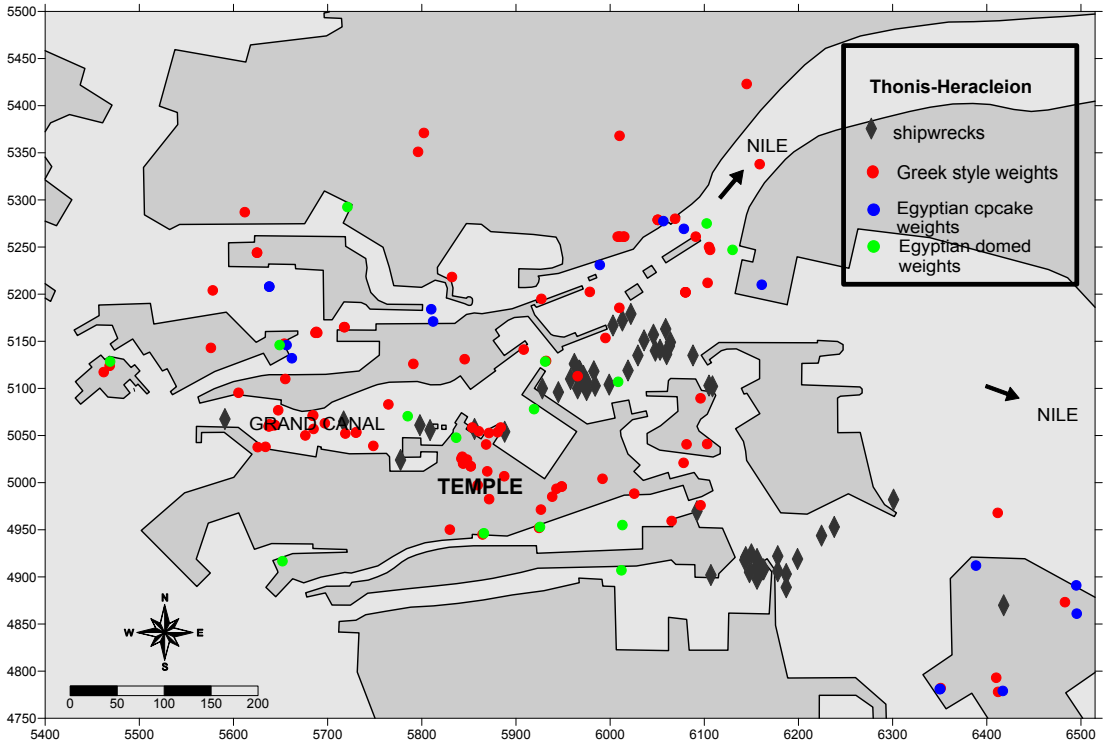


Figure 4.2 Distribution map of Greek style weights and Egyptian style weights ©Franck Goddio/Hilti Foundation.

The spatial distribution of the Athenian weights shows a concentration (nos. **29**, **30**, **33**, and **34**) at the western end of the Grand Canal (Figure 4.1). These are also the examples with the best preservation. One is found in the North passage in relative isolation from other weights, while another is in the northwest of the site. In this particular location several Egyptian-style weights (nos. **147–54**) were found nearby (Figure 4.2). At the western end of the Grand Canal two uninscribed weights (nos. **30** and **31**) were found in the vicinity of weights (nos. **29**, **30**, and **33**, ladles (Figure 2.4) and a bark (Figure 2.5). Another inscribed weight (no. **48**) was found near to an Athenian weight (**no. 34**). The Grand Canal contains many objects associated with ritual activity (see **chapter 3** and **5**), and it is therefore likely that the weights were dropped in the water with similar intent. Surprisingly, the weights in the Grand Canal are all Aegean-style weights, with one exception (no. **181**) in a domed shape.

4.3.1.2. Weights with Attic symbols, no legend

Cat. no. (symbol)	Weight (g) (reconstructed mina)	% deviation (no. of dr/mina)	Multiple/fraction
35 (astragal)	859 (429.5)	-6.0 (105)/-11.8 (112)	Stater (double mina)
36 (amphora)	304.1 (456.2)	-6.4 (112)	Third of a stater
37 (half amphora)	173.5 (520.5)	-13.3 (138)	Sixth of a stater
38 (shield)	159.5 (478.5)	+4.8 (105)/-1.8 (112)	Sixth of a stater
39 (moon crescent)	113.8 (455.2)	-0.3 (105)/-6.5 (112)	Eighth of a stater
40 (moon crescent)	111.6 (446.4)	-2.3 (105)/-8.3 (112)	Eighth of a stater
41 (quarter amphora)	89.7 (538.2)	+10.5 (112)/-10.3 (138)	Twelfth of stater

Table 4.5 Weights with Attic symbols, no legend.

The following weights (nos. **35–41**, Table 4.5) are on the Attic system, as they have symbols known to indicate fractions or multiples of the Attic system. They lack the letters present in the previous six weights, thus preventing a positive Athenian identification. The astragal, or knucklebone, on weight no. **35** is known as the symbol for a stater or double mina. The identification of the standard is complicated by damage to the weight. In this case the lightest standard of 105 dr/mina is the closest match, however, to allow for the extent of the damage and wear the heavier standard of 112 dr/m is preferred. Two weights from Olynthus are good parallels for this weight, both for its date and for the symbol to weight relationship. The date for Olynthus

weights is first half of the 4th century BC, before the sack of the town in 348 BC.[620] The amphora weight no. **36** is much worn and consequently the 112 dr/m standard is reconstructed. The next weight (no. **37**) with a half amphora is more problematic: the preservation seems very good with perhaps some wear visible on the amphora, but the reverse shows a superfluous rim of lead from the casting process. A 138 dr/m Hellenistic standard is suggested here, but this is problematic, since a 13.3% loss does not seem likely. The earlier standards, however, would require an even more unlikely weight gain. This is unsatisfactory and the obvious conclusion is that perhaps this weight is on a non-Attic weight system.

The round, but very worn shape of the symbol on weight no. **38** must be identified as either a shield or a tortoise. On the 'Solonic' system the tortoise is the denominational symbol for a sixth of a stater (at 152.23g), and the shield for a quarter of a stater (at 228.35g). A weight gain must be understood in order for the weight to fit the 'Solonic' standard. A gain is highly unlikely as the weight is very worn. Hitzl does not recognize the shield as a denominational symbol in the Late Classical system, replacing it with the half-amphora for a sixth of a stater. The tortoise remains as a quarter of a stater (at 243.6g). The weight of no. **38** (at 159.5g) in the Attic weight standard is closest to a sixth of stater. Therefore, in light of the lack of better solutions, I propose to interpret this weight as a sixth of a stater weight on the Late Classical system with the shield symbol as an archaism. It may be argued, however, that the weight loss (-1.8%) in this interpretation is not large enough to accommodate its poor preservation.

Weights **nos. 39** and **40** both have a moon crescent as a denomination symbol. In the Late Classical and Hellenistic systems the moon crescent designates a sixth of a mina (at 81.2g and 100.1g respectively), which does not correspond to the mass of these two weights. Considering their weight, they must be interpreted as a symbol for an eighth of a stater on the 'Solonic' standard as reconstructed by Hitzl.[621] The frame on the weights, i.e. the raised rim around the edge, suggests a 4th century date and consequently the heavier Late Classical system of 112 dr/m. This would require

[620] Robinson 1941: 461–2, nos. 2417 (Inv. 31.266, 896 g, from the house of Archidamus, a coin magistrate A 11 room e, pl. CXLIV), 2418 (Inv. 34.23, 812.5 g, from trial trench 7 between the North and South hills, pl. CXLIV).

[621] Hitzl 1996: 112.

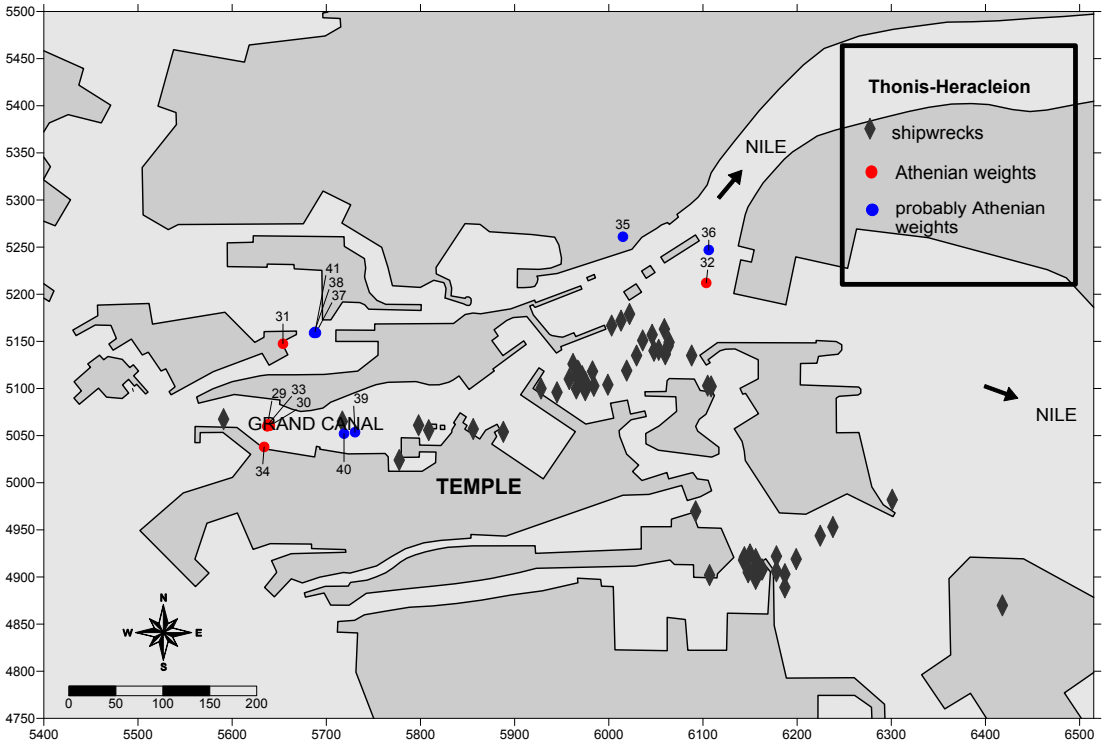


Figure 4.3 Distribution map of weights with Attic symbols, no legend, ©Franck Goddio/Hilti Foundation.

significant weight loss in both weights, whereas no. **40** in particular is very well preserved. As weights on the older 105 dr/m system, they would be very rare examples. Their more advanced form typical of the 4th century BC makes this unlikely. Again, for these two weights no satisfactory conclusion can be reached. The final weight in this selection, **no. 41**, has a worn quarter amphora as a fractional symbol, for a twelfth of a stater. A weight gain, which would be required on the Late Classical standard, seems unlikely. The significant loss of 10.3% on the suggested Hellenistic weight standard (138 dr/m) is not unlikely. No quarter amphora specimens on this standard are known from Athens.

This group of weights with Attic symbols lacks the straightforward interpretation of the Athenian weights with legends. The parallels from Olynthus for weight no. 7 underline the importance of other weight systems in the Aegean, and these are less well understood. Perhaps only for weights nos. **36** and **41**, both poorly preserved, an Attic system may be suggested with any degree of confidence.

The spatial distribution of this group of weights mirrors that of the Athenian weights (Figure 4.3). There are two in the central part of the Grand Canal (nos. **39** and **40**) near a shipwreck. Three were found in close proximity in an ancient waterway in

the northwest of the site (nos. **37**, **38**, **41**), which is in the general direction of what is identified as another temple precinct in the north of the site.[622] One weight **(no. 36)** was found in the North passage, and another on the north bank of the North passage **(no. 35)** together with several other weights (nos. **42**, **54**, **70**, **82**, n.b. not depicted in Figure 4.3).

4.3.1.3. Weights with non-Attic denominational symbols

Cat. no. (symbol)	Weight (g) (reconstructed mina)	% deviation (no. of dr/mina)	Multiple/fraction
42 (M)	372.0 (372.0)	-18.6 (105)/-23.6 (112)	Mina
43 (astragal)	460.8 (460.8)	-3.7 (112)	Mina
44 (M)	445.8 (445.8)	-2.4 (105)/-8.5 (112)	Mina

Table 4.6 Weights with non-Attic symbols

These three weights have known symbols that are not identifiably Attic; either the denomination symbol does not match preserved mass (no. **43**), or the symbol, M in this case, is not known in the Attic system (nos. **42** and **44**). Parallels from Olynthus suggest that the M in raised relief, such as no. **42**, must be short for mina.[623]

Weight no. **42** is battered and for a mina on the Attic system very light; even reconstructing the 105 dr/m standard would require 18.6% weight loss. The astragal on weight no. **43** is the denomination symbol of a stater (i.e. double mina) in the Attic system, instead of the single mina in this particular case. A parallel for the astragal equal to one mina may be found in Olynthus.[624] If the change of symbol is accepted for the mina, then a mina weight on the Late Classical system shows a reasonable loss of -3.7%. Weight no. **44** has an M incised in one of its faces.[625] It seems well preserved, making an assessment of an acceptable weight loss difficult. Only one weight (no. **42**) clearly does not make a satisfactory match with the suggested weight standard.

[622] H15/G1, see Goddio 2007: 74 fig. 3.6, 75.

[623] For a lead weight with M in relief, see Robinson 1941: 453 no. 2389 (Inv. 34.8, 419g, from House A iv 9 room i, pl. CXLI); and for a bronze example, see Robinson 1941: 453 no. 2390 (Inv. 34.13, 418.5g, from House A vii 9 room d, pl. CXL). The house is dated to late 5th or early 4th century BC.

[624] Robinson 1941: 462 no. 2419 (Inv. 34.10, 415g, from Trial trench in street XIII, pl. CXLIV), central elevation like that of an astragalus with a depression around it; for a very damaged example, Pernice 1894: 85 no. 13 (480.66g).

[625] The M may also be scratched in the weight in Olynthus, see Robinson 1941: 451–3, nos 2384–88, pl. CXL.

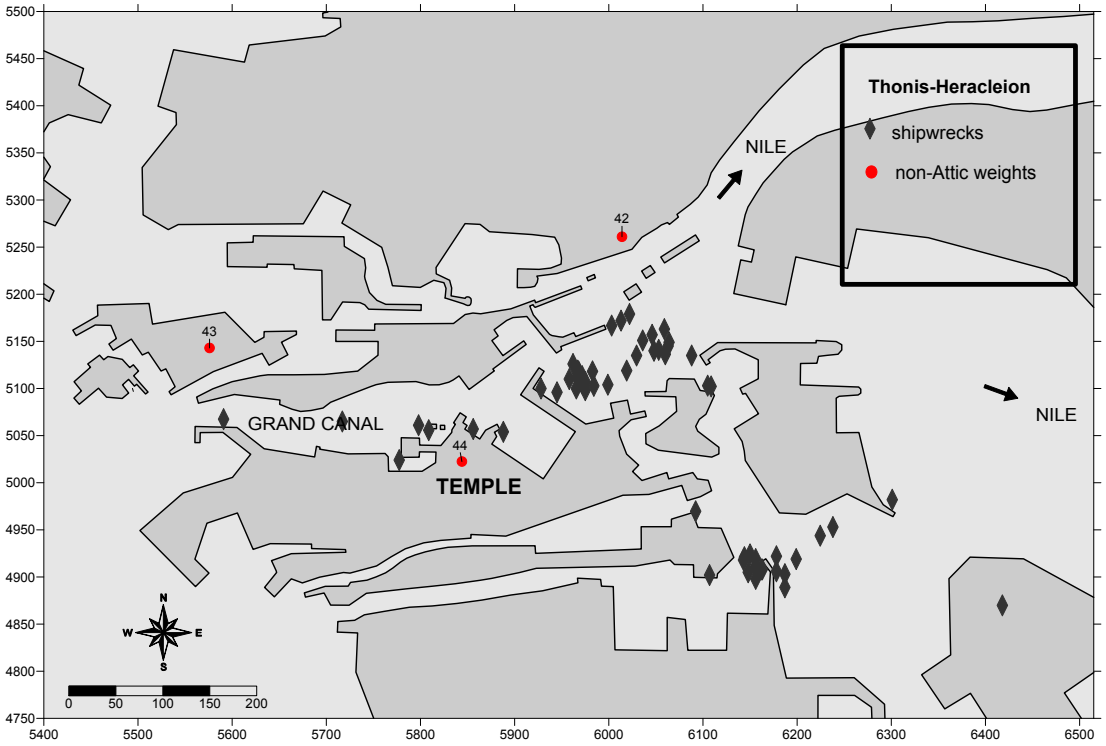


Figure 4.4 Distribution map of weights with non-Attic symbols, ©Franck Goddio/Hilti Foundation.

The spatial distribution (Figure 4.4) shows that all these weights were found on land. Weight no. **44** is exceptional as it was one of a small number found in the temple precinct. Weight no. **43** was found on land in the west of the site in isolation from any other weights. On the north bank of the North passage weight no. **42** was found in a group of several others (nos. **35**, **54**, **70**, **82**).

4.3.1.4. Weights with markings

This group contains the remaining weights from Thonis-Heracleion with markings. Some of these weights may be market weights (nos. **45–47** and perhaps **48**, **49**). Others are clearly multiples of the Attic drachma (nos. **50–54**). The first three weights (nos. **45–47**) are probably half a mina, as suggested by the letters **η(μ)** for the fraction 'half' on nos. **45** and **46**, which indicates a shift in unit from stater to mina. Weight no. **47** is stamped with a round impression on one of the faces. The meaning of the stamp is unclear. It is not readily recognizable as an indication of a fraction and resembles a monogram. Perhaps it is a sign of the owner of the weight or another official (see Section 3.1.1.3). As a well-preserved weight, it is difficult to envisage a 9% weight loss in order to fit on a known fraction of the Attic system. For the lighter lead weights of the square plinth shape or more in the shape of a cube, the significant unit is

one Attic drachma.[626] Dividing the mass of this weight (no. **48**) by one Attic drachma (at 4.35g), suggests that it may be interpreted as a 50-drachma piece.

Cat. no.	Weight (g) (reconstructed mina or drachma multiple)	% deviation (no. of dr/mina OR multiple of Attic drachma)	Multiple/fraction
45	239.9 (479.8)	-1.5 (112)	Half of a mina
46	235.0 (470.0)	-3.5 (112)	Half of a mina
47	218.8 (436.0)	-4.5 (105)/-10.5 (112)	Half of a mina
48	209.4 (217.5)	-10.7 (112)/-3.7 (50 dr)	Half of a mina/50 drachma?
49	105.8 (423.2 or 108.75)	-7.3 (105)/-2.7 (25 dr)	Quarter of a mina or 25 drachma?
50	68.1 (69.6)	-2.2 (16 dr)	16 dr?
51	51.5 (52.5)	-1.9 (12 dr)	12 dr?
52	51.3 (52.5)	-2.3 (12 dr)	12 dr?
53	41.6 (43.5)	-4.4 (10 dr)	10 dr
54	24.85 (26.1)	-4.8 (6 dr)	6 dr

Table 4.7 Weights with other inscriptions or markings

In the same vein, a multiple of 25 drachmas may be suggested for weight **no. 49**. The letters KH appear in orange patina dots on one face of the weight. Alternatively, a fraction of a quarter mina on the Late Classical standard is possible, although this would require a weight loss of between -7.3% for the 105 dr/m standard, or -13.1% for the 112 dr/m, which is excessive in view of the good preservation of the weight. There are two weights from Olynthus of similar weight to this example from Thonis-Heracleion with a T for *tetartèmorion* in raised relief, meaning a quarter (of a mina).[627]

I suggest a similar interpretation for the remaining weights in this group (nos. **50–54**). Weight no. **50** is unique with a raised rectangular protrusion in the centre of one of the faces and what seems to be a two-handled amphora to one side of the protrusion, and on the other side perhaps the letters E and Ξ may be read. The protrusion itself is worn, as is the surface of the weight with the letter(s). The weight is too heavy to be an eighth of a mina piece (57.1g on 105 dr/m system, 60.9g on 112 dr/m), which does not match with its worn condition, and currently it weighs just under 16 drachmas (at 4.35g). Weights nos. **51–52** are nearly equal in weight and too

[626] A discussion of weights based on the drachma follows below in section 4.3.1.5.

[627] Robinson 1941: 457, no. 2399, 3 x2.6 x 1.5 cm 107.5g (i.e. a fourth of a mina) House A; Olynthus 2400 3 x 3 x 1.3 cm weight 106g House A.

light for the lightest fraction in the market system, which is an eighth of a mina (i.e. 57.1g or 60.9g). Even with the traces of modern cleaning in weight no. **52** a loss of 15.8% seems unlikely. The closest multiple of the Attic drachma is 12. Weight no. **52,** however, has 5 circular impressions, one in each corner and another in the centre.[628] This suggests a multiple of 5, making a unit of 10.3 g. This points towards a weight standard of Levantine origin (cf. Table 4.2).

Weight no. **53** is a square plinth-shaped object. It has an impression of a tetradrachm on one side and a punched impression of a ram's head on the other side.[629] The bifacial nature of this weight is unique. According to A. Meadows, this type of tetradrachm on no. **53** was in production at Athens between 350 and 290 BC. As it weighs 41.6g, Meadows suggests that this is the equivalent of ten Attic drachmas, which would make a convenient conversion to eight Persian *sigloi* (a Persian silver coin at 5.4g). The proposed conversion between the Attic and Persian coin systems and the presence of the countermark make this one of the most intriguing objects in the corpus.[630] It may perhaps also be interpreted as half a *kharsh* (at 42g), a Persian weight, which is the equivalent of five shekels (at 8.4g).[631] Meadows interprets the impression of a ram's head as a countermark, or stamp, a phenomenon known from both bronze and lead weights in the Aegean. Lang suggests that the act of countermarking may be linked to periodic inspections of the weights in the marketplace by the *metronomoi*.[632] Could this scenario be envisaged for Thonis-Heracleion? The countermark of a ram's head is most likely the symbol of the god Amun, the main deity of the Egyptian temple and the economic authority of the town. Temple personnel were in charge of collecting taxes and controlling the flow of goods through this harbour town.[633] The presence of the

[628] A similar arrangement of, in this case stamped, impressions is found on LW62, a weight much heavier than than no. **24**, see Lang and Crosby 1964: 31, pl. 8.

[629] See the entry by A. Meadows, in Goddio and Fabre 2008[2]: 343, cat. no. 367.

[630] Persian sigloi are only rarely found outside Asia Minor. Cypriote kingdoms, however, minted on the Persian silver *siglos* standard, see Markou 2011: 67–8.

[631] Porten 1968: 66; for a discussion of the *kharsh* and shekel in the Aramaic papyri from Elephantine, see Naster 1970.

[632] For examples from the Athenian Agora, see Lang and Crosby 1964: 21–2.

[633] The Heracleion stela, detailing the flow of incoming taxes, was erected within the temple precinct; see Goddio 2007: 90 fig. 3.37.

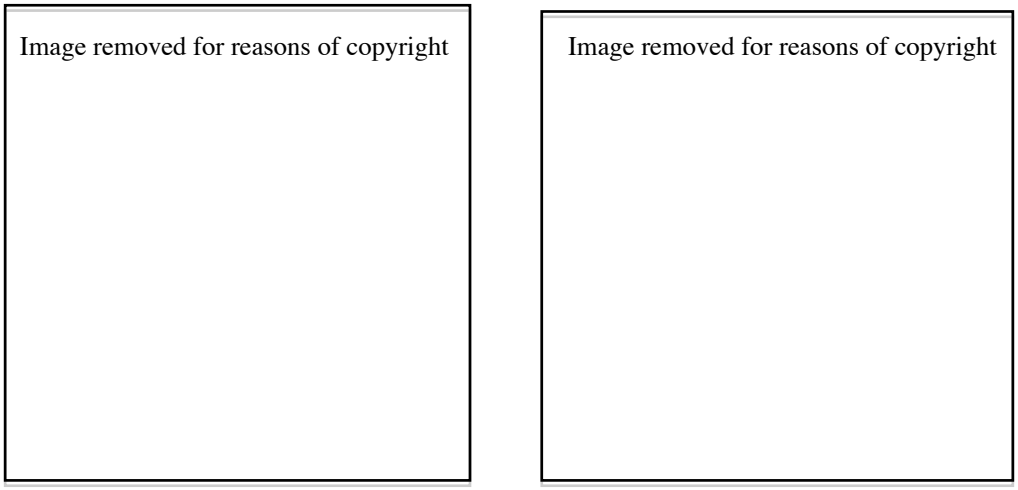


Figure 4.5 APM 7097 (left) and APM 7096 (right), courtesy of the Allard Pierson Museum, Amsterdam.

ram's head suggests an involvement from the temple in the regulation of weights in the town.[634]

Weight no. **54** is the lightest of the examples with symbols or letters. It has a worn impression of an Athena head on a square plinth-shaped lead object. Its shape suggests it is a weight, perhaps the equivalent of six Attic drachmas. The Allard Pierson Museum in Amsterdam, the Netherlands, houses two very similar lead objects with impressions (APM 7096 and 7097) (Figure 4.5).[635] The first is a round lead object (APM 7096) and it is a heavier weight at 74.94g with the impression of an Athena head.[636] It is nearly three times as heavy as no. **54**. The second (APM 7097) is a very good parallel in terms of weight for no. **54** at 25.53g. The impression, however, is of a tetradrachm with an owl, ATHE in mirrored writing, a half-moon crescent and an olive branch.[637] It is also square and only a little smaller than no. **54**. In short, the weights of the objects with impressions of coins (?) are as following 24.85g (no. **54**), 25.53g (APM7097), 41.6g (no. **53**), and 74.94g (APM7096). The impressions of images present

[634]Kisch 1965; Vleeming 1991; Müller-Wollermann 2007.

[635] Jongkees 1950; I am grateful to Olivier Berger for drawing my attention to these two objects and to Mrs drs. G. Jurriaans-Helle, curator of the Allard Pierson Museum, for supplying me with images.

[636] APM7096, provenance is said to be Alexandria, 4th century. H. 4.7cm x W. 4,7cm. See Algemeene Gids 1937: 96 no. 836; also Hill 1922: 14, pl. 1, no. 9.

[637] APM7097, provenance is said to be Alexandria, 479–300 BC, h 025 (mm) x b 023 (mm). See Algemeene Gids 1937: 96 no. 835. Both were acquired in 1934: Scheurleer 1921, from the collection von Bissing D153.

on Attic coins suggest a link with the Greek world[638] and it seems reasonable to propose that the basic unit of these objects is the Attic drachma. Another example of a lead plinth-shaped object with a coin impression comes from the Romanian Black Sea coast and weighs the equivalent of an Athenian tetradrachm (16.57g).[639] This and similar pieces have been interpreted as test-pieces for the production of dies or as substitutes for votives.[640] According to this hypothesis, the test-piece would be used to check the design of the die, an object used in the process of coin production. The image is an impression on the weight. If the impression was made by a die used in coin production, it would result in an image in *raised* relief – similar to that impression on a coin. Instead it seems a coin was used, as the image is *impressed in the surface* of the weight.

The distribution of the final group of weights with markings does not show any grouping of two or more pieces together (Figure 4.6). Instead they were found around the site on areas that were land in antiquity, or at the edge of water and land. It is interesting to note that none were found in the underwater areas with signs of ritual activity where, for example, the Athenian and probably Athenian weights were found.

To summarise, the 26 lead weights with symbols, letters, and inscriptions are a significant addition to the existing corpus of Greek weights. They have an impact for Greek metrology as well as being the first of their kind to be found in Egypt. Regarding the implications for Greek metrology, several well-preserved examples show a remarkable accuracy between their mass and the weight symbol present on the object.[641] The weights with symbols and legends (nos. **29–34**) are beyond doubt on the Late Classical standard of the Attic weight system. Moreover, some weights are unique (e.g. **no. 29**). In others the symbol does not match the multiple or fraction with which it is normally associated on the Attic weight standard (nos. **42–44**), or the system cannot be positively identified as Attic (nos. **35–41**). The final group (nos. **45–54**) contains weights too light to be a fraction of the Attic system, and they are consequently interpreted as multiples of a drachma. The majority of weights are on the Late Classical

[638] It is not always clear that the images are impressions or negatives of coins, as the coin itself is not visible in the impression.

[639] Ashmolean Inv. no. AM 2004.53; Meyer 2006: 25.

[640] Jongkees 1950: 300.

[641] Preservation of lead in a marine environment is very good, see Tylecote 1983.

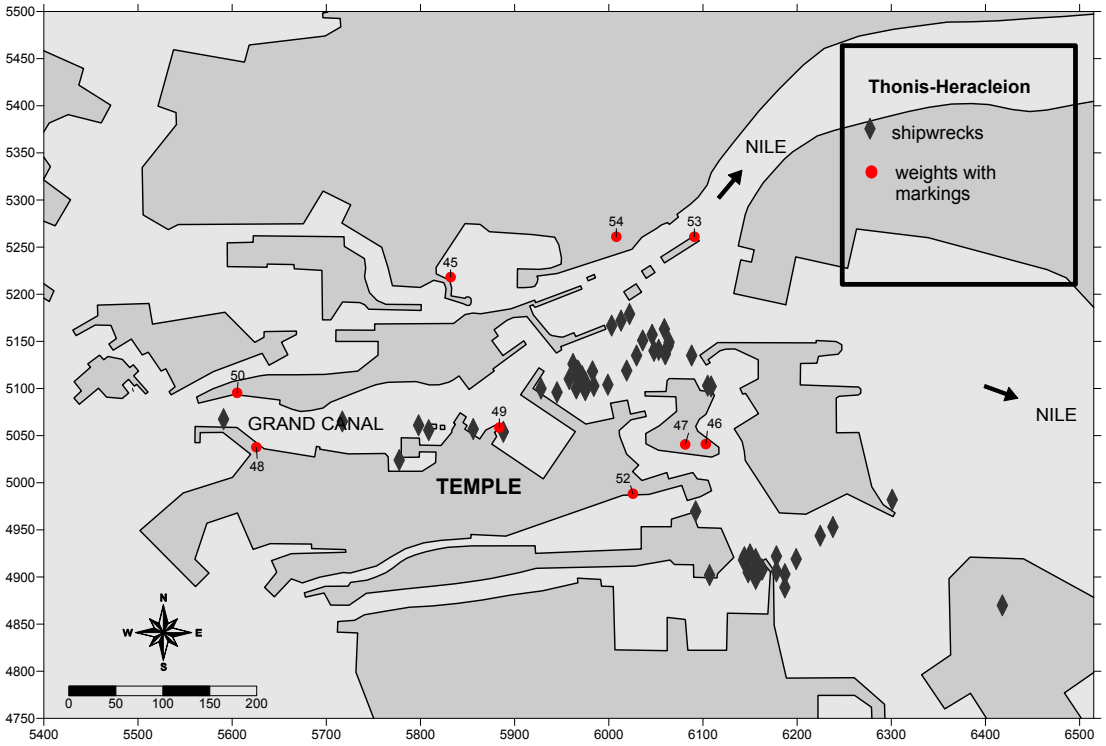


Figure 4.6 Distribution map of weights with markings, ©Franck Goddio/Hilti Foundation.

system, dated from the beginning of the 4th century BC until the beginning of the 3rd century BC.

Using the modified dating of the Late Classical system, the weights on this standard belong to the fourth century BC, probably the last three quarters of it. At this time Athens was importing grain from the Black Sea and from Egypt.[642] The raising of the standard from 105 to 112 dr/m could be explained by it facilitating the conversion to the Kyzikene mina,[643] an important weight standard in the Black Sea region, tying into the grain trade.

The dating of the ceramic assemblage in the vicinity the clusters of weights (Figure 4.3 and Figure 4.4) corroborates this dating in broad terms. The ceramic evidence from the North passage contains material from the 5th and 4th centuries BC.[644] The concentration in the western part of the Grand Canal is also fairly mixed, with local coarse wares and imported fine wares dating from the 5th century BC to the early Ptolemaic Period.[645] The Grand Canal was a canal used for ritual activity rather

[642] Garnsey 1988: 151–2, 157, 161–2.

[643] The 112 dr/m standard is (nearly) identical to the Kyzikene standard, see Hitzl 1996: 110; and Kroll 2013.

[644] Area C, see Grataloup 2010: 153–4.

[645] Area E, see Grataloup 2010: 155.

than a place for market exchange: the ceramics are all fine wares, while amphorae are completely absent. Apart from the group in the Grand Canal there are two other clusters in the geographical distribution of the weights (Figure 4.1, Figure 4.3): one in the North passage around the islands, where there is evidence of cultic activity, and another towards the northwest of the site. The categories 'other inscribed weights', 'non-Athenian' and 'other inscribed weights' are predominantly found at the edge of water and land, or slightly inland (e.g. nos. **42–4**, **46–7**, **54**).

The presence of Athenian weights and Athenian-style weights in Egypt documents contact between Egypt and Athens. The majority of the weights discussed is on the Late Classical system of the Attic standard and may be dated to the 4th century BC. The trade network between Egypt and Athens, involving grain, but also faience, textiles, natron, papyrus, was well established by the 4th century BC at the latest. The weights may either reflect smaller transactions for private purposes, or their location in the ancient waterways is indicative of ritual activity. They are not suitable for transactions or taxations on the large scale that we may surmise took place at the site. They cannot be taken as direct evidence of trade activities.

The appearance of Athenian weights in Thonis-Heracleion is remarkable. The appearance of these weights elsewhere in the Aegean is predominantly local: Corinthian weights at Corinth, Athenian weights at Athens, where they were used in the local marketplace. The location of the Athenian weights in the ancient waterways, in areas associated with ritual activity instead of an area associated with exchange, may offer an explanation. Perhaps merchants carrying sets of weights dedicated item(s) necessary in their trade as a token of thanks for a safe voyage.

The analysis of the lead weights with symbols and markings serves as an anchor for the discussion of the remaining uninscribed square lead weights. The shape and material of these weights closely mirrors the weights with symbols and inscriptions and consequently the analysis uses the Attic weight system established for these weights as the point of departure. The absence of any markings will always leave room for other interpretations regarding attribution to weight standards, and the preceding discussion has demonstrated the difficulty in ascertaining the weight standard in each individual case. It is highly likely that some of the weights are on other weight systems that the Athenian/Attic system. Similar weights are found around the Mediterranean and it is

assumed that they are the equivalent in weight of coins, such as the Attic drachma or later an Islamic dirham.[646] For the interpretation of the following weights the strong possibility of weight standards other than the Attic should be borne in mind. For some of the weights two (or more) suggestions are given without reaching a definitive conclusion.

4.3.1.5. Aegean-style, uninscribed weights

There are 92 remaining Aegean-style weights. As they are more informative as a group than individually, they are discussed in three parts: weights larger than 100g, ones weighing between 50–100g, and those lighter than 50g. All lack any markings or symbols. Weights nos. **55–80** all weigh more than 100g, and are 28% of the total corpus of weights. Their mass falls within the range of the smallest fractions of the market weight system. Some weights are good fits with the suggested fraction/multiple; others (e.g. nos. **55**, **62**, **66**, **68–70, 76**) deviate significantly from their suggested denomination on the Attic standard.

This selection may be split into three further groups: 12 weights on the 112 dr/m Late Classical standard, 8 weights on the later Hellenistic standard of 138 dr/m, and several that are closer to a multiple of a drachma as opposed to a fraction of a mina.

The analysis of the epigraphic weights above shows that both securely identified and well-preserved weights indicate a high level of accuracy in terms of determining the mass of the object. Consequently, a deviation larger than one or two percent from the suspected fraction or multiple must be attributed to the state of preservation of the object. In such a case, the absence of symbols and markings makes it harder to identify the intended weight and to quantify the wear and tear, which can then be used to see whether both suggestions work together. Table 4.8 lists the weights with their mass and the closest fraction on the Attic weight system. Of the 26 weights, most fall within a range of 10% deviation for the suggested fraction.[647] The combination of the shape, the other weights with markings, the fit of the weights within the Attic system, and the material strongly suggests that the Attic weight system was employed for these weights.

[646] For a number of these small weights in a catalogue, see Tekın and Merzeci 2012.
[647] Hitzl 1996: 47; Lang and Crosby 1964: 17.

Cat. no.	Weight (g)		% deviation (no. of dr/mina)
55	504[648]	Weight? Mina?	+3.4 (112) / -16.0 (138)
56	464.7	Mina?	-4.6 (112)
57	456.6	Mina?	-6.2 (112)
58	383.1	Third of a stater?	-4.3 (138)
59	374.2	Third of a stater?	-6.5 (138)
60	373.2	Third of a stater?	-6.7 (138)
61	273.4	Quarter of a stater?	+12.2 (112) -8.9 (138)
62	265.9	Quarter of a stater?	+9.2 (112) -11.4 (138)
63	223.1	Quarter of a stater?	-8.4 (112)
64	219.3	Quarter of a stater? 50 dr	-10.0 (112) +0.8
65	217.0	Quarter of a stater? 50 dr	-10.9 (112) -0.2
66	213.5	Quarter of a stater? 50 dr	-12.4 (112) -1.8
67	185.7	Sixth of a stater?	-7.2 (138)
68	179.0	Sixth of a stater?	-10.5 (138)
69	176.5	Sixth of a stater? 40 dr	+8.7 (112) / -11.8 (138) +1.4
70	170.9	Sixth of a stater? 40 dr	+5.2 (112) / -14.6 (138) -1.8
71	165.3	Sixth of a stater?	+1.8 (112)
72	163.3	Sixth of a stater?	+0.6 (112)
73	117.7	Eighth of a stater?	-3.4 (112)
74	110.4	Eighth of a stater?	-9.4 (112)
75	110.0	Eighth of a stater?	-9.7 (112)
76 (bronze)	107.2	Eighth of a stater? Sixth of a mina?	-12.0 (112) +7.1 (138)
77	103.7	Eighth of a stater? Sixth of a mina? 1 gold stater=24 dr	-14.7 (112) +3.6 (138) -0.7
78	103.5	Sixth of a mina? 1 gold stater? 24 dr	+3.3 (138) -0.9
79	103.4	Sixth of a mina? 1 gold stater? 24 dr	+3.3 (138) -1.0
80	100.7	Sixth of a mina? 1 gold stater? 24 dr	+0.6 (138) -3.5

Table 4.8 Uninscribed weights 100g and heavier

[648] Weights above 500g are weighed on an normal kitchen scale to an accuracy of 1g.

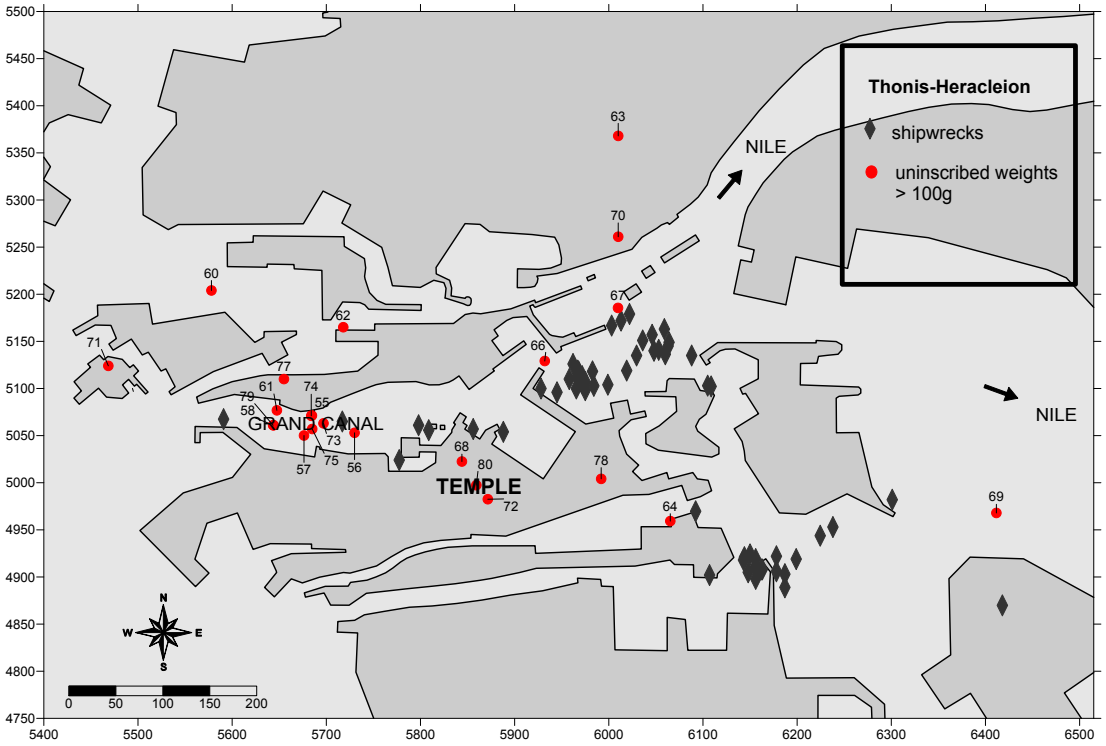


Figure 4.7 Distribution map of uninscribed weights, 100g or heavier ©Franck Goddio/Hilti Foundation.

The geographical distribution (Figure 4.7) of the uninscribed weights larger than 100g shows one large group in the western part of the Grand Canal in the vicinity of the Athenian and likely Athenian weights (Figure 4.3). Three weights (nos. **68**, **72**, **80**) were found in the temple area, two more (nos. **64** and **78**) around the harbour south of the temple. All other weights are dotted around the site in isolation from one another, mainly on land or at the edge of water and land. Two exceptions (nos. **60** and **69**) had an underwater location, with another (no. **67**) near shipwrecks and harbour infrastructure. The concentration of weights in the western part of the Grand Canal is remarkable, especially in contrast with the following group.

Weights nos. 81–91

There are 11 weights between 50–100g, which are listed in Table 4.9. They are the lighter fractions on the mina standard, 4 one-sixths (nos. **81–4**) and 7 one-eighths of a mina (nos. **82–91**). With two exceptions at 9%, all weights fall within a 5% deviation range of the suggested fraction based on the Attic weight standard. This narrow range of deviation, if the identification is correct, is another argument for the 112 dr/m standard, because the weights are too heavy for the 110 dr/m standard. Most of the weights in this group are on the 112 dr/m Late Classical standard dated to the

4th century BC. Only two weights may potentially be on the later 138 dr/m Hellenistic standard (nos. **84–85**).

Cat. nos.	Weight (g)		% deviation (no. of dr/mina)
81	82.7	Sixth of a mina?	+1.8 (112)
82	81.1	Sixth of a mina?	-0.1 (112)
83	79.2	Sixth of a mina?	-2.5 (112)
84	76.7	Sixth of a mina? Eighth of a mina?	-5.5 (112) +2.3 (138)
85	75.2	Eighth of a mina?	+0.3 (138)
86	74.5	Eighth of a mina?	-0.7 (138)
87	62.5	Eighth of a mina?	+2.6 (112)
88	62.3	Eighth of a mina?	+2.3 (112)
89	59.1	Eighth of a mina?	-3.0 (112)
90	54.6	Eighth of a mina? 15 dr of 3.6g	-10.3 (112) +1.1
91	54.5	Eighth of a mina? 15 dr of 3.6g	-10.5 (112) +0.9

Table 4.9 Weights 100–50g

The geographical distribution (Figure 4.8) of this small group of weights is different to the previous and following distributions. The groups were chosen purely according to their mass, and it seems unlikely that this different distribution is meaningful. The main group of 7 weights (nos. **82**, **83**, **84**, **85**, **87**, **89**, **90**) is either in the water or near the bank of the North passage. In the southeast there is one isolated weight (no. **86**), in an area where two more weights lighter than 50g were found (no. **108**, and further away no. **102**).

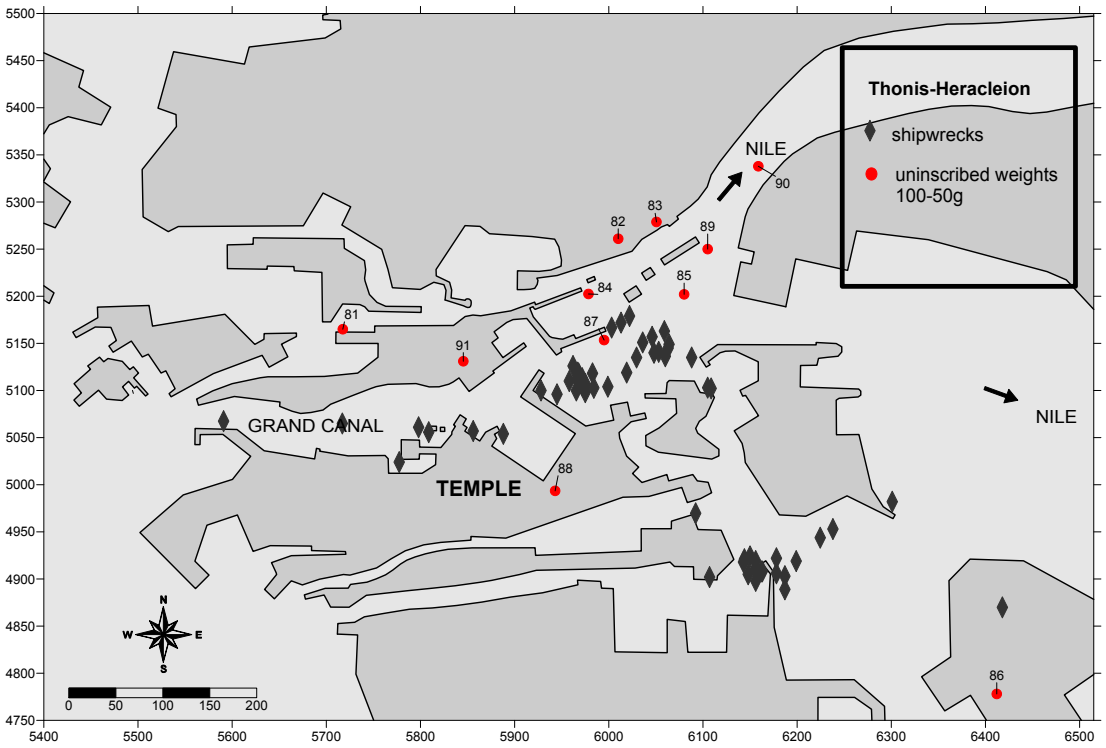


Figure 4.8 Distribution map of uninscribed weights, between 100-51g, ©Franck Goddio/Hilti Foundation.

Weights nos. 92–146

The last group is the largest and contains 54 weights under 50g (Table 4.10).[649] These weights are lighter than any fraction on the Attic weight system, i.e. an eighth of a mina or 60.03g on the Late Classical standard. Nonetheless, their shape and material points to a similar Aegean context. The dominance of weights lighter than 25g in this group suggests that the significant unit of these weights is light. For other similar small weights, the Attic drachma has been seen as a likely candidate.[650] In view of the connection with Athens established in the group of inscribed weights, the Attic drachma is used as the unit of choice for interpreting the weights in this group. For some, an alternative 3.6g drachma is proposed, which is the Ptolemaic drachma.

[649] This pattern of a predominance of lighter weights is more pronounced in the collection of lead weights in the Petrie Museum. Of the 153 weights there, only 18 examples are larger than 50g. Thus, the surprising feature of Thonis-Heracleion is perhaps the proportionally large number of heavier weights, rather than the occurrence of the smaller ones.

[650] Hultsch 1882: 142–4 §12; Pernice 1894: 27, 45–7.

Cat. nos.	Weight (g)	Multiple of Attic drachma (4.35g)	Deviation (%)
92	49.2	12 dr?	–6.3
93	47.2	11 dr?	–1.4
94	40.3	10 dr?	–7.4
95	40.1	10 dr?	–7.8
96	33.7	8 dr	–3.2
97	24.6	6 dr	–5.7
98	24.2	6 dr	–7.3
99	24.1	6 dr	–7.7
100	23.5	6 dr	–10.0
101	23.3	6 dr	–10.7
102	22.7	6 or 5 dr	–13.0/+4.4
103	22.7	6 or 5 dr	–13.0/+4.4
104	22.7	6 or 5 dr	–13.0/+4.4
105	21.5	5 dr	–1.1
106	20.3	5 dr	–6.7
107	20.0	5 dr	–8.0
108	18.5	5 or 4 dr?	–14.9/+6.3
109	17.0	4 dr?	–2.3
110	16.5	4 dr?	–5.2
111	13.9	4 dr of 3.6g	–3.5
112	13.6	4 dr of 3.6g	–5.6
113	13.3	3 dr?	+1.9
114	13.2	3 dr?	+1.1
115	12.0	3 dr?	–8.0
116	11.9	3 dr?	–8.8
117	10.5	3 dr of 3.6g?	–2.8
118	9.0	2 dr?	+3.4
119	8.2	2 dr? 1 shekel (8.43g)?	–5.7/–2.7
120	7.9	?	
121	7.7	?	
122	7.3	2 dr of 3.6g	+1.4
123	7.3	2 dr of 3.6g	+1.4
124	7.2	2 dr of 3.6g	0
125	7.0	2 dr of 3.6g	–2.8
126	6.2	?	
127	6.0	?	
128	5.0	?	

Cat. nos.	Weight (g)	Multiple of Attic drachma (4.35g)	Deviation (%)
129	4.3	1 dr	–1.1
130	4.2	1 dr	–3.4
131	4.0	1 dr	–7.0
132	3.9	1 dr of 3.6g	+8.3
133	3.9	1 dr of 3.6g	+8.3
134	3.6	1 dr of 3.6g	0
135	3.5	1 dr of 3.6g	–2.8
136	3.5	1 dr of 3.6g	–2.8
137	3.5	1 dr of 3.6g	–2.8
138	3.3	1 dr of 3.6g	–8.3
139	2.9	?	
140	1.9	½ dr of 3.6g	+5.6
141	1.7	½ dr of 3.6g	–5.6
142	1.7	½ dr of 3.6g	–5.6
143	1.7	½ dr of 3.6g	–5.6
144	1.7	½ dr of 3.6g	–5.6
145	1.6	½ dr of 3.6g	–11.1
146	1.0	?	

Table 4.10 Weights 50–0g

This large group of small (and light) weights was spread across the site. The surprising feature is the large number of weights from the area in and around the temple (Figure 4.9). There is a group in the north of the temple island, in the area identified as either a platform or another temple, another in the central part of the temple, as well as on the southwestern periphery near the harbour on the south (nos. **97**, **99**, **109**, **135–7**, as well as nos. **104** and **127**). In the north there are two (nos. **107**, **112**) in an area where an older temple or sanctuary stood.[651] If one narrows the selection of weights down further by mapping just those under 25g, the concentration on the main temple area is even more evident.

Although Pernice includes a large number of lighter weights, as does Petrie, and other publications contain small numbers, they do not feature in metrological

[651] H15/G1, see Goddio 2007: 74 fig. 3.6, 75.

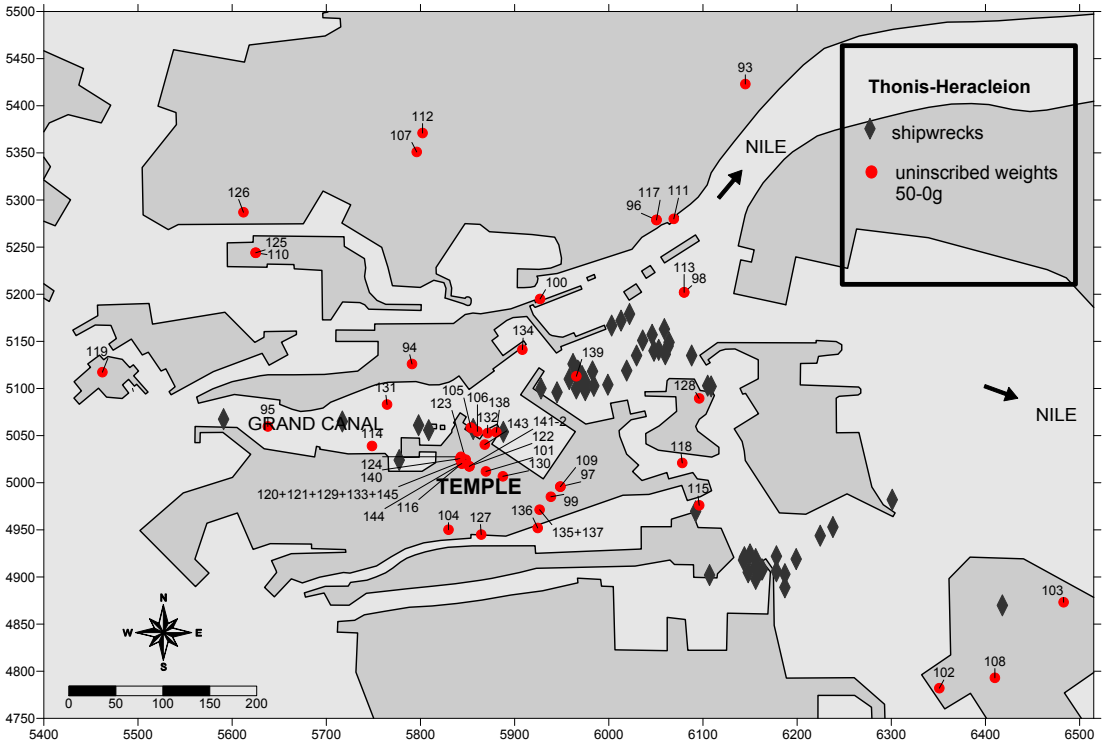


Figure 4.9 Distribution map of uninscribed weights, between 50-1g, ©Franck Goddio/Hilti Foundation.

analyses.[652] Petrie, for example, mentions 'small square leaden weights' of small denominations, but is hesitant to use them for analysis due to a fear that they may be too inaccurate through the original 'balance error', as well as post-depositional corrosion to the metal, to be reliable for analysis.[653] As a result a discussion of these weights is largely absent, sometimes leading scholars erroneously to assume light weights are entirely absent in the archaeological record.[654]

The presence of the small weights in the temple raises two points: firstly, it indicates a tentative dating to the late 4th century to the first half of the 2nd century BC in connection with the use of the temple, and subsequently may be interpreted a *terminus ante quem* for the building of the temple. Secondly, the location on land and near the temple as opposed to an underwater deposition may suggest a different role compared to the previous (groups of) weights.

[652] Pernice 1894: 45–7, 144–64, nos. 420–595; Petrie 1926: 23–4, pl. xliii–xliv; and limited numbers elsewhere, see Iliffe 1936: 68 no. 16 (7x), pl. XXXIV; Robinson 1941: 466–8 nos. 2445–8, pl. CXLVIII, nos. 2457–9, pl. CXLIX; Lang and Crosby 1964: BW 6 and BW 7, LW 58–60; see Hitzl 1992: 254–5; Hitzl 1996: 119; Weiß 1997: 154 nos. 3–4; Tekın and Merzeci 2012: nos. 9–35.

[653] Petrie 1926: 22.

[654] For remarks on the small weights and accuracy, see Bresson 2000: 215 n. 26.

4.3.2. Why weights in the temple?

There is a discrepancy between the distribution pattern of the (potentially) Athenian weights, the other inscribed and uninscribed weights, which are predominantly found in the waterways, and the lighter — less than 100g — weights without any markings found on land with a concentration in the temple area. The distribution of the Athenian weights in the waterways is probably associated with the cultic activity deduced from other objects such as ladles found there (Figure 4.1 and Figure 2.3).

The concentration of the lighter uninscribed weights in the temple area, on the other hand, raises several questions. How were these particular weights used — to weigh coins or as weights to facilitate transactions in daily retail trade/low-level market exchange?[655] And why were these weights found on land, particularly in the area of the temple of Amun at Thonis-Heracleion? The questions, how were these weights used and the connection with coins and transactions, lead to the use of coinage and bullion in Egypt, particularly since the square lead weights have been interpreted as multiples of the Attic drachma.

4.3.2.1. Nature of commercial exchange in Egypt

In Egypt, the nature of commercial exchange developed from a pre-monetary economy into fully a monetized one at the end of the first millennium, when the Ptolemaic kings started minting coins. This increasing use of coinage was relatively late to arrive in Egypt and the Levant compared to elsewhere around the Eastern Mediterranean. For the early first millennium BC, Sherratt and Sherratt argue that the increased commercial activity around the Mediterranean and the disappearance of central ruling powers had a number of effects. One of these was the growing importance of standardisation in transactions.[656] Until then, exchange in Egypt took the form of barter, although this had been abstracted by the New Kingdom to the point where the goods were valued to the deben, that is a standard measure expressed in

[655] In a study on silver fractional coinage, Kim addresses the role and scope of low-value coinage in the Greek economy, pushing the dating of its appearance back to close to the appearance of large(r) denomination coins. For a summary of the importance of low-value coinage, see Kim 1994: 4–6.

[656] Sherratt and Sherratt 1993: 363.

copper, acting as a proto-currency.[657] The evidence from Egypt regarding international trade with the Mediterranean during the Third Intermediate Period and the following Kushite dynasty is scanty. The growth in commercial activity and the movement of soldiers during the late 7th (perhaps) and 6th centuries BC necessitated the increased stock of silver bullion in numerous places in the Mediterranean,[658] and it has been argued that the first appearance of silver bullion and coinage in Egypt is associated both with the large numbers of foreign mercenaries in the Egyptian army and the increase in trade with the Aegean.[659]

Archaeological evidence for this development is preserved in the form of a small number of hoards containing only silver bullion without any coins. Thus, it seems that bullion pre-dates the introduction of coinage in Egypt in the last quarter of the sixth century BC.[660] The first hoards found in Egypt with coins — containing mainly Attic tetradrachms — may be dated to around 500 BC at the earliest, most of them being slightly later.[661] The first minting of silver coins *in* Egypt, in the form of imitation Athenian tetradrachms, seems to have started in the fourth century BC:[662] tetradrachms struck with the name of Artaxerxes (III) in demotic, and a series of coins with the names of Persian satraps Sabakes and Mazakes in Aramaic.[663] The impact of these developments is still debated.[664]

The traditional view is that the use of coinage as a means of exchange was very restricted in Egypt,[665] and it seems that throughout the Late Period transactions were

[657] This is the final stage of exchange before the introduction of coinage: the weighed metal value should be considered as a proto-currency, see Carradice and Price 1988: 20–2. The stages are also described for central Italy by Nijboer 1998: 62–3.

[658] Sherratt and Sherratt 1993: 363.

[659] Muhs 2005: 4. For the appearance of silver bullion in the 6th century BC, see Kroll 2001: 14–5; for Greece, see Kroll 2008b; Manning 2010: 131–2.

[660] Kroll 2001: 3.

[661] Kroll 2001: 4–7.

[662] For the coin hoards, see Nicolet-Pierre 2005: 8–9; for the minting, see Kroll 2001: 10.

[663] For an overview with references, see Nicolet-Pierre 2005: 11–4.

[664] E.g. Müller-Wollermann 2007.

[665] O'Rourke 2001: 288; for an opposing view see Müller-Wollermann 2007.

conducted by means of weighing goods against bullion (see below).[666] In the Greek world by contrast, where the coins were struck *en masse* and the development of coinage originated, it is clear that coins were taken at face value.[667] Thus, it is questionable whether small-scale transactions were carried out in coinage in Egypt.[668] If small-scale transactions were *not* carried out in coinage, goods must have been weighed or valued by other means. The location of the small weights in the temple area is interesting in this respect. The temple as an economic institution would have played a role in regulating transactions and collecting taxes, by checking the weights (and bullion?) in circulation for accuracy to ensure and assure traders a fair trade environment.

An important argument against transactions using coinage, and an illustration of the interest of Egyptian temples in regulating transactions is demonstrated in numerous demotic legal documents mentioning the 'silver of the treasury of Harsaphes', the Egyptian god Heryshef, occurring first in the 22nd dynasty[669] to that of 'the city', that is Amun in Thebes, and 'Ptah', into the 4th century BC.[670] The expression itself has been taken to indicate either a certification of the quality of the silver involved,[671] conceived as an ingot with a stamp of the temple as authentication,[672] or a certification of its

[666] Excavations in the priests' quarters from the Late Period in Karnak, for example, yielded many pieces of silver bullion, many with cuts, indicating that payments could be made using silver bullion, A. Masson personal communication; in general, see Kroll 2001: 11–4.

[667] This seem to be the case for small fractional coinage too, where even small deviations would have been significant, see Kim 1994: 75–6; and for the sensitivity of the balances to 0.1g, see Kim 1994: 79.

[668] Manning 2010: 136–7.

[669] P. Berlin 3048, see Möller 1921.

[670] The most extensive and well–referenced discussion of the expression and its implications is Vleeming 1991: 87–9 n. uu; for translation of a number of early demotic documents containing the expression, see Malinine and Pirenne 1950: docs 15, 16 (Harsaphes, yr 30 and 45 of Psamtik I), 19 (Ptah, yr 20 Darius), 29 (Harsaphes, yr 16 of Taharqa), 32, 33 (Ptah, yr 29 and X of Darius I), 34 (Harsaphes, yr 10 Shabaka), 35 (Harsaphes, yr 3 of Taharqa), 36 (Harsaphes, yr 32 of Psamtik I), 37 (Ptah, yr 5 of Darius).

[671] Müller-Wollermann 2007.

[672] E.g. Préaux 1939: 273–4. Manning interprets this phrase to mean that the treasury of Ptah was the guarantor of 'a silver bullion standard' during the Persian period, see Manning 2010: 131. He refers to two other examples of the formula mentioning "pieces of refined silver" in contracts from the reign of Darius (I) and Nektanebo I respectively, see Martin 1999: 197, n. i; referring to the same demotic documents, Vleeming thinks the phrase "pieces of refined silver" refers to weights, see Vleeming 1991: 89 n. 80, 81, 82, 87–90.

weight.[673] Vleeming discusses this expression with references to (abnormal) hieratic and early demotic documents with a philological commentary.[674] He proposes a shift over time in the meaning of the phrase. In the earliest text, a high official connected to the royal treasury loans 5 deben of silver from the treasury of Harsaphes to be returned with interest (see above). This suggests weighed bullion, whereas later texts suggest measurement against official standard weights. This shift in phrasing may have been caused by the increasing presence of silver and copper mentioned above during the first millennium. Aramaic documents mention the phrase "stones of the king" and more rarely "stones of Ptah" as the unit for weighing silver.[675] A small number of weights with the inscription "of the treasury of Heliopolis" and "of the treasury of Re" has been found,[676] whereas there are no silver ingots preserved among the silver hoards from Egypt with an inscription or markings of similar meaning.[677] With this evidence it seems more likely that the temple served to verify and authenticate metal in circulation through measuring against the official unit stored in the temple from the 26th dynasty onwards.[678]

By the beginning of the 4th century BC demotic documents indicate that the Egyptian kite was equated to the coin stater.[679] The first mention of a Greek coin stater occurs in demotic documents from the Khargeh Oasis from 410 BC.[680] From the middle of the 4th century Vleeming suggests the phrasing of the expression 'silver of the treasury of NN' refers to coins.[681]

The temple of Amun in Thonis-Heracleion would have played an important role in the commercial dealings of the town, which would have included a customs and

[673] Vleeming 1991: 89.

[674] Vleeming 1991: 87–9; for an opposite view on the same material, see Müller-Wollermann 2007: 1353–5.

[675] Porten 1968: 63, n. 7 and 8 for attestations.

[676] Griffith 1892: 443–4; Griffith 1893: 308 no. 6a. The weight with the inscription "of the treasury of Re" is from Defenneh, see Petrie 1888a: pl. XLVII no. 118.

[677] As noted by Vleeming 1991: 88 n. 71.

[678] Vleeming 1991: 88; Müller-Wollermann stresses that both quality and quantity must have been checked, Müller-Wollermann 2007: 1353 n. 12.

[679] The first mention of a stater is in 410 BC, see Chauveau 2000: 138–9, and n. 3–4, see doc. 1, and doc. 4 for the explicit *Ionian* stater.

[680] O. Man. 661, or document no. 1, see Chauveau 2000: 138–9.

[681] Vleeming 1991: 89 n. 83.

taxation role. The twin of the Naukratis stela found in Thonis-Heracleion from 378 BC illustrates the city's role as customs-office, but it deals with the distribution of collected taxes.[682] A single document from the period of the Persian Empire casts some light on the actual process of taxation.

4.3.2.2. Ahiqar scroll

In Elephantine an archive of Aramaic papyri was discovered from the Jewish garrison stationed there. One of the documents in the archive contained an erased customs register in Aramaic, published in 1993.[683] It dates to year 11 of an Achaemenid king, probably Xerxes according to the editor, which dates it to 475 BC,[684] or possibly his successor Artaxerxes I, which would move the date to 454 BC.[685] The text lists the entry and departure of 42 ships during the course of this year. Types of ships are distinguished, as well as their provenance: there are boats from Ionia, 36 in total, and presumably Sidon, since the cargo consists of wine from Sidon. The toponym *kzr* used in the Aramaic text might refer to a city in Judea.[686]

The papyrus, however, was reused and found in Elephantine, which is not the appropriate geographical location for ships inbound from Ionia and the Levantine coast. The Egyptian delta has been considered as the probable location of the customs office, and it is most likely to have been Thonis-Heracleion.[687] Thus, the papyrus is an important document for the present discussion for two reasons: it contains an account of the taxes taken from boats carrying goods in and out of Egypt, giving an unprecedented glimpse into the administration at the border of the Persian Empire. It is also contemporaneous to, and most likely to be located *in*, Thonis-Heracleion. The products imported and exported, as well as the exact taxation methods are not the primary interest here.[688] The interesting point about this document is the fact that the

[682] Von Bomhard 2012.

[683] Yardeni 1994; Porten and Yardeni 1993.

[684] Yardeni 1994: 68.

[685] Briant and Descat 1998: 60–2.

[686] Briant and Descat 1998: 62–4.

[687] Before the discovery of the city Briant and Descat already argued that the most likely original location for the customs office was 'Thonis', see Briant and Descat 1998: 91–5.

[688] Discussed in detail in Briant and Descat 1998: 69–81.

amounts are calculated and recorded in Greek stater and Persian weights and measures.[689] The term Greek (Ionian) stater is used in the text, similar to the use of the term in Demotic texts. Some scholars, on the other hand, believe that the term stater does not in this case refer to a specific coin, but expresses a Persian weight unit.[690]

Unfortunately, the small weights from Thonis-Heracleion are uninscribed and consequently do not help to resolve this issue of Greek or Persian weight standards. The Greek shape, their material, and tetradrachm impressions, however, justify favouring the Greek weight standard over the Persian one here. The small weights must represent transactions of high value, where accuracy was imperative. M. Cottier remarks that taxation rates in the customs document are not calculated in round numbers but contain additional small fractional units.[691] He suggests that the Ionian merchants paid these in coins, which were recorded as weight units and accepted as bullion. The small fractional units are supplementary taxes, an 'agio', to cover costs of weighing coins, checking fineness, and converting them to Persian weight standards.[692] In this scenario, the question of whether Greek coins or Persian weight standards were weighed is artificial, as the process of weighing would have been the same in practice.[693]

Weighing and qualifying of metals against an official standard unit is particularly important in societies that use metals as an expression of price.[694] The location of the

[689] For the amounts and conversion, see Naster 1970: 34–5; Porten 1968: 62–72; for the text with the amounts, see Yardeni 1994: 70–6.

[690] Cottier 2012; Briant and Descat 1998.

[691] Cottier 2012: 57–8.

[692] Cottier 2012: 58.

[693] Coin weights are a well–known phenomenon from the Byzantine, (early) Islamic and medieval periods, but the identification of a coin weight from antiquity would be a novelty. As opposed to market weights that are used to weigh goods, the purpose of coin weights is to control and check the gold, silver and bronze/copper coins in circulation. From the Byzantine and (early) Islamic periods for example, coin weights were made of glass. Miles describes them as "coin–like disks bearing inscriptions on one side and sometimes on both" (p. 79) in his publication of a large group of 700 early Islamic examples, see Miles 1964. For a brief mention of Byzantine glass coin weights, see Miles 1964: 78 (compiled from Petrie, Monneret de Villard, and Jungfleisch), indicating that they were used to weigh the solidus (4.55g), semis (2.27g), and tremissis (approx. 1.52g); for the Fatimid period, see Balog 1961. The weights reached a high level of accuracy, with a margin of usually only one or two hundredths of a gram, see Balog 1976: 22, 25–8.

[694] For Neo–Assyrian sources on the handling of precious metals, see Radner 1999: 134–7; the weighing happens with silver 'sealed with the seal' of a deity, i.e. sealed ingots, under the responsibility of a treasurer (p. 136–7). One

relatively small weights in the temple area of Thonis-Heracleion is illustrative of the interest of the state in accurate taxation practices and more generally, transactions that will not lead to discontent. The weight with the tetradrachm impression and the counterstamp of the ram's head **(no. 25)** is an important piece because the impression of the ram's head connects the drachma weight system with the temple. The presence of fractional units in the customs account that may indicate an agio on taxation is an attractive scenario for interpreting the small lead weights in the temple area. Other high value transactions that do not involve (international) taxation, e.g. trade in precious metals or spices, cannot be excluded. It is worth emphasizing that there may be a difference between the 'domestic' and 'international' markets. The Greek (/Persian) weight systems identified in the square lead weights and the documentary evidence from the Ahiqar scroll, illustrative of international connections, leave the role of the indigenous Egyptian weight system in Thonis-Heracleion for examination next.

4.3.3. Egyptian-style weights

Thonis-Heracleion also yielded Egyptian-style weights. The shape of these weights is the domed and cupcake shape typical for the Late Period, as Cour-Marty has shown.[695] And unlike the Aegean style weights discussed previously, the Egyptian weights are made in lead and bronze, with even two stone examples. As becomes clear in Table 4.11 and Table 4.12 there are a considerable number of weights where the identification of the metal is unclear as the colour and shine are inconclusive. The identification is on the basis of visual inspection only.[696]

The basic unit of the Egyptian style cupcake weights is the deben. In Table 4.2 the range for the deben is given as 8.8–9.8g, which is a wider range than the Attic drachma that was used to calculate both the market mina and the unit of the smaller lead weights. There are some damaged weights in the group of domed and cupcake-shaped weights, but the shape of the damage and the preserved mass of the weights usually allow for a reconstruction of the multiple/fraction. The deviation values are

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can also think of the Imperial standards of length on public display as a benchmark in Trafalgar Square, London, as part of the imperial units applied throughout the British Empire in the 19th century.

[695] Cour-Marty 1991: 54–5 fig. 26, forms 2 and 3.

[696] Establishing the chemical composition of a metal object through scientific testing

qualified with the deben unit mass (i.e. 91g, or 93g) based on which the deviation was calculated. I have chosen to be flexible in assigning a deben unit value within the broad band given in table 3.2 and not to opt for an average. The accuracy of the weights, therefore, is difficult to establish. For a restricted number an attempt was made to suggest a deviation. For the majority, however, this was unfeasible due to the uncertainty of the weight standard and the lightness of the weight.

There are 16 Egyptian cupcake weights (nos. **147–162**). The heaviest weights are made of stone, one from white quartzite (no. **147**), and one from pink granite (no. **148**).[697] They are exceptionally heavy at 46.5kg and 28kg. The majority of the metal cupcake weights are made of bronze and six have been provisionally identified as made of lead. They are much lighter, with eleven out of thirteen weighing less than 100g.

Cat. nos.	Weight (g)	Multiple/fraction	Deviation
147	46,500	500 deben (93g)	0% on 93g deben
148	28,000	300 deben	0.3% on 93g deben
149 (lead?)	1,840	20 deben	0% on 92g deben
150 (lead?)	372.9	4 deben	0.2% on 93g deben
151 (bronze or lead?)	119.9	1.3 deben – chunk missing	?
152 (lead?)	90.5	1 deben	–0.5% on 91g deben
153 (lead)	71.9	1 deben –Ptolemaic? or 8 kite?	
154 (lead?)	55.1	6 kite	
155 (bronze?)	39.8	5 (4.5) kite – chunk missing	
156 (bronze)	38.9	5 (4.2) kite – chunk missing	
157 (bronze)	38.4	4.1 kite – bits missing	
158 (bronze)	28.0	3 kite	
159 (bronze)	27.5	3 kite	
160 (lead?)	17.4	3 (2) kite – 30% missing?	
161 (bronze)	14.9	2 (1.5) kite – surface missing	
162 (bronze?)	12.6	1.5 (1.35) kite – surface missing	

Table 4.11 Egyptian-style cupcake weights

The distribution of the Egyptian-style cupcake weights is restricted to the northern parts of the site, stretching from the North passage to the north west in the general direction of the older temple (Figure 4.10). A group of these weights was found

[697] Ordinary, domestic-use scales were used for these two stone weights, as opposed to kitchen scales. Consequently, accuracy is limited to around 500g.

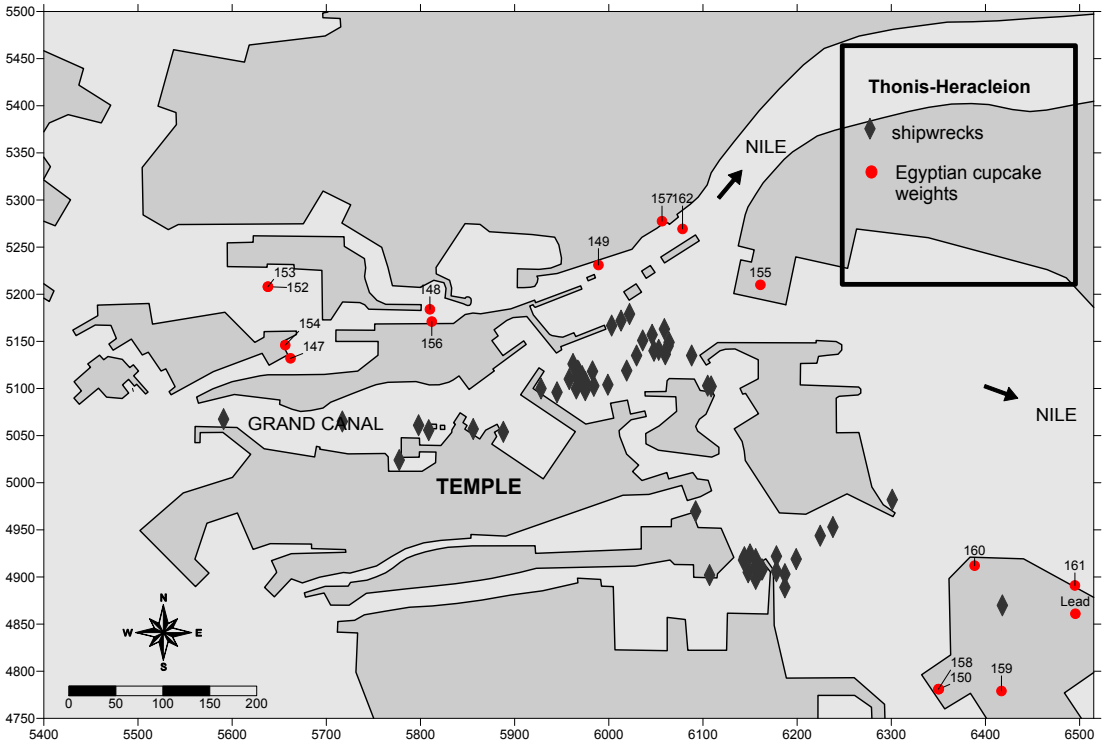


Figure 4.10 Distribution map of Egyptian cupcake weights VIII Egyptian cupcake, ©Franck Goddio/Hilti Foundation.

in the southeast of the site around where the silver ingots were found (see Section 3.1.4). The distribution in the north suggests that they may be earlier than the Greek-style weights discussed above. The lack of overlap in location is also remarkable, both with the Greek-style weights and with the Egyptian domed weights.

The following group of domed weights was initially included with the previous cupcake weights. The distinction is on the basis of shape: both are round weights in terms of their base, and rounded in profile. Weights with fully rounded profiles are termed 'domed' weights, those with a carination in their profile 'cupcake'. This seemed a superficial distinction, but the identification of the multiple/fraction was less straightforward for the domed weights than for the previous cupcake-shaped weights. The spatial distribution of the two groups of weights also showed distinct concentrations. Consequently they are treated separately.

Two differences between the two groups are notable. In contrast to the cupcake weights all domed weights are made of lead, with one possible exception. The weight division within the 21 weights in this group is different in comparison to the previous group. There are 10 domed weights weighing more than 100g. Especially in these heavier weights it has proven difficult to suggest a multiple (Table 4.12).

Cat. nos.	Weight (g)	Multiple/fraction	Deviation
163 (lead)	800	8.6 deben??	
164 (lead)	449.9	5 deben? 1 mina?	
165 (lead)	335.6	3.6 deben? 40 shekel (8.4g)?	
166 (lead)	313.8	3.4 deben? 36 shekel (8.7g)?	
167 (lead)	263.5	2.8 deben/30 shekel (8.7g)	
168 (lead)	228.7	2.5 deben/28 shekel (8.2g)	
169 (lead)	179.6	1.9 deben/20 shekel (8.7g)	
170 (lead)	171.1	1.8 deben/20 shekel (8.7g)	
171 (lead)	133.3	1.4 deben/16 shekel (8.3g)	
172 (lead)	131	1.4 deben/ 16 shekel (8.3g)	
173 (lead)	75.2	8 kite	
174 (lead)	73.9	8 kite	
175 (lead)	71.4	8 kite	
176 (bronze?)	67.8	7 kite	
177 (lead)	58.0	6 kite	
178 (lead?)	57.6	6 kite	
179 (lead)	46.5	5 kite	
180 (lead)	43.1	4.6 kite	
181 (lead)	39.04	4.2 kite	
182 (lead)	36.0	4 kite	
183 (lead)	27.0	3 kite	

Table 4.12 Egyptian-style domed weights

A Near Eastern weight standard is the obvious remaining option if the Egyptian weight standard gives less than satisfactory results. Similar weights with shekel signs were found in Defenneh and the Levant.[698] These shekel weights, together with the weights mentioned in the Aramaic archive in Elephantine, have demonstrated the presence of this Near Eastern weight standard (at 8.4g and 8.7g shekel). The attributions to both the shekel and the Egyptian deben for these weights are tentative, but the round numbers for the shekel multiples are persuasive results, suggesting that the Near Eastern shekel is also present in Thonis-Heracleion.

[698] For the weight from Defenneh, see Petrie 1888a: pl. XLVII no. 119; for further references on the shekel sign and its interpretation Scott 1964: 56 n. 12; see also section X (n. 67) above.

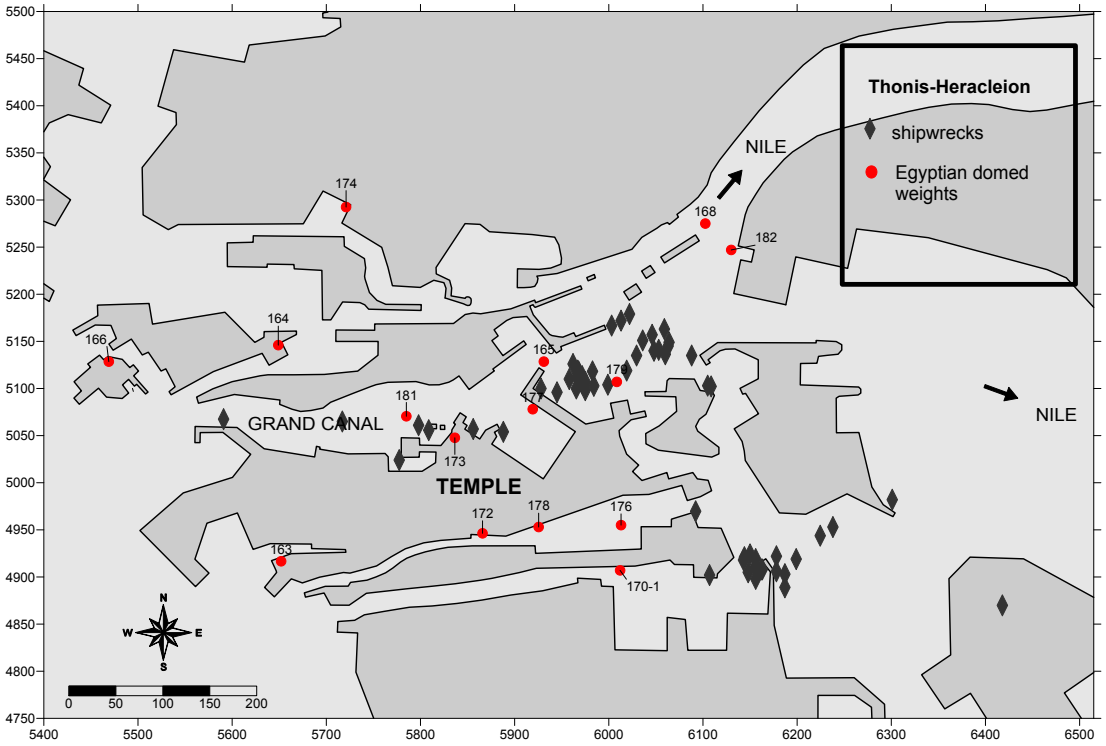


Figure 4.11 Distribution of Egyptian style domed weights, ©Franck Goddio/Hilti Foundation.

The domed weights are concentrated spatially around the temple island and the North passage (Figure 4.11). Most appear in the ancient waterways or at the edge of water and land. Only one (no. **181**) was found in the Grand Canal, all the others in harbour areas that had less ritual activity. Thus it is possible that this distribution pattern reflects more the processes of 'rubbish' and accidental loss than deliberate deposition.

4.4. Conclusions

This chapter is a study of all weights used for exchange identified until (and including) the 2010 season during prospection and excavations at Thonis-Heracleion. It is the first extensive analysis of a corpus of weights from a single site in Egypt. Previous catalogues of Egyptian weights deal mainly with museum collections. Petrie's lists from his excavations in the delta are a notable exception.

The corpus of lead weights from the site increases the number of lead weights known from Egypt significantly. The majority of lead weights are in a Greek shape. The symbols and markings on the weights, together with the current mass, allow a dating through cross-referencing with weights from other sites in the Aegean. Most of the

datable weights are on Greek weight standards that were used in the 4th and 3rd centuries BC. This pattern matches the general increase in activity at the site as the ceramics suggest. The first overview of the coins from Thonis-Heracleion indicates a similar pattern.[699]

The weights give a glimpse into activities at the site through their mass, the nature of their markings, and their location. The distribution of the corpus, with the majority of weights under 200g, does not point toward any involvement in the taxation of the large quantities or volumes of goods that must have entered and left the port. The two stone weights may be the two exceptions. In the shape of an Egyptian cupcake weight and weighing 27 and 45kg respectively, they are an anomaly in the corpus. Their location in the North of the site is as yet not directly related to known trade activities.

The lightness of the lead weights in general suggests a market location comparable to the corpus of weights found in the Athenian agora or from Olympus. The remarkable difference between the weights from Thonis-Heracleion and these Greek sites, however, is the fact that the majority of the weights from Thonis-Heracleion are on a non-Egyptian standard. The non-Egyptian weights are not spatially separate from the Egyptian weights. There are no isolated areas with just Greek or non-Greek weights, with one exception in the western part of the Grand Canal, where there is a concentration of Greek weights. After the groups of Greek and non-Greek weights are broken down into smaller groups, some patterns do emerge. The majority of the weights are found in the Grand Canal and the North Passage. A group of smaller and lighter weights are found in the temple area. The general scatter of weights around the site and the nature of the underwater excavations make it difficult to reconstruct the archaeological context for individual weights. For this reason, most have been discussed as groups based on inscriptions, mass, and shape.

Firstly, two processes may be considered to explain the location of most of the weights in Thonis-Heracleion in ancient waterways: deliberate deposition or rubbish disposal. The most persuasive argument for a deliberate deposition in the water instead of an (accidental) rubbish deposition is that weights with the Athenian symbols and letters (nos. **29–34**) were found near large concentrations of objects with a ritual use or connotation, such as ladles and lead votive barks. Some weights are in excellent

[699] Personal communication Andrew Meadows.

condition. These facts, combined with the absence of shipwrecks in the vicinity, make a strong argument for a deliberate deposition of weights. In this case, the Athenian weights may perhaps be interpreted as a votive during a ritual offered by a merchant after a safe voyage.

Secondly, one 'land' concentration stands out among the predominantly underwater contexts of the weights. Many smaller and lighter lead weights were found in the temple area. Weight no. **25**, with its ram's head counterstamp and the tetradrachm impression, clearly illustrates the economic role played by the temple (see above). The use of silver bullion was prevalent in Egypt until the Ptolemaic period and a hypothesis was advanced that the small weights found in the temple area played a role in the taxation process, perhaps as part of an agio payment, which was a small fee to cover the cost of the tax transaction. This would be a low amount and thus explain the smaller fractions appearing in the Aramaic customs account. In this hypothesis, this tax would have been paid to temple personnel, who would have weighed the payment, perhaps (partly) in coins supplied by foreign merchants.

The lead weights from Thonis-Heracleion enlarge the corpus of metal weights from Egypt significantly and they double the number of lead weights from Egypt. The weights with Athenian inscriptions — recovered from excavations, excluding those in museum collections for which it is difficult to prove provenance — were previously known only from Athens. The presence of these weights in Egypt is an important discovery in itself. After their original weight standard was established, the Athenian weights were dated to the (second half of the) 4th century BC. Their appearance in this Egyptian port city is highly likely to be related to the well-known trade relationship between Athens and Egypt.

Greeks were migrating from their homelands in the Aegean from the 9th and 8th centuries onwards, looking for new fertile areas to settle and found colonies and for trade. At a later stage, possibly as early as the 6th century BC, it became necessary to import grain into Greece from the Black Sea and Egypt. The inability of city-states to sustain their own population in the Aegean was an important development in the 6th century.[700] Although the chronology and the size of the grain imports are debated, it is beyond doubt that by the 4th century there were grain transports from Egypt to Athens.

[700] Sherratt and Sherratt 1993: 374.

Other Egyptian exports would have been papyrus and linen.[701] Papyrus especially grew abundantly in Egypt and was exported throughout the ancient world as the ancient equivalent for paper. In return it has been suggested that wine and olive oil where the most important products destined for import to Egypt.[702]

There is epigraphic evidence of an Egyptian presence in Athens. An inscription from 333/2 BC mentions a sanctuary for the worship of Isis in Piraeus founded there by Egyptians merchants.[703] In return, Athens was able to supply Egypt with silver that was sought after but not present in large quantities in Egypt.[704] To sum up, it is highly likely that Thonis-Heracleion played a role in the Greek-Egyptian (grain) trade because it is located so strategically at the mouth of the Nile and the Mediterranean coast. The weights discussed here are not directly related to this trade in bulk goods, but should be interpreted as an expression of the trade contact between the two.

The ratio between the Aegean and Egyptian weights at Thonis-Heracleion, as well as the large number of metal weights, is different from the pattern of weights recovered from Naukratis. The implication is that the roles of the two settlements differed. The comparison between the two corpora is an exciting future avenue of research, which will be greatly aided by a new study of the weights from Naukratis as part of the *Naukratis Project* at the British Museum.

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[701] Austin 1970: 35–6.

[702] Möller 2007: 364–5; Smolárikova 2001; Austin 1970: 36–7; these goods also appear in the Aramaic customs account, see Briant and Descat 1998: 69–73.

[703] Rhodes and Osborne 2003: no. 91, esp. p. 465.

[704] Milne describes the grain for silver pattern, although the article in general is outdated; see Milne 1939: 178–9. Although galena ores are present in the Eastern Desert (see **Chapter 1**), it is generally thought that most of the silver found is imported when its use increases in the New Kingdom, see Hill 2007: 23 n.2.

CHAPTER 5. LEAD CONTAINERS FROM THONIS-HERACLEION

This chapter explores the context of the lead containers from Thonis-Heracleion and their parallels across Egypt and the Mediterranean. Their large number and the scarcity of parallels make this group an interesting category within the lead assemblage at Thonis-Heracleion. This chapter opens up a new perspective on the use of lead for containers, which is both earlier and more diverse in character than previously thought. The lack of comparable vessels does not make for a straightforward analysis with regard to their date and function. Comparable ceramic and bronze containers from around the Mediterranean are useful to construct a framework for the dating and function, as well as other objects made of lead. The possibility that some of the lead containers were objects used primarily on ships is considered as well as (final) deposition of other groups in a ritual context. Ceramic evidence from the vicinity of the containers suggests a date range from approximately 450 BC to the end of the town around 150 BC. This is approximately 300 years earlier than any other large lead object in the Mediterranean, which has only yielded lead containers smaller than 16 cm.

5.1. Introduction

The assemblage of lead containers from Thonis-Heracleion is found in the ancient waterways and to a lesser degree on land (Figure 5.1). There are 131 containers and lids of containers in the catalogue. Other lead objects such as 1 situla, 7 ladles, and 14 lead oil lamps are not discussed (see Chapter 1). The distribution of the whole corpus shows a general scatter. Coherent groups within the corpus were identified on the basis of their shape, mapped, and subsequently evaluated. The catalogue is sorted according to size, the largest mentioned first, and the typology is based on shape and weight.

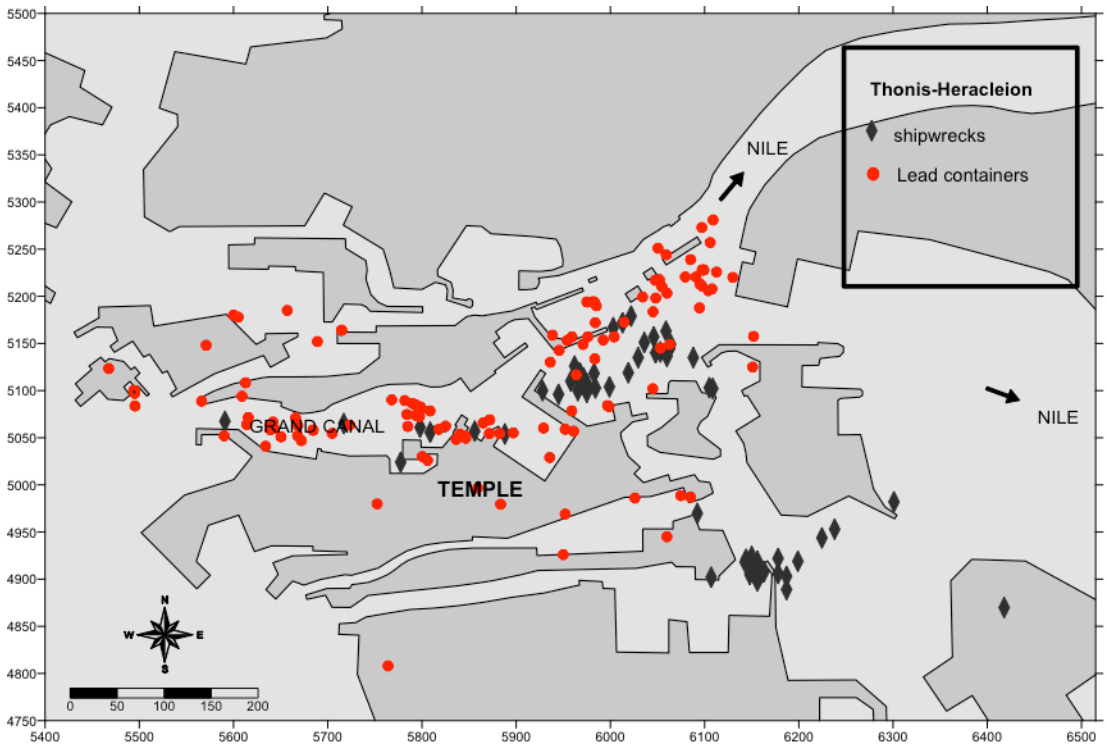


Figure 5.1 Distribution map of all lead containers in the catalogue, ©Franck Goddio/Hilti Foundation.

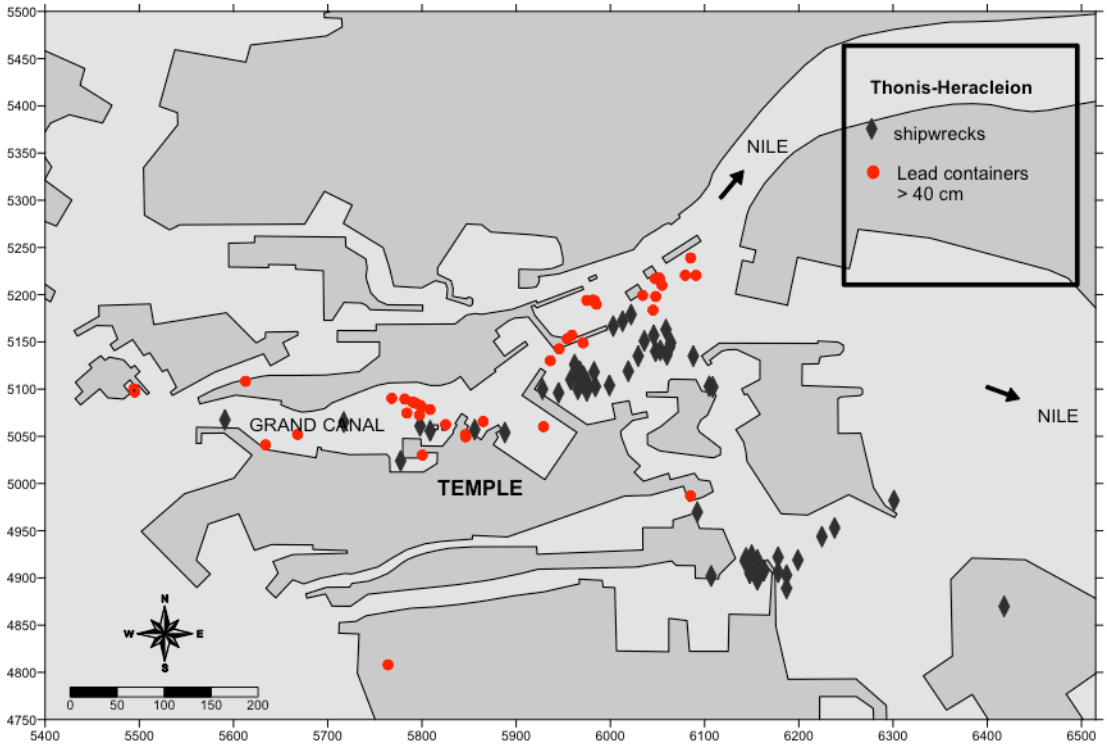


Figure 5.2 Distribution map of all containers larger than 40 cm in diameter, ©Franck Goddio/Hilti Foundation.

This chapter neither describes nor mentions all lead containers found at the site. A list of containers in underwater storage with recorded diameters *larger* than those studied on land precedes the catalogue. These containers were unavailable for study, as they remain *in situ* or were removed to a secure underwater area. They are an important sub-category in a discussion on the use and abundance of lead at Thonis-Heracleion, as well as larger than any other known in the ancient Mediterranean. Consequently they could not be left out of the analysis.

Underwater storage is used for several reasons. The most important is the limited storage space available in the Maritime Museum in Alexandria. The excavators also considered the conservation of the larger vessels as best served by preservation *in situ*. Thus, any vessel with a diameter larger than 40 cm, with one exception, is currently underwater (Figure 5.2). Objects without recorded measurements and without photographic record, for example the incomplete or fragmentary containers, are not included in the discussion or the catalogue.

It seems that the majority of the lead containers are of an open shape, such as bowls or buckets. At opposite ends of the spectrum there are exceptions. The description of the largest containers suggests they are all closed shapes. The image of one of the largest vessels, which remains *in situ* underwater,[705] is of a closed, bulbous shape (Figure 1.5). Among the smallest containers from the site are also closed shapes (see catalogue).

Overall, the size ranges from largest vessels of 75 cm in diameter or more (nos. **184–197**) to small vessels around 3 cm in diameter (Figure 5.3). The containers in the catalogue, including lids, all measure 40 cm and less and they may be divided into two groups. The majority are around 10 cm or smaller, and only 38 examples have larger diameters. A similar pattern is found with the preserved lids: of the 16 lids, only two are larger than 10 cm in diameter at 20 and 30 cm respectively (nos. **282–3**).

Closed shapes are also present among the miniature containers.[706] The miniature objects is a relatively small, coherent group and well known as votive objects, hence their exclusion from this chapter. Identical miniature objects are found elsewhere in

[705] Goddio 2007: 105, fig. 3.65.

[706] For parallels from the collection of the Greco-Roman Museum in Alexandria, see Boussac and Seif el-Din 2009.

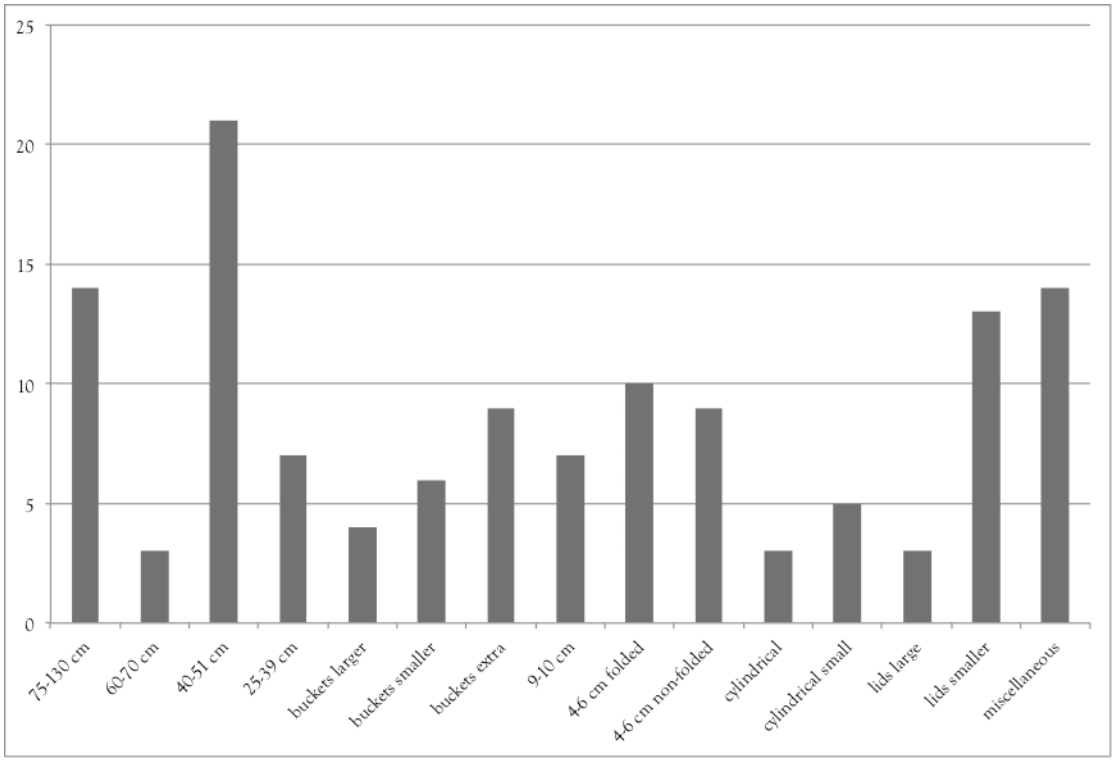


Figure 5.3 Distribution of containers by diameter.

Egypt and the Aegean, from tombs and temples.[707] Goddio notes that the lead containers are often found associated with deposits of other votive offerings.[708] Their contextual associations should, therefore, aid in establishing if there are significant concentrations of objects indicative of a particular use or deposition. The presence of lead barks in the water in proximity to lead containers, bronze mirrors, and ladles, for example, suggests a similar ritual context for some of the containers. Comparison to similarly shaped vessels may help in establishing in a container's original purpose or function.

Several factors complicated the establishment of a typology for the catalogue of lead containers. Due to the malleability of the lead, shape distortion occurs frequently during use or deposition/abandonment: in addition, some containers were deliberately folded in antiquity prior to deposition (see Section 5.3.7). This prevents the use of measurements as a straightforward variable in a typology.[709] It was possible to estimate the original maximum diameter of a number of these containers, but for others the

[707] Boussac and Seif el-Din 2009: 235–6, cat. nos 58–63.

[708] Goddio 2007: 126.

[709] For the use of the term 'variable' in typologies, see Adams and Adams 1991: 170.

diameter of the base of the vessel, i.e. probably not the maximum diameter, is the only available measurement. Comparison on the basis of diameter is far from straightforward, hence the broad ranges in the typology (Figure 5.3). If the vessel is complete, its weight is worth considering due to the inherent value of the metal. Containers that are the same shape but differ slightly in size may well contain the same amount of lead, differing in mass due to thicker walls. By mapping several groups of vessels while considering diameter size and weight, differences in distribution patterns and perhaps dating and function are revealed. A combination of these measurements and the weight of the vessel resulted in the division of objects into several categories in the catalogue. The structure of the analysis below follows the categories and subdivisions that were established.

A word of caution on the metal identification of the vessels is necessary. No scientific analyses were performed to verify the chemical composition of the artefacts; identification is based on visual inspection only. This means that it is impossible at present to be certain that these containers are indeed made of unalloyed lead, as is assumed here. Analysis of the chemical composition is planned as a future avenue of research. The first goal would be to check the chemical composition of the containers, and the second to see whether the composition varied according to the size of the intended vessel, considering the large difference between the biggest and the smallest containers.[710]

5.2. Lead containers – parallels

5.2.1. Egyptian parallels

Only a small number of lead containers from Egypt and a limited number from elsewhere around the Mediterranean have been published. Lead containers as a phenomenon appear first in the first millennium BC. Von Bissing described four lead containers in the Cairo Museum in his catalogue of metalware; the other 157 are of

[710] Analysis of a hoard of pewter vessels from Appleford (UK) indicates that there are three compositional categories with different ratios of tin, copper and lead chosen according to the size and shape of the intended vessel; see Pollard 1983.

bronze, silver, and iron.[711] There is a shallow bowl or plate from Qaw el-Kebir with a rounded base measuring 12.7 cm in diameter and 5.5 cm high.[712] The bowl is decorated with an incised concentric circle under the rim on the exterior and two concentric circles on the inside. Von Bissing suggested that the object was cast and then finished by turning on a wheel. The other lead containers are three smaller bowls or cups said to be from Saqqara.[713] The diameters are 12.0 cm, 15.5 cm, and 13.7 cm;[714] the height ranges from 7.5 to 11.0 cm. All containers are all described as squashed or crushed ("zerdrückt"), and one has holes.[715] The measurements are sufficiently close to suggest that they were similar in size and possibly in shape. Photographs, however, are not present for of the two containers, and the single published photograph of a container does not have enough depth of field to assess the degree of the squashing or crushing in order to compare it to the examples from Thonis-Heracleion. Von Bissing also commented on the thickness of the walls of the vessels and suggested that — although their crushed state makes it difficult to judge — they were shaped (driven), as opposed to cast. Bowl no. 3558 has a single hieroglyph incised in its exterior wall just under the rim.[716]

The three containers from Saqqara listed by Von Bissing are good parallels for those found at Thonis-Heracleion. They match with regard to their bowl shape and flat circular base, as well as their range of size. Von Bissing tentatively suggested a Late Period date for the Qaw el-Kebir example and a Greco-Roman date for the Saqqara examples, with question marks for all of the entries. The Greco-Roman dating is plausible for objects from Saqqara. Apart from the Old and New Kingdom necropoleis containing many secondary graves from the Late Period, that is pre-existing shafts and subterranean chambers that were reused for further (large numbers of) burials, there

[711] Von Bissing 1901: CG 3546, and CG 3556–8.

[712] Von Bissing 1901: 57 CG 3546 = JdE 30240.

[713] These three are listed as found in Saqqara in February 1861, see von Bissing 1901: 64 CG 3556–8; Nriagu 1983: 251–3.

[714] Von Bissing 1901: 64 CG 3556, photograph included, CG 3557, no photograph, CG 3558, no photograph, respectively.

[715] Von Bissing 1901: 64 CG 3558.

[716] Gardiner no. U6, det. for '*d*, to hack up; or phon. for *mr* as in *mrí* love or *mrḥt* unguent, see Gardiner 1957[3]: 516.

are large shaft tombs of the Persian period and the area is famous for the animal necropoleis in the north.[717] It is possible that the lead containers come from Saqqara, in view of its proximity to Cairo and the fact that in throughout the 19th century there was much interest in the antiquities in Saqqara.[718] The animal necropoleis at Saqqara are also contemporaneous with Thonis-Heracleion, with the earliest material is from the late 7th century[719] and activity throughout the Late and Ptolemaic Periods.[720]

Two of three lead containers found during modern excavations in the southern dependencies of the main temple complex have datable contexts. Block 4 contained one 'badly crushed' lead vessel and is part of a complex from the 30th dynasty.[721] The 'West Dump' also contained one lead vessel, which was lightly incised with two lotus flowers and a chequer pattern on the exterior. Documents in this dump date between the First Persian Period and the late 4th century BC.[722] One lead container, also crushed, was a surface find.[723]

In one of the halls of the Memphite palace of Apries, ruler of the 26th dynasty, Petrie found a large lead tank that was later removed to the Cairo Museum.[724] The floor of the hall sloped down to a drain in which the tank was fitted. It measured 73.7 cm by 87.4 cm, and 17.8 cm to 26.7 cm deep.[725] It is unclear if the drain was intended to catch rainfall, which would require the hall to be at least partially open to the sky, or for the collection of other liquids. Work areas of the palace, such as a room with

[717] E.g. Smith et al. 2006; Jeffreys and Smith 1988; Insley Green 1987; for (caches of) bronze statuettes found, see Davies 2007.

[718] Saqqara was known from early in the 19th century: already in the 1820s and 1830s reliefs with a provenance likely from Saqqara appeared in the collections of the Cairo and European museums, see Martin 1991: 9. Auguste Mariette identified the Serapeum in Saqqara in 1850, with further work and identification happening in the decades following this discovery, see Mariette 1882: 5-7; Malek 1983: 72. It is clear from successive maps published by different excavators, such as Mariette and De Morgan 40 years later, that much more clearance work was done in Saqqara. For discussions of these maps, see Jeffreys and Smith 1988: 1, 55–8.

[719] E.g. the inscribed situlae are well dated, see Insley Green 1987: 66–74 no. 163–76, 168–75, figs. 99–101, 103–6.

[720] Smith et al. 2006: 3–4.

[721] H. 8.4 cm, Martin 1981: 1, 33 no. 332.

[722] H. 7.9 cm, Ø (top) 14.2 cm, Ø (base) 9.5 cm, Martin 1981: 62–3, 64 no. 758.

[723] Ø (base) 10.0 cm, Martin 1981: 94 no. 1149.

[724] Petrie 1909a: 2, pl. XIII.

[725] Measurements converted from inches given in Petrie 1909a: 2.

fireplaces that is interpreted as a kitchen, are close to the room with the tank. A pipe drained the tank leading away presumably to the ditch surrounding the palace.[726] The appearance of lead in this setting as the lining of a tank shows a familiarity with the metal that is not borne out by the nature or the number of lead objects recovered from Egypt.

Apart from the seven lead containers there are no other examples from Egypt to my knowledge. One much later container dates to the 5th–7th centuries AD.[727] There are a number of references in Ptolemaic papyri to lead workers and lead vessels (see Section 2.2.2.8). This apparent paucity of lead vessels in Egypt is seen elsewhere in the Mediterranean, where numbers are even more limited before the 1st century AD.

5.2.2. Lead containers in the Mediterranean world

The earliest examples of lead containers are from 3rd millennium Mesopotamia. Lead vessels are known from the cemetery at Ur, which produced 38 metal objects made of lead.[728] Lead vessels in shapes known from ceramics were also found at Susa.[729] They are remarkable exceptions, as I know no other lead containers until the 1st millennium BC.

D. Robinson excavated Olynthus in the 1920s and 1930s, where, apart from a large number of bronze and iron objects, nearly a thousand objects made of lead were found.[730] Robinson associated this abundance with the presence of lead mines in the area. The town is contemporaneous with the settlement at Thonis-Heracleion: objects date to the 5th and 4th centuries BC until Philip II of Macedon destroyed the town in 348 BC. It is clear that the city was plundered.[731] The larger objects were removed, and

[726] Petrie 1909a: 2, pl. XIII.

[727] A round, shallow lead bowl excavated in 1913-14 in the Wadi Sarga Monastery, BM E73285, no. 1919,0505.794; 5th - 7th century AD; Ø 5.4 cm (max).

[728] For Mesopotamia, see Moorey 1994: 294–6; e.g. a lead tumbler in the British Museum from Woolley's excavations in Ur: Reg. no. 1935,0112.111, First Dynasty of Ur, 3000–2750 BC; H.: 5.5 inches W.: 4 inches; or a spouted pottery jar with foot pinched in with fingers and part of lead cover adhering, also from Woolley's excavations in Ur: BM no. 134625, Reg. no. 1935,0112.121, Early Dynastic III, 2500 BC; Ø 6.5 inches H. 11 inches

[729] Tallon 1987 i: 318; Tallon 1987 ii: 81-2 nos. 800–805, 284.

[730] Robinson 1941: ix.

[731] Cahill 2002: 48–52.

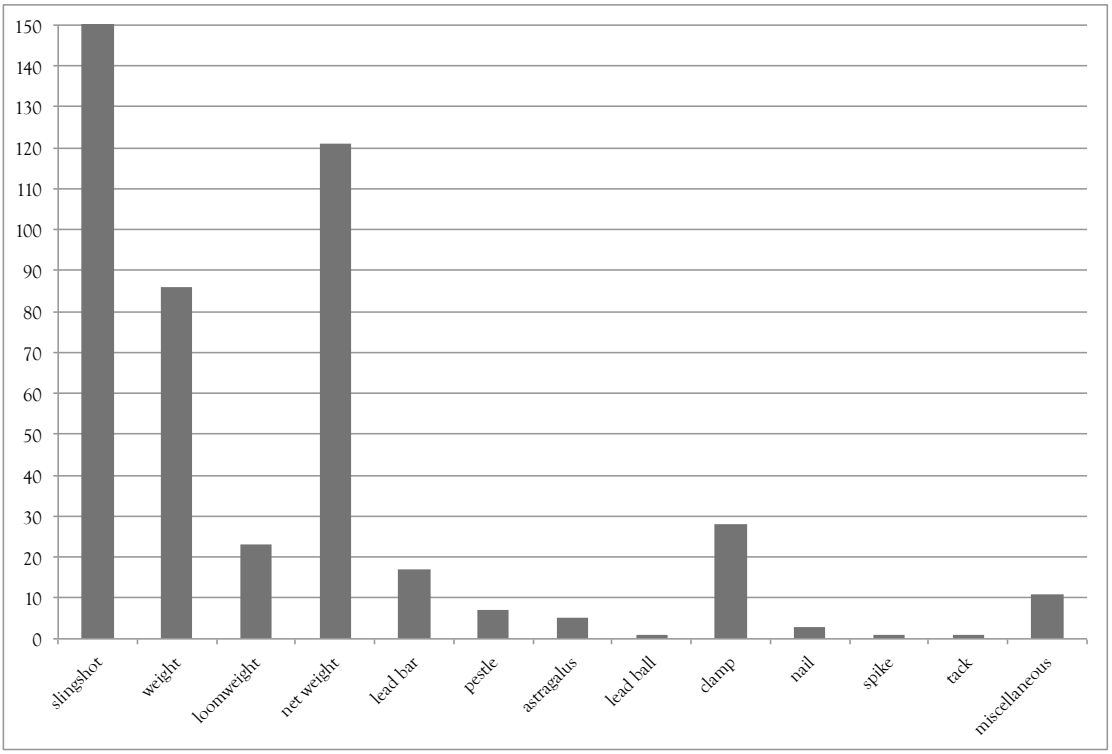


Figure 5.4 Distribution of lead objects per category in Olynthus.

the remaining metal finds are mainly fragments, but they include slingshots, weights, loomweights, clamps, dowels, vases, statuettes, discs, oil lamps, inscribed bars, pestles, sieves, dishes, *astragali*, stoppers, ornaments, many rivets, but only four containers or 'boxes'.[732] All four are of roughly similar shape and size, with diameters ranging between 3.8 cm and 7.2 cm. One (no. 592) has a lid. The provenance of two of these vessels is unknown. A third is from a grave 156 in the Riverside cemetery: this is the object listed from this grave.[733] The fourth vessel is from the South Hill, Section F. The sack of the town in 348 BC serves as a *terminus ante quem* for dating. The small number of lead containers, as well as other larger metal objects, is likely to be related to the looting, which left only small and insignificant examples for archaeologists to find (Figure 5.4).

A similar, round lead box, with a cover with a knob and a stand, was found in a tomb in Cassope, Epirus.[734] Hellenistic in date, it is now in the British Museum. These

[732] Robinson 1941: 189–90, nos. 589–92, pl. XLVI.

[733] Robinson 1941: 535.

[734] Reg. no. 1852,0902.1, Ø 5.7 cm.

five containers are the only ones identified so far from the Mediterranean world until the 1st century AD.

5.2.2.1. Hellenistic or Roman?

As lead containers are so rare, I searched for larger objects made of lead[735] in order to verify when objects of a significant size started to be made of lead and to compare and contrast the dating of the lead containers from Thonis-Heracleion (see Section 5.3). It quickly became clear that there was a gap between the dating of large lead objects from Thonis-Heracleion and lead objects of comparable size elsewhere.[736] This perceived gap is caused by a lack of precise terminology for the dates of larger lead objects.

Larger lead objects without a well-established context often receive a generic 'Roman' date. For millennia, artefacts in galena and lead-containing ores had been smaller than 10 cm in dimension and taken the form of statuettes, trinkets, and weights.[737] As the Romans certainly used and mined lead on an increased scale, there is an inclination to consider any lead object larger or different to the smaller statuettes and trinkets as 'Roman'. The increase in lead mining and resulting increase in lead particles in the atmosphere, the peak in shipwrecks during the 1st centuries BC and AD[738] (on which metal objects are better preserved than on land), and the use of lead in buildings reinforce this picture of lead being typically Roman. I do not argue that this picture is false, merely that there is a danger of circular reasoning — large lead objects must be Roman because they are always Roman — where the possibility that lead objects may be earlier can be forgotten.

The situation is not helped by the omission of specific dates in favour of a general terminology such as the description of lead as a 'very common and cheap metal' during the Hellenistic and Roman periods, implying analogous dates, for example by Galili

[735] 'Larger' here is taken to indicate containers and other utilitarian objects larger than the small lead boxes from Olynthus, measuring between 3.8 and 7.2 cm, see Robinson 1941: 189–90, nos. 589–92, pl. XLVI.

[736] Two early lead objects already discussed are exceptions: the tank in the palace of Apries and the lead ingot from the Porticello wreck (**chapter 2**).

[737] E.g. Nriagu 1983: 66–9; Tylecote 1991[2]: 7–8; for Egypt: Lucas and Harris 1962: 243–4; Krysko 1986; Ogden 2000: 168–9.

[738] A. Wilson 2011: 33–4.

and Sharvit in their discussion of braziers from Bodrum and Israel.[739] Parker, in his catalogue of wrecks in the Mediterranean,[740] interprets 'Roman' as between 150 BC and 400 AD, while M. Leonard, in her study of the braziers from Bodrum, labels the period from the end of the 2nd century to the middle of the 1st century BC as Hellenistic.[741] While it is true that the Roman domination commenced at different periods in different regions of the Mediterranean, such usage obscures a pan-Mediterranean comparison if the definition is not made explicit. For Egypt, labelling the entire period between 150 BC and 400 AD as 'Roman' is wrong. Here the terms Ptolemaic Period and Hellenistic Period are used interchangeably for the time of Ptolemaic rule from 305 BC until the Romans conquered Egypt in 30 BC.

5.2.2.2. 'Other' larger lead objects

To return to the lead braziers as larger objects made of lead, Galili and Sharvit described and discussed several of these braziers in an article, paying particular attention to the design and practicalities of using lead for this purpose.[742] Two lead braziers were found underwater near Bodrum together with 11 ceramic examples[743] and another 13 of the coast of Israel.[744] Presumably the braziers were either carried as cargo, in the case of the pristine Bodrum examples without traces of blackening and burning, or as functioning equipment for the kitchen on board ship, as with the some of the examples from the Israeli coast that bear such traces.[745] Galili and Sharvit refrain from dating these vessels more precisely, apart from mentioning that the decoration of their chimneys resembles that of lead coffins, for example one from Caesarea.[746]

This example shows that relatively large lead objects are not a Roman phenomenon *per se*. Leonard dates the Bodrum lead braziers to the Hellenistic Period, more specifically the end of the 2nd to the mid 1st century BC, on the basis of similar

[739] Galili and Sharvit 1999: 168, 170.

[740] Parker 1992: 8.

[741] Leonard 1973: 22, 24–5 nos. 9 and 10.

[742] Galili and Sharvit 1999.

[743] Leonard 1973.

[744] Galili and Sharvit 1999: 168.

[745] Galili and Sharvit 1999: 169.

[746] Galili and Sharvit 1999: 168, 170.

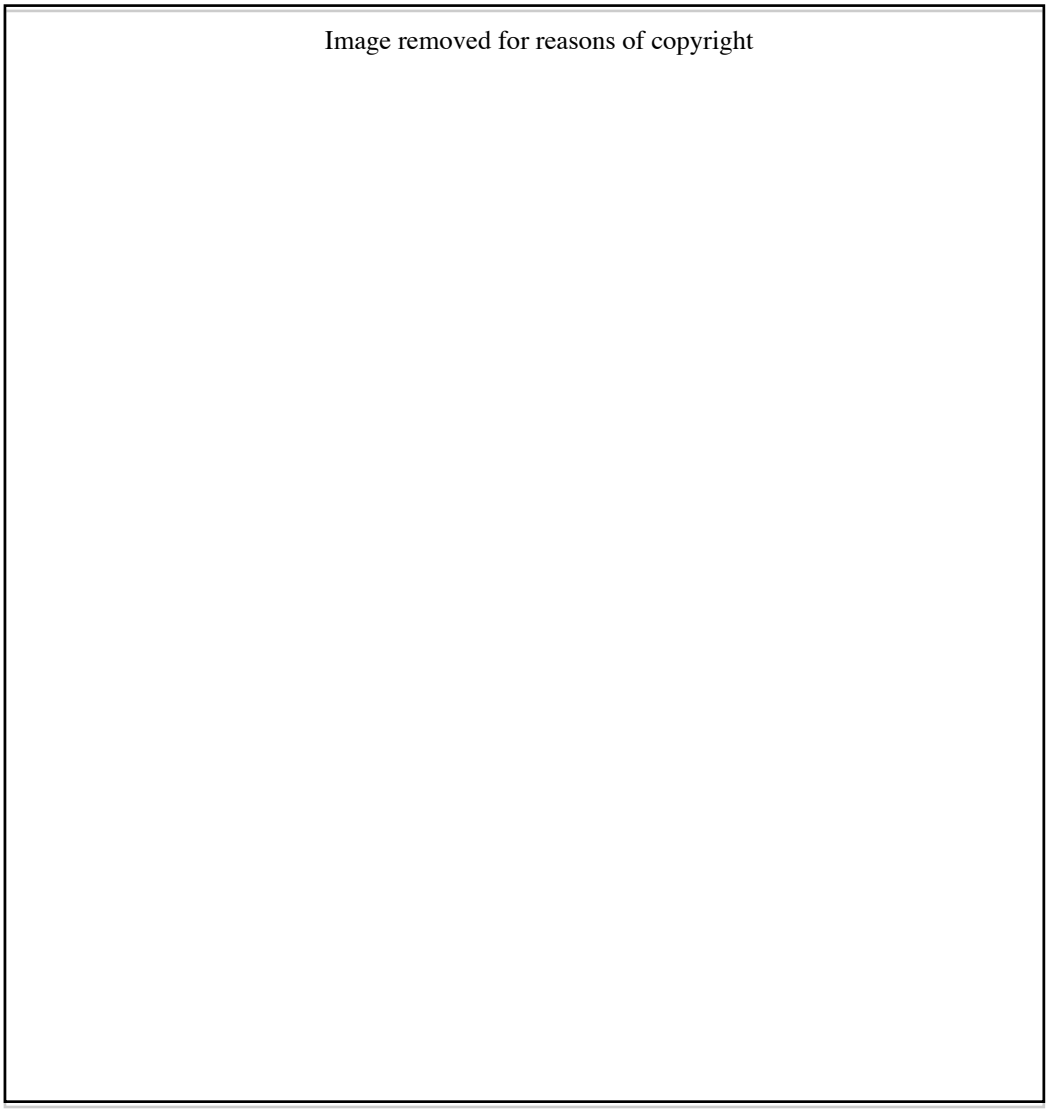


Figure 5.5 Food and water handling equipment of unspecified provenance: A, lead braziers; B, lead containers; C, lead cooking-pots. (E. Galili), from Rosen and Galili 2007: 302 fig. 6.

material from Delos.[747] This dating highlights the importance of using a well-defined terminology. Until the recent discovery of the lead containers in Egypt, the braziers found in the waters around Bodrum were the earliest known large lead objects in the Eastern Mediterranean. They are, however, still smaller than many containers from Thonis-Heracleion, and the date is later than the context from the Egyptian port city suggests.

Rosen and Galili summarize the diversity of lead objects found on Roman shipwrecks on the Israeli coast such as lead sheathing, sounding leads, brailing-rings for ropes and sails, and net sinkers.[748] Although this is not what the authors suggest, it is

[747] Leonard 1973: 22, 24-5 nos. 9 and 10.

[748] Rosen and Galili 2007.

worth pointing out that these are not objects restricted to or first appearing in Roman wrecks. Interestingly, Rosen and Galili mention and show lead containers and cooking pots, unfortunately without giving any further details on where they were found (Figure 5.5).[749] They associate the use of lead containers explicitly with ships, as "the inherent fragility of ceramic utensils tended to decrease their use by ever-shaking water-craft",[750] which they suggest explains their sole appearance on wrecks. The previous overview of lead containers, however, showed that their numbers are limited, too limited in my opinion to warrant such a generalisation.

From the first century AD there are several more examples of lead containers from shipwrecks from the western Mediterranean. There is one lead container (39.5 cm max. diameter, 20.6 cm high) recorded from the Grand Rouveau on the southern French coast,[751] a wreck from the middle of the 1st century AD.[752] A similar-shaped but larger vessel (40 cm max. diameter, 32 cm high)[753] was found on a wreck at Diano Marina – on the Italian coast between Nice and Genua – of the same general date,[754] another on the Dramont D,[755] a wreck in the bay of Saint-Raphael west of Nice, which is also 1st century AD, (32.1 cm max. diameter, 24.8 cm high).[756] Finally, another was found on the La Garoupe A near to Antibes,[757] (46 cm max. diameter, approx. 25 cm high).[758] *Dolia*, very large ceramic containers, are recorded from all these ships except Dramont D. All of the wrecks are securely dated through the cross-referencing of the types of ceramics, both the amphorae and the *dolia*, providing a clear date for the lead containers. The Rena Maiore, a Roman wreck from the Augustan age near Sardinia, contained four folded or crushed and cut lead containers, with moulded designs and

[749] Rosen and Galili 2007: 301, 302 fig. 6.

[750] Rosen and Galili 2007: 302–3.

[751] Parker 1992: 204, no. 478.

[752] For an image of the reconstructed vessel, Corsi-Sciallano and Liou 1985: 59, 61, fig. 44.

[753] Corsi-Sciallano and Liou 1985: 59 n. 59: Exposition Gênes 1983 = *Navigia fundo emergent. Trentatre anni di ricerche e di attività in Italia e all'estero del Centro sperimentale di archeologia sotto-marina. Mostra di archeologia sottomarina in Liguria*, Gênes, 15-24 octobre 1983, catalogue: 117–8, no. 46.

[754] Parker 1992: 163, no. 364.

[755] Parker 1992: 167–8, no. 374.

[756] Joncheray 1975: 12.

[757] Parker 1992: 187, no. 436.

[758] Benoit 1958: 33; Fiori 1972: 35.



Figure 5.6 Dye vats in Pompeii (D. Robinson).

inscriptions.[759] Two of the containers are similar in size and folded. The measurements in their current state are 56 cm by 32 cm.

The quantity of lead containers from wrecks is larger than those found from other excavations. Nonetheless, a nautical dimension should not be attributed to lead containers purely on the basis of their presence in shipwrecks. They appear on land in Egypt as well as in Olynthus, and larger lead vessels from the 1st century AD, for example, are known from the fulleries in Pompeii and Herculaneum (Figure 5.6).[760]

This overview of lead containers from Egypt and the rest of the Mediterranean shows a predominance of relatively small bowls and other containers from Egypt from the Late Period, 4th century BC, and Ptolemaic Period. These bowls are reminiscent of the smaller open shapes found at Thonis-Heracleion. The number of lead vessels from the rest of the Mediterranean is much smaller, but it is likely that many remain unpublished. The earliest datable larger lead objects — the lead braziers from Bodrum — are late 2nd to mid-1st century BC. In order to establish the development of the use of lead for utilitarian objects, it is imperative that the date attributed to the containers be clearly defined.

In conclusion, the lead containers at Thonis-Heracleion constitute a considerable expansion of their object category in the Mediterranean world. The occupation of Thonis-Heracleion and the dating of the lead containers from elsewhere in Egypt are roughly contemporaneous, but the material in the broader Mediterranean world is generally later in date, with the exception of a few small containers.

[759] Brown 2011: 263; Riccardi and Genovese 2002: 1314–8, and figs. 2–4.

[760] Moeller 1976: 13, and pl. I.

5.3. Lead containers from Thonis-Heracleion – spatial distribution and chronology

A large number of containers remain underwater, due either to their size or to their fragmentary condition (Table 5.1). The identification of these containers cannot be verified, but the description, combined with the measurements of some, allows analysis on a conceptual level. Containers found in 2001[761] and 2002,[762] for example, remain underwater in their entirety, as well as the overwhelming majority of those identified in 2004.[763] Diameters are recorded for a number of containers from 2003,[764] 2006,[765] 2007,[766] 2008,[767] and 2010.[768] Not all objects from the site were studied, and it

[761] No diameter was recorded for H.2001.H1.2186; it is therefore excluded from discussion in this chapter.

[762] The following containers from 2002 are not discussed because their diameters were not recorded: H.2002.XX.3255, H.2002.XX.3256, H.2002.XX.3257, H.2002.XX.3258, H.2002.XX.3259, and H.2002.XX.3262.

[763] For the following containers diameters were recorded: H.2004.XX.8506 (12 cm), H.2004.XX.8850 (20 cm), H.2004.XX.8856 (10 cm), H.2004.XX.8858 (20 cm), H.2004.XX.8918 (15 cm), H.2004.XX.8919 (10 cm), H.2004.XX.8920 (20 cm), H.2004.XX.8926 (15 cm), H.2004.XX.8927 (15 cm), H.2004.XX.8930 (10 cm), H.2004.XX.8931 (15 cm), H.2004.XX.8932 (15 cm), H.2004.XX.8933 (20 cm), H.2004.XX.8934 (15 cm), H.2004.XX.8939 (20 cm), H.2004.XX.8941 (15 cm), H.2004.XX.8967 (15 cm), H.2004.XX.8968 (10 cm), H.2004.XX.8969 (15 cm), H.2004.XX.8971 (15 cm), H.2004.XX.8973 (10 cm), H.2004.XX.8975 (15 cm), H.2004.XX.8981 (15 cm), H.2004.XX.8984 (10 cm), H.2004.XX.9005 (15 cm), H.2004.XX.9006 (15 cm), H.2004.XX.9136 (15 cm), H.2004.XX.9138 (20 cm), H.2004.XX.9148 (15 cm), H.2004.XX.9149 (15 cm), H.2004.XX.9150 (15 cm), H.2004.XX.9170 (15 cm), H.2004.XX.9490 (12 cm), H.2004.XX.9496 (15 cm), H.2004.XX.9503 (15 cm), and H.2004.XX.9505 (10 cm).

The diameter was not recorded for following containers from 2004: H.2004.XX.8921, H.2004.XX.8946, H.2004.XX.8948, H.2004.XX.8949, H.2004.XX.8952, H.2004.XX.8958, H.2004.XX.8965, H.2004.XX.8972, H.2004.XX.8973, H.2004.XX.8976, H.2004.XX.8978, and H.2004.XX.9172.

[764] For the following containers diameters were recorded: nos. 26-9, 34, H.2003.XX.6085 (6.2 cm), H.2003.XX.6225 (3.5 cm), H.2003.XX.6295 (4 cm), H.2003.XX.6347 (4 cm), H.2003.XX.6381 (3.3 cm), H.2003.XX.6478 (4.5 cm), H.2003.XX.6487 (5.8 cm), H.2003.XX.6574 (2.5 cm), H.2003.E6.6576 (2.9 cm), H.2003.XX.6669 (11.6 cm), H.2003.XX.6699 (2.6 cm), H.2003.XX.6707 (5.3 cm), H.2003.XX.6785 (10 cm), H.2003.XX.6917 (4.6 cm), H.2003.XX.6941 (10 cm), H.2003.XX.7064 (15 cm).

The diameter was not recorded for following containers from 2003: H.2003.XX.6227, H.2003.XX.6246, H.2003.XX.6535, H.2003.XX.6611, and H.2003.XX.7073.

[765] The following containers from 2006 are not discussed since the diameter was not recorded: H.2006.XX.10035, H.2006.XX.10043, and H.2006.XX.10044.

[766] For the following containers from 2007 diameters were recorded: no. **213,** H.2007.XX.10099 (4.9 cm), H.2007.XX.10222 (14.8 cm), and H.2007.XX.10705 (2 cm).

is possible that there are still additional examples in the storerooms. The numbers presented below in Table 5.1 should therefore be taken as a general guideline.

Unstudied material is not included in the catalogue or analysis. An exception is made for the largest containers from the site, as they are unique and extraordinary objects. Two photographs, combined with the general measurements of the other vessels allow for some discussion of their role in the town. The catalogue also includes a list of all the containers with a diameter larger than 40 cm. Other containers with recorded diameters are found in the references of the preceding paragraphs.

	Total	Underwater	Maritime Museum
2001	**7**	7	0
2002	**34**	18	16
2003	**67**	26	41
2004	**107**	64	43
2006	**15**	4	11
2007	**14**	6	8
2008	**1**	1	0
2009	**2**	0	2
2010	**2**	0	2
Total	**249**	126	123

Table 5.1 Overview of the number of lead containers identified each year, detailing which ones remain underwater and which are stored in the Maritime Museum, Alexandria

The distribution map of *all* lead containers (Figure 5.1) shows that the majority of containers were found in ancient waterways. This pattern, however, is a general indicator. Only after the group of lead containers is divided into different types that the emerging patterns yield more specific information on activities at Thonis-Heracleion. The excavators suggest the lead containers may have been deposited in the water during rituals.[769] They may have been dropped from ships, by accident or as part of general rubbish accumulation processes. The remains of a large number of ships were identified in the harbour basins to the east, but they remain unexcavated, apart from cleaning of

The diameter was not recorded for following containers from 2007: H.2007.XX.9984, and H.2007.XX.10710.

[767] The diameter was not recorded for following containers from 2008: H.2008.XX.10996.

[768] No record for H.2010.XX.12037.

[769] Goddio 2007: 126, also personal communication Franck Goddio.

the outline of hulls and sampling of the timbers.[770] Consequently, lead containers cannot yet be attributed to the cargo of any identified wreck, with the exception of one that was found on the excavated ship no. 17 (see Section 5.3.1.5). When discussing the dating, the description below focuses on the ceramic assemblage, and where applicable the numismatic assemblage, in the vicinity of containers. The stratigraphic relationship between the (groups of) container(s) and their surroundings is unclear, as most were recovered during prospection.

5.3.1. The largest containers

This section concentrates on the groups of the largest containers, with a diameter between 25 cm to 120 cm, all of which all remain underwater. One member of this group is in the Maritime Museum (no. **214**). The group merits a discussion in terms of sheer size and choice of material.

5.3.1.1. Container no. 184

The largest container (no. **184**, Figure 1.5 on the left) was found in 2001 at the entrance of the temple harbour in the south of the site, at the edge of the water of the harbour area to the east of the temple (Figure 5.7). It has a unique morphology at the site and is rectangular in section with *two* apertures. Measurements are not recorded, but comparison with the image of no. **190** (Figure 1.5 on the right) suggests it is larger than the 120 cm recorded for that container. The records do not mention any interior structure, so I assume it to be hollow until it can be examined again. Ceramic evidence found in the vicinity indicates a Ptolemaic dating, to the 3rd and 2nd century BC.[771] The container was found during prospection in a mobile sand layer, so the context is mixed. A broad date range contemporaneous with the ceramics i.e. 300–150 BC, is therefore proposed.

[770] Fabre 2011: 15, fig. 1.4.

[771] Area G, see Grataloup 2010: 156.

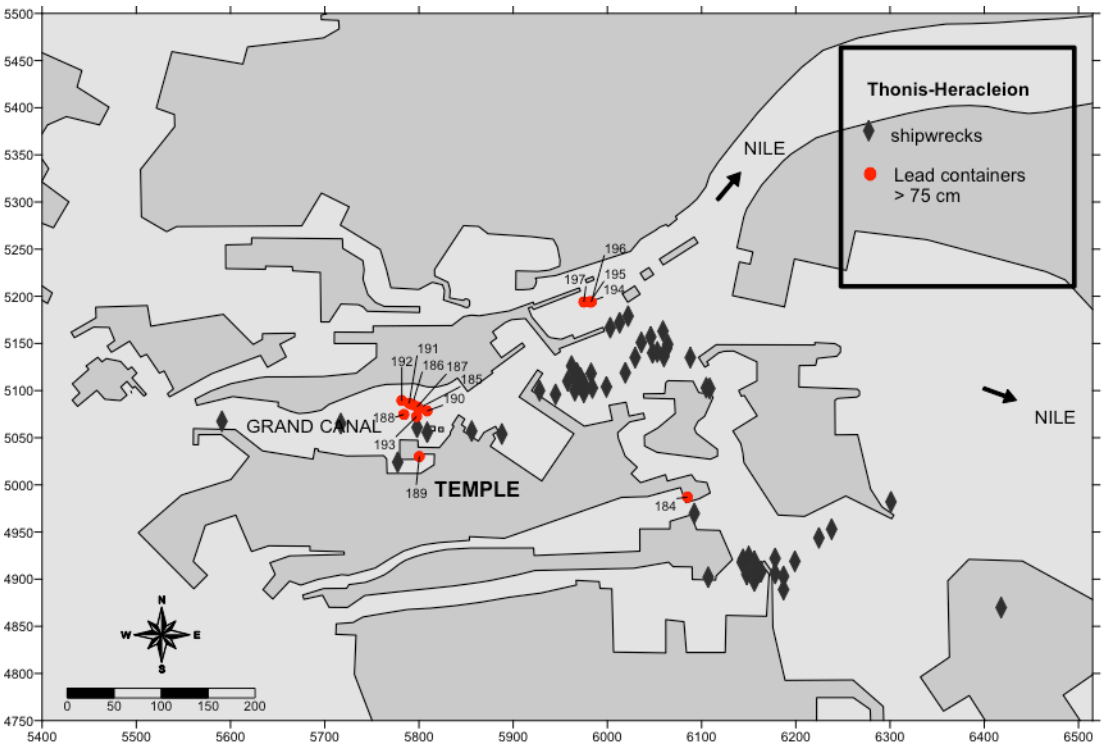


Figure 5.7 Distribution map of lead containers larger than 75 cm in diameter, ©Franck Goddio/Hilti Foundation.

5.3.1.2. Containers more than 75 cm in diameter in the Grand Canal

The cluster of nine lead containers in the Grand Canal in the centre of the site (nos. **185, 186, 187, 188, 190, 191, 192, 193, 205**) was found during two consecutive seasons in 2001 and 2002, with two more in 2004 (Figure 5.7). The excavators describe them individually as a 'grand récipient de plomb' and 'cisterne'. This section and the next include any lead objects described in this way, even though no measurements are recorded for some of them. The image of no. **190** shows a closed, round, and bulbous vessel.

Several of the largest containers were found in the cluster in the Grand Canal. No. **189** was found to the south of this cluster, at the southern edge of the remains of a wooden structure emerging from the temple island.[772] The distance between the containers is significant: between the northernmost one (no. **192**) and the one to the southeast (no. **190**) is 28.5 m, and the distance between the latter and the closest one to the west (no. **193**) is 12.4 m. Although the containers were found during prospection

[772] Goddio 2007: 98–100, and fig. 3.52–5.

dives and not during excavations, the mobile sand layer, as the archaeological context of this group in the Grand Canal, provides a date range through the ceramics and coins in the vicinity.

Excavations in the Grand Canal were conducted near mole H2,[773] directly north of the temple, closest to the large containers. Many bronze ritual objects were found in the area, as well as a concentration of the gold finds from the site.[774] Fineware ceramics and coins were recovered from the same surveys during which the large containers were found. The ceramic assemblage is dominated by imported fineware from Attica, mainly vessels such as *skyphoi* and *lekythoi* used for liquids.[775] The assemblage is more indicative of an area of ritual activity rather than shipwrecks or storage. The squat *skyphoi* date from the middle of the 5th century to the first half of the 4th century B.C. tapering off in the second half of the latter. Many *lekythoi* are dated from the late 5th to first half of the 4th century B.C. There are also fragments of painted table amphorae of either East Greek or Levantine origin,[776] dated to the end of the 5th and first half of the 4th century B.C. Amphorae and local wares, on the other hand, are rare, except for a production of fineware vessels (cups, bowls and jugs) in marl clay, particularly typical at certain sites in the Egyptian delta during the Persian period.[777]

All coins found in the vicinity of the containers in the Grand Canal were around the southern edge of the cluster, container no. **190** being closest in most cases.[778] Within one meter of this container were found an Athenian bronze coin of the 4th century BC (no. H2793, 0.75 m distance), a Macedonian bronze coin of Alexander of an uncertain mint (no. H678, c. 336-323, 0.75 m distance), and a Ptolemaic coin from series 2 (no. H685, 0.50 m distance).[779] A Macedonian bronze coin of Philip II (no. H687, c. 358-336), as well as a bronze coin from Cos, also 4th century BC (no. H682),

[773] Goddio 2007: 102–11, figs 3.61–5, fig. 3.71.

[774] Goddio 2007: 124–5, figs 3.102–4.

[775] Grataloup 2012: 174–5, 180–1; I thank Catherine Grataloup for her help and comments on the discussion of the ceramics.

[776] Lehmann 2000.

[777] Grataloup 2012.

[778] Only the coins that could be identified are included here. I thank Andrew Meadows for sharing his work on the coins with me.

[779] For the dating and seriation of the Ptolemaic coins, see Picard and Faucher 2012.

were found around 1.5 m away. Twenty other identifiable coins were found in a radius of between 2 and 5.6 m from the group (Table 5.2); these are from the 4th and 3rd century BC, with only three (or four?) later coins. The context is mixed, but the ceramics and the majority of coins are in agreement, so the small number of later coins is interpreted as intrusive material.

Excavation number	Distance	Date, type
681	2.1 m (from no. **190**)	Ptolemaic series 2-3
1400	2.5 m (from no. **193**) 2 m (from no. **190**)	Ptolemaic series 2-3
1412_7	2.5 m (from no. **190**)	c. 336-323, illegible Macedonian coin of Alexander
2789_4 and _5 2789_2 2789_1 2789_12 and 2789_25 2789_29	2.6 m (from no. **190**)	Ptolemaic series 2 Ptolemaic series 2-3 Ptolemaic series 6-7 Ptolemaic series 9 illegible Roman coin
3050	2.8 m (from no. **192**)	Ptolemaic series 2-3
2792	3 m (from no. **190**)	Fourth c., Athenian tetradrachm
683	3.5 m (from no. **190**)	4th c., bronze coin of Rhodes
6492_1 and 6492_2	3.5 m (from no. **188**)	Ptolemaic series 2-3
689	3.9 m (from no. **190**)	Ptolemaic series 1-2
690	4.1 m (from no. **190**)	Ptolemaic series 1-2
8015	4.9 m (from no. **191**)	Ptolemaic series 2
680	5 m (from no. **190**)	4th c., bronze coin of Cos
2745_2	5.6 m (from no. **190**)	mid-late 4th c., bronze coin of Sidon

Table 5.2 Coins between 2m and 5.6m from cluster in Grand Canal

In the centre of the Grand Canal, close to the lead containers, many wooden posts were found. The excavator interprets them as part of an anchorage post.[780] Radiocarbon determination of samples from the wooden posts gives a 4th century BC dating. Excavations in area H2 yielded objects from the whole occupation range of the site, but the majority were from the 4th and 3rd centuries BC.[781] Other finds from the temple area also suggest its important position during the 4th and 3rd centuries BC, for example the Heracleion stela, twin to the Naukratis Stela, from year of Nektanebo I, i.e.

[780] Goddio 2007: 105.

[781] Goddio 2007: 103, fig. 3.61, and 105.

378 BC.[782] Thus, both the broader archaeological context and the objects found in the vicinity are in agreement with a general 4th and 3rd century date.

The chronological boundaries of this area in the Grand Canal as a whole are established through ceramics and coins. The ceramics start in the late 5th century BC and taper off in the second half of the following century, whereas the coins suggest a date between the (middle of the) 4th century and early 3rd century BC. Taken together, the ceramics and the coins combine to suggest a 4th to early 3rd century BC dating as an indicator for the lead containers. More specifically, the archaeological context of the containers suggests 4th to early 3rd century BC.

5.3.1.3. Containers, large but unspecified size

Another group of four large containers (nos. **194–7**) were found during prospection in 2002 (Figure 5.7). They are located in the middle of a harbour basin north of the central basin, or close to area K7, which was subject to targeted excavation in 2008.[783] The containers were found resting in a thin layer containing sherds on top of a layer of compact clay strata at least 80 cm thick.[784] No measurements were recorded for this group, but they are described elsewhere as larger than 1 m in diameter.[785] A head of a statuette of a male in a Cypriote style was found in the vicinity. Heinz dates the statuette stylistically to the late 5th century BC.[786] The ceramics from the strata of the excavation are dated from the late 5th century to the middle of the 4th century BC.[787] The relationship between this archaeological context and the group of lead containers is, however, unknown. Like the cluster of large containers in the Grand Canal, the containers in this group were found near remains of wooden infrastructure.[788]

[782] Von Bomhard 2012; Goddio 2007: 83.

[783] Fabre and Goddio 2012: map 4.

[784] Fabre and Goddio 2012: 85, n. 5; Goddio 2007: fig. 3.62.

[785] Fabre and Goddio 2012: 85 n. 5.

[786] H11031, Heinz 2013: no. 122.

[787] Fabre and Goddio 2012: 85–8.

[788] Fabre and Goddio 2012: 85, n. 5.

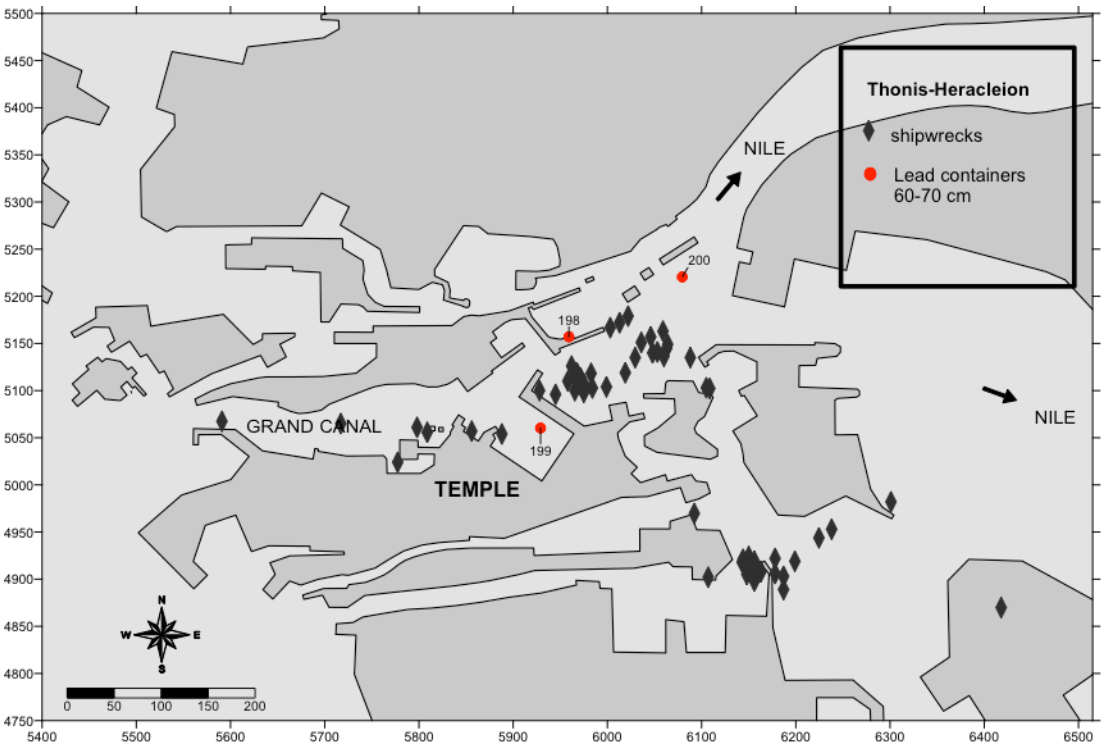


Figure 5.8 Distribution map of containers with diameters between 60 and 70 cm, ©Franck Goddio/Hilti Foundation.

5.3.1.4. Containers Ø 60–70 cm (nos. 198–200)

There are three other large containers (nos. **198, 199, 200**) dotted around the harbour basins in the east (Figure 5.8). All three were found in 2004. They remain underwater, and no photographs were taken. No. **10** was found at the edge of the water in the vicinity of other, smaller lead containers (nos. **206** and **215**). No. **199** was found in isolation in the water of the temple harbour on the northern part of the temple island, and no. **200** was near no. **208** in the water in the middle of the North Passage. The ceramic evidence from the North Passage suggests an earlier start date of activity in this area than the ceramics from the Grand Canal.[789] This finding is complemented by the absence of a significant number of coins in this area.[790]

It is problematic to make suggestions about the function of these containers in view of the small number in this size range and their scattered distribution across the site, which is compounded by the absence of photographs. Their distribution, however,

[789] Area C, see Grataloup 2010: 153–4.

[790] Personal communication A. Meadows.

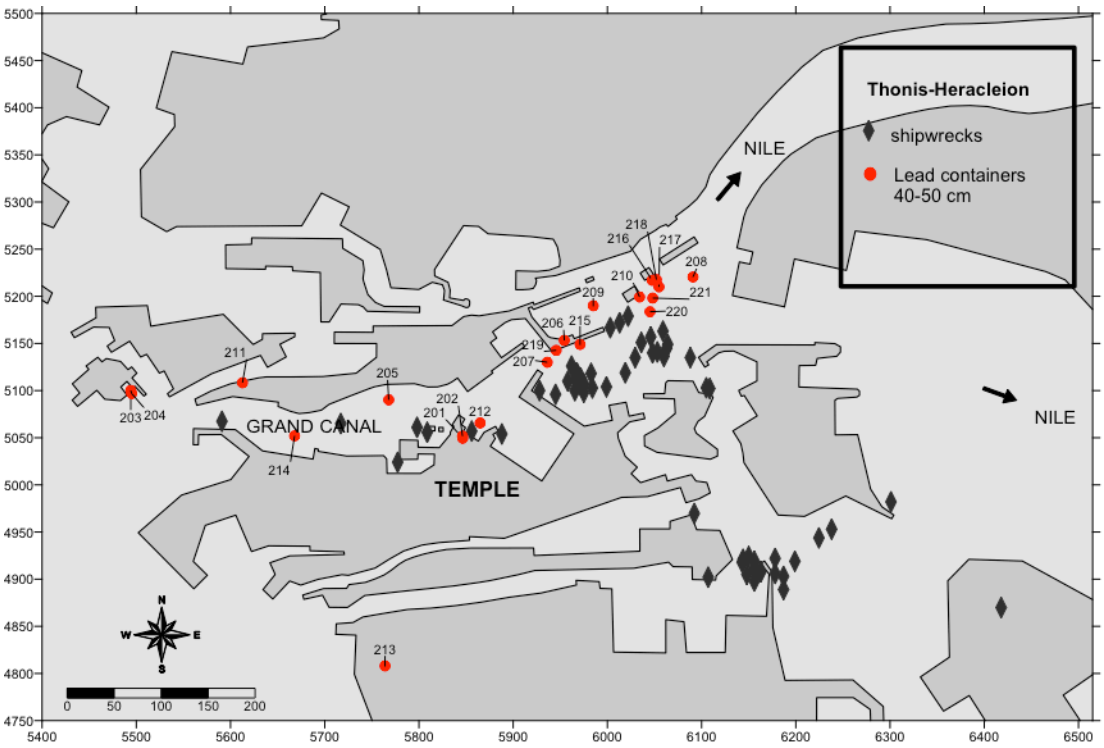


Figure 5.9 Distribution map of containers with diameters between 40 and 50 cm, ©Franck Goddio/Hilti Foundation.

slots well into that of containers with a diameter between 40 and 50 cm, suggesting that their attributes of accessibility, stability, transportability and graspability, and therefore their function and usage, are more similar to those of smaller containers than larger ones.

5.3.1.5. Containers Ø 40–50 cm (nos. 201–221)

There are twenty containers with a diameter between 40 and 50 cm recorded in the database (nos. **201–221**), only one of which is currently in the Maritime Museum, Alexandria (no. **214**). As with all previous containers, the distribution map for these ones shows a general occurrence in the ancient waterways (Figure 5.9).

One container of this size (no. **214**) is stored on land. It is a round bulbous container with no neck and a narrow aperture. A small ceramic bowl from the Ptolemaic period was found inside it (no. H6501) and another container (no. **234**) was in its vicinity. The containers were found in the western end of the Grand Canal, which contained ceramics from the late 5th century to early Ptolemaic period,[791] among a loose cluster of objects that were collected by the excavators over the course of a

[791] Area E, see Grataloup 2010: 155.

week's work: a lead bark (no. H6351), a lead bar (no. H6350), and a small lead ball (no. H6349). Container no. **234** was found 2.4 m away from no. **214**.

No. **205** has a diameter of 50 cm and was also found in the Grand Canal. It is likely to belong to the cluster of large containers discussed above (see Section 5.2.1).

The spatial distribution shows two concentrations in waterways in the east of the site (Figure 5.9). One group is in the central harbour area, 40 m south of zone K7 with diameters ranging between 40 cm and 70 cm; the other group is further to the northeast in the water of the North Passage (nos. **210**, **216**, **217**, **218**, **220**, and **221**). No. **208** was found close to no. **200** towards the east of the group. All are 40 cm in diameter, except nos. **208** and **210**, which measure 50 cm. Containers nos. **210** and **220** were found very close to a wooden jetty or pier projecting in a southwesterly direction.[792] This general area contains mainly imported pottery from the 5th and 4th centuries BC.[793]

The other containers were found scattered on land at the entrance of the Grand Canal (nos. **201** and **202**, distance between them 90 cm), close to 2186, or in the harbour area of E6 in the far west (nos. **203** and **204** at 1.25 m distance from each other). In the far south there is one more container found on land (no. **213**). Nos. **201** and **202** occur together with a concentration of other lead containers (distance between nos. **201** and **235** is 2.8 m, nos. **202** and **235** 2.4 m, nos. **202** and **237** 9.4 m, nos. **201** and **237** 9.5 m; see Section 5.3.2). Zone E6 has architectural remains from the Byzantine period, so that the dating of the context of containers nos. **203** and **204** is not securely contemporaneous with the other examples.[794] In view of the lack of images of the containers, it is impossible at present to compare their shape and appearance for differences that might have implications for their chronology.

This group of twenty containers shows a wide spatial distribution. Ceramic evidence points to a chronological shift in activity at the site from the north to the south. It is tempting to speculate that the group of containers in the North Passage and those in the Grand Canal should be placed in a chronological seriation similar to the

[792] The jetty is not visible on the basemap used to plot the distributions; see instead Goddio 2007: 125 fig. 3.104.

[793] Area C, see Grataloup 2010: 153–4.

[794] Goddio 2007: 74–5 fig. 3.6, 120–1 fig. 3.94–5.



Figure 5.10 Container (HE10_248) *in situ* in ship 17, Christoph Gerigk/©Franck Goddio/Hilti Foundation.

ceramics. One observation that may be made is the repeated presence across the site of remains of wooden structures in the vicinity of lead containers.

One further container is particularly relevant as it has a firm archaeological context. Ship 17 in the north of the central basin, one of three currently being excavated, contains a lead container with a diameter of approximately 40 cm (Figure 5.10).[795] This container, which has thick walls, is badly distorted. It was discovered at the stern of the ship on its starboard side. There were no timbers preserved under the container, so it raises the possibility that once the hull disintegrated, the vessel migrated further down through a void in the planking into the clay under its own weight. The outer diameter should have been around 40 cm: the diameter of the rim is approximately 20 cm. The wood samples show that three quarters of the ships are made of local *Acacia sp*. The ship has many of the characteristics of river-faring boats. The ceramics associated with the vessel give a range of the middle of the 5th century to the middle of the 4th century BC.[796] This date for a lead container of this size is the earliest in the Mediterranean.

[795] Alexander Belov, personal communication. He also provided the information on the archaeological context. For the location of ship 17 see Fabre 2011: 15 fig. 1.4.

[796] Radiocarbon dating on the wood samples gives a wider date range than the ceramics, see Belov forthcoming.

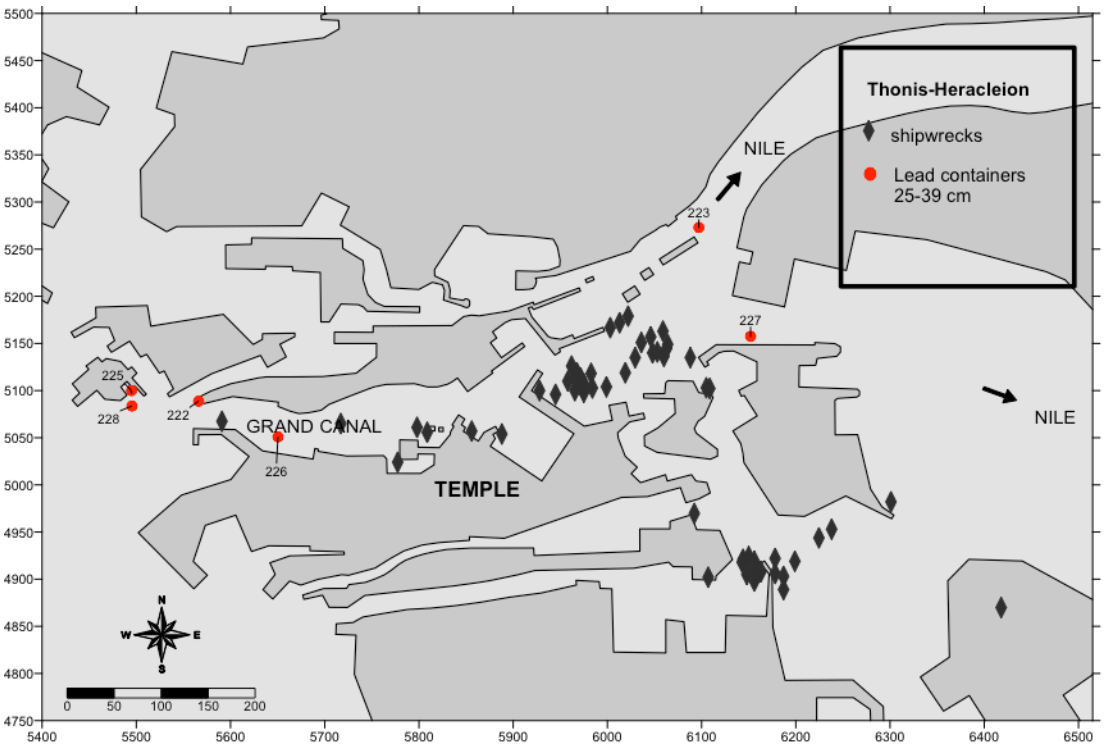


Figure 5.11 Distribution map of containers with a diameter between 25 and 39 cm, ©Franck Goddio/Hilti Foundation.

5.3.1.6. Containers Ø 25-39 cm (nos. 222–228)

The following set of seven containers (nos. **222–228**, no coordinates for no. **224**) is still underwater and no photographs are present for any of them. This small group shows a distribution of isolated instances, with only two found near to each other (nos. **225** and **228**) (Figure 5.11). In terms of size, the analysis of the larger containers is based on the assumption that all have the same closed and bulbous shape as the single picture, the single larger container, and the descriptions in the database suggest. For the containers discussed here, there is a partial overlap in diameter size with the (distorted) larger buckets discussed next. The small number, overlap between two consecutive categories, lack of photographs, and disparate distribution prevents a discussion of dating and function.

5.3.2. Buckets

From this point all containers mentioned in the discussion were available for me to study in the storerooms of the Maritime Museum, Alexandria. As there are no

previously assigned groups of shapes for lead containers in other catalogues or names for them, the subdivision in categories below is my own. This category consists of containers selected on the basis of their size and weight. The four larger and heavier containers are reminiscent in size and shape to certain bronze containers (see below). The lead containers are so similar to each other, even in their current distorted shape, that it is beyond doubt that they belong to the same type. Slightly smaller containers, six in total, of a similar open shape are also included in this category.

Another group of lead containers is clearly at the smaller end of the spectrum. The remaining 15 containers between the 'buckets' and the small containers are more difficult to define. The present division into groups is proposed on the basis of their weight. The heavier group of eight containers is probably connected to the buckets and is presented as such. The remaining seven containers are more diverse in form and are unlikely to be a coherent group (see below).

5.3.2.1. Buckets with a base diameter of approx. 20 cm (nos. 229–232 and 233–238)

The 10 containers in this category are divided into 2 subgroups. The base diameter ranges from 18 to 21 cm, for the 4 containers in the larger and heavier group, to between 8.7 cm and 15 cm for the 6 smaller containers. All are bucket-shaped with a round base.

The well-preserved examples of the group of larger containers (nos. **229**, **230**, **231**, **232**) show that the walls were originally straight (i.e. not curved) and sloped slightly outward. All 4 examples have a curled rim or lip. They have relatively thick walls and weigh between 2.8 and 5.0 kg. These four containers are strikingly uniform in appearance.

The smaller containers (nos. **233**, **234**, **235**, **236**, **237**, **238**) are similar in appearance, with a round base and flaring walls, but they vary more in size. Their walls seem to slope less than the larger examples. They do not have curled rims, and they are smaller overall and significantly lighter, weighing 0.55–1.0kg. Although lead was relatively cheap compared to other metals, the difference in weight between these two groups suggests a conscious decision at the time of manufacture.

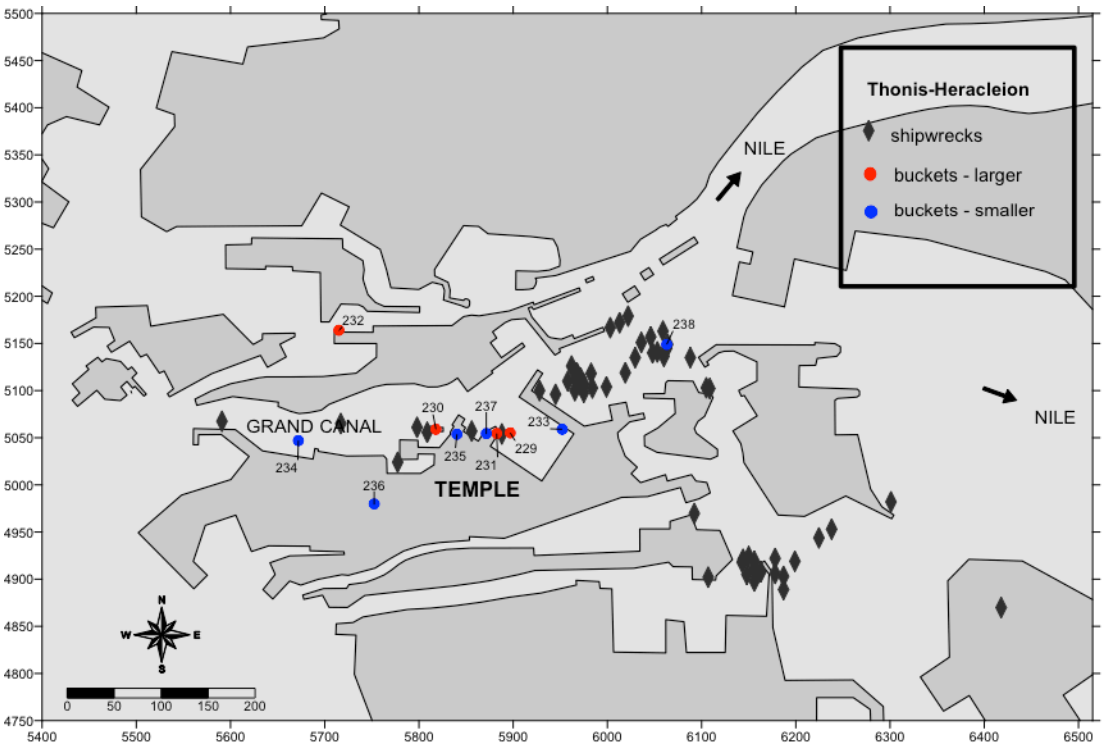


Figure 5.12 Distribution map of buckets, ©Franck Goddio/Hilti Foundation.

A map of the distribution of the 10 selected lead vessels shows a cluster of five at the edge of land and water directly north of the temple area (Figure 5.12). Five more containers were found in a scatter around the site. Others were found in close proximity to ships (nos. **229–231**, and **238**), in an underwater context without an apparent connection to a ship (no. **234**), or at the edge of water and land (nos. **232**, **233**, **237**). Proximity, again, is relative. Some of the clustered objects were in fact found several meters apart, for example 16 m between nos. **229** and **231**, and 78.5 m between nos. **229** and **230**.

Objects excavated in area H4 span the occupation of the site from the end of the 7th century to the 2nd century BC,[797] with the majority dating to the 4th and 3rd centuries,[798] including the ceramics.[799] This ties in with the dating of a bronze container of a similar shape from Luxor, which has an inscription attributed to the Ptolemaic

[797] This excavation H4 was at the eastern end of the Grand Canal running perpendicular to the Canal, see Goddio 2007: 102–11, fig. 3.61

[798] Goddio 2007: 74, fig. 3.6, 105.

[799] Area F, see Grataloup 2010: 155.

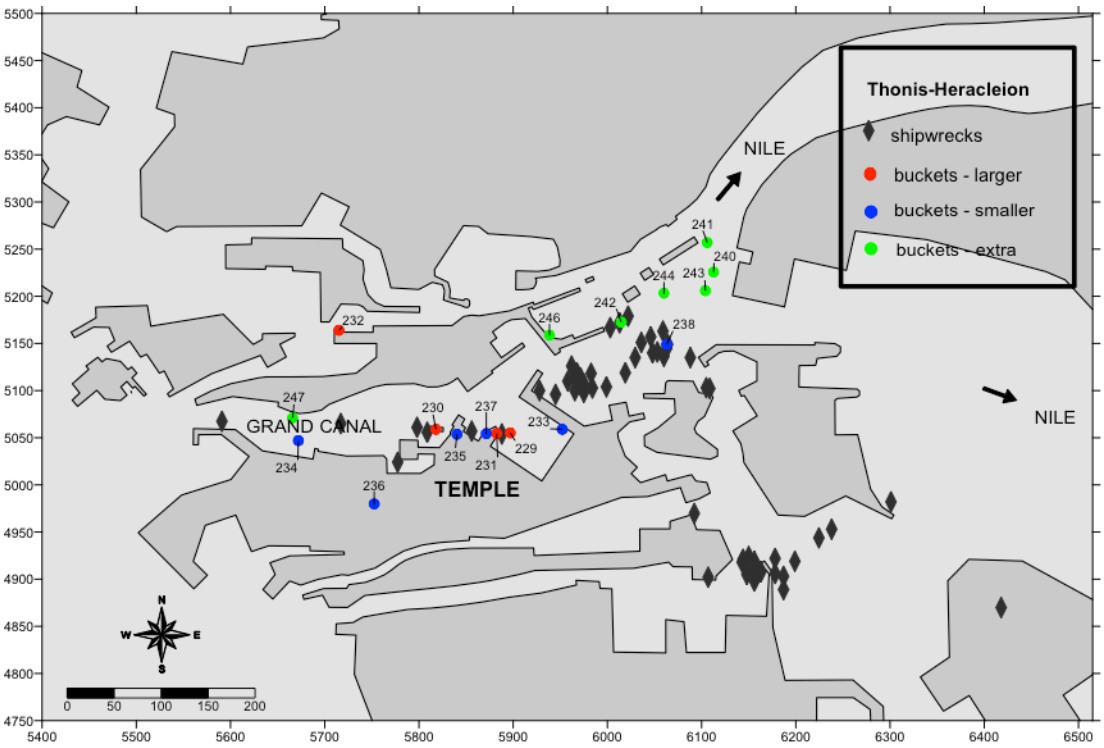


Figure 5.13 Distribution map of buckets, and 'extra' buckets, ©Franck Goddio/Hilti Foundation.

period demonstrating that this shape of metal container was present in Egypt at this time.[800]

Thonis-Heracleion was abandoned in the mid 2nd century BC. These criteria come together to date the deposition of these lead containers in the approximate range 300–150 BC.

5.3.2.2. Related group of 'buckets' (nos. 239–246)

A further group of eight containers, nos. **239–246**, is slightly different in shape but still similar to the buckets in the previous section (Figure 5.13). The base diameter of these containers is generally smaller than that of the buckets, and they are taller. Together with the smaller base they give a different overall impression. Their spatial distribution clusters in a different area to the northeast of the site. Nos. **242** and **246** are near or on the jetty in the central harbour towards the north passage, with nos. **240, 241, 243,** and **244** progressively north in the water of the Grand Canal.

This area was near the northern passage leading to the Nile and yielded mainly imported ceramics dating from the 5th and 4th centuries.[801] This could indicate an

[800] Von Bissing 1901: CG 3542 with image.

earlier date for this group of eight compared to the two groups of buckets above. The geographical area encompasses the passage to the Nile, but dotted in the water were a number of islands with at least one sanctuary.[802] Lead barks were found in the same area south of the 'Long Island' in which these containers were found.[803] The cluster is around the jetty in the central harbour basin and near the islands on the route to the North Passage and the Nile.[804]

The buckets in this group have a similar open shape but taller and narrower appearance than the previous group. Their different geographical location in the North Passage suggests the possibility that they are of the same type but are an earlier variant than those discussed above. A similar date to the container from ship 17 is suggested, i.e. 450–350 BC.

5.3.3. Containers Ø 9-10 cm (nos. 247–253)

This is a relatively small group of seven containers (nos. **247–253**) with a diameter between the average bucket and the smaller vessels (Figure 5.14). All weigh between 75 and 425g.

There is one exception of a heavier container in this category that weighed 1274g (no. **250**). Its shape is not similar to the containers described as buckets. It is also folded flat, which complicates matters since its original shape is unclear. It is also unlike any of the folded containers in the corpus. It was found near a bronze statuette of an ibis (no. H9125).

The distribution in diverse areas across the site is interesting and may be reflected by the shape of the vessels. The two in the Grand Canal are a closed bowl (no. **249**) and an open bowl (no. **248**), with another bowl in the harbour basin (no. **252**). Two others are a flat dish shape (nos. **253** and **254**) and were also found in the harbour basin leading to the North Passage. The heaviest container was found slightly north of (no.

[801] Area C in Grataloup 2010: 153–4.

[802] For the coin die and a discussion of the direct archaeological context of these islands, see Meadows 2011: 97–9.

[803] Heinz 2013: nos. 307, 310, 317.

[804] For a detailed map of the area, see Goddio 2007: 114, fig. 3.85.

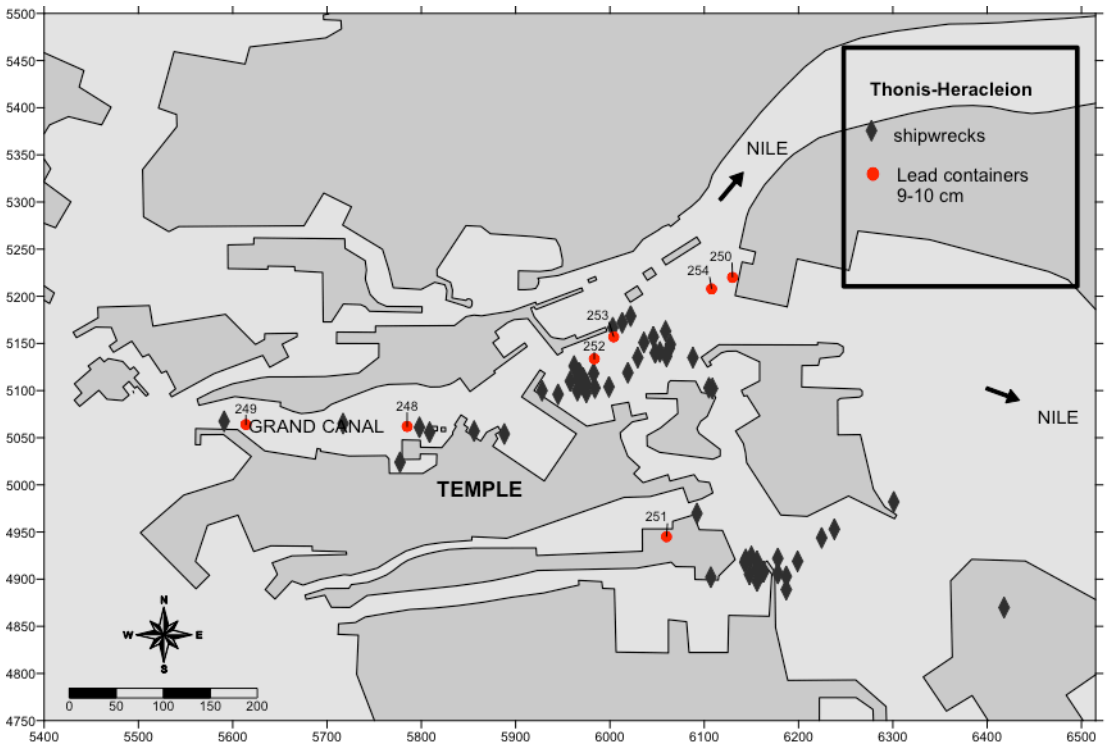


Figure 5.14 Distribution map of containers with a diameter between 9 and 10cm, ©Franck Goddio/Hilti Foundation.

254). There is one container in the south (no. **251**) in an area that has predominantly 2nd century BC ceramics,[805] which appears in relative isolation.

The discussion above leads to the conclusion that this category based on size in the current typology is artificial. The small number of objects, the disparate distribution, and the different shapes require an individual analysis. Individually, they probably span the chronology of the site, starting with the objects in the North Passage and ending with the dish near the southern harbour. The distribution shows a predominance of find spots in areas that are known for ritual activity.

[805] Area G, see Grataloup 2010: 156, and fig. 12.2.

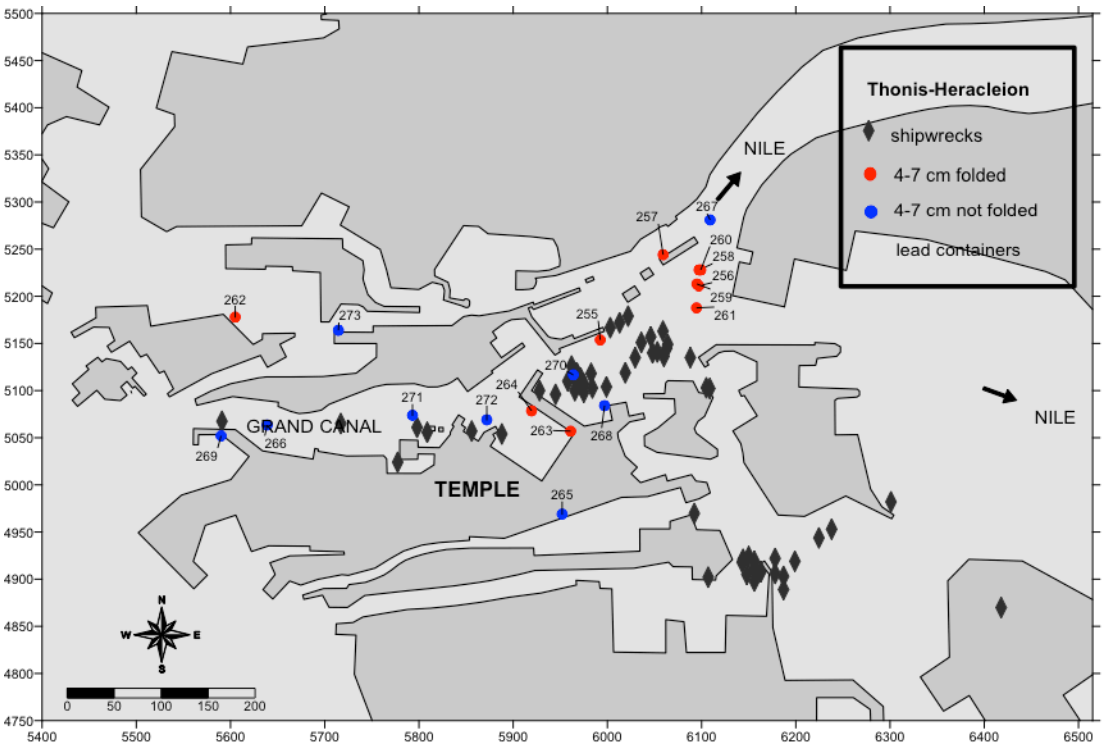


Figure 5.15 Distribution map of containers with a diameter between 4 and 7cm, ©Franck Goddio/Hilti Foundation.

5.3.4. Containers Ø 4-7 cm (nos. 254–273)

The containers defined by their diameter size as between 4–7 cm as small show a more even spread across the site than the previous groups (Figure 5.15). The group is divided into ten folded (nos. **265–264**) and nine non-folded containers (nos. **265–273**). A rough topographical division is visible between the folded and non-folded containers. The folded containers appear mostly in the North Passage (seven examples) with one (no. **255**) near the jetty in the central harbour area. Another was found in the northern harbour of the temple island at the edge of water and land (no. **263**) and one in the northwest of the site (no. **262**).

The non-folded containers concentrate around the Grand Canal and the temple island itself. One was found on the temple island near the southern harbour (no. **265**) and several around the other harbour basins of the island (nos. **263**, **268**, **269**). Further to the north was no. **273**.

The distribution of the small folded containers is mirrored by the general pattern of folded containers, which is concentrated in the North Passage. This pattern suggests

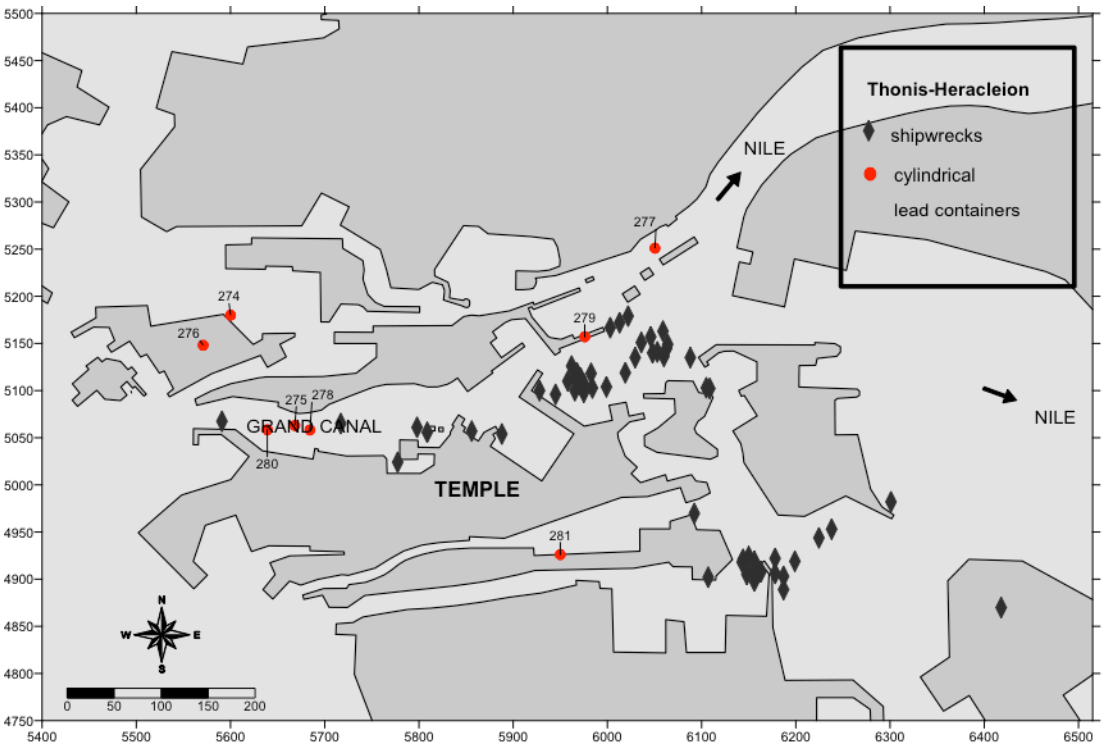


Figure 5.16 Distribution map of cylindrical containers, ©Franck Goddio/Hilti Foundation.

the practice of folding ceased to be relevant by the end of the 4th century BC, when there was a chronological shift visible in the ceramics from the area of the North Passage to the Grand Canal.

5.3.5. Small cylindrical containers (nos. 274–281)

A group of eight small, cylindrical lead containers was found in the western areas of the site (Figure 5.16). One was in the North Passage (no. **277**) and another on the jetty in that area (no. **279**). There was a cluster in the western end of the Grand Canal, and one south of the temple area (no. **281**). These containers have a closed shape, reminiscent of ceramic vessels for precious liquids such as perfume and certain oils, or are cylindrical. Their distribution mirrors the patterns distinguished above, that is North Passage, Grand Canal, and in the south, although their shape is different. They were found in all areas of the site, and chronologically they probably span much of its date range (450–150 BC).

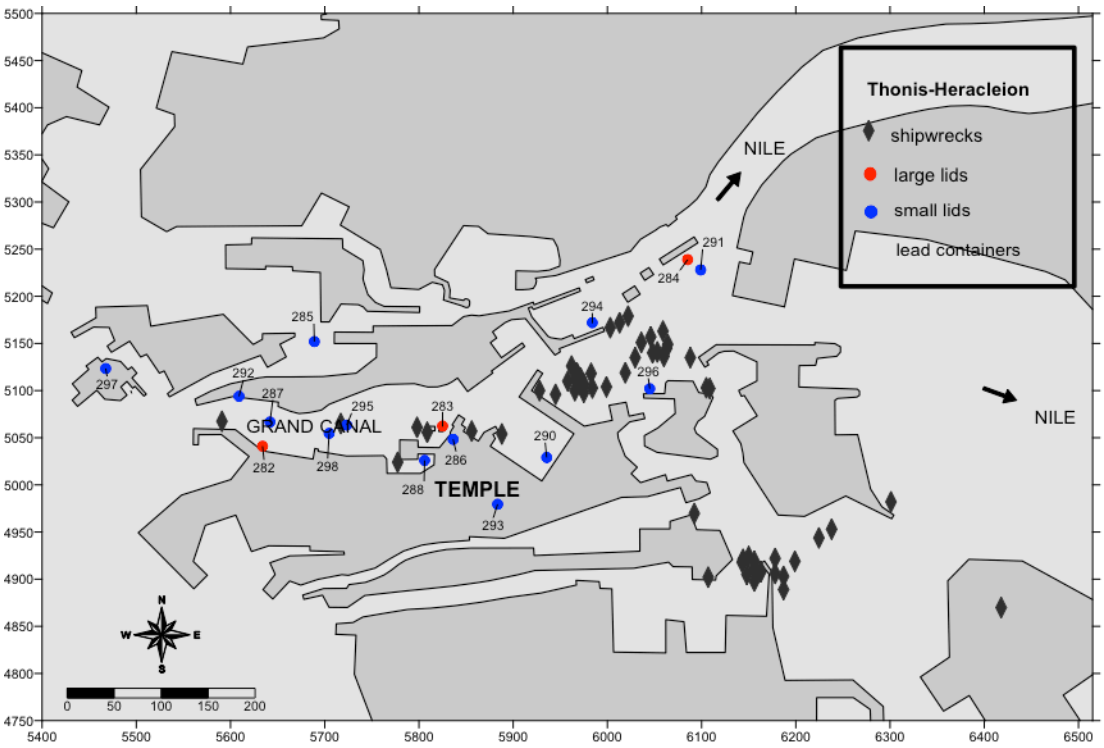


Figure 5.17 Distribution map of lids, ©Franck Goddio/Hilti Foundation.

5.3.6. Lids

The lids were found across the site, often in the vicinity of groups of lead containers (Figure 5.17). There are two lids with a large diameter, and one knob of a similar large lid, two of which are in the North Passage (nos. **284** =knob, **291** near a small container) and one near the cluster of large containers in the Grand Canal (see Section 5.3.1.2, no. **283**). Several lids were found in the western end of the Grand Canal (**282** (with **214**), **292**, **295**, **298**). It is likely that some containers had a lid and that some of these containers are still on site. As suggested for the small cylindrical containers above, the date range of the lids is likely to match that established for the containers as a whole.

5.3.7. Folded containers

The deliberate folding of the containers appears in several of the size categories, with many towards the smaller end of the range (Figure 5.18). Folding and crushing or crumpling of the lead containers is the result of two different processes, of which the second presumably only occurs after deposition. The term 'folded' describes the flat

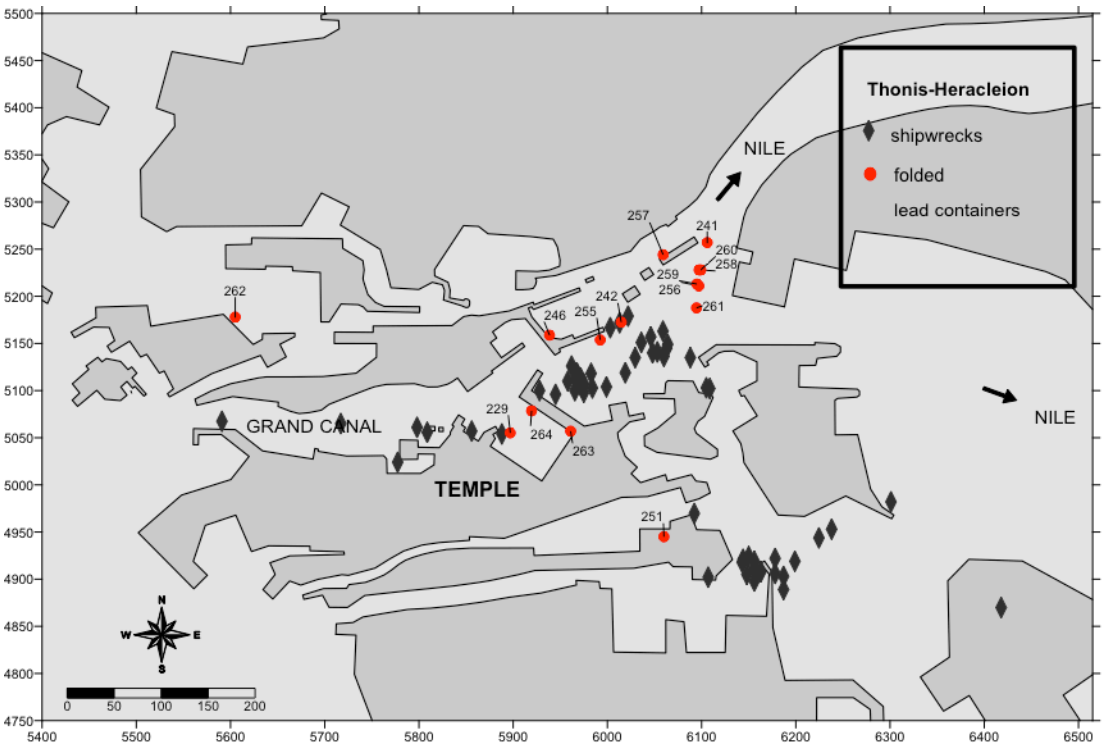


Figure 5.18 Distribution map of all folded containers, regardless of size, ©Franck Goddio/Hilti Foundation.

end result where the walls of the container are deliberately folded over each other from opposite sides. The result is a flat object with the remains of the round base visible on one side and a straight line where the rim meets or overlaps on the other.

The distribution of the folded containers shows a concentration in the northeastern part of the site, in the water of the North Passage. None have been found in the temple area itself. Other containers are located at the edge of water and land close to the temple harbour (nos. **229, 263**, **264**), one further south (no. **251**) in an area with Ptolemaic activity, and one to the northwest (no. **262**). The shape of the folded containers suggests that they had an open shape originally, that is the walls fold inwards so that their edges form a straight line instead of the opening of a closed vessel remaining visible (Figure 5.19).[806] The majority of the folded examples are small, in the 4–7 cm category.

[806] E.g. no. **301**.



Figure 5.19 Container no. **245** view from above.

Their occurrence in the North Passage suggests this was a practice of the 5th and 4th centuries BC, decreasing after that, as it is not commonly found in areas with an early Ptolemaic ceramic assemblage.

5.3.8. Miscellaneous category

This is the final category of lead containers (Figure 5.20). They are not the same size or repertoire as the miniature vessels, but not much larger, and diverse in shape. Further work is required in order to be able to establish whether this is a group similar to the miniature vessels. A number of closed shape containers appear in the Grand Canal (nos. **303–306**) and are almost certainly also associated with the practice of ritual deposition in the area. The distribution of the others is more generally in the water or at its edge, with one appearing near many sunken ships (no. **309**).

5.4. Reflections on role and location

The previous discussion concentrated on dating the containers in the city, generally on the basis of the ceramic and sometimes numismatic assemblage. Only one container was excavated in association with a ship, giving the earliest secure date range as 450–350 BC. Others may be more conservatively assigned to an early Ptolemaic dating, i.e. 300–150 BC, for the large containers in the Grand Canal for example. The distribution of the containers, combined with their shape and size, permits further suggestions as to their role and location.

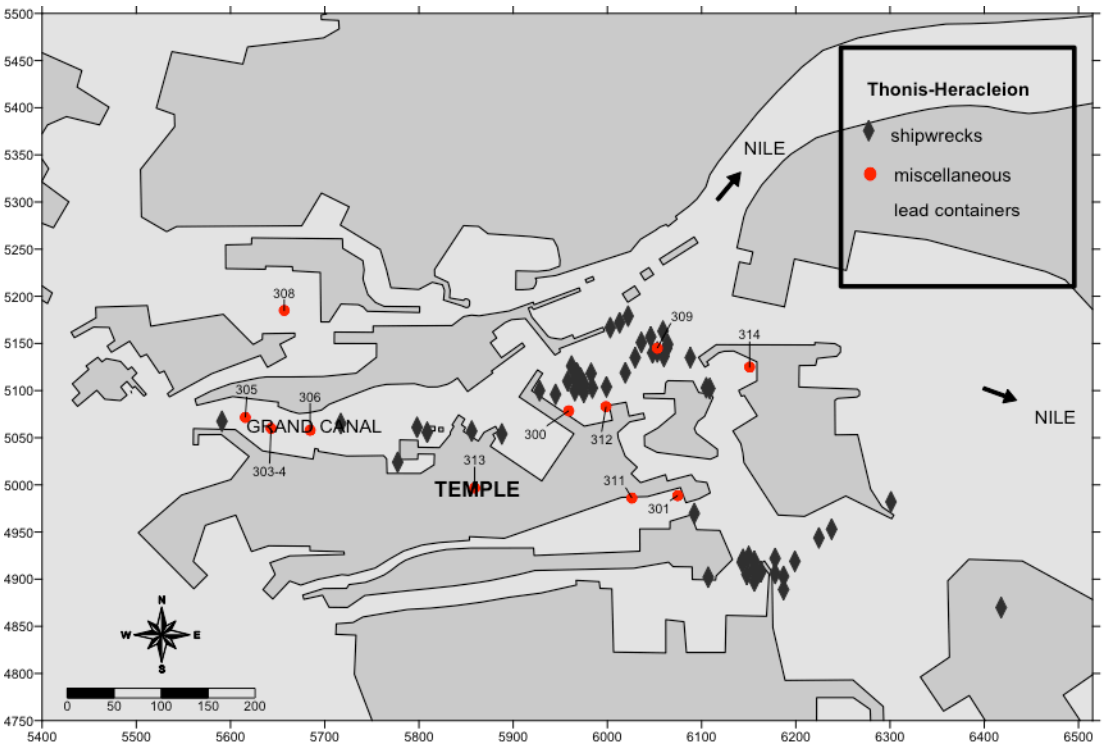


Figure 5.20 Distribution map of the 'miscellaneous category of containers, ©Franck Goddio/Hilti Foundation.

5.4.1. Interpretation of the large containers in the Grand Canal

There are no close parallels in lead for large containers of this shape. In order to address the role and location of these large containers, a discussion of objects of a similar size is necessary. The functional attributes of large ceramic and metal containers are similar in terms of accessibility, stability, transportability and graspability,[807] offering a useful framework for interpreting the lead containers.

During excavations in the 19th century, 12 large bronze cauldrons with handles were found in room AB of the North-West Palace at Nimrud, where it seems they were collected and left together with many other metal objects after the sack of city in 614 and 612 BC.[808] Now lost, two examples measured 76.2 cm wide and 91.4 cm deep; four were filled with metal objects, one with ashes and bones, and seven were found empty.[809] Curtis notes – following Layard – that cauldrons occur on reliefs depicting

[807] Christakis 2005: 5.

[808] For the dating and room AB at Nimrud, see Curtis 2013: 2–6.

[809] Curtis 2013: 3–6, 67.

spoils and tribute, perhaps suggesting a link with the Levant and Tiglath-Pileser III's campaign in 740 BC, but it remains unclear whether these examples are of Assyrian or foreign manufacture.[810] Whether or not the reliefs are representations of the bronze cauldrons Layard found in Nimrud, they indicate that large metal containers were not a novelty at Thonis-Heracleion and that they were used for transport and storage of goods.

In a different material, examples of large ceramic vessels such as Greek *pithoi* and Roman *dolia* may also serve as a comparison. Examples are known in the Aegean from the Late Bronze Age, and they are well suited to storing subsistence commodities, such as grain and wine.[811] Examples of straight-sided *pithoi* in domestic contexts in Egypt are known from Aswan and Elephantine.[812]

The lead containers from Thonis-Heracleion are closer to the Roman *dolia* with their bulbous shape. Container **no. 190** (Figure 1.5) is similar in shape and size to the *dolia* found on ships and on land from the western Mediterranean. The containers on the wrecks are specifically associated with a regional wine trade to Gaul, which was based at Minturnae in Italy,[813] and they are interpreted being developed in response to a need for bulk transportation of cheap wine. The earliest example, the Cap Bénat B, dates to the late 2nd to early 1st century BC.[814] The latest are from the middle of the 3rd century AD, with a distinct peak in *dolium* use onboard ships in the 1st century AD.[815] It should be stressed that this phenomenon of *dolia* on ships was short-lived and restricted to the western Mediterranean. The large size of the *dolium* has repercussions for its functionality.

[810] Curtis 2013: 67–9.

[811] Christakis 1999: 4; 2005: 53–9.

[812] For Aswan, see Müller 2010: 432, 442 fig. 5; for the straight sided storage jars from Elephantine, of smaller dimensions than the lead containers at 45–65 cm diameter and 62–78 cm high, dated to 550–400 B.C. (Phase V), see Aston 1999: 220 no. 1970, pl. 68 and b/w pl. 11; for two found in archaeological layers in house P associated with the reign of Nektanebo II (360–342 B.C., Phase VIa, house P), see Aston 1999: 266 no. 2305, pl. 85 and b/w pl. 14; for 4th to 3rd century BC (Phase VIa, house P), see Aston 1999: 270 no. 2337, pl. 87 and b/w pl. 15.

[813] Heslin 2011: 161.

[814] Parker 1992: 98 no. 173.

[815] Heslin 2011: 157, 158–9, table 9.1.

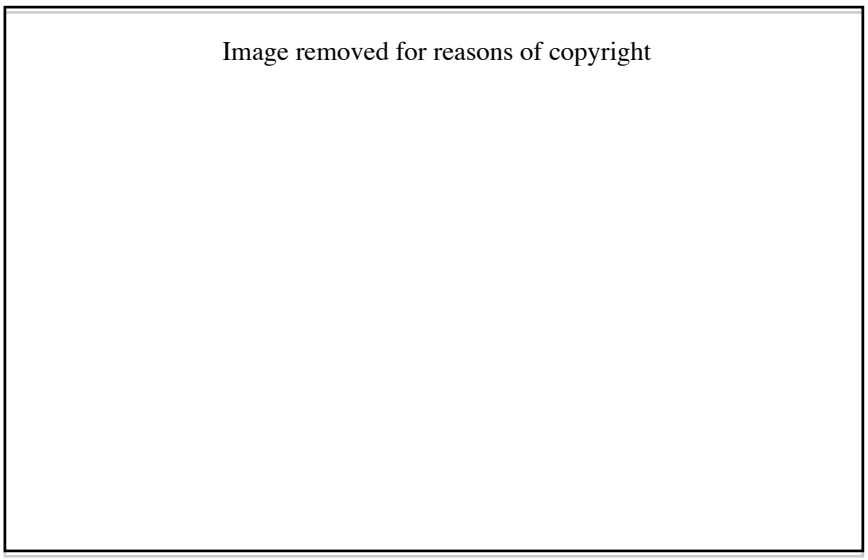


Figure 5.21 Reconstruction of Le Grand Ribaut D, from Gianfrotta and Hesnard 1988: pl. XLIX.

Large ceramic vessels occur either as permanent fixtures in a ship, or buried in the floors of warehouses with part of the vessel, or just the neck, protruding above ground.[816] They were generally left behind when a settlement was abandoned.[817] Artefact size influences the portability of objects, easing or complicating transport. The transportability of the large lead containers is thus an important consideration, due to the sheer mass both of the vessel and of its content. Like their ceramic counterparts, they are therefore likely to have been immobile or fixed, perhaps on a ship, or in a warehouse or other such storage context.[818]

Regarding accessibility and stability, the presence of the containers in the middle the Grand Canal could suggest that they were once part of the outfit of a ship, even if their diameters vary. The pattern of the 11 ceramic *dolia* from the Grand Ribaut D wreck,[819] for example, shows a variation in size; some being slightly larger than others, and a distribution in which the *dolia* are at the centre of the wreck while the spaces near the bow and stern are for amphoras (Figure 5.21).[820] The distribution within this wreck

[816] E.g. in warehouses in Ostia, see Heslin 2011: 159 fig. 9.1.

[817] Schiffer 1987: 95, fig. 4.7.

[818] For an analysis of the context of Cretan Bronze Age *pithoi*, see Christakis 2005: 53–9.

[819] Parker 1992: 203–4, no. 477.

[820] Gianfrotta and Hesnard 1987: pl. XLIX.

is three *dolia* per row, whereas Thonis-Heracleion shows a 'row' of two. The contents of these containers would be decanted using pumps and smaller containers.[821]

If this possible role as part of a ship's outfit is considered further, it should be noted that *dolia* were also better suited to riverine transport, e.g. in the Rhône valley, because they were able to carry more in less hold space than the equivalent volume in amphoras, making transport more efficient and accommodating to a hull with less draft, which is suited to shallow waters.[822] The majority of the wood samples from the wrecks in Thonis-Heracleion are of the local acacia tree, *Acacia sp*. and *Acacia tortilis/radiana*,[823] and for a certain number of the ships it is clear that the hull construction is very suited to the marshy and shallow water environment of the Egyptian Mediterranean coast.[824] The most important drawback, however, in interpreting the containers as part of a ship's equipment is the lack of associated timber that would indicate the presence of an accompanying hull. Consequently, the possibility that the containers were part of a ship's outfit remains hypothetical.[825]

Another possibility is that the containers were deliberately deposited in the water, if they were connected to rituals and therefore too sacred to reuse or recycle. Was sinking in the water perhaps the most convenient method to dispose of them, in the middle of the canal where the water may have been deepest? This interpretation, however, poses problems, as the act of removing them from a ship would be problematic due to the imbalance this would cause, perhaps enough to endanger even a wide, flat-bottomed riverine vessel.[826] Neither of these interpretations — part of a shipwreck or deliberate disposal — seems very likely or even plausible.

Returning to the storage of commodities from an economic and ritual perspective, it is possible to suggest a third interpretation. Storage facilities would have been

[821] Heslin 2011: 164–6; Christakis 2005: 54.

[822] Heslin 2011: 163; Pallarés 1985: 617–8; and Marlier 2008.

[823] Fabre 2011: 17–9; Gale et al. 2003: 335–6.

[824] Fabre 2011: 28–9.

[825] There is no sign of timber or other indication of a shipwreck near container no. **190**, just coins and ceramics, see Goddio 2007: 104, fig. 3.62.

[826] It is precisely the problem of potentially capsizing a ship as the result of the weight shift if a *dolium* fractures that may explain the limited use of this type of transport, see Heslin 2011: 161 esp. n. 10. The lead container no. **190** weighed approximately half a tonne, F. Goddio, personal communication.

necessary both for the daily provision of the sanctuary and for fulfilling the economic role of the temple in taxation. The wooden posts suggest a scenario with some form of harbour infrastructure; perhaps a pier that would provide a fixed environment for the large containers and would allow boats to berth and either take on or unload liquids from the large containers. The large quantities of fineware ceramics found in the Grand Canal support the idea of the canal as an area with much ritual activity. In this perspective, the lead containers can be interpreted as a storage facility managed by the temple for dedicatory purposes. The fineware cups and jugs found in the Grand Canal near the containers were perhaps used to decant the liquid kept in the large vessels,[827] possibly fresh water or wine.[828] Water seems most likely: water libation rituals are common in Egyptian temples.[829] Fresh water was an important commodity in a port city: demand would be high for drinking water in a harbour town at the edge of the sea, and the management of the saline seawater, the tides, and the Nile flood would also have been a major concern for Thonis-Heracleion, which was located at the interface between the sea, the Nile, and the town's canal system.[830]

The comparison with large ceramic containers provides a framework to interpret their function and use. Ceramic vessels of similar dimensions are mostly used for storage of foodstuffs. They are found in a fixed location — either buried in the floor or as a fixture in a ship and left *in situ* at abandonment. For the lead containers from Thonis-Heracleion, this suggests a similar storage context associated with a wooden mooring area and subsequent deposition *in situ*. A hypothesis was advanced that they were part of a storage facility for rituals, perhaps involving offerings of water or wine,

[827] Christakis 2005: 54.

[828] The text of four near-identical 19th dynasty donation stelae found in Gebel Silsileh mentions throwing offerings into the Nile, an act rarely mentioned in Egyptian texts, see Barguet 1952: 62–3 and n. 1.

[829] I give two examples of water rituals performed in the vicinity of a body of water: for barque sanctuaries see Colin 2005: 283–5; for the ramp of the reign of Taharqa leading to the water in Karnak, see Traunecker 1972. For libations in general, see Borghouts 1979.

[830] For a study on the role of water and its bountiful connotations connected with the Nile flood in the Hellenistic and Roman period, see Wild 1981. The examples discussed by Wild are of a different nature than the ritual proposed here, but it does demonstrate the importance of water as a concept in Egyptian (inspired) ritual. The discovery of the unique colossal Hapi statue (SCA 281), a male deity personifying the Nile flood, underlines the significance of the (veneration of the) Nile flood in this harbour town, see Goddio and Fabre 2008[2]: 105, 306 no. 102; Goddio 2007: 90 fig. 3.37.

conducted in the Grand Canal. It may be far-fetched to suggest that these could have involved ritual libations for a successful and safe journey.

5.4.2. Container no. 184

If the size of these large containers makes it likely that they were found *in situ*, as is argued above for the cluster of large containers in the Grand Canal, then the find spot of no. **184** at the entrance of the southern harbour of the temple island is an indication for assessing its function (Fig. 1.5). A lead vessel with two openings such as this one is reminiscent of force pumps found in mines and on wrecks that can be made of lead.[831] There is one example from Sierra de la Cartagena, Spain, from a mine.[832] A 2nd to 1st century BC (i.e. Roman) date is suggested for this area of the mine. A wooden case was present in this example, housing a complex set of tubes and valves.[833] The body of the vessel requires at least three openings for the mechanism to work, two from opposite sides and a central opening, this area resembling a Y-shape. It is possible that no. **184** is the Y-shaped part of the machine and the other aperture is not described, or the lead container itself houses a more complex internal structure in place of the wooden casing of the example from Sierra de la Cartagena. Even if this were the case, another aperture would have to be present. No internal structure within the container from Thonis-Heracleion was described in the database or in the daybooks of the excavation, nor is any other aperture mentioned. The comparison with a force pump is therefore a hypothetical suggestion pending further study of the container's interior. The container is, however, interpreted as being located on land, not in the water, which makes it less likely that it was a pump. The lead force pump from Spain is only slightly later than the date range suggested for no. **184**.

5.4.3. Containers 40–50 cm

This size range known from lead objects elsewhere, for example the lead tank from the Palace of Apries, the braziers from Bodrum, the basins in Pompeii (Figure 5.6),

[831] Stein 2004: 249, appendix 2.

[832] Measuring H. 80 cm and L. 74 cm, see Domergue 1990: 457–60, pls. XIIb and XXIIIa, fig. 36.

[833] Domergue 1990: 549 fig. 36, for a bronze example, see 548 fig. 35.

and the folded containers from the Rena Maiore wreck. The dimensions of the containers are still considerable and would suggest a fixed storage function, as argued above for the largest containers on the site.

The discussion of the largest containers with their cluster in the Grand Canal has demonstrated that a find spot in the water does not require the presence of a wreck, nor is the casual accumulation of rubbish a ready explanation for their presence.

Both container no. **214** and the one found on ship 17 have a closed bulbous shape, reminiscent of container no. **190**. Since they are large, it is likely that they fulfilled a similar storage function to the largest containers from Thonis-Heracleion. The connection with ship 17 is interesting in terms of context: no other container has yet been found in association with a ship. Undoubtedly, more will be found as more ships are excavated, similar to the instances in wrecks elsewhere in the Mediterranean.

5.4.4. Buckets

Evidence for the dating of the lead containers deriving from their spatial distribution and the presence of other objects nearby seems to indicate a 4th century or early Hellenistic date. From Egypt, one parallel for the shape and size of the lead containers is found in F.W. von Bissing's 1901 catalogue of metalware in the Egyptian Museum in Cairo.[834] This is a well-preserved bronze vessel said to be from Luxor, with a round base and straight, flaring walls. It has a pictorial composition running around the vessel under the rim of which no clear picture is published, only descriptions mentioning three divinities facing right: Amun-Min, a second deity (possibly Atum or Osiris), and Harpokrates. Behind Amun-Min there is an altar, and between the deities are clusters of lotus flowers.[835] On the other side of the vessel there is an *ʿnḫ* sign. To Maspero, the style of the inscription was Ptolemaic and von Bissing agreed with this date. The container is 23.3 cm in diameter and 15.0 cm high, offering a good parallel for the size and shape of the lead containers, while the inscription provides a broad date.

[834] Von Bissing 1901: CG 3542 with image; and Maspero 1883: 387–8, no. 5674.

[835] Sign M16, Gardiner 1957[3]: 481.

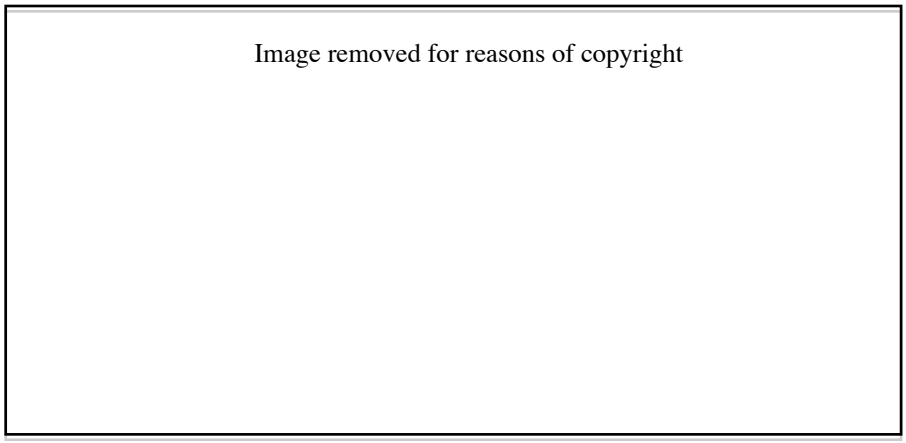


Figure 5.22 Bronze buckets from Pompeii (no. 8039 = 18.6 cm in diameter), from Tassinari 1993 (ii): 299.

A more distant parallel in time and place can be found in Pompeii. S. Tassinari's catalogue of the bronze vessels from this Roman town includes several bucket shapes of type W in her typology,[836] but no. 8039 is the only one with a similar rim.[837] It is from the Casa del bell'Impluvio (I,9,1).[838] The bucket-shaped container with a curled rim is very similar to the larger containers from Thonis-Heracleion (Figure 5.22), it measures 18.6 cm in diameter and 14.8 cm in height. Room 2, a small room of the main house where the container was found, was a shop: it has an opening to the street as well as a door to the main house. The piece was one of a larger range of metal vessels found in this shop together with a human skeleton.[839] The shop has therefore been interpreted as that of a *faber aerarius*, a metalworker,[840] with the group of metal vessels being the current stock. They would be contemporaneous with the eruption in 79 AD, not antiques, and thus much later than the examples from Thonis-Heracleion. The presence of these vessels in a room identified as a shop also precludes any potential conclusions about their use after sale.

The clustering of containers at the edge of the water at the eastern end of the Grand Canal at Thonis-Heracleion should be considered further (Figure 5.12).[841] This

[836] Tassinari 1993 i: 106–7.

[837] No. 8039, Tassinari 1993 i: 137 n. 5.

[838] Della Corte 1913: 35; Eschebach 1993: 48; PPM I: 919.

[839] Gassner 1986: 132.

[840] Gassner 1986: 23 n. 77.

[841] See also the excavations in H2 and H4, which are in the vicinity but not directly related, see Goddio 2007: 74, fig. 3.6; 103, fig. 3.61.

patterning is distinctive, even though it is not unusual to find many metal artefacts in the waterways. This area has a concentration of anchors in the canal and four sunken ships in the vicinity, which may indicate a preferred space for mooring.[842] The presence of limestone blocks suggests that there was a sharp, man-made boundary between water and land, and the remains of this structure may have facilitated the clustering of objects in this area, instead of a more general dispersal. Many bronze and gold objects were found here,[843] and the excavator suggests that they are indicative of ritual activity connected with the temple of Amun nearby, which was the principal monument of the town.[844] The bronze objects include ladles and mirrors normally associated with rituals.[845] The density of gold objects on the landside of the area is higher than anywhere else on the site. It is tempting to associate the lead containers discussed here with the patterning of bronze cult instruments and gold objects. One of the containers (no. **229**) had bronze objects trapped within, perhaps pointing to a role in a ritual.

The excavators suggest there was ritual activity on this canal connected to the adjacent temple. The one example of the folded container (no. **229**) with the bronze objects in the interior could point to a role in ritual for this shape of container. This is, however, the only lead vessel in the whole corpus from Thonis-Heracleion that had other metal objects inside it. The first area with a concentration of lead containers is at the water's edge, at the entrance of the Grand Canal in a highly conspicuous part of the town. Near its administrative and religious centre, there is a concentration of gold objects and bronze ritual instruments, as well as lead containers spread across the edge of the land and in the water itself. The nature of the objects, combined with their concentration, is such that ritual activity is surmised. For example, the majority of the ceramics in the area around the large containers in the Grand Canal (see Section 5.2.1) are fineware in shapes for drinking, such as goblets, with a notable absence of amphora sherds and other transport containers and coarse wares.

A similar ritual purpose may also be suggested for the other buckets in the Grand Canal (see Section 5.3.2.2). Lead barks, oil lamps, and ladles were found in the water in

[842] Goddio 2007: 107, fig. 3.68.

[843] See Goddio 2007: 124-5, figs. 3.102–4.

[844] Goddio 2007: 124–5, figs. 3.102–3.

[845] Robinson 2009: 48–9, fig. 34; Goddio 2007: 109, fig. 3.71, 124–6.

this area, as well as the folded lead containers (Figure 5.18). It is likely that the lead barks, which do not have a practical purpose, were deliberately deposited in the water. I would argue that this possibility also extends to objects found in their vicinity. In this part of the North Passage no ships have been identified. The oil lamps and ladles also do not point towards an economic explanation for the lead containers in this area. Ceramics in the vicinity do include amphoras, but more detailed analysis is required before more definitive statements can be made. Ritual deposition of objects in water is mentioned in the Book of the Temple, where in connection with the cult of Osiris the text seems to suggest that the 'old' Osiris figurines, which were disposed of annually, may have been thrown in a temple's sacred lake to make place for new ones.[846] J. Quack addresses the ritual renewal of Osiris figurines and the act of throwing in the water.[847] This concept is well attested in texts and should be interpreted as a burial, or a ritual destruction. According to the Book of the Temple, cultic spaces associated with Osiris were usually located outside the main temple building, although still in an area with restricted access.[848] The lead objects – containers, barks and so forth – are not Osiris figurines, but the texts demonstrate that the act of throwing items in the water was a option, especially in an Osirian context. Nautical processions between Thonis-Heracleion and East-Canopus for the Khoiak festival are mentioned in the Canopus decree, and it is highly likely that these passed through the Grand Canal.[849] Their find spot just north of the temple was close to the temple and a very visible location (see Section 5.4.4). The shift in pattern from further east and north in the North Passage to the Grand Canal may be explained by the construction of the adjacent temple in the 4th century BC, after which the focus moved there.[850]

[846] Quack 2010: 25 ff.

[847] Quack 2000/2001: 12, 14. 15.

[848] Quack 2010: 24, 28.

[849] Travel of the deity during a festival is known from elsewhere, for example between Dendara and Edfu, see Fairman 1954/55: 196ff. Fairman pointed out that these ceremonies have features of harvest festivals, but that many of them were Osirianized in the Ptolemaic Period, see Fairman 1954/55: 200.

[850] For sanctuaries on the islands in the North Passage, F. Goddio, personal communication.

5.4.5. Folded containers

In total nineteen folded containers have been recovered from Thonis-Heracleion; ten of these, or half of the corpus, have diameters of 4–7 cm. The folded containers all concentrate in the North passage.

An Egyptian parallel for this practice of folding containers is found in the temple treasure of Tod, in the Nile valley in Upper Egypt.[851] In 1936 the treasure was found in four boxes in the sand foundations of the Middle Kingdom temple of Senwosret I (c. 1965–1920 BC).[852] Several silver dishes had been folded flat in a manner similar to the examples from Thonis-Heracleion (Figure 5.19).[853] Although the silver vessels are much earlier than the lead containers from Thonis-Heracleion, they show that the practice of purposefully and ritually folding containers is not unique to that site. The folding and the underwater deposition strongly suggest that containers were purposefully removed from the normal cycle of reuse and recycling, sealing objects off after ritual use.

5.4.6. Thoughts on the cultic connection: lead objects inside or outside the temple?

Finally, the concentration of objects, lead, bronze, and gold, at the entrance of the Grand Canal, both on land and in the water, warrants a broader perspective on the temple of Amun-Gereb (H1) and the surrounding structures.[854] More specifically, the area to the north of the north central temple wall immediately adjacent to the Grand Canal is enigmatic, as the walls do not align with others in the temple. In this area were found several lead buckets, two larger lead containers, and numerous square lead weights.

[851] Bisson de la Roque 1950: 10, nos. 70541–4, also 70547, 70553, 70555, 70557, 70563, 70565, and pl. X; Kemp and Merrillees1980: 295 and n. 724.

[852] Bisson de la Roque 1950:ii; Bisson de la Roque et al. 1953: 7.

[853] Especially no. 70541, which acquired a similarly elongated shape as a result.

[854] Called the northern zone, see Goddio 2007: 96–100, figs. 3.48 and 3.54.

The temple of Amun-Gereb is only preserved to a few courses of masonry,[855] with most of the construction material and architectural remains absent. Reconstructions therefore have to be based on the alignment of walls and the presence of remains of statuary. I propose that the temple was most probably on an east-west axis, as is usual for Egyptian temples, with the entrance of the temple oriented towards the east.[856] The south wall and centre-north wall are aligned on the same axis and seem to form a rectangular shape suitable for a temple. Interpreted in this way, the southern temenos wall and the centre-north wall of the temple[857] would be its outer walls. A north-south axis is also possible, but unusual for Egyptian temples. Furthermore, the walls of the temple would form at best a square enclosure, which is also unusual, if all the remains of the walls are considered part of the temple itself.

The possibility of an east-west axis is perhaps strengthened by the observation that the similar stratigraphy on either side of the centre-north wall is at different heights, suggesting a different context.[858] The temple pylon, typically with depictions of the ritual smiting of enemies,[859] would in this case have been very visible to traffic travelling to the port city from North passage to the town. The naos, other statuary, and stela were found in the central temple area.[860] This leaves the walls to the north of the centre-north wall open to interpretation.[861]

Visually, the area to the north of the temple is very prominent. Any structure built here at the junction of the harbour basins, the main temple, and the Grand Canal would have been would have played a significant role in the cultic landscape of the town. The area encompasses a number of walls, some of which separate the land from the surrounding water. North of the centre-north wall many wooden posts were found, suggesting a wooden structure.[862] At the far north of this area three large heaps of limestone blocks were found, surrounded by water to the west, and are interpreted as

[855] Goddio 2007: 76-77 fig. 3.8, and for photographs of an interior wall see Goddio 2007: 82 figs. 3.17–3.19.

[856] Arnold 2003: 167–8.

[857] Goddio 2007: 78–88, figs. 3.9 and 3.20.

[858] Goddio 2007: 83.

[859] Arnold 2003: 183.

[860] Goddio 2007: 90 fig. 3.37.

[861] I.e. the east wall, the western walls, and the mid-west wall, see Goddio 2007: 93–100.

[862] Goddio 2007: 83 fig. 3.20.

the (remains of) pillars.[863] The alignment of the heaps of limestone extended to the east, with what is described as the remains of a great wall. On the inside of this wall, finds include the lead containers, bronze ritual objects, many gold and silver coins, fine pottery, pieces of statuary, and a wooden naos.[864]

I present two scenarios for this area. If the axis of the main temple is east-west, as proposed above, the area to the north would be part of a different structure from the temple proper. The presence of the wooden naos, the ritual objects, and the gold foundation plaque have been used to interpret this northern area as part of the temple or as a different, separate sanctuary for Khonsu,[865] such as a *mammisi* (birth house). This smaller temple would be dedicated to the child deity in the local triad. In the case of Thonis-Heracleion the triad is Amun-Gereb, the main god of the temple, typically with Mut as female consort, and Khonsu the child.[866] The axis of a *mammisi* is normally at a right angle to that the main temple with its entrance facing the main temple axis.[867] This poses two problems. The naos and other cult objects would be located at the rear in the interior of the temple, near the Grand Canal in the case of Thonis-Heracleion, whereas most of the objects, including the naos, were found on the southern side of the northern wall. Moreover, the closed exterior walls of an Egyptian temple would hardly make the most of the prime location of this area.

Another scenario for this area is that they are the remains of a platform or terrace for cultic activities. This innovation in temple layout was first introduced in the New Kingdom during the reign of Ramesses II, but only became a popular feature under the Ptolemies.[868] This development is interpreted as a response to a change in cultic practices. A platform outside of the temple allows larger numbers of people, who would not have access to the temple itself, to participate in rituals or interact with the deity.[869] Examples of these platforms are found in the Nile valley, where the best-preserved temples are. Arnold remarks that this discrepancy may be due to ritual practices being

[863] Goddio 2007: 96 fig. 3.48.

[864] For distributions, see Goddio 2007: 124–5 figs. 3.102–4.

[865] F. Goddio, personal communication.

[866] Guermeur 2005: 140–2.

[867] Arnold 2003: 33; Arnold 1999: 285–88, table 3.

[868] Arnold 1999: 288–92, esp. table 3.

[869] Arnold 1999: 292; Jaritz 1980: 59–65.

different in Lower Egypt.[870] The absence of cultic platforms north of the Fayum may, however, be simply the result of the poor preservation of temple complexes in the north of Egypt, and it is not in itself evidence of different ritual practices.

Defining features of such platforms are elevation from the river and accessibility via a ramp, and they occur at the bank of the Nile or of a canal.[871] They had three exterior masonry walls and often protruded into the waterway. Consequently, they may have also been misinterpreted as landing areas or quays.[872] Stairways leading down to the water are a regular feature,[873] as well as a processional way or dromos connecting the platform to the main temple. At Thonis-Heracleion, there is little space for such a processional way. Objects on the cultic platform may be several *naoi*, stelae and obelisks, as is known from the cultic platform at Elephantine from the reign of Augustus.[874] Jaritz suggests that in Roman times the terraces fulfilled a similar function to the Hellenistic agora as a meeting place for cult practices and marketplace.[875]

The location of this area to the north of the temple, with its natural focus on the waterways, is ideal for such a terrace or platform for people to gather when the deity leaves the temple and as a marketplace. Processions between the Osiris temple at Canopus and the Amun-Gereb temple in Thonis-Heracleion during the Khoiak festival are known to have taken place from their mention in the Canopus decree.[876] These processions would have involved the cult statue and its entourage leaving the temple and embarking onto a boat. This embarkation would have been in an area close to the temple. There is a jetty just to the west of the walls of the proposed terrace that would be an obvious candidate for this purpose. All examples of these cultic platforms, however, are on the axis of the temple, which would in turn require the temple to be on a north-south axis. Nonetheless, this remains an attractive hypothesis as it explains

[870] Arnold 1999: 291.

[871] For the ground plans of several temples and their terraces or platforms, see Jaritz 1980: pls. 50–1.

[872] Arnold 1999: 288.

[873] Arnold 1994: 178.

[874] Jaritz 1980: 60 fig. 29.

[875] Jaritz 1980: 63.

[876] Pfeiffer 2004: 144-162; processions of deities as well as travelling priestly delegations between temples during festivals are known, cf. Alliot 1954: 474; a nautical procession was also undertaken at Dendara during the Khoiak festival, see Chassinat 1966: 64 §XIII.

the patterning of objects recovered in the area — a wooden naos, cultic instruments associated with libations (ladles and buckets), as well as the small weights discussed in the previous chapter — and the strategic location and openness of the terrace. It would have been a focal point for festivals in a way that a closed Egyptian temple by its nature could not be. It would have formed an important space in front of the temple where transactions could have been made similar to other terraces and *dromoi* and processional avenues in Egypt.

5.5. Conclusions

This aim of this chapter has been to do several things: to show the diversity of the sizes and shapes of the lead containers, to establish a dating framework, to assess function and role through a typology and spatial distribution, and finally to understand the (post-) depositional processes affecting the containers.

The corpus from Thonis-Heracleion is the largest from any site in the Mediterranean. In the absence of an existing typology, it was first necessary to break the assemblage into smaller groups. Measurements of the diameter form the basis of the division, due to the underlying relationship between function, size, and shape of the containers. The other important parameter is the mass of the metal containers, the heavier being the more inherently expensive. Geographical distribution then seems to indicate a chronological development in some cases (see Section 5.3.3).

A robust framework for several categories of containers was established through analysis of the ceramics and coins found in their vicinity. The archaeological context was not a closed one, but general patterns of ceramics across the site were used to show the deposition of these lead containers from as early as the beginning of the 4th century BC to the abandonment of the site around the middle of the 2nd century. One container on ship 17 may be as early as the mid-5th century BC.

The discussion of the archaeological context is also significant in view of the limited numbers of lead containers known from other sites in antiquity. The earliest larger objects are the lead braziers from Bodrum, Turkey, dated to the late 2nd or early 1st century BC on the basis of comparative material. It is, however, clear from the broad chronological boundaries established for Thonis-Heracleion that the lead containers from there are much earlier than the braziers from Bodrum. There are,

however, smaller lead containers from Saqqara and Olynthus that are of the 4th century BC.

The lack of comparable material for the dating and interpretation of these containers make it difficult to establish their function. In view of their size, the largest examples are interpreted as metal storage containers. Ceramic containers such as *pithoi* and *dolia* typically occur in fixed environments such as floors and as fixtures in a ship. They are also mostly left *in situ* at abandonment. Parallels from wrecks in the western Mediterranean show that containers of this size were used for the transport of (and trade in) wine and that their size made them suitable for ships traveling in shallow rivers. Bronze cauldrons are known from Nimrud from the 7th century BC. Thus, in the absence of signs of a shipwreck the location in the middle of the Grand Canal and closeness to wooden posts suggests a fixed environment, perhaps a pier. This structure may have been used in festivals concentrating on the cultic platform to the north of the temple and processions on the Grand Canal. Liquids such as fresh water or wine could have been stored in the large containers and decanted into the fineware cups, which were then deposited in the canal.

The location of the 'buckets' at the north of the temple just in the water also suggests a role in rituals. Perhaps rituals were conducted on (boats on) the Grand Canal and the buckets thrown in the water, or on the platform after which the buckets were dumped over the edge of the platform into the water. Distortion makes it impossible to establish the volume measure of the buckets, but the uniformity of their shape strongly suggests standardization. The changing ratio of diameter to height in the buckets connects with a general chronological trend established through ceramics at the site and may provide a seriation of the bucket shapes.

The distribution of these containers shows a distinct pattern of deposition in an underwater context in antiquity that fits seamlessly in the general pattern of metal finds for the site. This is likely the result of depositional processes in which the object disappeared underwater and was therefore unavailable for normal recycle and reuse. The number of lead containers from the site is therefore not a direct result of any special feature of the town or of the nature of the activities there, but rather a reflection of the site's physical characteristics.

Evidence from Egypt suggests a ritual context for lead containers, whereas previous evidence from the eastern Mediterranean pointed towards a purely nautical use for larger lead objects such as containers and braziers. The evidence from Thonis-Heracleion shows both ritual and purely functional contexts. For the largest containers, including one from ship 17, the most likely explanation is storage, probably connected to remains of wooden structures in the water. The buckets and the practice of folding, especially in the North Passage, suggests that these containers were involved in rituals and were deliberately then put out of use.

The diversity of lead containers revealed in Thonis-Heracleion shows a level of familiarity and pervasiveness of the metal, or in other words metallisation, that is not generally appreciated for antiquity. Thonis-Heracleion slots into those settlements that are considered to have exceptional assemblages, such as Olynthus and Pompeii. Perhaps it is time to acknowledge that we do not know enough, and not enough is preserved, to understand the level of metallisation of normal life in a settlement in antiquity. What is considered exceptional at sites such as Pompeii and Thonis-Heracleion may be closer to the norm in its richness than generally appreciated. It is difficult to maintain instead, that certain objects, such as lead containers were only used on ships, or used instead of ceramics on ships because they would be less liable to break.

CHAPTER 6. CONCLUSIONS

6.1. Summary of findings

At the onset of this project the goals were twofold: to establish a dating framework for the lead artefacts and to explain the presence of this large corpus of lead in Thonis-Heracleion, an Egyptian port city of the Late Period. Four interdisciplinary chapters have dealt with the appearance of lead in Egypt and from this port city in the Late Period, from which three distinct categories within the corpus have been highlighted. Combining these different strands provides a narrative for the presence of the large and diverse assemblage of lead objects from this port city. Two central arguments were advanced: firstly that the large quantity of lead artefacts in Thonis-Heracleion is not exceptional but rather an accurate reflection of the metallisation of ancient societies; and secondly that due to its deposition underwater the corpus of lead objects sheds light on aspects of ancient communities that normally remains invisible due to the ease of recycling.

The first chapter took a broad perspective on the presence of lead in Egypt until the Roman period before comparing the results with the lead corpus from Thonis-Heracleion. The chapter started with a review of the earliest lead metallurgy and proceeded to give an overview of lead in Egypt in both written and archaeological sources. The overview in this chapter updates and expands all previous treatments of lead in Egypt. It shows that many object categories seen in Thonis-Heracleion do, in fact, have parallels from Egypt, including lead containers, weights, plumb bobs, oil lamps, and miniature vessels, although these are found in very limited numbers.

Each of three case studies deals with a large category of lead objects within the corpus. Individually, they elucidate the role of Thonis-Heracleion from different angles. The chapter on lead ingots surveys the trade in lead through lead ingots known from around the Mediterranean, before focussing on the sample from Thonis-Heracleion and their direct parallels. Lead ingots of the Late Bronze Age are known from reliefs in tombs of the New Kingdom and archaeological specimens from the Levantine coast. The closest parallels in shape for the loaf-shaped ingots from Thonis-Heracleion are

those from the Porticello wreck and a lead bar from Olynthus. Both ingots are from the first half of the 4th century. The ingots from Thonis-Heracleion were spread out over a fairly large area from the North Passage to the west of the site via the Grand Canal. A 4th century dating for these ingots is very likely, especially when the trade links between Athens and Egypt are considered.

The links are made visible in the lead weights themselves, which contains the first Athenian weights found in Egypt. This study contributes to Greek metrology as it is a significant addition to the corpus of Greek weights. They are well preserved and provide valuable data to support the 112 dr/m standard in the Attic system. The relatively precise dating was established through cross-referencing with other published weights. The weights without markings and symbols were divided according to shape. The Greek-style square plinth-shaped weights are in the majority, with a concentration in the area just north of the temple. They were perhaps used in small-scale transactions that took place in this area, if my suggestion that it is a cultic terrace is correct. The Greek weights date to the 4th and 3rd centuries BC, a dating that is independent of local archaeological evidence. The small, uninscribed Greek-style weights are probably 4th and 3rd century BC. Egyptian cupcake-shaped weights were found in the northern parts of the site, that is, the North Passage and other areas north of the Grand Canal. They are difficult to date as the Egyptian weight standards were very stable, but their spatial distribution in the north of the city may suggest that they belong to an earlier period than the Greek weights.

The containers are a new category of lead objects. Due to limited numbers known from the ancient world they have not been studied in any coherent way, with the lead braziers in Bodrum being an exception as they belong with the larger group of ceramic braziers. If one takes the chronological boundaries given by the ceramic assemblage into consideration, it is clear that the lead from Thonis-Heracleion predates the mid-2nd century BC. Furthermore, the general increase in numbers of lead objects around the Mediterranean from the 6th century BC onwards gives a rough upper chronological boundary. The ceramic and numismatic assemblage in the vicinity of groups of containers allows the dating to be narrowed down for certain groups of containers, such as the large containers in the Grand Canal.

Examination of all the evidence from Thonis-Heracleion has repercussions for the dating of lead objects in general. As discussed in chapter 4, a blanket dating of 'Roman' is often employed for larger objects made of lead without a definition of the chronological boundaries. Direct parallels for the material suggests that the dating of the corpus of lead objects should be extended further from perhaps no earlier than second half of 5th century to the abandonment of Thonis-Heracleion in the mid-2nd century BC. The upper chronological limit is based on the parallels of the Porticello ingot, the containers in Olynthus, and the excavated container in ship 17. The 4th and 3rd century BC is firmly established through the lead weights that bear symbols and markings.

The exploratory chapter on lead in Egypt and the three chapters on different categories address the place of lead in this port city during the Late Period. The majority of the lead objects were found deposited in areas identified as ancient waterways. This is likely to be the main reason why the lead corpus from Thonis-Heracleion is much larger than the small numbers of lead objects elsewhere. The nautical dimension of lead objects found on shipwrecks in the Mediterranean is much less evident or pronounced in Thonis-Heracleion, as very few ships have been excavated so far. The processes resulting in underwater deposition are more difficult to identify in individual cases. Some objects have a clear ritual connotation, such as the lead barks and metal ladles. The pattern of these objects mirrors the pattern of the Athenian weights for example, and suggests a ritual deposition for these weights instead of an accidental drop overboard. The deposition in water suggests that deliberate ritual burial also may have been intended for more containers than just the folded examples, such as the buckets in the North Passage. Normal rubbish disposal processes, where unwanted or worn-out objects are deposited in waterways, or where items are accidentally dropped into the water and then lost in the silt at the bottom of the canals, cannot be discounted.

The underwater deposition thus affords a sample of metal objects in circulation in an Egyptian settlement, albeit one at the interface between different peoples and perhaps through the position on a trade route, one that had a more than average access to metals. This interpretation is reinforced by the presence of many different categories of lead objects already known from Egypt but in much smaller numbers than in Thonis-

Heracleion. The majority of the more than five hundred lead objects from Olynthus are sling bullets, but there too many different categories of lead objects were present. It is only the number that is extraordinary, not the diversity. Lead objects also take their place in ancient society at an earlier date than previously known. Evidence from Thonis-Heracleion shows that by the 4th century BC lead was present in significant quantities, and that this development may have started in the last half of the 5th century BC.

6.2. Evaluation and future prospects

The French excavators at Thonis-Heracleion selected the topic of this thesis. It is a large and exceptional group of material at the site, and lead is not generally present in large quantities on archaeological sites. The objects themselves are often overlooked in museum collections and only summarily mentioned in excavation reports. It was, therefore, clear that analysis of the lead corpus was a novel and intriguing doctoral topic for someone who would enjoy working with a disparate data set. Focusing on objects made of the same material instead of a coherent group of objects made of diverse materials has influenced the internal cohesion of the thesis, but this is the result of the constraints placed on the project.

Initially, the aim was to incorporate all the lead objects from the site. The scope was narrowed as the diversity and extent of the corpus became clear during the course of fieldwork. Choosing categories out of a larger corpus was required in order to balance the number of objects and the scope of each category with enough analytical depth for a new contribution in each category. The choice of types of objects was influenced by the topic of S. Heinz' research on amulets and votives, objects with a clear religious connotation. As a contrast I chose to work on categories associated with trade and transport. A future publication on the lead objects from Thonis-Heracleion would incorporate more categories of lead objects than those presented here and it would include a contribution on lead amulets and votives from the site.

I concentrated on finding parallels in order to date the lead objects and using spatial distributions to identify significant groups. The direct archaeological context of the finds is only discussed in some cases, e.g. the large lead containers, where the daybooks from the excavation mention only a selection of the objects discovered per

day. In most cases, the lead objects are relatively small and unremarkable and they are recorded without mention of any specific context. The absence of readily available parallels for most lead objects meant the focus was on the presence of lead at the site, their spatial distribution and dating, and putting the material into a wider Mediterranean context.

The strengths of this research lie in the combination of the results obtained from each individual chapter. It is a study of lead at a single site, which fills a gap in existing scholarship. It shows that the use of lead as a material on a large scale is much earlier than previously realised and that the impressive range of objects from the site is not exceptional. There are parallels for many of the categories in Egypt as well as elsewhere in the Mediterranean, but the number of objects at Thonis-Heracleion is truly remarkable.

Future research should concentrate on procuring more detailed stratigraphic contexts of the material, which will undoubtedly follow now that more targeted excavations are being conducted at the site. Clarification of the archaeology of the North Passage with its sanctuaries on the islands and continued collaboration will aid in determining whether or not the containers are ritually deposited. Other categories of objects not discussed in this thesis have much potential, such as the anchors and the oil lamps. The anchors are most informatively studied in a research project, focusing on nautical equipment and ships. The corpus of oil lamps considered as a whole should include the bronze and ceramic examples. Another exciting new avenue is the scientific analysis of the metals that will elucidate technical questions such as the alloys used and how they were manufactured, as well as the potential issue of the scale of recycling of lead at the port. The present study aims to put the corpus of lead on the map in Thonis-Heracleion as well as the broader Mediterranean in broad brushstrokes, while filling in more detail in three selected areas — ingots, weights and containers. Further research is required to expand the work into a broader material culture context at the site. It is my hope that this work will provide a useful stepping-stone for others.

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The Place of Lead in an Egyptian Port City in the Late Period

A Thesis submitted for the Degree of Doctor of Philosophy

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Volume 2 – Catalogue

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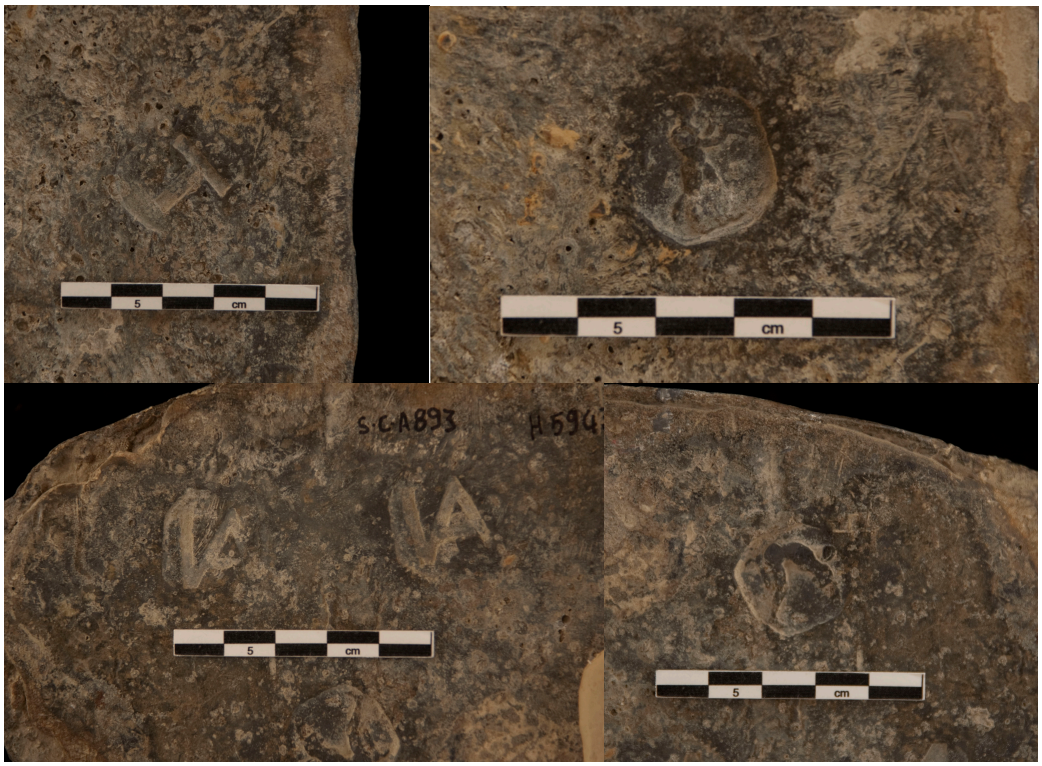
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CATALOGUE TO CHAPTER 3: INGOTS

Loaf-shaped ingots

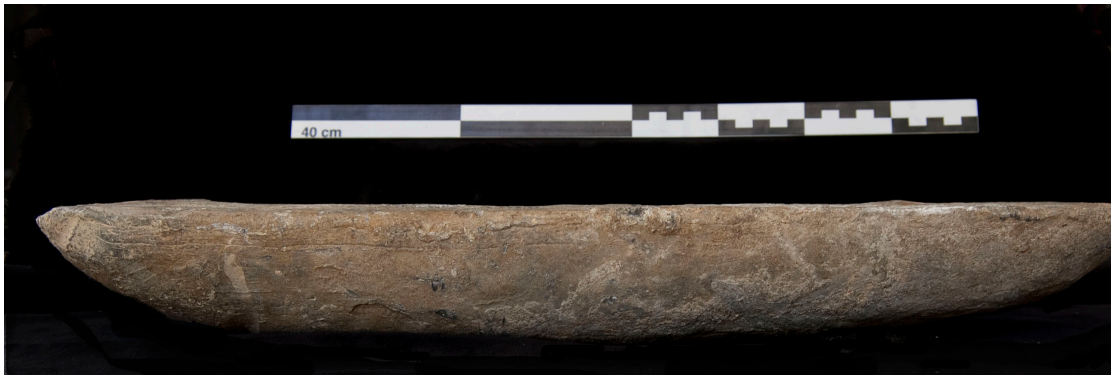


Number 1

Dimensions: L. 46.9 cm; W. 11.0 cm; H. 6.0 cm
Lead, 23,000g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.5943 (SCA 893)
Provenance: Aboukir Bay, found on a jetty near the central basin.
Complete.

Loaf-shaped ingot, semi-circular in section, multiple pouring layers visible on the side. The base has 7 stamps, all in a hectagonal shape. Three groups of 2 identical stamps: IA monograms, or NA; two athletes, two lute players and one stamp with a T.

- Goddio and Fabre 2008[2]: no. 357.
- Cf. Porticello C35, Eiseman and Ridgway 1987: 54–60, figs. 4-19, 4-20, and 4-21.



Number 2

Dimensions: L. 51.0 cm; W. 10.5 cm; H. 6.0 cm
Lead, approx. 23,000g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.5944 (SCA 1128)
Provenance: Aboukir Bay, found during prospection, no coordinates recorded.
Complete with a hole in the flat base, good preservation on one half of the ingot, other half loss of original surface.

Loaf-shaped ingot, semi-circular in section, with a partial stamp on the rounded top of the ingot. It is a part of a triangular stamp with two diagonals in the central space. Discuss There is a hole in the base with an empty space extending into the ingot around 3–4 cm deep. Numerous striations indicate the partial solidification/drying of the lead when pouring in mould on the short side of the ingot with the stamp.



Number 3

Dimensions: L. 48.2 cm; W. 12.0 cm; H. 6.0 cm
Lead, 22,000g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10000 A
Provenance: Aboukir Bay, found in the southwest of the site near harbour.
Complete, white with many marine encrustations and shells.

Loaf shaped ingot, semi-circular in section, no lead visible except at the bottom and partly around the edges and some patches on the top. No markings visible.

Number 4

Dimensions: L. 48.1 cm; W. 11.9 cm; H. 6.0 cm
Lead, 20,900g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10000 C
Provenance: Aboukir Bay, found in southwest of site near harbour.
Complete, smooth and dark grey (cleaned?), no encrustations.

Dark grey ingot, semi-circular in section, layering of the lead due to pouring in the mould. Some parallel marks along the long side and on top, perhaps tool marks. Some marks at one end parallel lines along the length and a *pi* shape, i.e. three strokes at right angles.

Number 5

Dimensions: L. 47.1 cm; W. 11.9 cm; H. 6.0-6.7 cm incl. encrustations
Lead, 20,100 g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10000 B
Provenance: Aboukir Bay, found in southwest of the site near harbour.
Complete, white with many marine encrustations and shells.

Loaf shaped ingot, shape clear, no lead visible except for one part to the end, about one third of the object. Encrustations include pottery sherd. No markings visible.

Number 6

Dimensions: L. 46.2 cm; W. 11.3 cm; H. 6.0 cm
Lead, 17,470g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6128
Provenance: Aboukir Bay, found in Grand Canal.
Complete, smotth surface after cleaning, some vague remains of marine encrustations.

Loaf shaped ingot, semi-circular in section, no stamps, no marks. Base rougher than no. 7 sections, possibly just marine encrustations, the other surfaces are smooth.



Number 7

Dimensions: L. 48.7 cm; W. 11.0 cm; H. 6.0 cm
Lead, 17,230g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9137
Provenance: Aboukir Bay, found in North Passage.
Complete, smooth surface, some remains of marine encrustations.

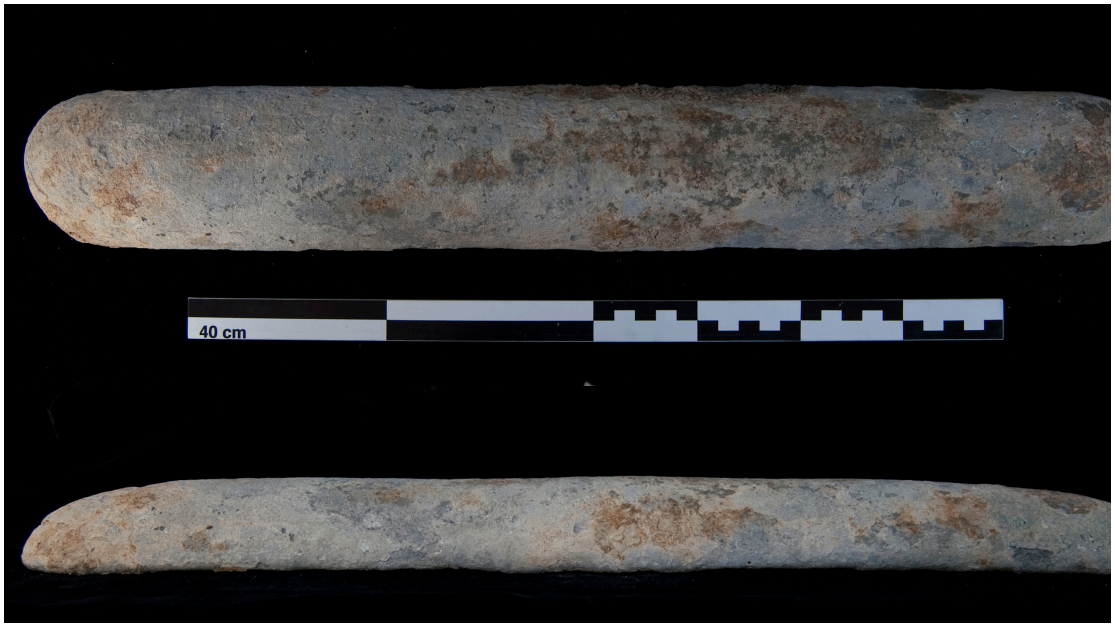
Lead ingot, semi-circular in section, layering and striations on one short ends is an indications of the lead being poured in the mould.



Number 8

Dimensions: L. 53.0 cm; W. 9.5 cm; H. 6.5 cm
Lead, 16,800g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6789
Provenance: Aboukir Bay, found on jetty near central basin.
Complete, but with a rough surface with marine encrustations.

Loaf shaped ingot, semi-circular in section, one edge sloping upward, and a relatively slim width. Some shallow, thin cut marks visible in the rounded top of the ingot, aligned to the length of the ingot. Shallow depression in one area on rounded top, the flat surface slopes up towards one short end.



Number 9

Dimensions: L. 57.0 cm; W. 8.0 cm; H. 4.0 cm
Lead, 13,129g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9731
Provenance: Aboukir Bay, found on land on the north bank of the North Passage.
Complete, remains of marine encrustations on the side and bottom/base.

Loaf shaped ingot, semi-circular in section, very regular shape, elongated compared to the other examples and flatter. Regularly shaped and the base is flat.



Number 10

Dimensions: L. 46.2 cm; W. 9.9 cm; H. 3.0 cm
Lead, 5,990g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9519
Provenance: Aboukir Bay, found during prospection.
Incomplete, eroded remains of ingot.

Eroded remains of ingot, the original surface is still present at the base.

- Cf. Porticello C34, Eiseman and Ridgway 1987: 53-4, figs. 4-17 and 4-18.



Number 11

Dimensions: L. 43.0 cm; W. 7.0 cm; H. 2.5 cm
Lead, 3,630g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9999
Provenance: Aboukir Bay, found in the southwest of the site near harbour.
Very worn and rough, only parts of original bottom remains.

Remains of ingot, no original surface except part of the bottom, chisel marks on bottom? And remains of large hole in bottom.

- Cf. Porticello C34, Eiseman and Ridgway 1987: 53–4, figs. 4-17 and 4-18.



Number 12

Dimensions: L. 23.3 cm; W. 12.0 cm; H. 4.7 cm
Lead, 1,386 g
Maritime Museum, Alexandria; Exc. No. H.2006.XX.9611
Provenance: Aboukir Bay, found during prospection.
Incomplete.

Two layers, pottery layer approx. 2 cm, and lead (?) slag, which is rough and porous, approx. 0,8 cm thick.



Number 13

Dimensions: L. 21.2 cm; W. 2.3 cm; H. 1.1 cm
Lead, 247g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8108
Provenance: Aboukir Bay, found during prospection.
Rough surface, remains of marine encrustations.

Flat backed stick of lead, semi-circular in section. Both ends widen and flatten out.

Stick-shaped ingots



Number 14

Dimensions: L. 42.5 cm; W. max. 1.7 cm; H. 1.5 cm
Lead, 702g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8027
Provenance: Aboukir Bay, found in northwest of the site.
Complete.

Stick shaped ingot with a rectangular section.



Number 15

Dimensions: L. 32.7 cm; W. 1.5 cm; H. 1.1 cm

Lead, 336g

Maritime Museum, Alexandria; Exc. no. H.2003.XX.7052

Provenance: Aboukir Bay, found in the harbour basin south of the temple.

Complete.

Thin and long ingot, flat on one side, half circle in section similar to loaf-shaped ingots.



Number 16

Dimensions: L. 15.8 cm; W. 3.3 cm; H. 3.4 cm

Lead, 44.9g

Maritime Museum, Alexandria; Exc. no. H.2006.XX.9648

Provenance: Aboukir Bay, found in the harbour basin south of the temple island.

Complete, smooth surface with some marine encrustations.

Stick-shaped ingot with a 90 degree turn at 3 cm from terminal.

Rectangular in section (0.7x0.55cm).



Number 17

Dimensions: L. 15.6 cm; W. 2.1 cm; H. 1.7 cm

Lead, 249g

Maritime Museum, Alexandria; Exc. no. H.2007.XX.10708

Provenance: Aboukir Bay, found during prospection, no coordinates recorded.

Complete, smooth surface with some marine encrustations.

Stick-shaped ingot, semi-circular in section.



Number 18

Dimensions: L. 13.3 cm; W. 0.9 cm; H. 1.2 cm
Lead, 34.3g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9647
Provenance: Aboukir Bay, found during prospection.
Complete (?), hole in one side.

Stick-shaped ingot, semi-circular in section.

Plano-convex ingots



Number 19

Dimensions: max. Ø 10.9 cm; H. 2.9 cm
Silver, 830g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9411
Provenance: Aboukir Bay, found in the North Passage.
Complete, many marine encrustations on base.

Cake or bun-shaped ingot with concave base. Possibly striations as a consequence of pouring metal into a mould are visible.

Number 20

Dimensions: L. 9.9 cm; W. 7.3 cm; H. 2.9 cm for the conglomerate
A: max. Ø 7.5 cm B: max. Ø 8.1 cm, min. 7.3 cm
Silver, 687g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9949 A+B
Provenance: Aboukir Bay, found to the east of the site.
Complete, but stuck together with flat sides, or resting surfaces, with marine encrustations.

Two cake or bun-shaped ingots concreted together with the flat sides, or resting surfaces. Possibly striations as a consequence of pouring metal into a mould are visible.



Number 21

Dimensions: max. Ø 7.0 cm; H. 1.9 cm
Silver, 358.7g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9938
Provenance: Aboukir Bay, found in the southeast of the site.
Complete, black patina/corrosion.

Cake or bun-shaped ingot.



Number 22

Dimensions: max. 7.8 cm; H. 1.5 cm
Silver? 346.1g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9975
Provenance: Aboukir Bay, found in the southeast of the site.
Complete, corroded surface.

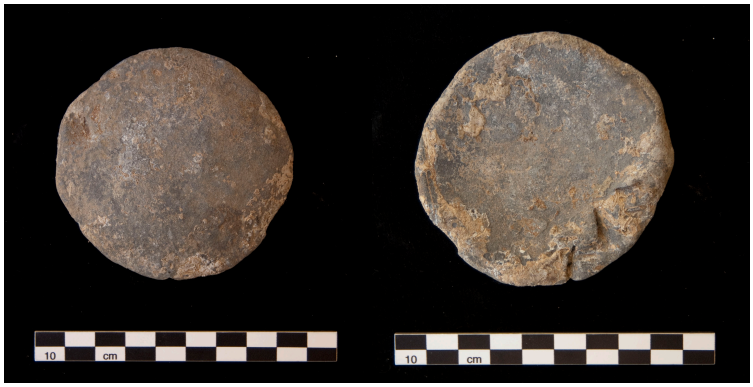
Cake or bun-shaped ingot, round and heavy. Silver?



Number 23

Dimensions: L. 6.0 cm; W. 5.4 cm; H. 3.3 cm
Silver, 253.1g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9944
Provenance: Aboukir Bay, found to the east of the site.
Complete?

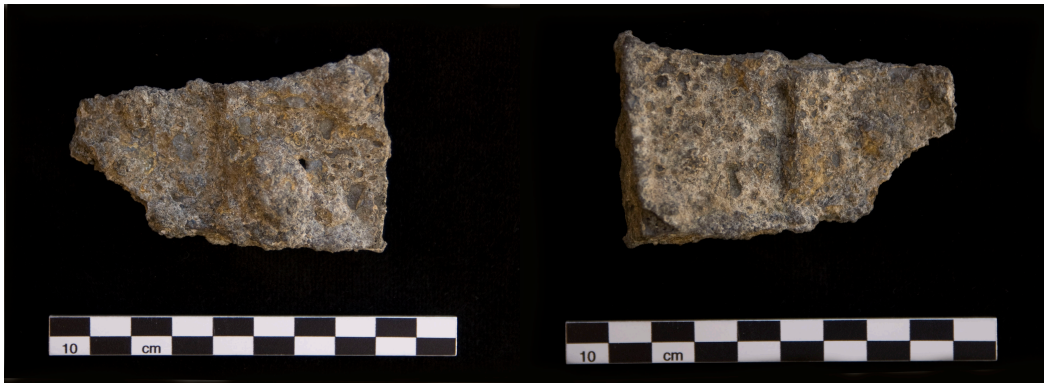
Accumulation/conglomerate of silver consisting of little kernels.
Same location as H9953 (420g, bronze conglomerate?).



Number 24

Dimensions: L. 7.9 cm; W. 7.6 cm; H. 1.5 cm
Silver? 250.1 g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8106 B
Provenance: Aboukir Bay, found in the west of the site on land.
Complete.

Cake or bun shaped ingot with cuts and gashes, slightly concave base. Silver?



Number 25

Dimensions: L. 8.0 cm; W. 5.0 cm; H. 2.8 cm
Silver, 227g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10097
Provenance: Aboukir Bay, found in the south of the site near a harbour.
Fragmentary and heavily corroded.

Unrecognizable piece of silver.

Number 26

Dimensions: max. Ø 5.1 cm; min. Ø 4.6 cm; H. 1.0 cm
Silver, 108.0g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9949 C
Provenance: Aboukir Bay, found to the east of the site.
Complete, many marine encrustations on base.

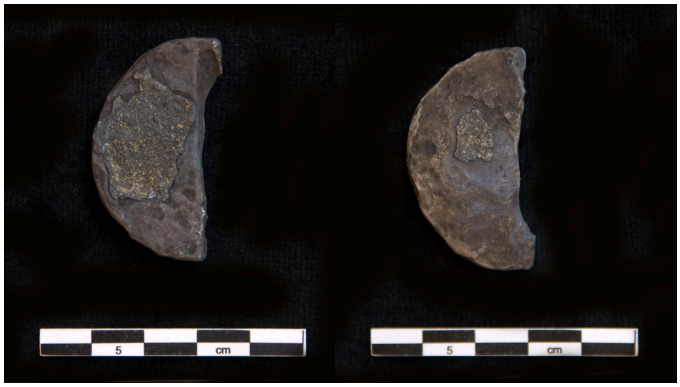
Small cake or bun-shaped ingot. Possibly striations as a consequence of pouring metal into a mould are visible.



Number 27

Dimensions: L. 4.7 cm; W. 4.1 cm; H. 1.1 cm
Silver? 56.0g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8106 A
Provenance: Aboukir Bay, found in the west of the site on land.
Complete.

Cake or bun-shaped ingot, slightly concave base. Silver?



Number 28

Dimensions: L. 4.2 cm; W. 3.5 cm; H. 0.8 cm
Silver? 28.2g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9986
Provenance: Aboukir Bay, found in the southeast of the site.
Ingot is cut in half, black corrosion.

Half of a cake or bun-shaped ingot.

CATALOGUE TO CHAPTER 4: WEIGHTS

Weights in the Athenian weight standard



Number 29

Triple stater, standard: 112 dr/mina
4th century BC
Dimensions: L. 9.1 cm; W. 9.1 cm; H. 5.6 cm (3.9 cm plinth)
Lead, 2927g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6723 (SCA 959)
Provenance: Aboukir Bay, found during prospection.
Complete and in excellent condition with evidence of shaving material of the back of the weight for accuracy. For this phenomenon see also cat. no. 5 (inv. no. 6253).

Square, plinth shaped weight with four spokes of the wheel in raised relief, normally the symbol of a double stater (= 4 mina). Uniquely, this example weighs a triple stater (= 6 mina). The letters DEMO are in raised relief in each corner. It is noteworthy that the H has not replaced the E, which would suggest an early date towards the end of the 5th century or beginning of the 4th century BC. The standard of 112 dr/mina changes early in the 4th century**.** There are no parallels for a triple stater weight.

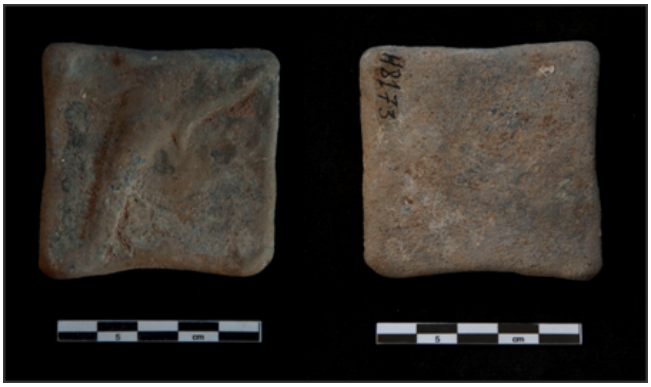
- Goddio – Fabre 2008[2]: 343, cat. no. 361.



Number 30

Double stater, standard: 112 dr/mina
4th century BC
Dimensions: L. 9.0 cm; W. 9.0 cm; H. 3.4 cm (1.2 cm plinth)
Lead, 1924g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6722 (SCA 958)
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight with four spokes of the wheel in raised relief, the appropriate symbol for a double stater (= quadruple mina). The letters DEMO are in raised relief in each corner.



Number 31

Mina weight, reconstructed standard: 112 dr/mina
(Second half of) 4th century BC
Dimensions: L. 5.8 cm; W. 5.9 cm; H. 1.5 cm (1.2 cm plinth)
Lead, 398.8g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.8173
Provenance: Aboukir Bay, found during prospection.
Complete, smooth on the back and very worn on the front.

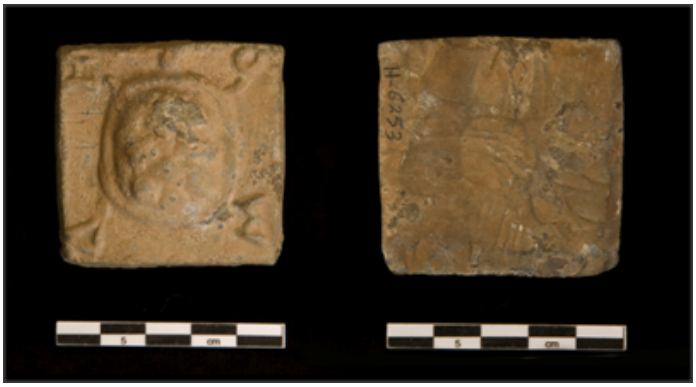
Square, plinth shaped weight with dolphin in raised relief, with remains of O and faint traces of H for DHMO still showing on the top right and left respectively, as well as a very faint part of the M on the bottom right. The denomination is half of stater (= one mina). The wear of the dolphin symbol and the very faint traces of the raised letters indicate severe erosion of the surface. This makes the reconstruction of the weight to the 112 dr/mina standard, and the object originally being nearly 18 % heavier, viable.



Number 32

Third of a stater, reconstructed standard: 112 dr/mina (483.8g), -10.8 % loss
(2nd half of) 4th century BC
Dimensions: L. 5.0 cm; W. 4.9 cm; H. 1.7 cm (1.2 cm plinth)
Lead, 287.9g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9042 (SCA 1075)
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight with a double handled amphora in raised relief. Weight is one third of a stater (= 6th of a mina) as the symbol indicates. There are traces of raised letters remaining on both sides of the amphora (TPI TH), meaning a third (ie. of a stater).



Number 33

One-fourth of stater, reconstructed standard: 112 dr/mina
(2nd half of) 4th century BC
Dimensions: L. 5.0 cm; W. 5.1 cm; H. 1.6 cm (0.8 cm plinth)
Lead, 238.2g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6253 (SCA 919)
Provenance: Aboukir Bay, found during prospection.
Complete, with evidence of shaving material of the back of the weight for accuracy.

Square, plinth shaped weight with a tortoise with head and four paws in raised relief and the raised letters DHMO, one letter in each corner. The weight is a quarter of a stater (= half of a mina) as the symbol indicates.

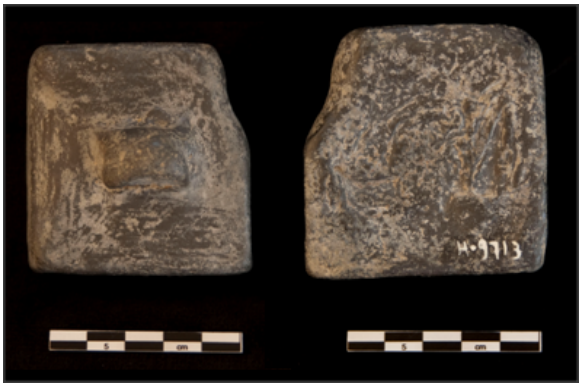


Number 34

One-eighth of stater, reconstructed standard: 112 dr/mina
4th century BC
Dimensions: L. 5.0 cm; W. 4.0 cm; H. 1.1 cm (0.8 cm plinth)
Lead, 116.7g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6507 (SCA 945)
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight with a half tortoise with head and two paws in high relief and the raised letters of DHEMO, one in each corner. Also in raised relief are MI and ET either side of the tortoise body. The H could belong to the DEMO inscription, but might need to be read as HMITE for 8th instead. The weight is 8th of a stater (= 4th of a mina) as the symbol indicates.

Weights in potentially Athenian weight standard



Number 35

Stater weight, reconstructed standard: 105 dr/mina,
5th century BC
Dimensions: L. 6.3 cm; W. 6.1 cm; H. 3.8 cm (2.2 cm plinth)
Lead, 859g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9713
Provenance: Aboukir Bay, found during prospection.
Complete, chip missing from corner.

Square, plinth shaped weight with an astragalus on top. Weight is a stater (= double mina). The shape of the weight is typical, however the raised letters present in other Athenian weights is missing. There are two parallels for this weight from excavations at Olynthus. Weights with an astragalus mentioned by Pernice (for those closest in weight to this specimen, see Pernice 1894: 83–4, nos. 7–12) all have inscriptions on them.



Number 36

One-third of a stater, reconstructed standard: 112 dr/mina
(2nd half of) 4th century BC
Dimensions: L. 4.7 cm; W. 4.6 cm; H. 2.1 cm (1.4 cm plinth)
Lead, 304.1g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9106 (SCA 1085)
Provenance: Aboukir Bay, found during prospection.
Worn. Some remains of marine encrustations.

Square, plinth shaped weight with an amphora in raised relief. Weight is one third of a stater as the symbol indicates. Raised letters as present in the other whole amphora weight are missing, or worn away, so an Athenian identification is uncertain, but likely. A lighter (and earlier) weight standard is unlikely, since there are no extant examples for the lighter weight standard, as well as the worn condition of the object itself.



Number 37

One-sixth of a stater, reconstructed standard: 138 dr/mina
3rd century until 2nd half of 2nd century BC
Dimensions: L. 3.6 cm (4.1 cm incl. protrusion); W. 3.6 cm; H. 1.8 cm (1.2 cm plinth)
Lead, 173.5g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8121 (SCA 1007)
Provenance: Aboukir Bay, found during prospection.
Complete, evidence of pouring of metal into mould, lines on the sides, plus extra lead at the top edge.

Square, plinth shaped weight with a half amphora. The weight is one-sixth of a stater (=third of a mina) as the symbol can indicate and not a quarter of a mina as some examples of half amphora weights are also reconstructed, the weight being too heavy for this identification. The weight lost 13.6 % in weight if the identification of the standard as Hellenistic is correct. However, the back of the weight still has some extra material at the edges, leaving there is little room for erosion of the weight, which is problematic. However, the fit with the 112 dr/mina weight standard is even more problematic, 7.8 % too heavy. The weights with this symbol from the Athenian agora published by Lang weigh consistently between 150-155g, ie. in accordance on this 112 dr/mina standard. The *heavier* weight from Heracleion-Thonis should therefore be younger than the examples from Athens, which is why the Hellenistic weight standard is suggested for this object.



Number 38

One-sixth of a stater, reconstructed standard: 138 dr/mina
3rd century until 2nd half of 2nd century BC
Dimensions: L. 4.0 cm; W. 3.5 cm; H. 1.5 cm (1.3 cm plinth)
Lead, 159.5g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8120
Provenance: Aboukir Bay, found during prospection.
Complete, but very worn.

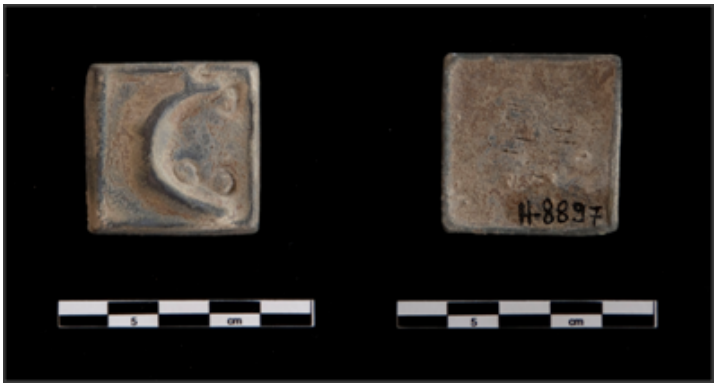
Square, plinth shaped weight with possibly the remains of a shield. Weight is one-sixth of a stater (=third of a mina) as the symbol indicates. The weight loss would be minimal on the 112 dr/mina standard, whereas the weight is battered. Consequently, a Hellenistic standard is suggested here for this weight.



Number 39

One-eighth of a stater, reconstructed standard: 112 dr/mina
4th century BC.
Dimensions: L. 3.6 cm; W. 3.5 cm; H. 1.2 cm (1.1 cm plinth)
Lead, 113.8g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6323
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight with a moon crescent in raised relief. Weight is one eighth of a stater (=fourth of a mina) as the symbol indicates. The frame around the weight suggests 4th century.



Number 40

One-eighth of a stater, reconstructed standard: 105 dr/mina
4th century BC
Dimensions: L. 3.5 cm; W. 3.5 cm; H. 1.3 cm (1.0 cm plinth)
Lead, 111.6g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8897
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight with a moon crescent in raised relief. Weight is one eighth of a stater (=quarter of a mina) as the symbol indicates. The back has 7 incised lines approx. 3 mm long. Next to the moon sickle are three incised/stamped letters? Delta, and two omikrons?

However, the frame around the weight suggests 4th century.



Number 41

Twelfth of a stater, 138 dr/mina (602.5g), - 10.7 % loss
3rd century to first half of 2nd century
Dimensions: L. 2.8 cm; W. 3.0 cm; H. 1.5 cm (1.0 cm plinth)
Lead, 89.7g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8122
Provenance: Aboukir Bay, found during prospection.
Complete, extra ridge of material around bottom edge.

Square, plinth shaped weight with a quarter amphora.

Weight is a twelfth of a stater (=sixth of a mina) as the symbol indicates.

Weights in a Greek weight standard, not identifiably Athenian



Number 42

Mina weight, standard unknown
Date unknown
Dimensions: L. 6.6 cm; W. 7.0 cm; H. 1.2 cm
Lead, 372.0g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9721 (SCA 1239)
Provenance: Aboukir Bay, found during prospection.
Complete, chip of top left corner.

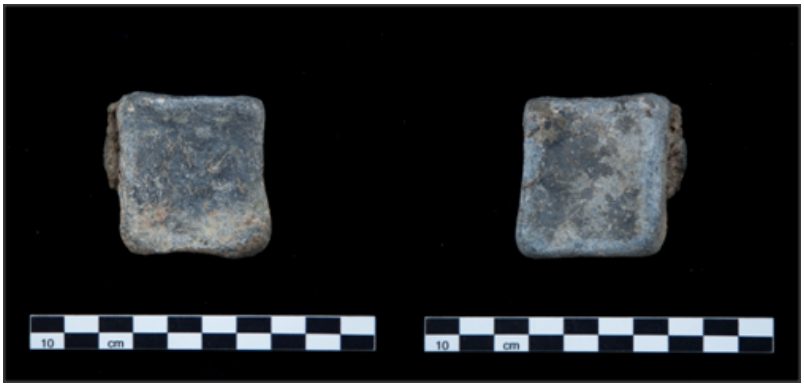
Square, plinth shaped weight with M, for mina, in raised relief on one side. The weight is thin and appears battered, which is necessary since there should have been significant weight loss for it to be a mina weight as the inscription indicates.



Number 43

Mina weight, 105 dr/mina (455g) or 112 dr/mina (483.8g), + 1.6 %gain or - 4.8 % loss
End of the fifth century BC or 4th century.
Dimensions: L. 5.7 cm; W. 5.2 cm; H. 2.9 cm (1.4 – 1.7 cm plinth, slanted)
Lead, 460.8g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6665
Provenance: Aboukir Bay, found during prospection.
Complete. Top of the plinth has a rough, pitted surface, not due to encrustations with toolmarks around the astragalus. There is a cut in the plinth extending into the edge of the astragalus on the top of the plinth, but not through the astragalus. The base of the plinth is very smooth, but shows an irregular surface due to the lead already cooling when poured into the mould.

Square, plinth shaped weight with an astragalus on top. Unusual is that the astragalus is normally a symbol for a stater, or double mina, whereas the weight is a single mina. The plinth is of irregular depth and thus has a slanting surface angle.



Number 44

Mina weight, 105 dr/mina (455g) or 112 dr/mina (483.8g), - 1.7 % or – 9.2 % loss
From the second half of the sixth century until the end of the fifth century BC
Dimensions: L. 4.7 cm; W. 4.4 cm; H. 2.5 cm
Lead, 445.8g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12092 A
Provenance: Aboukir Bay, found during prospection.
Complete, with some additional material that does not belong to the object.

Square, plinth shaped weight with traces of M for mina in raised relief. There is 1-1.5 mm of surface missing on the face with the M. Weight is cast, centre of weight is hollow due to retraction of lead when cooling.

Other weights with inscriptions or markings



Number 45

Half mina weight, standard: 112 dr/mina, -0.08 % loss
Date unknown
Dimensions: L. 5.1 cm; W. 4.6 cm; H. 1.1 cm
Lead, 239.9g
Maritime Museum, Alexandria; Exc. no. H.2009.XX.11203
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight with H lightly scratched or incised on one face and the letters delta pi on the other (not pictured, the letters appeared after cleaning), probably indicating half of a mina.



Number 46

Half mina, standard: 112 dr/mina, - 2.9 % loss
4th century BC
Dimensions: L. 4.6 cm; W. 4.6 cm; H. 1.2 cm
Lead, 235.0g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10772
Provenance: Aboukir Bay, found during prospection.
Complete, traces of modern cleaning on back.

Square, plinth shaped weight with two incised letter HM for half of a mina.



Number 47

Half mina, standard: 105 dr/mina, - 3.6 % loss
5th century BC
Dimensions: L. 4.9 cm; W. 5.1 cm; H. 0.9 cm, stamp Ø 2.2 cm
Lead, 218.8g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6944
Provenance: Aboukir Bay, found during prospection.
Complete.

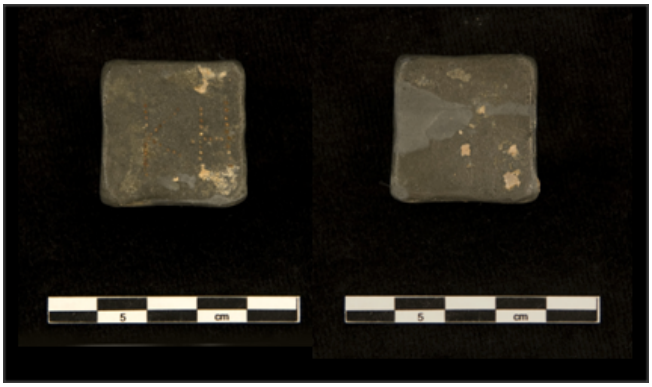
Square plinth shaped weight with a round stamp. Given its current weight, it seems reasonable to propose that this was another half mina weight. Circular stamp (∅ 2.2 cm max.) impressed on one face of the weight, with a circle and letters in raised relief inside the circular impression.



Number 48

Dimensions: L. 4.4 cm; W. 4.6 cm; H. 1.2 cm (1.4 cm max. at corner)
Lead, 209.4g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6508
Provenance: Aboukir Bay, found during prospection.
Complete, some remains of marine encrustations.

Square, plinth shaped weight with a letter pi scratched into one of the faces. The weight is the equivalent of 48 drachma, perhaps originally 50 drachma?



Number 49

Dimensions: L. 3.0 cm; W. 2.9 cm; H. 1.3 cm
Lead, 105.8g
Maritime Museum, Alexandria; Exc. no. H.2002.XX.3536
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight with the letters KH in orange patina dots.



Number 50

Dimensions: L. 3.0 cm; W. 2.7 cm; H. 1.6 cm max. (1.1 cm amphora incl., 0.8 cm plinth)
Lead, 68.1g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8101
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight with a rounded rectangular raised object in the centre, a two handled amphora in raised relief on the one side of the rectangular object, and two letters (?) in raised relief on the other side of the rectangular object, E and Ξ?



Number 51

Dimensions: L. 3.3 cm; W. 3.8 cm; H. 0.5 cm
Lead, 51.5g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6800
Provenance: Aboukir Bay, found during prospection.
Complete.

Thin, slightly rectangular piece of lead of regular thickness with the letters E scratched in one face and possibly O (or just encrustations?) on the other face. 12 drachma?



Number 52

Dimensions: L. 3.4 cm; W. 3.2 cm; H. 0.5 cm

Lead, 51.3g

Maritime Museum, Alexandria; Exc. no. H.2006.XX.9589

Provenance: Aboukir Bay, found during prospection.

Complete with many traces of post excavation cleaning tool marks. Half of the object (diagonal divide) has a pitted surface, the other half is smooth.

Square, flat object with 5 small circles in sunk relief on one face, similar to a face on a dice: one circle with a dot in the centre in each corner, one in the middle. Weight?



Number 53

Dimensions: L. 2.7 cm; W. 2.6 cm; H. 0.7 cm
Lead, 41.6g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9484 (SCA 1101)
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, flat coin weight with an impression of tetradrachm on one face and a smaller impression of a ram's head on the opposite face, a symbol of the god Amun. This type of tetradrachm was in production at Athens between 350-290 BC. 9 or 10 Attic drachma to 8 Persian sigloi?

- Goddio and Fabre 2008[2]: 343, cat. no. 367.

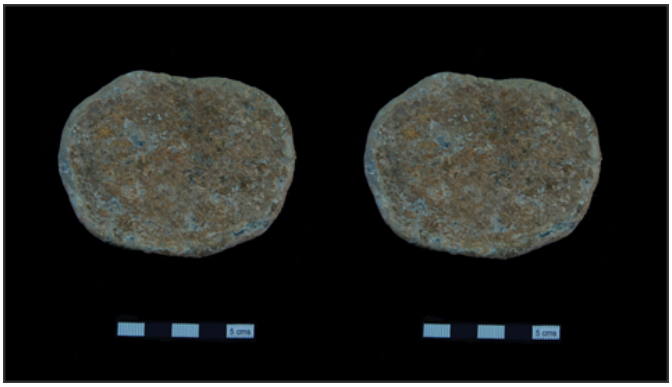


Number 54

Unknown
Dimensions: L. 2.8 cm; W. 3.0 cm; H. 0.4 cm
Lead, 24.85g
Maritime Museum, Alexandria; Exc. no. H.2006.XX. 9710 (SCA 1236)
Provenance: Aboukir Bay, found during prospection.
Complete, worn impression.

Square, flat coin weight. Worn impression of Athena head, facing left. 6 Attic drachma.

Uninscribed weights



Number 55

Mina weight?
Dimensions: L. 8.3 cm; W. 6.4 cm; H. 1.4 cm
Lead, 504g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.6301
Provenance: Aboukir Bay, found during prospection.
Complete, surface corroded.

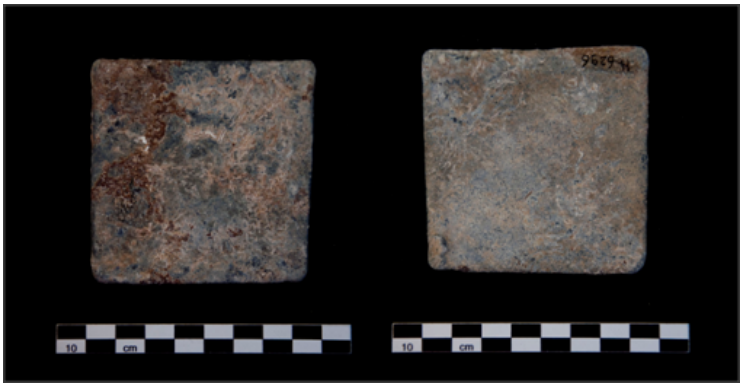
Weight? Flat plaque of lead.



Number 56

Mina weight, standard: 112 dr/mina, - 4,0 % loss
4th century BC
Dimensions: L. 6.5 cm; W. 5.1 cm; H. 1.8 cm
Lead, 464.7g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6324
Provenance: Aboukir Bay, found during prospection.
Complete, traces of marine encrustations.

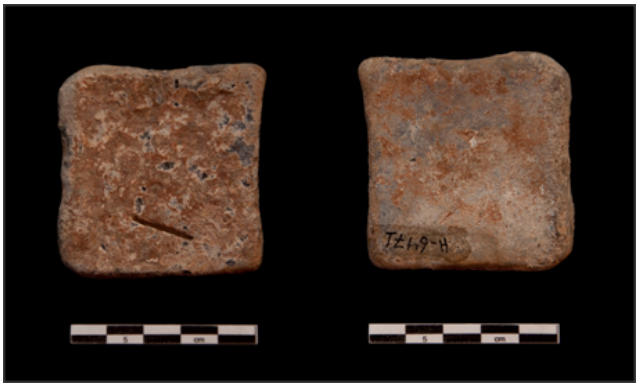
Rectangular plinth shaped weight, slightly concave on one face and concave edges, possibly weighing one mina? Similar to **no. 99** (inv. no. 6632).



Number 57

Mina weight, standard: 112 dr/mina, - 5.6 % loss
Dimensions: L. 7.9 cm; W. 7.8 cm; H. 0.9 cm
Lead, 456.6g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6296
Provenance: Aboukir Bay, found during prospection.
Complete, some remains of marine encrustations.

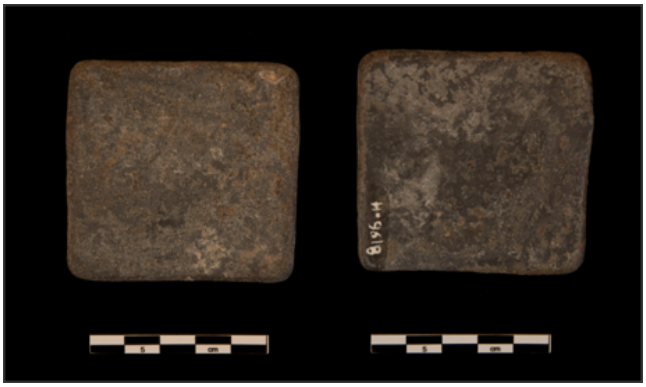
Square, plinth shaped weight, possibly weighing one mina. It is of equal thickness except at one corner where there is some excess material.



Number 58

Third of a stater?
Dimensions: L. 5.8 cm; W. 5.7 cm; H. 1.4 cm
Lead, 383.1g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6471
Provenance: Aboukir Bay, found during prospection.
Complete, smooth surface and marine encrustations on one face.

Square, plinth shaped weight with a diagonal slit of 1.7 cm and 1 mm thick on one face. Comp. 6946. 89 (=) 90 Attic dr.? Compare 6946.



Number 59

Third of a stater?
Dimensions: L. 6.5 cm; W. 6.2 cm; H. 1.2 cm
Lead, 374.2g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9618
Provenance: Aboukir Bay, found during prospection.
Complete.

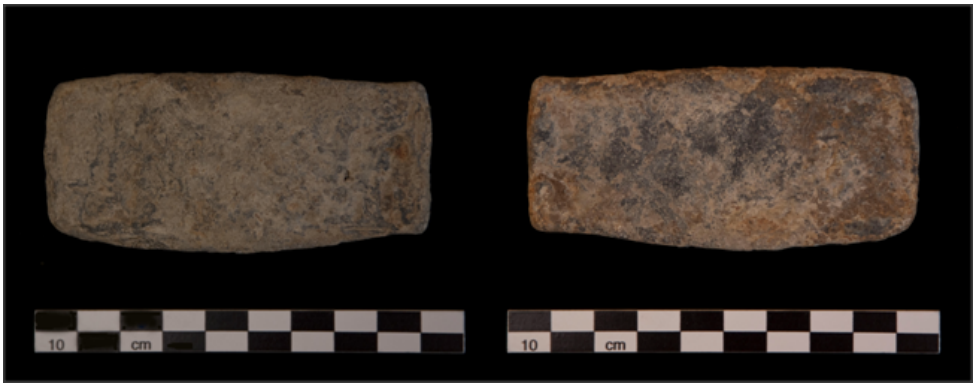
Square, plinth shaped weight. One mina?



Number 60

Third of a stater?
Dimensions: L. 6.3 cm; W. 5.0 cm; H. 1.5 cm
Lead, 373.2g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6632
Provenance: Aboukir Bay, found during prospection.
Complete, brown patina and remains of marine encrustations.

Rectangular shape, with smooth rounded sides, one flat face and on the other a deep depression. Thickness tapers, section on the one long side thicker than section on the opposite. Like **no. 27** 6324.



Number 61

Quarter of a stater?
Dimensions: L. 9.0 cm; W. 4.2 cm; H. 1.3 cm
Lead, 273.4g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6398
Provenance: Aboukir Bay, found during prospection.
Complete.

Slightly curved rectangular slab of lead, weight? 110 persian sigloi?



Number 62

Quarter of a stater?
Dimensions: L. 6.0 cm; W. 5.6 cm; H. 1.05 cm
Lead, 265.9g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6488
Provenance: Aboukir Bay, found during prospection.
Complete, smooth surface with some remains of marine encrustations on one face.

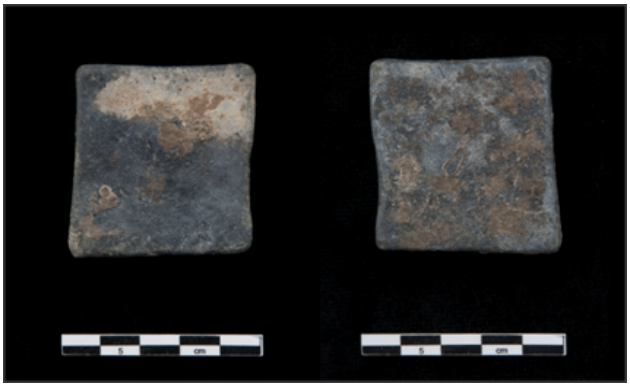
Square, flat slab (weight?) with rounded edges. Some faint depressions are present on one face. Half mina: 532g.



Number 63

Quarter of a stater?
Dimensions: L. 4.9 cm; W. 4.9 cm; H. 0.9 cm
Lead, 223.1g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9550
Provenance: Aboukir Bay, found during prospection.
Complete, edges are well made and straight. Much cleaned post excavation.

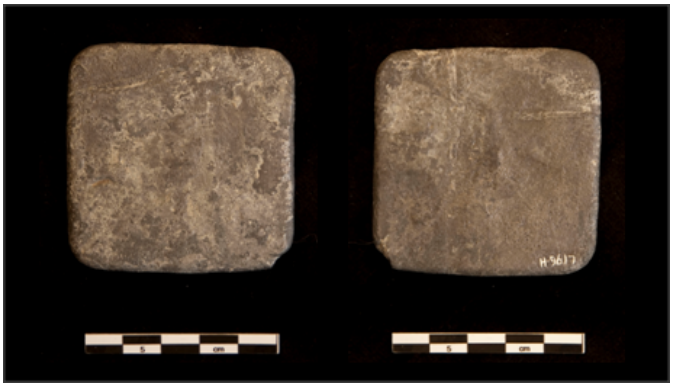
Square, plinth shaped weight.



Number 64

Quarter of a stater?
Dimensions: L. 4.7 cm; W. 4.4 cm; H. 1.1 cm
Lead, 219.3g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.11966
Provenance: Aboukir Bay, found during prospection.
Complete.

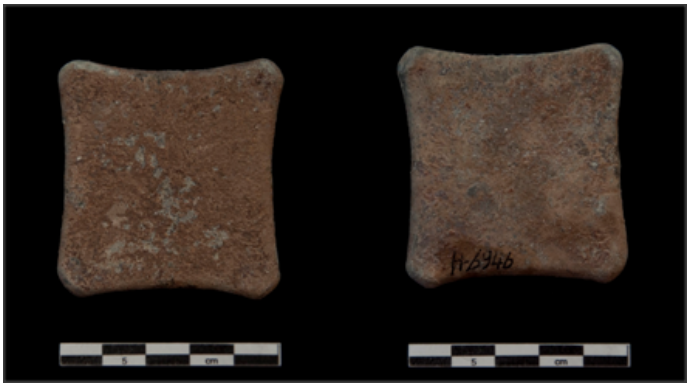
Flat, plinth shaped weight. 50/51 Attic dr?



Number 65

Quarter of a stater?
Dimensions: L. 6.0 cm; W. 6.0 cm; H. 0.7 cm
Lead ?, 217.0g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9617
Provenance: Aboukir Bay, found during prospection.
Complete, chip missing from one corner.

Square, very flat plinth shaped weight.



Number 66

Quarter of a stater?
Dimensions: L. 5.5 cm; W. 5.2 cm; H. 0.9 cm
Lead, 213.5g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6946
Provenance: Aboukir Bay, found during prospection.
Complete with a smooth surface.

Square, flat coin weight, concave sides and an even thickness. 50 Attic drachma? (215g) (Comp. H. 6471).



Number 67

Sixth of a stater?
Dimensions: L. 4.5 cm; W. 4.4 cm (4.1 cm excl. encrustations); H. 1.4 cm (1.2 cm excl.)
Lead, 185.7g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9109
Provenance: Aboukir Bay, found during prospection.
Complete, but with obscuring marine encrustations and the surface is corroded.

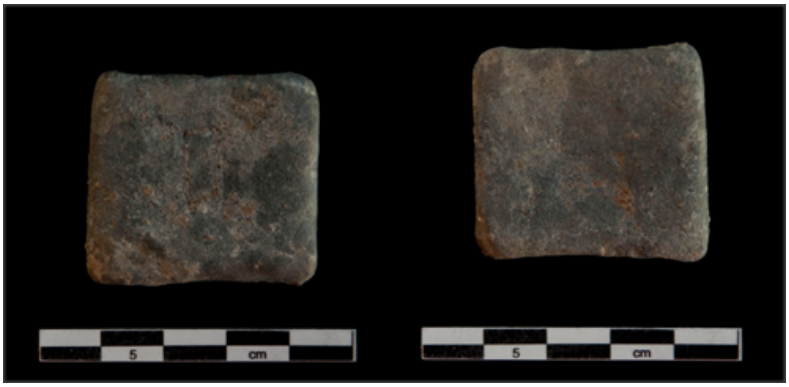
Square, plinth shaped weight, there is a rectangular protrusion in a diagonal on one face.



Number 68

Sixth of a stater?
Dimensions: L. 4.3 cm; W. 4.2 cm; H. 1.1 cm
Lead, 179.0g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12092 B
Provenance: Aboukir Bay, found during prospection.
Complete, chips missing.

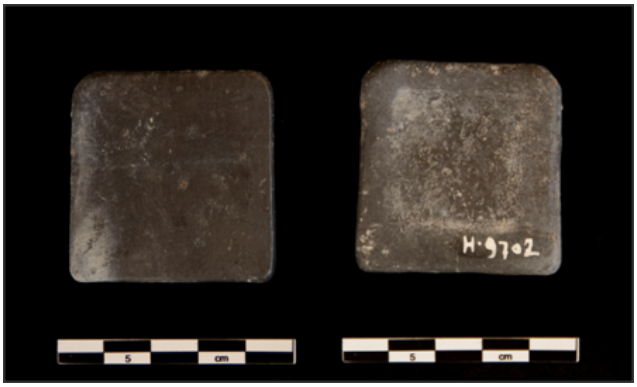
Square, plinth shaped weight.



Number 69

Sixth of a stater?
Dimensions: L. 4.3 cm; W. 4.2 cm; H. 1.2 cm
Lead, 176.5g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9946
Provenance: Aboukir Bay, found during prospection.
Complete, rough and irregular surface.

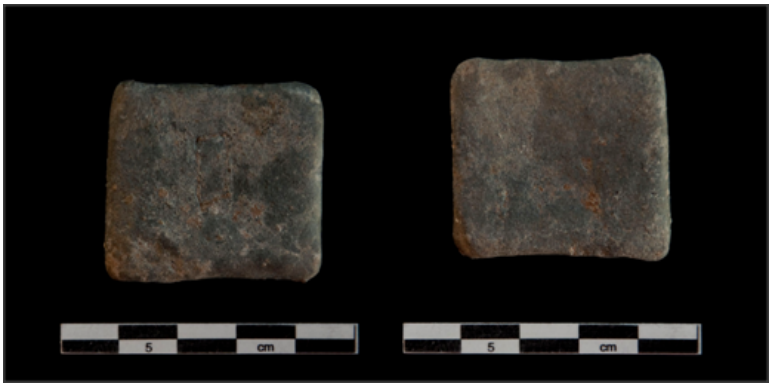
Square, plinth shaped weight. Third of a mina? Some random lines (decoration?) are present, but it seems very rough.



Number 70

Sixth of a stater?
Dimensions: L. 4.5 cm; W. 4.4 cm; H. 1.0 cm
Lead, 170.9g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9702 B
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, flat coin weight. 40 Attic drachma?



Number 71

Sixth of a stater?
Dimensions: L. 3.7 cm; W. 3.4 cm; H. 1.4 cm
Lead, 165.3g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6598
Provenance: Aboukir Bay, found during prospection.
Complete, flat smooth surface.

Square, plinth shaped weight with a rectangle scratched in one face.



Number 72

Sixth of a stater?
Dimensions: L. 4.5 cm; W. 3.8 cm; H. 1.1 cm
Lead, 163.3g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6380
Provenance: Aboukir Bay, found during prospection.
Complete, smooth surface, one face with some marine encrustations.

Slightly rectangular, plinth shaped weight.



Number 73

Eighth of a stater /quarter mina weight
4th century BC
Dimensions: L. 3.7 cm; W. 3.7 cm; H. 1.3 cm
Lead, 117.7g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6497
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight, round flat protrusion on top off centre. Strange irregular shaped lead formation added to the back, rest of the plinth is concave. The plinth is of equal thickness around all edges.



Number 74

Eighth of a stater /quarter mina weight
Dimensions: L. 2.5 cm; W. 2.5 cm; H. 1.8 cm
Lead, 110.4g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6299
Provenance: Aboukir Bay, found during prospection.
Complete.

Dice shaped weight. 105 dr standard or 30 Ptolemaic drachma.



Number 75

Eighth of a stater /quarter mina weight
Dimensions: L. 3.4 cm; W. 3.3 cm; H. 1.3 cm
Lead, 110.0g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6254
Provenance: Aboukir Bay, found during prospection.
Some damage to the square protrusion.

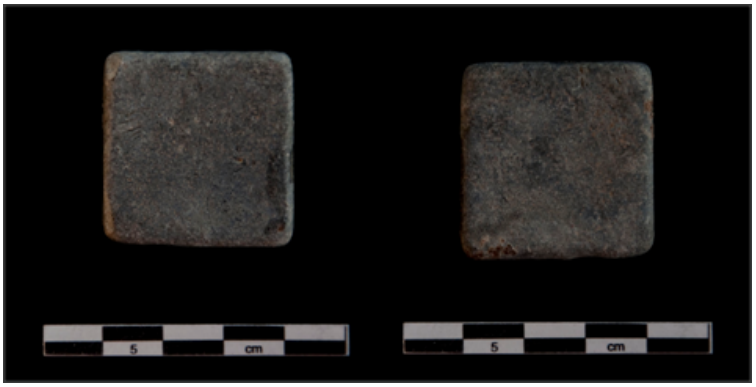
Square, plinth shaped weight with squarish protrusion on one face and very rounded edges.



Number 76

Eighth of a stater or sixth of a mina?
Dimensions: L. 4.1 cm; W. 4.2 cm; H. 0.9 cm
Bronze, 107.2g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.no number
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight.



Number 77

Eighth of a stater or sixth of a mina?
Dimensions: L. 3.3 cm; W. 3.2 cm; H. 1.1 cm
Lead, 103.73g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6615
Provenance: Aboukir Bay, found during prospection.
Complete.

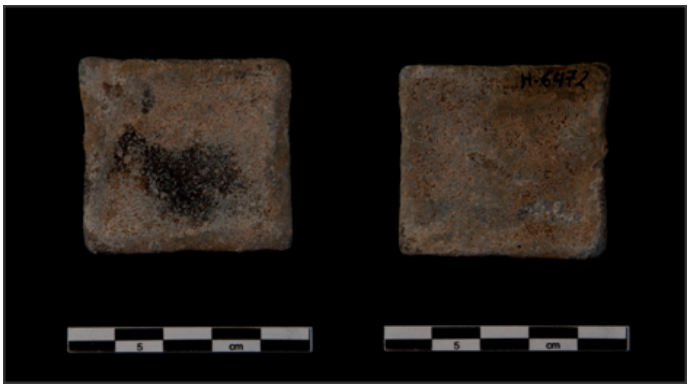
Square, flat weight.



Number 78

Eighth of a stater or sixth of a mina?
Dimensions: L. 3.8 cm; W. 3.6 cm; H. 0.9 cm
Lead, 103.5g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6094
Provenance: Aboukir Bay, found during prospection.
Complete with rounded, worn corners, one of which is chipped.

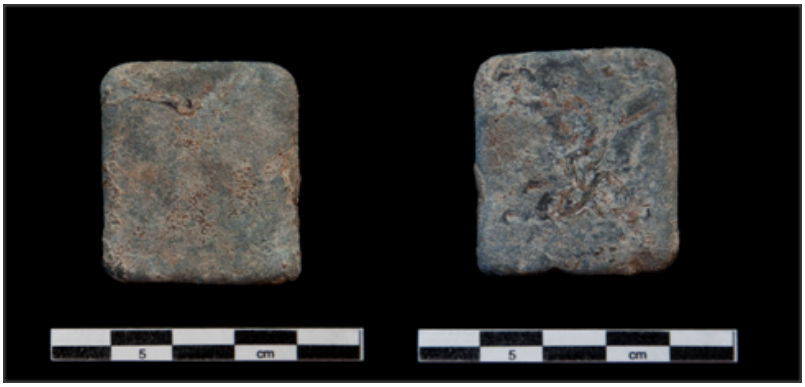
Square, flat coin weight, plinth is unequal in thickness. 24 Attic drachma? C shaped impression, 6 scratches or strokes on a diagonal angle in one quadrant near the C shape.



Number 79

Eighth of a stater or sixth of a mina?
Dimensions: L. 4.3 cm; W. 4.0 cm; H. 0.8 cm
Lead, 103.4g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6472
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, flat coin weight, plinth of equal thickness. 24 Attic drachma?



Number 80

Eighth of a stater or sixth of a mina?
Dimensions: L. 3.7 cm; W. 3.3 cm; H. 0.9 cm
Lead, 100.7g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6006
Provenance: Aboukir Bay, found during prospection.
Complete, small chips of edge missing, some remains of marine encrustations present.

Square, flat coin weight. 24 Attic drachma?

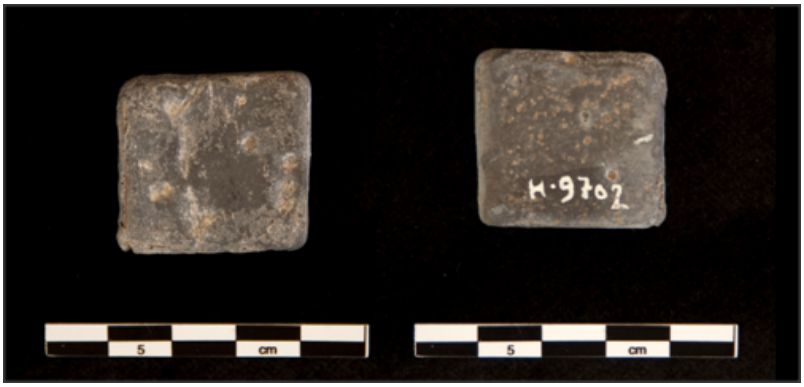
Weights under 100g



Number 81

Sixth of a mina?
Dimensions: L. 3.7 cm; W. 3.6 cm; H. 0.9 cm
Lead, 82.7g
Maritime Museum, Alexandria; Exc. no. H.2003.XX. 6489
Provenance: Aboukir Bay, found during prospection.
Complete.

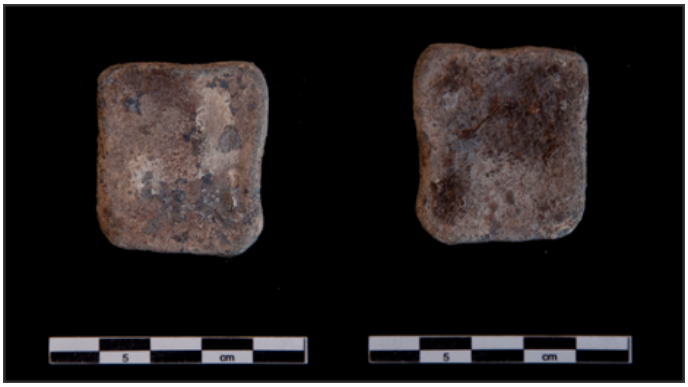
Square, plinth shaped weight with different metal (?) showing on both sides of object.



Number 82

Sixth of a mina?
Dimensions: L. 2.8 cm; W. 3.0 cm; H. 1.1 cm
Lead, 81.1g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9702 A
Provenance: Aboukir Bay, found during prospection.
Complete.

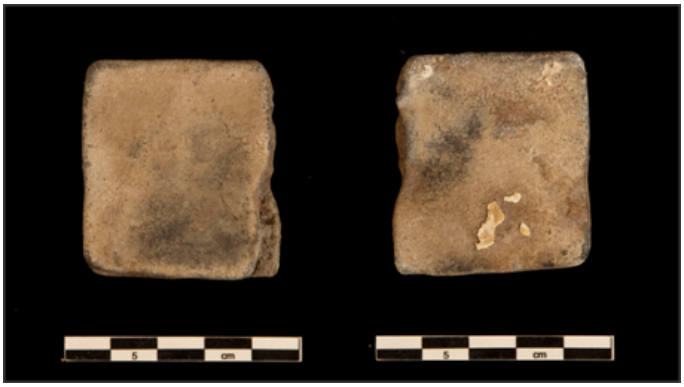
Square, plinth shaped weight.



Number 83

Sixth of a mina?
Dimensions: L. 3.9 cm; W. 3.4 cm; H. 0.8 cm
Lead, 79.2g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12012 A
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight.



Number 84

Sixth of a mina/eighth of a mina?
Dimensions: L. 4.6 cm; W. 4.2 cm; H. 0.7 cm
Lead, 76.7g
Maritime Museum, Alexandria; Exc. no. H.2008.K9.11017
Provenance: Aboukir Bay, found during prospection.
Complete, crack down the middle of the object. One edge missing.

Square, very thin object. Possibly too thin for a weight. (H 0.5 cm, max 0.7 cm)



Number 85

Sixth of a mina/eighth of a mina?
Dimensions: L. 3.1 cm; W. 3.1 cm; H. 1.0 cm
Lead, 75.2g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9694 C
Provenance: Aboukir Bay, found during prospection.
Complete, with a crack and some pitting in the surface.

Square, plinth shaped weight.



Number 86

Eighth of a mina?
Dimensions: L. 2.3 cm; W. 2.2 cm; H. 1.6 cm
Lead, 74.5g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9983
Provenance: Aboukir Bay, found during prospection.
Complete, worn but shiny due to modern cleaning.

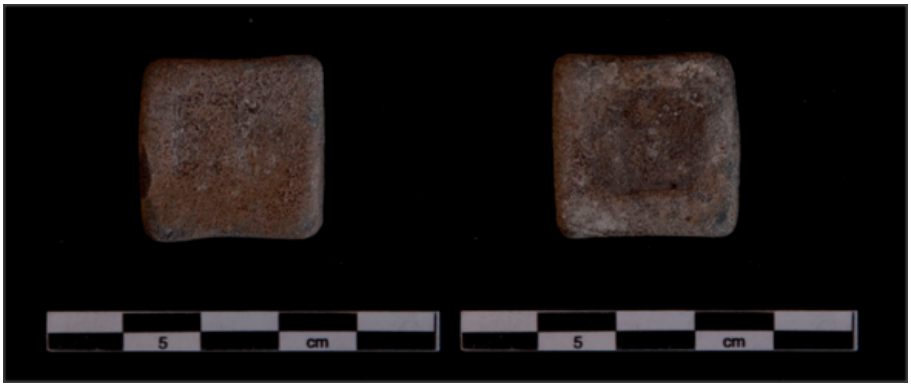
Square, nearly dice shaped weight.



Number 87

Eighth of a mina?
Dimensions: L. 3.0 cm; W. 2.9 cm; H. 0.8 cm
Lead, 62.5g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6947
Provenance: Aboukir Bay, found during prospection.
Complete.

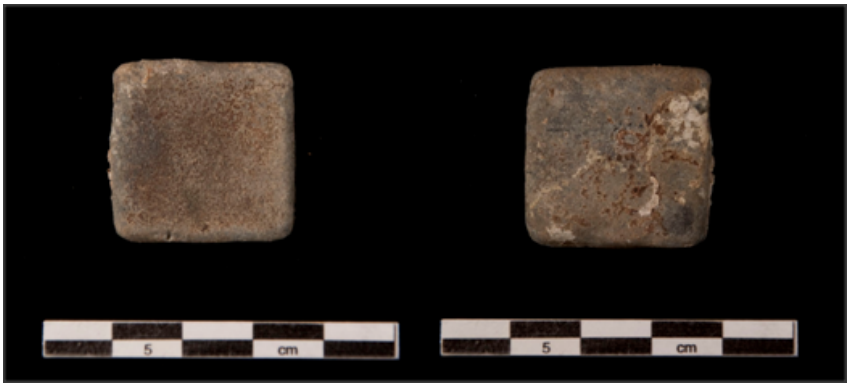
Square, plinth shaped weight.



Number 88

Eighth of a mina?
Dimensions: L. 2.2 cm; W. 2.2 cm; H. 1.3 cm
Lead, 62.3g
Maritime Museum, Alexandria; Exc. no. H.2009.XX.11415 A
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight with shallow depressions on faces.



Number 89

Eighth of a mina?
Dimensions: L. 2.6 cm; W. 2.6 cm; H. 0.8 cm
Lead, 59.1g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9113
Provenance: Aboukir Bay, found during prospection.
Complete, traces of marine encrustations.

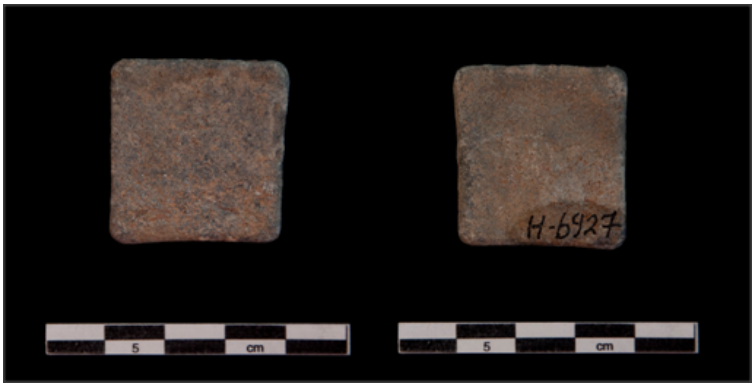
Square, plinth shaped weight equal thickness.



Number 90

Eighth of a mina?
Dimensions: L. 3.2 cm; W. 3.1 cm; H. 0.6 cm
Lead, 54.6g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9523
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, flat weight.



Number 91

Eighth of a mina?
Dimensions: L. 3.0 cm; W. 2.9 cm; H. 0.7 cm
Lead, 54.5g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6927
Provenance: Aboukir Bay, found during prospection.
Complete.

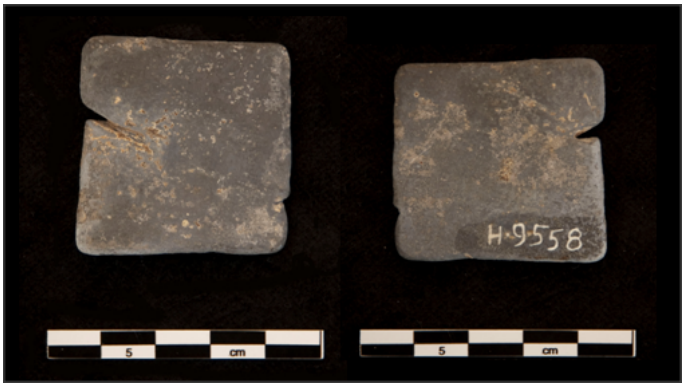
Square, flat weight.

Weights under 50g

Number 92

Dimensions: L. 2.6 cm; W. 2.7 cm; H. 0.7 cm
Lead, 49.2g
Maritime Museum, Alexandria; Exc. no. H.2004.XX. unknown number.
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, flat plinth shaped weight.



Number 93

Dimensions: L. 3.9 cm; W. 3.8 cm; H. 0.4 cm
Lead, 47.2g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9558
Provenance: Aboukir Bay, found during prospection.
Complete with agash.

Square, very flat object.



Number 94

Dimensions: L. 2.1 cm; W. 2.0 cm; H. 1.1 cm
Lead, 40.3g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8111 A
Provenance: Aboukir Bay, found during prospection.
Complete.

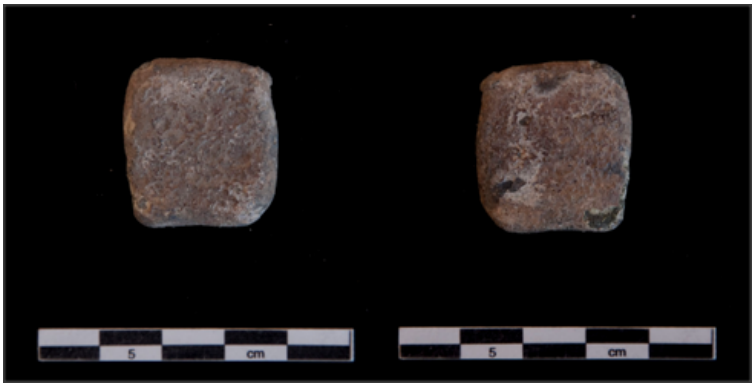
Square, plinth shaped weight.



Number 95

Dimensions: L. 2.0 cm; W. 1.9 cm; H. 1.2 cm
Lead, 40.1g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6357
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, relatively high plinth shaped weight. There is a small hole in the surface of one face. Close to H6723 in Grand Canal and ladle H6292.



Number 96

Dimensions: L. 2.8 cm; W. 2.5 cm; H. 0.7 cm
Lead, 33.7g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12012 B
Provenance: Aboukir Bay, found during prospection.
Complete, parts of surface missing.

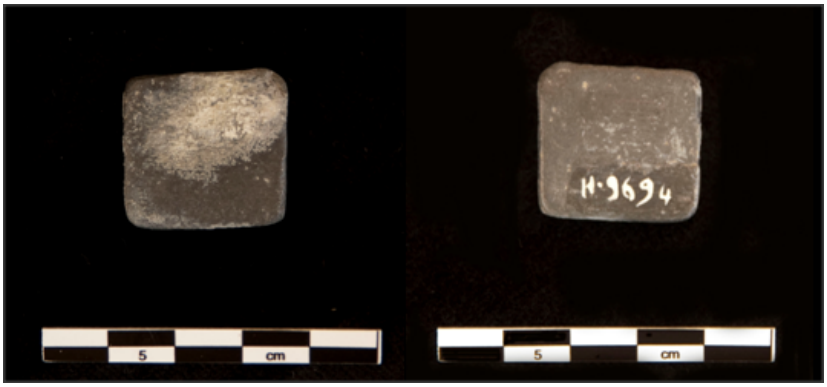
Square, plinth shaped weight.



Number 97

Dimensions: L. 2.5 cm; W. 2.6 cm; H. 1.0 cm
Lead, 24.6g
Maritime Museum, Alexandria; Exc. no. H.2009.XX.11554 B
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, flat coin weight. 6 Attic drachma?



Number 98

Dimensions: L. 2.5 cm; W. 2.4 cm; H. 0.5 cm
Lead, 24.2g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9694 B
Provenance: Aboukir Bay, found during prospection.
Complete.

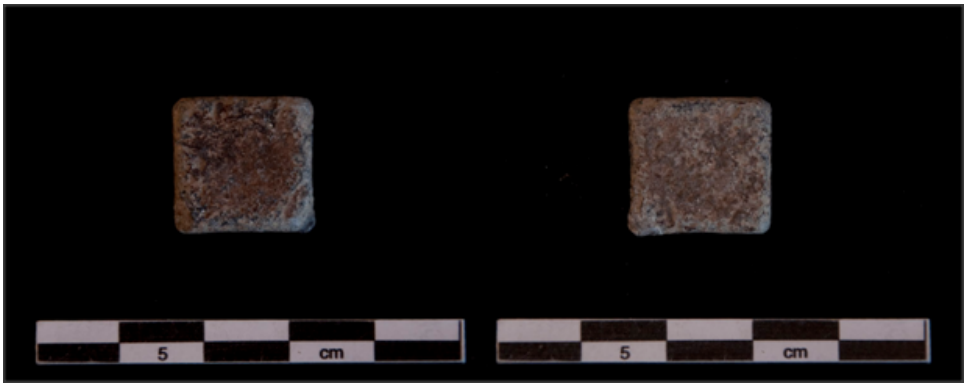
Square, flat coin weight. 6 Attic drachma?



Number 99

Dimensions: L. 2.1 cm; W. 2.0 cm; H. 0.7 cm
Lead, 24.1g
Maritime Museum, Alexandria; Exc. no. H.2009.XX.11450 A
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, flat coin weight. 6 Attic drachma?



Number 100

Dimensions: L. 1.7 cm; W. 1.6 cm; H. 0.9 cm
Lead, 23.5g
Maritime Museum, Alexandria; Exc. no. H.2009.XX.11290
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, flat weight.



Number 101

Dimensions: L. 1.5 cm; W. 1.35 cm; H. 1.3 cm
Lead, 23.3g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10726
Provenance: Aboukir Bay, found during prospection.
Complete, but worn edges.

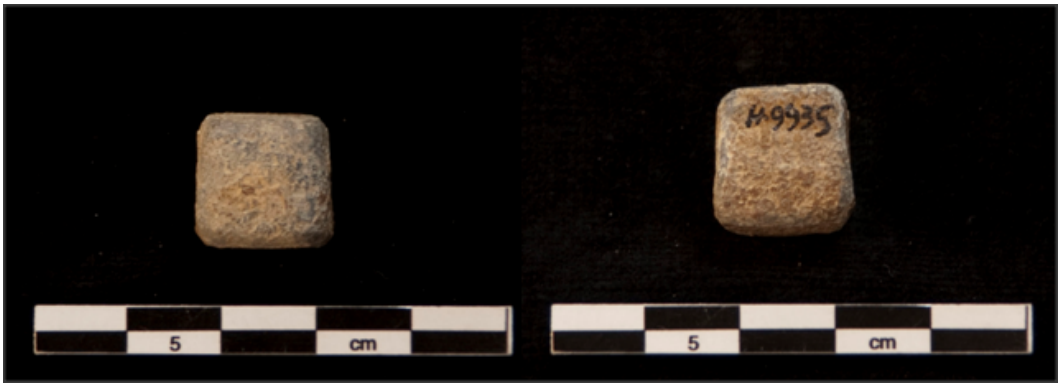
Dice shaped weight.



Number 102

Dimensions: L. 1.6 cm; W. 1.6 cm; H. 0.95 cm
Lead, 22.7g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9989
Provenance: Aboukir Bay, found during prospection.
Complete, one corner very rounded.

Dice shaped, but not as high, coin weight. 5 Attic drachma.



Number 103

Dimensions: L. 1.5 cm; W. 1.5 cm; H. 1.25 cm
Lead, 22.7g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9935
Provenance: Aboukir Bay, found during prospection.
Complete.

Dice shaped weight. 5 Attic drachma?



Number 104

Dimensions: L. 1.8 cm; W. 1.9 cm; H. 1.0 cm
Lead, 22.7g
Maritime Museum, Alexandria; Exc. no. H.2009.XX.11514
Provenance: Aboukir Bay, found during prospection.
Complete.

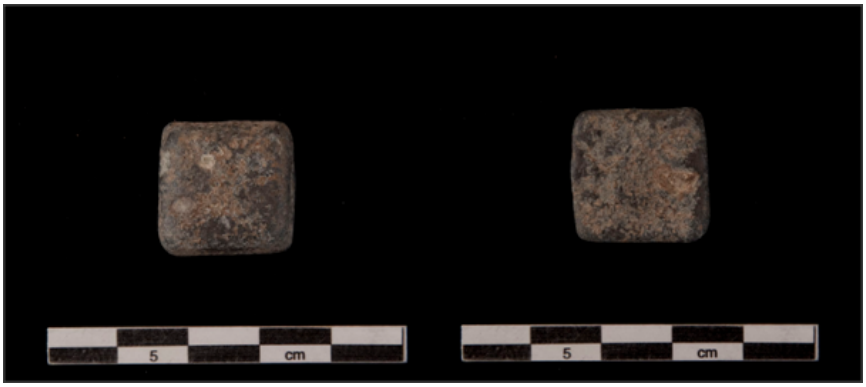
Square, plinth shaped weight tapering to the top.



Number 105

Dimensions: L. 1.4 cm; W. 1.5 cm; H. 1.2 cm
Lead, 21.5g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.5986
Provenance: Aboukir Bay, found during prospection.
Complete.

Dice shaped coin weight. 5 or 6 Attic drachma?



Number 106

Dimensions: L. 1.9 cm; W. 1.9 cm; H. 1.8 cm
Lead, 20.9g
Maritime Museum, Alexandria; Exc. no. H.2002.H4.3485 (SCA 497)
Provenance: Aboukir Bay, found during prospection.
Complete, chip missing from flat base.

Square, slightly tapering to and rounded at the top.

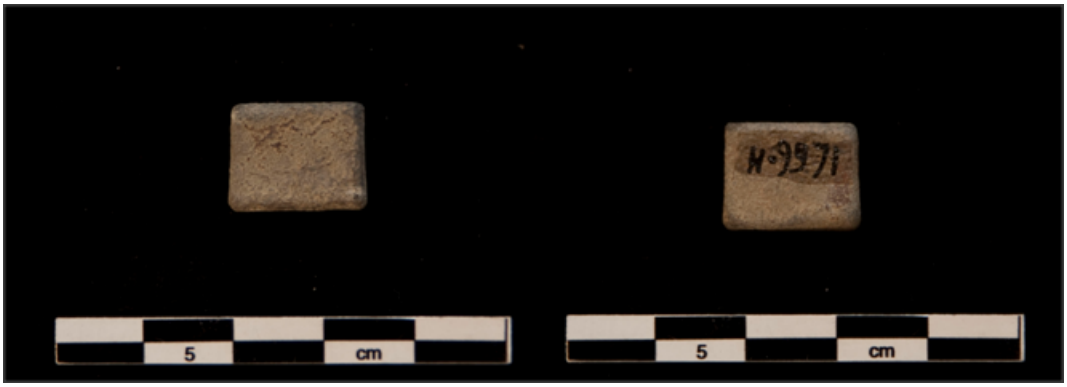
Two small depressions on one half of a face of the object.



Number 107

Dimensions: L. 2.5 cm; W. 2.3 cm; H. 0.4 cm
Lead, 20.3g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8077 A
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight, but very flat.



Number 108

Dimensions: L. 1.5 cm; W. 1.2 cm; H. 1.1 cm
Lead, 18.5g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9971
Provenance: Aboukir Bay, found during prospection.
Complete.

Rectangular, nearly dice shaped weight. 2 kite or tetradrachm?



Number 109

Dimensions: L. 1.9 cm; W. 1.9 cm; H. 0.7 cm
Lead, 17.0g
Maritime Museum, Alexandria; Exc. no. H.2009.XX.11554 A
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, flat weight, 1 tetradrachm ?

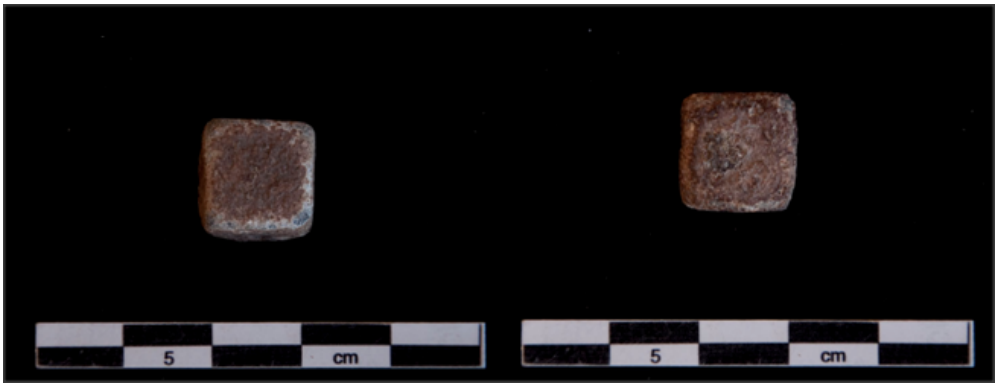


Number 110

Dimensions: L. 1.6 cm; W. 1.6 cm (1.2 cm at bottom); H. 0.9 cm
Lead, 16.5g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8064 A
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, dome shaped weight with a small circular protrusion in the centre of the dome.

1 tetradrachm?



Number 111

Dimensions: L. 1.4 cm; W. 1.3 cm; H. 0.95 cm
Lead, 13.9g
Maritime Museum, Alexandria; Exc. no. H.2009.XX.11250
Provenance: Aboukir Bay, found during prospection.
Complete.

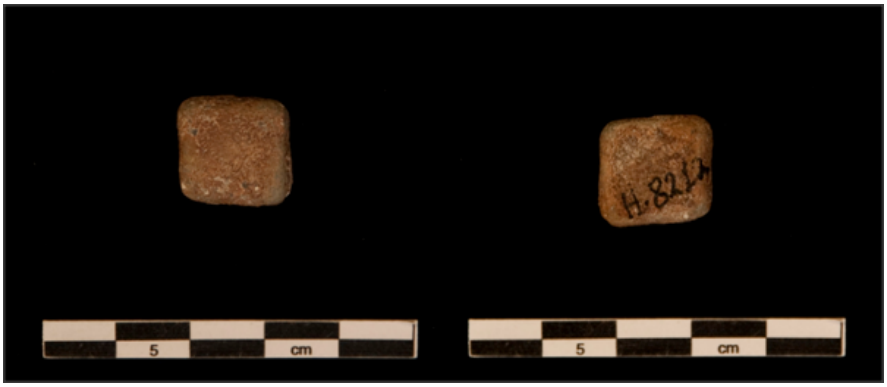
Square, flat weight.



Number 112

Dimensions: L. 1.4 cm; W. 1.5 cm; H. 0.8 cm
Lead, 13.6g
Maritime Museum, Alexandria; Exc. no. H.2004.G1.8212
Provenance: Aboukir Bay, found during prospection.
Complete.

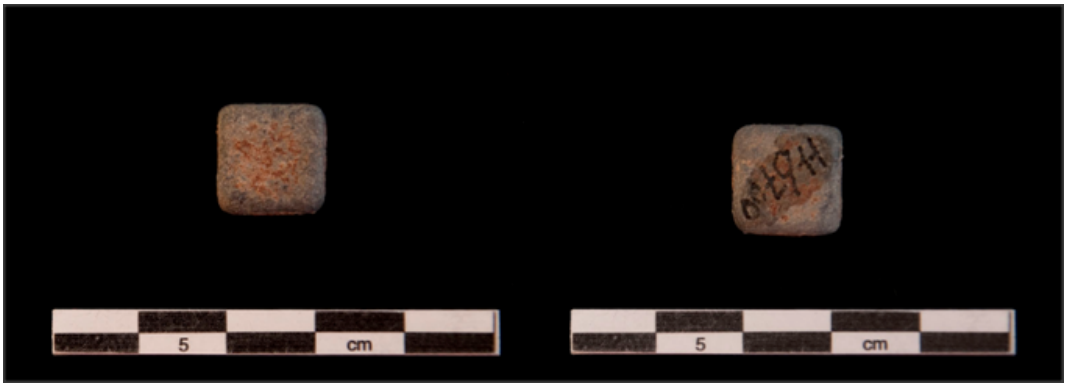
Square, plinth shaped weight, 3 Attic drachma?



Number 113

Dimensions: L. 1.5 cm; W. 1.5 cm; H. 0.7 cm
Lead, 13.3g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9694 A
Provenance: Aboukir Bay, found during prospection.
Complete.

Dice shaped weight, 3 Attic drachma?



Number 114

Dimensions: L. 1.3 cm; W. 1.2 cm; H. 0.9 cm
Lead, 13.15g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6700
Provenance: Aboukir Bay, found during prospection.
Complete.

Dice shaped weight, 3 Attic drachma?

Number 115

Dimensions: L. X cm; W. X cm; H. X cm
Bronze, 12.0g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9749
Provenance: Aboukir Bay, found during prospection.
Complete, One side is dull dark brown, the other side is a shiny bronze colour.

Square, slightly trapezoidal weight.



Number 116

Dimensions: L. 1.2cm; W. 1.3 cm; H. 0.9 cm
Lead, 11.9g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12134 B
Provenance: Aboukir Bay, found during prospection.
Complete.

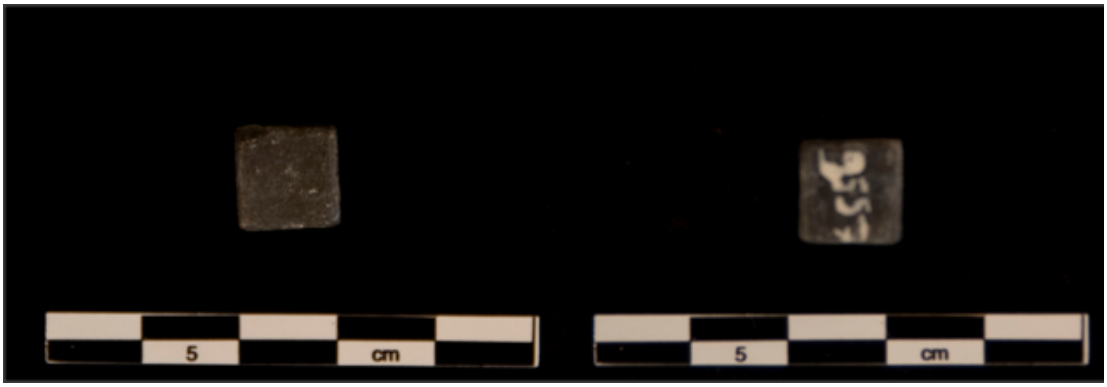
Square, dice shaped weight. Shown with **no. 144** (on the right).



Number 117

Dimensions: L. 1.1 cm; W. 1.1 cm; H. 1.1 cm
Lead, 10.5g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12012 C
Provenance: Aboukir Bay, found during prospection.
Complete, rough shape.

Square, dice shaped weight.



Number 118

Dimensions: L. 1.1 cm; W. 1.1 cm; H. 0.8 cm
Lead, 9.0g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9557
Provenance: Aboukir Bay, found during prospection.
Complete.

Dice shaped weight, 1 kite/2 Attic drachma = 1gold stater?



Number 119

Dimensions: L. 1.1 cm; W. 1.1 cm; H. 0.8 cm
Lead, 8.2g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6627
Provenance: Aboukir Bay, found during prospection.
Complete, one face corroded, some parts missing at edge.

Square, dice shaped weight with a needlepoint – dot – indent in centre of one face.

2 Attic drachma = 1 gold stater?



Number 120

Dimensions: L. 1.0 cm; W. 1.0 cm; H. 0.9 cm
Lead, 7.9g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12092 C (top left)
Provenance: Aboukir Bay, found during prospection.
Complete.

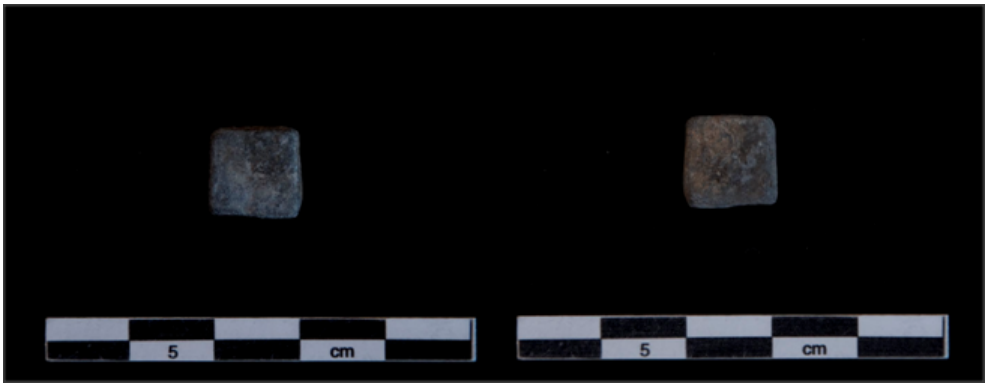
Square dice shaped weight.



Number 121

Dimensions: L. 1.3 cm; W. 1.2 cm; H. 0.6 cm
Lead, 7.7g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12092 D (top right)
Provenance: Aboukir Bay, found during prospection.
Complete.

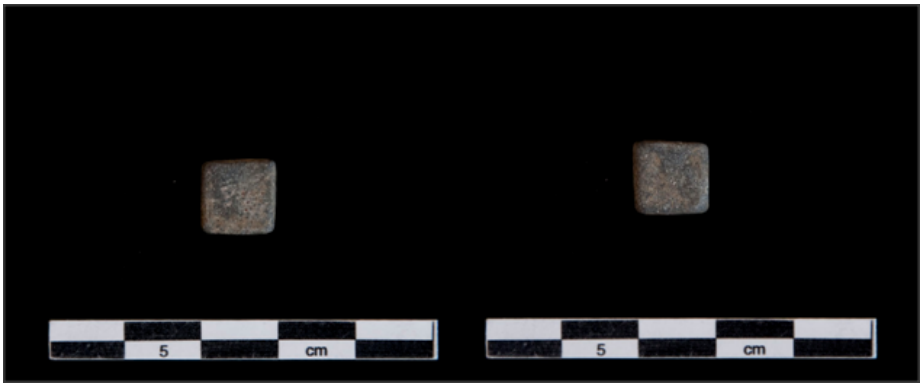
Square, plinth shaped weight.



Number 122

Dimensions: L. 1.1cm; W. 1.1 cm; H. 0.7 cm
Lead, 7.3g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12163 D
Provenance: Aboukir Bay, found during prospection.
Complete.

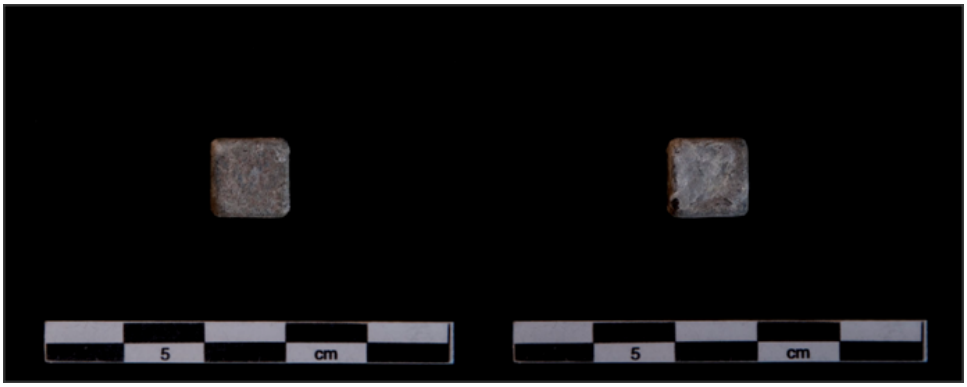
Weight, 2 Ptolemaic drachma?



Number 123

Dimensions: L. 1.0 cm; W. 1.0 cm; H. 0.8 cm
Lead, 7.3g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12183
Provenance: Aboukir Bay, found during prospection.
Complete.

Small dice shaped weight, 2 Ptolemaic drachma?



Number 124

Dimensions: L. 1.0 cm; W. 1.0 cm; H. 0.8 cm
Lead, 7.2g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12203
Provenance: Aboukir Bay, found during prospection.
Complete.

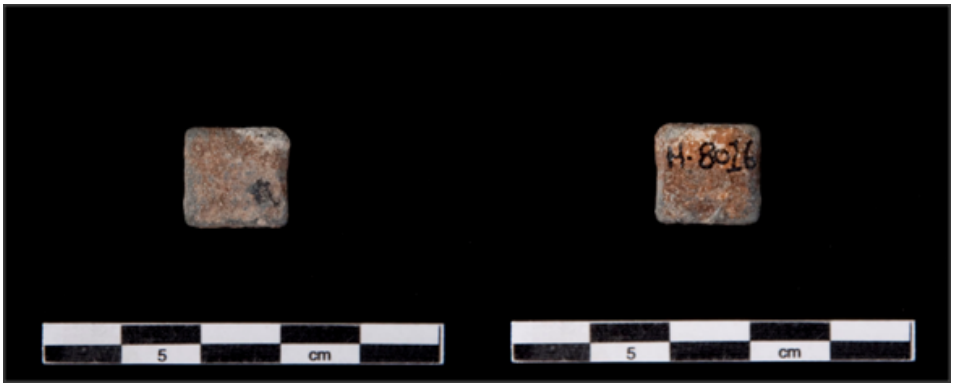
Square, dice shaped weight. 2 Ptolemaic drachma?



Number 125

Dimensions: L. 1.3 cm; W. 1.0 cm; H. 0.8 cm
Lead, 7.0g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8064 B
Provenance: Aboukir Bay, found during prospection.
Complete.

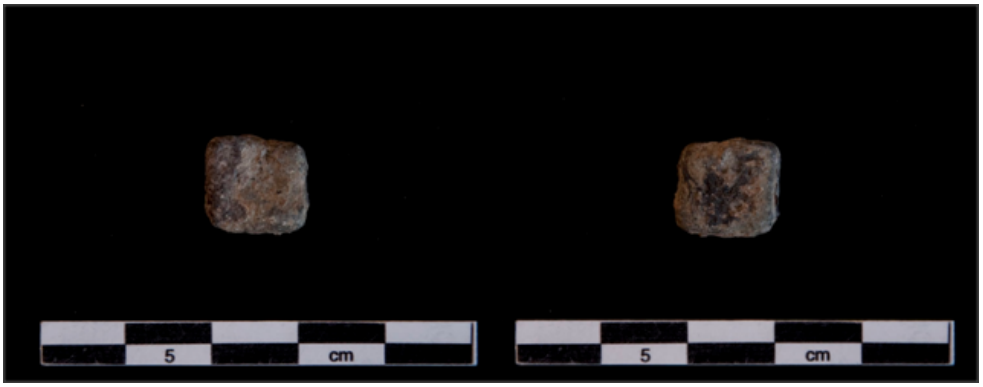
Weight? Rectangular box like object, diamond shape in section. Like 11450 B.



Number 126

Dimensions: L. 1.3 cm; W. 1.3 cm; H. 0.5 cm
Lead, 6.2g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8016
Provenance: Aboukir Bay, found during prospection.
Complete.

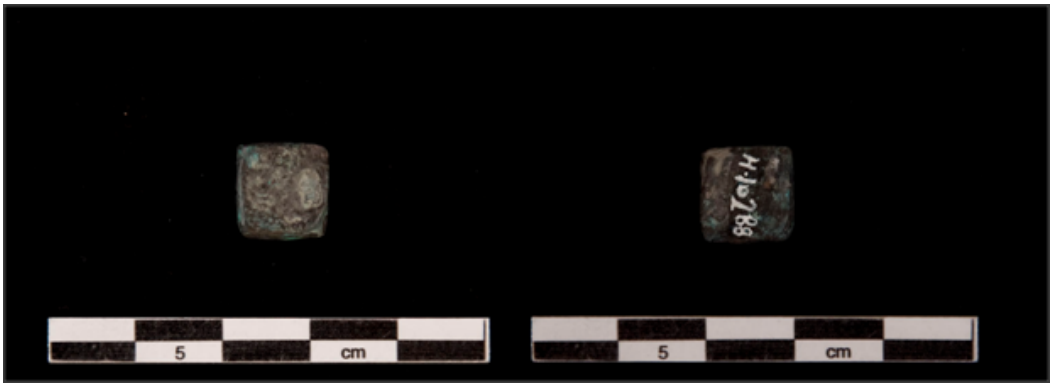
Square, flat plinth shaped weight. 1.5 Attic drachma?



Number 127

Dimensions: L. 1.2 cm; W. 1.2 cm; H. 0.7 cm
Lead, 6.0g
Maritime Museum, Alexandria; Exc. no. H.2009.XX.11362
Provenance: Aboukir Bay, found during prospection.
Complete, but the surface is irregular.

Square, plinth shaped weight.



Number 128

Dimensions: L. 1.1 cm; W. 1.1 cm; H. 0.7 cm
Bronze ?, 5.0g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10288
Provenance: Aboukir Bay, found during prospection.
Some surface missing and there are chips of corners.

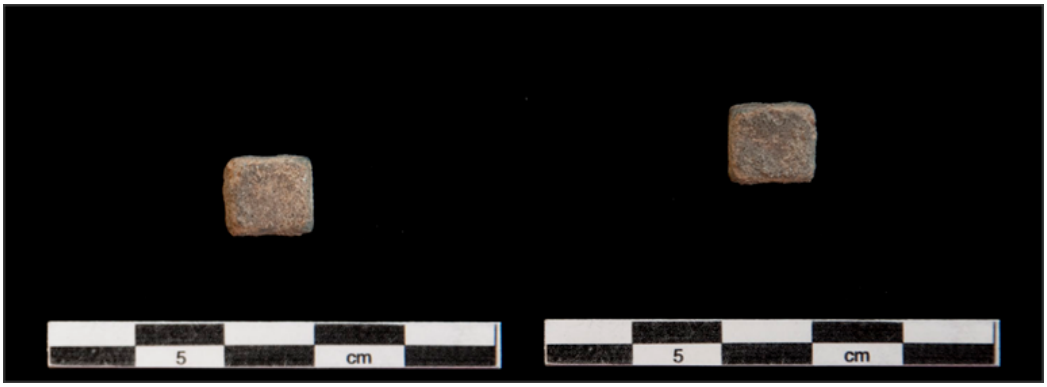
Square, plinth shaped weight.



Number 129

Dimensions: L. 1.0 cm; W. 1.0 cm; H. 0.6 cm
Lead, 4.3g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12092 E (bottom left)
Provenance: Aboukir Bay, found during prospection.
Complete.

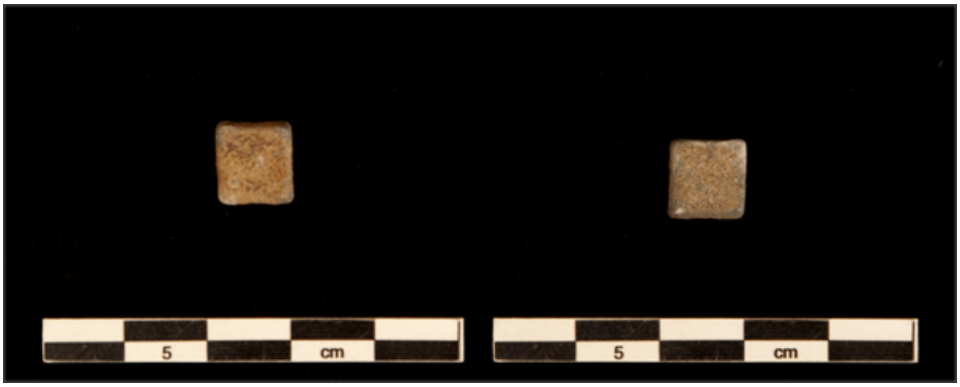
Square, plinth shaped weight.



Number 130

Dimensions: L. 1.0 cm; W. 0.9 cm; H. 0.6 cm
Lead, 4.2g
Maritime Museum, Alexandria; Exc. no. H.2002.H1.5580 (on tag, in quadrant "H1"; below "BG/188")
Provenance: Aboukir Bay, found during prospection.
Complete.

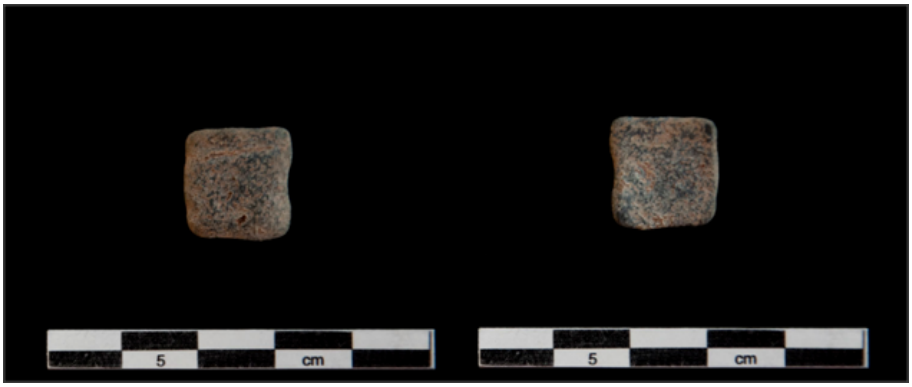
Square, dice shaped weight, 1 Attic drachma



Number 131

Dimensions: L. 1.0 cm; W. 0.9 cm; H. 0.5 cm
Lead, 4.0g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.11013
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, flat weight, 1 Attic drachma?



Number 132

Dimensions: L. 1.5 cm; W. 1.4 cm; H. 0.3 cm
Lead, 3.9g
Maritime Museum, Alexandria; Exc. no. H.2002.H4.3109 (on tag, in quadrant "H4"; below "–CL/11")
Provenance: Aboukir Bay, found during prospection.
Complete.

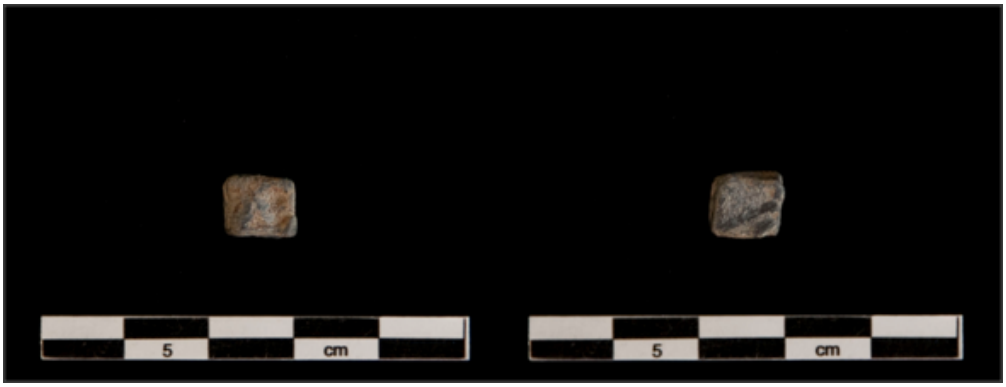
Square, flat, thin plaque of lead, weight? Slightly bent.



Number 133

Dimensions: L. 0.9 cm; W. 0.9 cm; H. 0.6 cm
Lead, 3.9g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12092 F
Provenance: Aboukir Bay, found during prospection.
Complete.

Square, plinth shaped weight.



Number 134

Dimensions: L. 0.9 cm; W. 0.8 cm; H. 0.75 cm
Lead, 3.6g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.5510
Provenance: Aboukir Bay, found during prospection.
Complete.

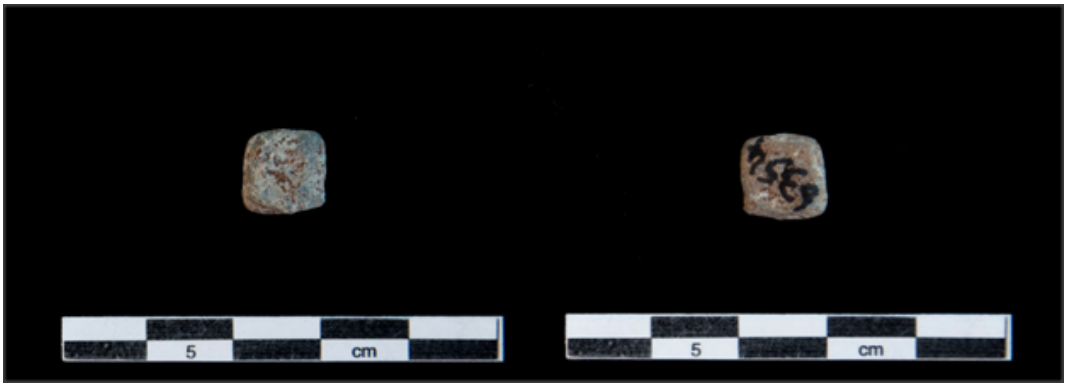
Irregularly shaped, square plinth shaped weight, 1 Ptolemaic drachma?



Number 135

Dimensions: L. 0.95 cm; W. 0.90 cm; H. 0.5 cm
Lead, 3.54g
Maritime Museum, Alexandria; Exc. no. H.2003.E3.6210 B
Provenance: Aboukir Bay, found during prospection.
Complete.

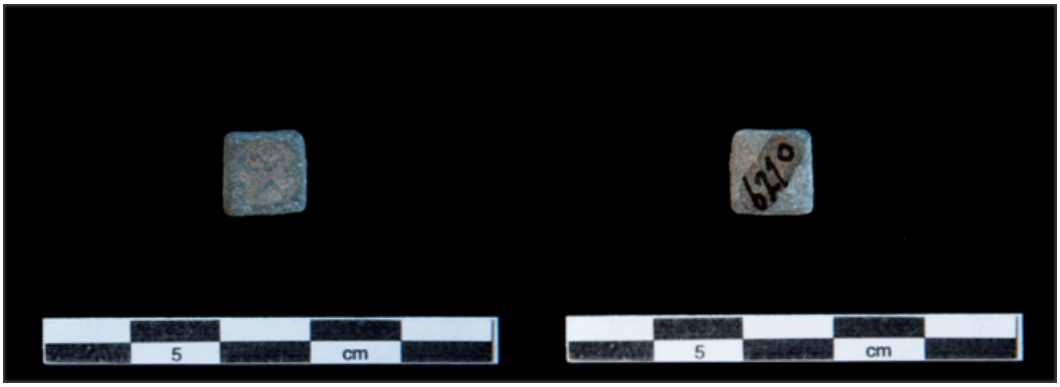
Dice shaped weight, 1 Ptolemaic drachma?



Number 136

Dimensions: L. 1.0 cm; W. 1.0 cm; H. 0.6 cm
Lead, 3.51g
Maritime Museum, Alexandria; Exc. no. H.2003.E3.6354
Provenance: Aboukir Bay, found during prospection.
Complete.

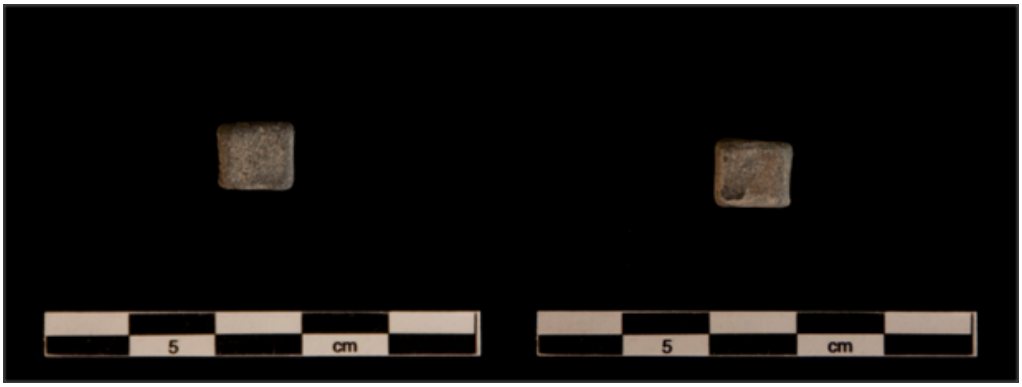
Half dice, square shaped weight, 1 Ptolemaic drachma?



Number 137

Dimensions: L. 0.95 cm; W. 0.95 cm; H. 0.45 cm
Lead, 3.48g
Maritime Museum, Alexandria; Exc. no. H.2003.E3.6210 A
Provenance: Aboukir Bay, found during prospection.
Complete.

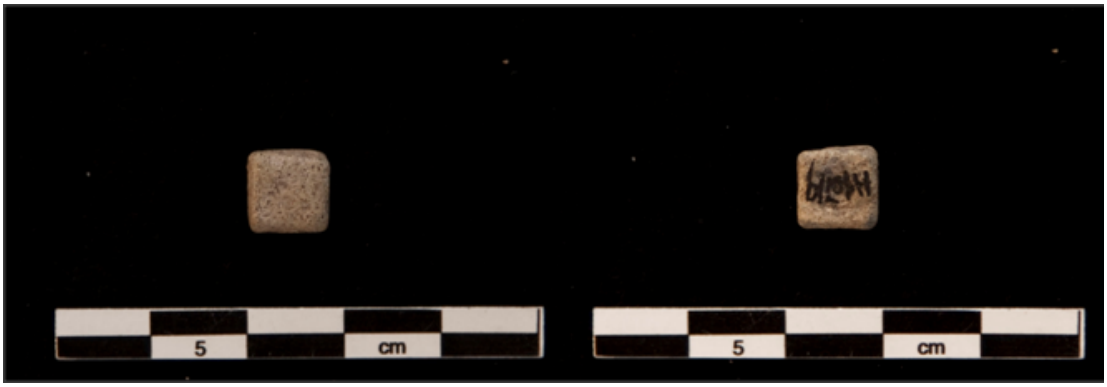
Dice shaped weight, 1 Ptolemaic drachma?



Number 138

Dimensions: L. 0.9 cm; W. 0.8 cm; H. 0.6 cm
Lead, 3.3g
Maritime Museum, Alexandria; Exc. no. H.2002.XX.3482
Provenance: Aboukir Bay, found during prospection.
Complete.

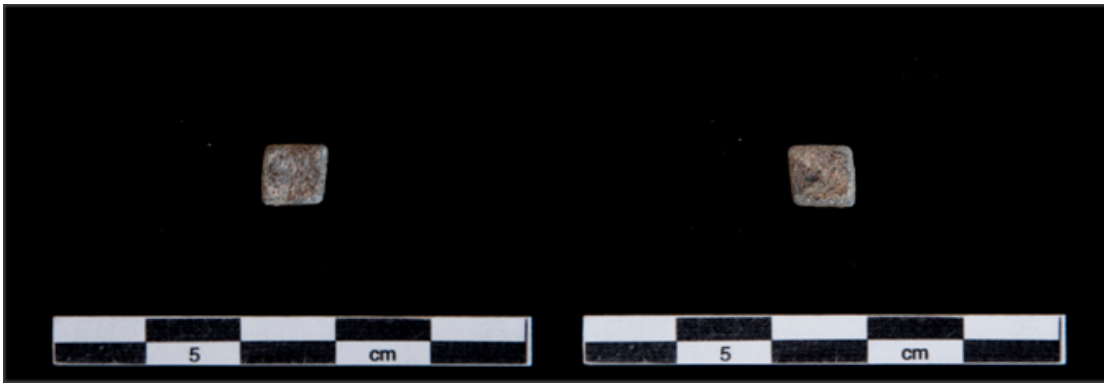
Small, square, plinth shaped weight. 1 Ptolemaic drachma.



Number 139

Dimensions: L. 0.8 cm; W. 0.8 cm; H. 0.5 cm
Lead, 2.9g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10719
Provenance: Aboukir Bay, found during prospection.
Complete.

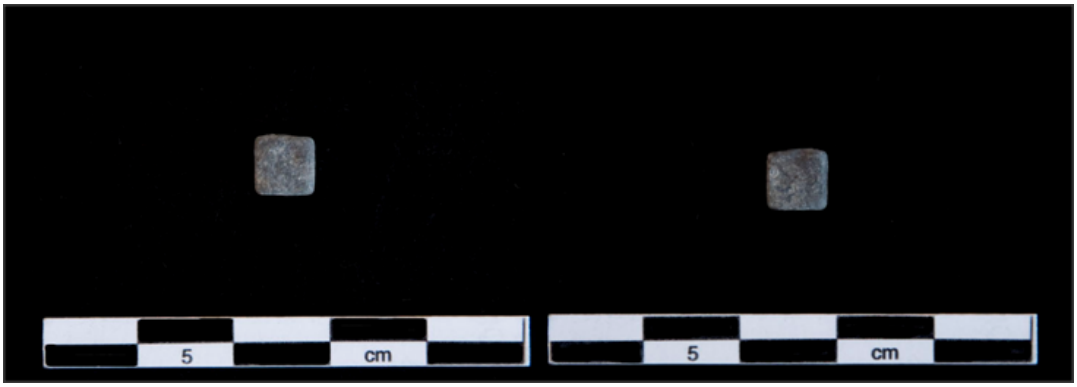
Square, plinth shaped weight.



Number 140

Dimensions: L. 0.6 cm; W. 0.7 cm; H. 0.5 cm
Lead, 1.9g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12193
Provenance: Aboukir Bay, found during prospection.
Complete.

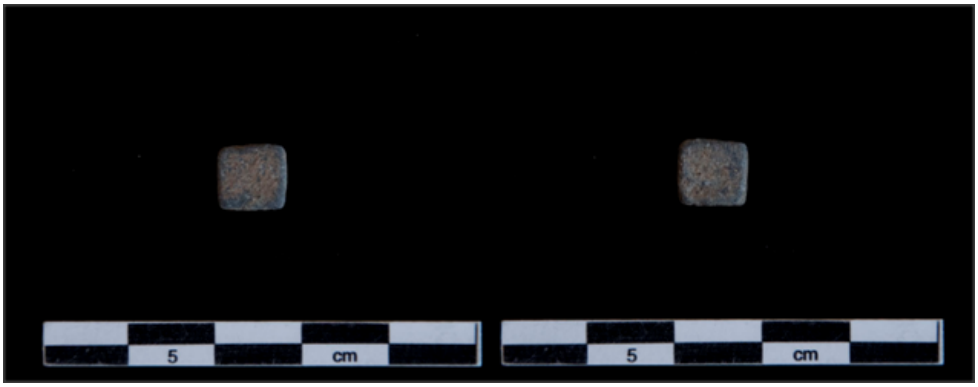
Square, nearly dice shaped weight. ½ Ptolemaic drachma?



Number 141

Dimensions: L. 0.7 cm; W. 0.7 cm; H. 0.5 cm
Lead, 1.7g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.12163 B
Provenance: Aboukir Bay, found during prospection.
Complete.

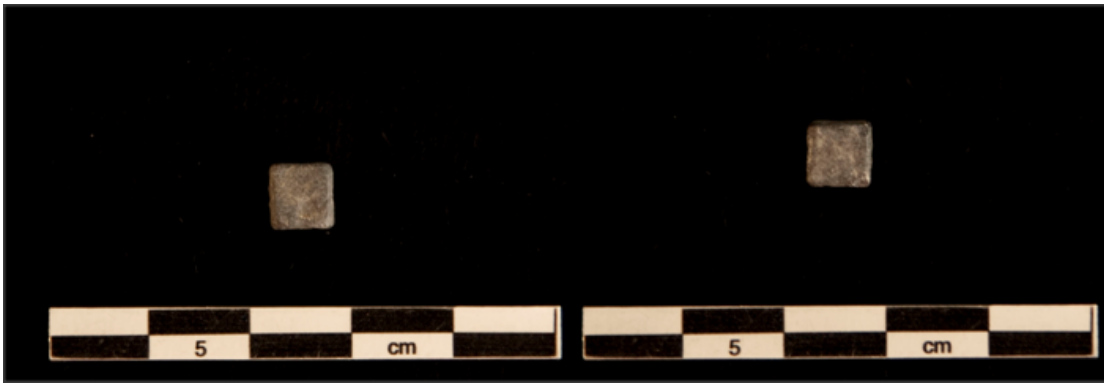
Weight, 0.5 Ptolemaic drachma?



Number 142

Dimensions: L. 0.9 cm; W. 0.8 cm; H. 0.4 cm
Lead, 1.7g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.12163 C
Provenance: Aboukir Bay, found during prospection.
Complete.

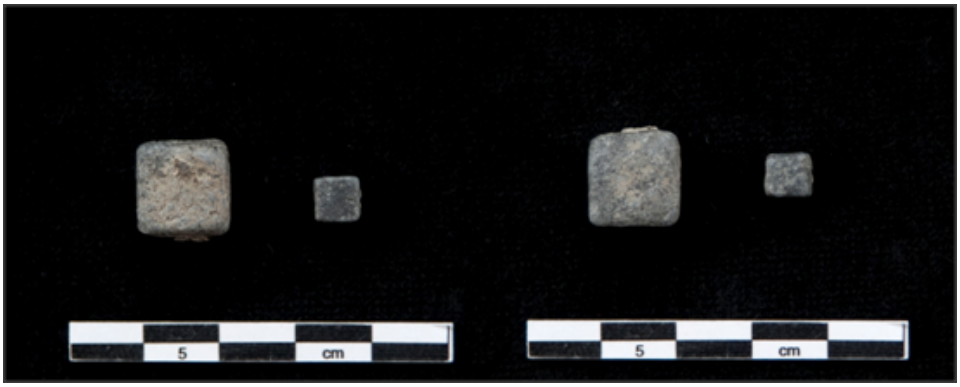
Weight, 0.5 Ptolemaic drachma?



Number 143

Dimensions: L. 0.7 cm; W. 0.7 cm; H. 0.5 cm
Lead, 1.7g
Maritime Museum, Alexandria; Exc. no. H.2002.XX.3783
Provenance: Aboukir Bay, found during prospection.
Complete.

Regularly shaped dice shaped weight, 0.5 Ptolemaic drachma?



Number 144

Dimensions: L. 0.6 cm; W. 0.6 cm; H. 0.5 cm
Lead, 1.7g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12134 A
Provenance: Aboukir Bay, found during prospection.
Complete.

Dice shaped weight, 0.5 Ptolemaic drachma? Shown with **no. 116** (on the left).



Number 145

Dimensions: L. 0.8 cm; W. 0.7 cm; H. 0.6 cm
Lead, 1.6g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.12092 G
Provenance: Aboukir Bay, found during prospection.
Complete, very rough shape.

Square, dice shaped weight, 0.5 Ptolemaic drachma?

Number 146

Dimensions: L. 0.6 cm; W. 0.6 cm; H. 0.4 cm
Lead, 1.0g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.12163 A
Provenance: Aboukir Bay, found during prospection.
Complete.

Weight?

Egyptian weights, cupcake shape



Number 147

Dimensions: Ø 36 cm max., Ø 28.0 cm bottom; H. 23.0 cm
Quartzite, 46 500g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.11206
Provenance: Aboukir Bay, found during prospection.
Complete, chip of bottom.

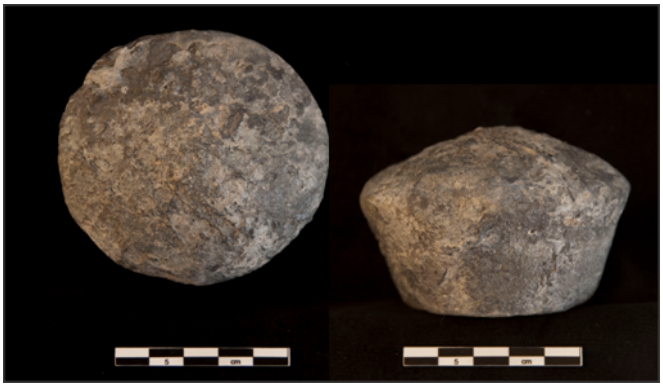
Egyptian style domed stone weight. 500 deben.



Number 148

Dimensions: Ø 30.5 cm max., Ø 18.0 cm bottom; H. 24.5 cm
Pink granite, 28 000g
Maritime Museum, Alexandria; Exc. no. H.2008.XX.10998
Provenance: Aboukir Bay, found during prospection.
Battered and parts of side missing.

Egyptian style domed weight of pink granite. 300 deben.



Number 149

Dimensions: Ø 8.0 cm max., Ø 5.8 cm bottom; H. 5.2 cm
Lead (?), 1 840g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9719
Provenance: Aboukir Bay, found during prospection.
Complete, but much corroded, and a fragment missing of bottom.

Egyptian style domed weight of 20 deben.



Number 150

Dimensions: Ø 4.7 cm max., Ø 3.3 cm bottom; H. 2.7 cm
Lead (?), 372.9g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9993
Provenance: Aboukir Bay, found during prospection.
Complete.

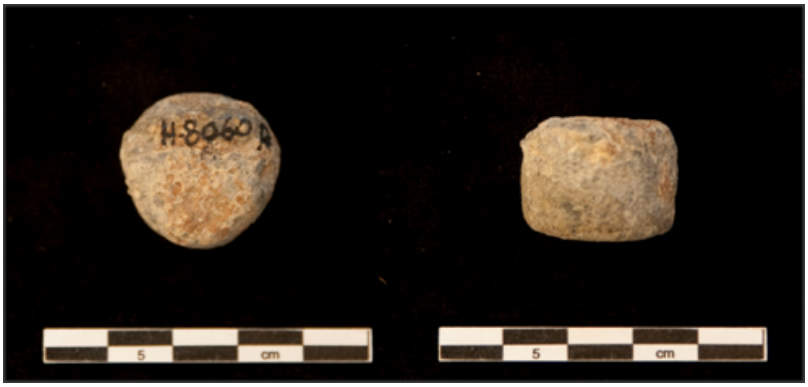
Egyptian style domed weight, flat on top of 4 deben.



Number 151

Dimensions: Ø 3.3 cm max., Ø 2.7 cm bottom; H. 2.7 cm
Bronze or lead (?), 119.9g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9982
Provenance: Aboukir Bay, found during prospection.
Chunk missing with a very rough surface.

Egyptian style domed weight.



Number 152

Dimensions: Ø 2.8 cm max., Ø 2.2 cm bottom; H. 1.8 cm
Lead (?), 90.5g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8060 A
Provenance: Aboukir Bay, found during prospection.
Complete.

Egyptian style domed weight of 1 deben.



Number 153

Dimensions: Ø 2.5 cm max.; H. 1.9 cm
Lead, 71.9g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8060 B
Provenance: Aboukir Bay, found during prospection.
Complete, rough surface and shape.

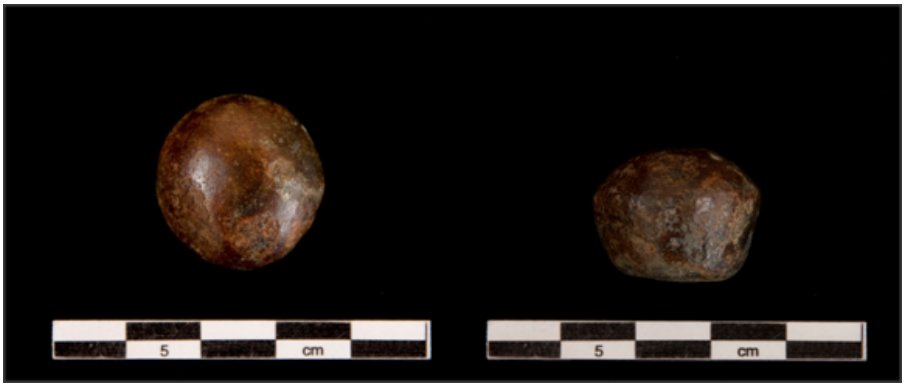
Cylindrical shaped weight, hollow on one (short) end of cylinder. 8 kite.



Number 154

Dimensions: Ø 2.5 cm max., Ø 2.1 cm bottom; H. 1.5 cm
Lead (?), 55.1g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8174 B
Provenance: Aboukir Bay, found during prospection.
Complete.

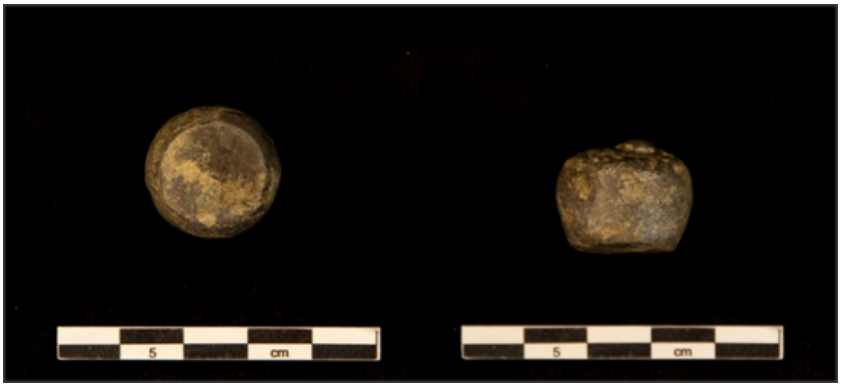
Egyptian style domed weight, relatively flat topped of 6 kite.



Number 155

Dimensions: Ø 2.4 cm max., Ø 1.7 cm bottom; H. 1.8 cm
Bronze (?), 39.8g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10282
Provenance: Aboukir Bay, found during prospection.
Complete, shallow pieces of surface missing.

Egyptian style domed weight. 4.5 kite?



Number 156

Dimensions: Ø 2.1 cm max., Ø 1.7 cm bottom; H. 1.8 cm
Bronze, 38.9g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6898
Provenance: Aboukir Bay, found during prospection.
Bits of top missing.

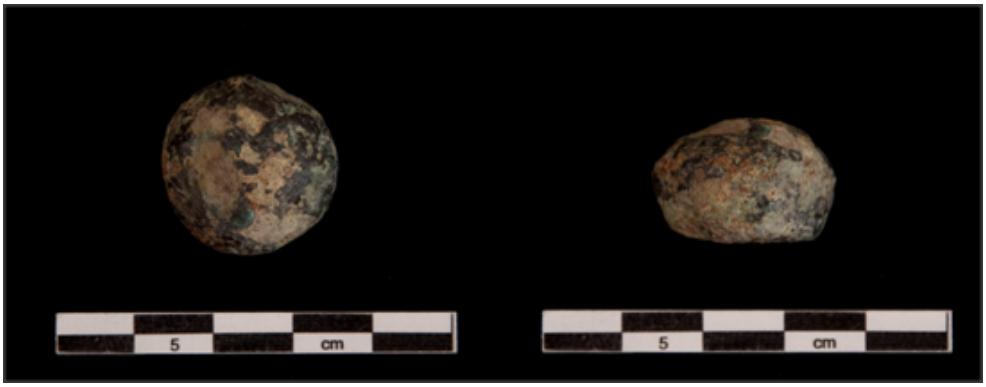
Egyptian style domed weight without the usual carination and a slight circular protrusion on top. 4 kite.



Number 157

Dimensions: Ø 2.5 cm max., Ø 1.8 cm bottom; H. 1.6 cm
Bronze, 38.4g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10252
Provenance: Aboukir Bay, found during prospection.
Complete, parts of the surface missing.

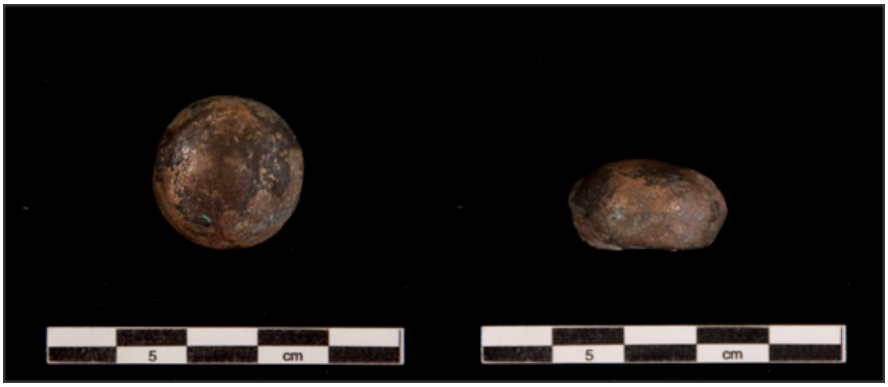
Egyptian style domed weight. 4 or poss. 5 kite.



Number 158

Dimensions: Ø 2.3 cm max., Ø 1.8 cm bottom; H. 1.5 cm
Bronze, 28.0g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9992
Provenance: Aboukir Bay, found during prospection.
Corroded and parts of the surface missing.

Egyptian style domed weight. 3 kite, or possibly 4 kite originally.



Number 159

Dimensions: Ø x2.2 cm max., Ø 1.7 cm bottom; H. 1.2 cm
Bronze, 27.5g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9924
Provenance: Aboukir Bay, found during prospection.
Complete, some surface missing on bottom through cleaning (?).

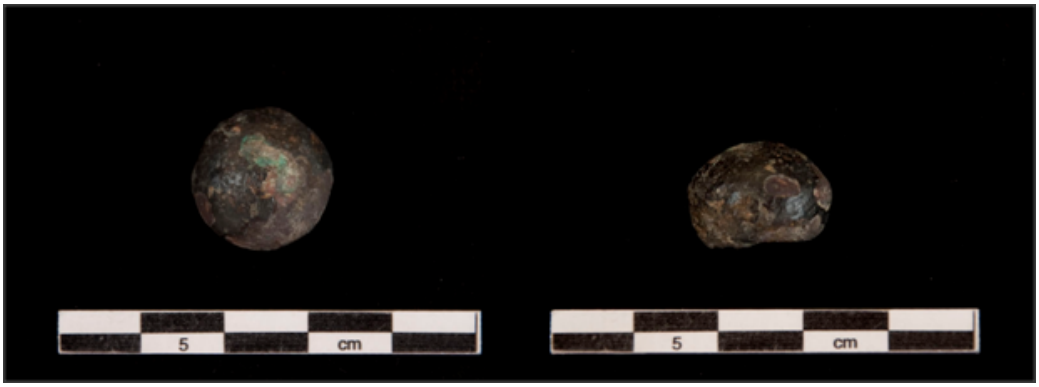
Egyptian style domed weight.



Number 160

Dimensions: Ø 1.9 cm max.; H. 1.5 cm
Lead, 17.4g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9927
Provenance: Aboukir Bay, found during prospection.
Approx. one third is missing, only a fragment of the original is left.

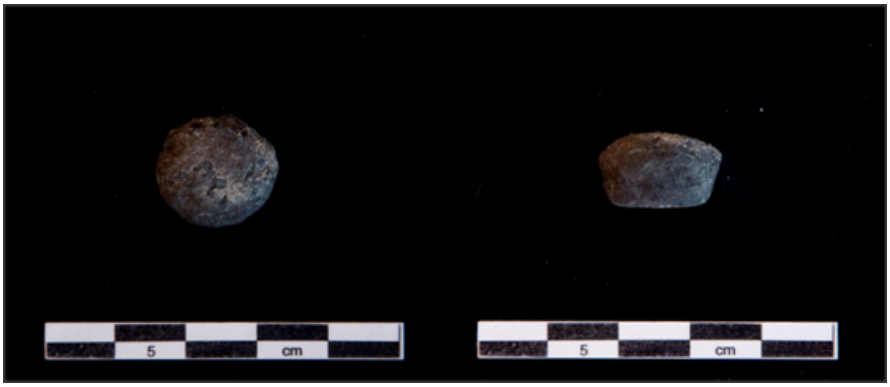
Egyptian style domed weight.



Number 161

Dimensions: Ø 1.7 cm max., Ø 1.5 cm bottom; H. 1.3 cm
Bronze, 14.9g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9977
Provenance: Aboukir Bay, found during prospection.
Complete, but significant parts of surface missing.

Egyptian style domed weight. 1.5 or 2 kite.



Number 162

Dimensions: Ø 1.7 cm max., Ø 1.3 cm bottom; H. 1.1 cm
Bronze (?), 12.6g
Maritime Museum, Alexandria; Exc. no. H.2009.XX.11239
Provenance: Aboukir Bay, found during prospection.
Complete, rough surface.

Egyptian style domed weight. 1,5 kite?

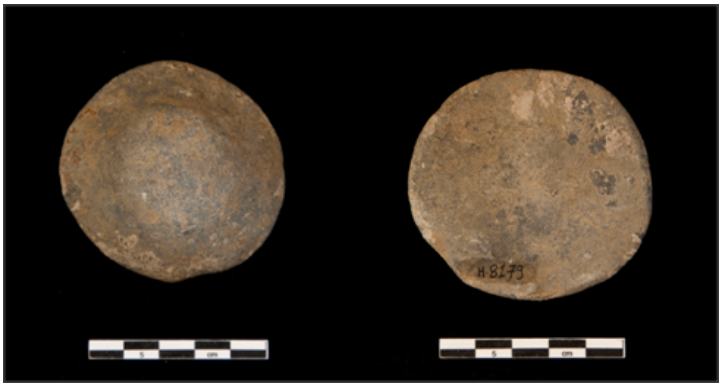
Egyptian domed shaped weight



Number 163

Dimensions: Ø 8.4 cm max.; H. 2.5 cm
Lead, 800g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.4455
Provenance: Alexandria.
Complete.

Round weight with round protrusion ("blob"), on bottom there are two depressions visible in the centre of which remains of protrusions.



Number 164

Dimensions: Ø 6.7 cm max.; H. 2.4 cm
Lead, 449.9g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8179
Provenance: Aboukir Bay, found during prospection.
Complete, smooth surface

Round weight with round protrusion ("blob"), section is a flat bell shape. 5 deben. Also 1 mina?



Number 165

Dimensions: Ø 5.0 cm max.; H. 2.6 cm
Lead, 335.6g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6948
Provenance: Aboukir Bay, found during prospection.
Complete, one cut (1.5 cm) on the edge of the base.

Hemispherical weight. The base is slightly concave and has a diameter of 3.6 cm, then there is a further edge flaring up, 3 mm high and 7 mm radius.



Number 166

Dimensions: Ø 4.9 cm max.; H. 2.8 cm
Lead, 313.8g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6599
Provenance: Aboukir Bay, found during prospection.
Complete.

Rounded domed weight. 3.5 deben.



Number 167

Dimensions: L. 3.5 cm; W. 3.1 cm; H. 4.0 cm
Lead, 263.5g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.6795 A
Provenance: Aboukir Bay, found during prospection.
Surface corroded and rough, and some marine encrustations.

High, nearly cylindrical domed weight, slightly rectangular in section. 3 deben.



Number 168

Dimensions: Ø 3.9 cm max.; H. 2.2 cm
Lead, 228.7g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10180
Provenance: Aboukir Bay, found during prospection.
Complete, smooth surface.

Cylindrical weight, no markings. 2.5 deben.



Number 169

Dimensions: L. 3.4 cm; W. 3.0 cm; H. 3.0 cm
Lead, 179.6g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.6795 B
Provenance: Aboukir Bay, found during prospection.
Surface corroded and rough, and some marine encrustations.

High domed weight, slightly rectangular in section. 2 deben.



Number 170

Dimensions: Ø 3.4 cm max.; H. 2.4 cm
Lead, 171.1g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.10098 B
Provenance: Aboukir Bay, found during prospection.
Complete.

Cylindrical weight (?), depressions on both flat sides.



Number 171

Dimensions: Ø 3.3 cm max.; H. 2.1 cm
Lead, 133.3g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10098 A
Provenance: Aboukir Bay, found during prospection.
Complete.

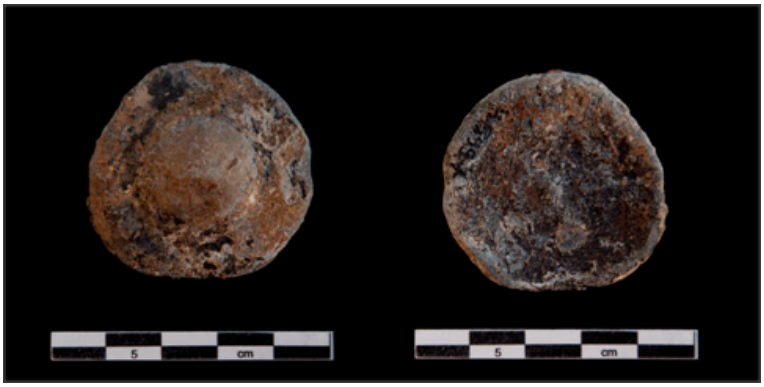
Rounded domed weight.



Number 172

Dimensions: Ø 3.1 cm max.; H. 2.3 cm
Lead, 131g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.11573
Provenance: Aboukir Bay, found during prospection.
Complete, but rough surface and very worn.

Between a cylinder and an Egyptian style domed weight.



Number 173

Dimensions: Ø 4.1 cm (2.0 cm Ø "blob"); H. 1.3 cm
Lead, 75.2g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.5997
Provenance: Aboukir Bay, found during prospection.
Complete, rough surface, marine encrustations

Flat disc with bulbous protrusion, "blob" on top. The base is slightly concave.



Number 174

Dimensions: Ø 2.8 cm max., 2.1 cm bottom; H. 2.3 cm
Bronze, 73.9g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8049
Provenance: Aboukir Bay, found during prospection.
Complete.

Rounded domed weight. Possibly weighted with lead. 8 kite.



Number 175

Dimensions: Ø 3.2 cm max.; H. 2.8 cm
Lead, 71.4g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6574 (SCA 949)
Provenance: Aboukir Bay, found during prospection.
Complete.

Rounded high domed weight, in the base a round hollow inside with further material present. 8 kite.



Number 176

Dimensions: L. 3.3 cm; W. 3.1 cm; H. 1.6 cm
Bronze (?), 67.8g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10071
Provenance: Aboukir Bay, found during prospection.
Complete.

Irregular shaped domed weight. 7.5 kite.



Number 177

Dimensions: Ø 2.7 cm max.; H. 1.3 cm
Lead, 58.0g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6918
Provenance: Aboukir Bay, found during prospection.
Complete, smooth surface.

Round cylindrical weight, slight indent in bottom. 6 kite?



Number 178

Dimensions: L. 2.7 cm; W. 2.4 cm; H. 2.4 cm
Lead (?), 57.6g
Maritime Museum, Alexandria; Exc. no. H.2003.E3.6244
Provenance: Aboukir Bay, found during prospection.
Irregularly shaped piece of lead.

Irregular pyramidal shaped piece of lead, weight?



Number 179

Dimensions: Ø 2.75 cm max.; H. 1.1 cm
Lead, 46.5g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10200
Provenance: Aboukir Bay, found during prospection.
Complete, one chip at the bottom missing.

Round bun shaped weight. 5 kite.



Number 180

Dimensions: Ø 3.5 cm max.; H. 0.9 cm
Lead, 43.1g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6799
Provenance: Aboukir Bay, found during prospection.
Complete, some remains of marine encrustations.

Flat disc with bulbous protrusion, "blob" on top. 5 kite / 0.5 deben. Some suggestive scratches possibly indicating an incised inscription, possibly also just remains of marine encrustations: a circle and one stroke.



Number 181

Dimensions: Ø 3.5 cm max.; H. 1.6 cm
Lead, 39.04g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6610
Provenance: Aboukir Bay, found during prospection.
Large part chipped off (20% loss?)

Rounded domed weight. 20% missing?



Number 182

Dimensions: L. 3.0 cm; W. 1.4 cm; H. 1.7 cm
Lead, 36.0g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9696
Provenance: Aboukir Bay, found during prospection.
Complete, shiny due to cleaning?

Domed weight, rectangular in section. 4 kite.

CATALOGUE FOR CHAPTER 5: CONTAINERS

Largest containers 75-130 cm

Number 184: H.2001.H2.2726; >120 cm (estimated), in situ. Two round apertures.

Number 185: H.2002.H1.3801; diameter 120 cm, H. 100 cm, in situ.

Number 186: H.2004.XX.8591; diameter 110 cm, in situ.

Number 187: H.2002.H1.3802, diameter 100 cm, H. 80 cm, in situ.

Number 188: H.2002.H1.2927; diameter 100 cm, H. 80 cm, in situ.

Number 189: H.2002.H2.2999; diameter 100 cm, H. 80 cm, in situ.

Number 190: H.2001.H2.2725; diameter 100 cm, in situ, two holes in walls.

Number 191: H.2001.H1.2415; diameter 75 cm, H. 85 cm, in situ.

Number 192: H.2001.H1.2417; diameter 75 cm, in situ.

Number 193: H.2002.H1.2928; dimensions unknown, in situ.

Number 194: H.2002.XX.3352; dimensions unknown, in situ.

Number 195: H.2002.XX 3353; dimensions unknown, in situ.

Number 196: H.2002.XX 3354; dimensions unknown, in situ.

Number 197: H.2002.XX 3355; dimensions unknown, in situ.

Containers (60-70 cm)

Number 198: H.2004.XX.8944; 70 cm, in situ.

Number 199: H.2004.XX.8979; 60 cm, in situ.

Number 200: H.2004.XX.8982; 60 cm, in situ.

Containers (40-50 cm)

Number 201: H.2001.XX.2513; 50cm, in situ.

Number 202: H.2001.XX.2514 50cm, in situ.

Number 203: H.2002.XX.3244 50 cm, in situ.

Number 204: H.2004.XX.8819 50cm, in situ.

Number 205: H.2004.XX.8849 50 cm, in situ.

Number 206: H.2004.XX.8929 50cm, in situ.

Number 207: H.2004.XX.8942 50cm, in situ.

Number 208: H.2004.XX.8983 50cm, in situ.

Number 209: H.2004.XX.8985 50cm, in situ.

Number 210: H.2004.XX.9171 50cm, in situ.

Number 211: H.2002.XX.3247 45cm, in situ.

Number 212: H.2001.XX.2186, 'chaudon', 44 cm, in situ.

Number 213: H.2007.XX.9901 42cm, in situ.

Number 214: H.2003.XX.6500 see below (above water).

Number 215: H.2003.XX.7065 40 cm, in situ.

Number 216: H.2003.XX.7066 40 cm, in situ.

Number 217: H.2003.XX.7067 40 cm, in situ.

Number 218: H.2003.XX.7068 40 cm, in situ.

Number 219: H.2004.XX.8925 40 cm, in situ.

Number 220: H.2004.XX.8951 40 cm, in situ.

Number 221: H.2004.XX.8974 40 cm, in situ.

Containers (25-39 cm)

Number 222: H.2002.XX.3248; 35 cm, in situ.

Number 223: H.2003.XX.7029; 35 cm, in situ.

Number 224: H.2010.XX.11953; 35cm, no coordinates, in situ.

Number 225: H.2004.XX.8820; 30cm, in situ.

Number 226: H.2004.XX.8842; 30cm, in situ.

Number 227: H.2004.XX.8945; 30cm, in situ.

Number 228: H.2006.XX.10052; 25cm, in situ.

Number 214

Dimensions: L. 43.5 cm; W. 45.5 cm; H. 27.5 cm, walls 3 mm thick, at the rim 5-6 mm thick
Lead, unknown weight.
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6500.
Provenance: Aboukir Bay, found towards the western end of the Grand Canal, near no. **234**.
Complete, some tears in walls of vessel.

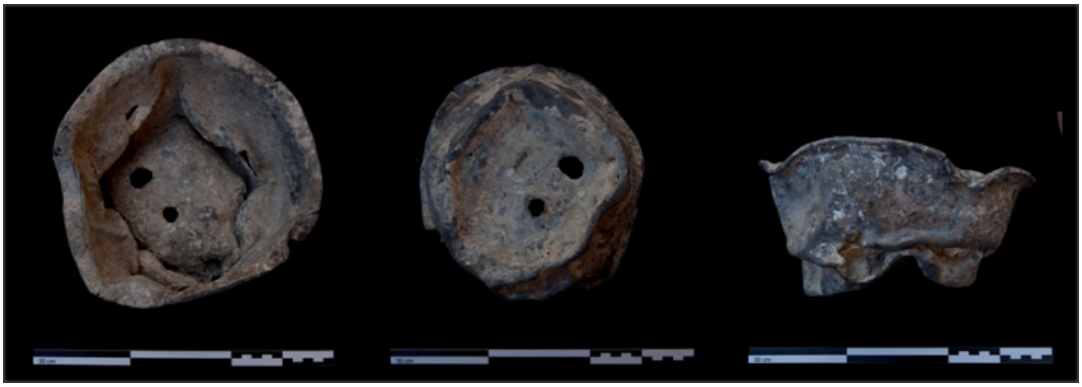
Large container, bulbous shape. Crumpled slightly from the top with folds in the lead.



Number 229

Dimensions: L. 32.2 cm; W. 20.3 cm; H. 13.6 cm, reconstructed base Ø 20/21 cm, walls 5–6 mm thick
Lead, 4980g
Maritime Museum, Alexandria; Exc. No. H.2002.XX.3015 (SCA 589)
Provenance: Aboukir Bay, in the water just north of the temple in the port (H3) at the entrance of the Grand Canal.
Complete, crushed/folded around a bronze pot inside, some cracks where lead is crushed over bronze, surface is good, not many encrustations.

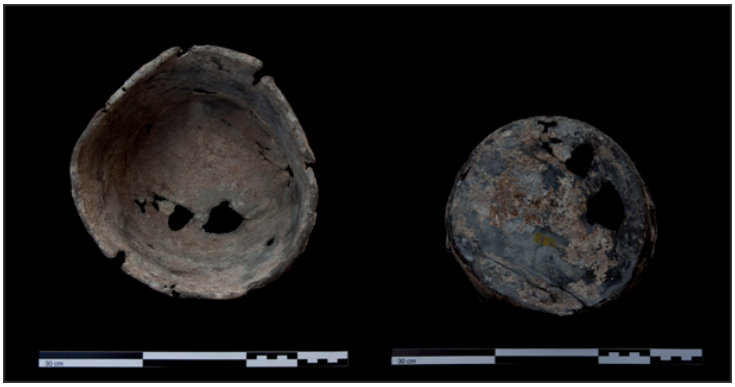
Wide-open rim folded out, round base, folded around two (bronze) objects. One bronze vessel is upside down, bulbous shape, articulated base visible pushed into vessel itself. One ring/bracelet with a tendon or protrusion. Similar to no. **230**.



Number 230

Dimensions: L. 25.3 cm; W. 27.5 cm; H. 15.2 cm max., walls 3 mm thick, at the rim 5-6 mm thick
Lead, 3941g
Maritime Museum, Alexandria; Exc. No. H.2002.XX.3005
Provenance: Aboukir Bay, found near the pillars in the Grand Canal just north of the temple island, near 8231.
Shape distorted with large holes.

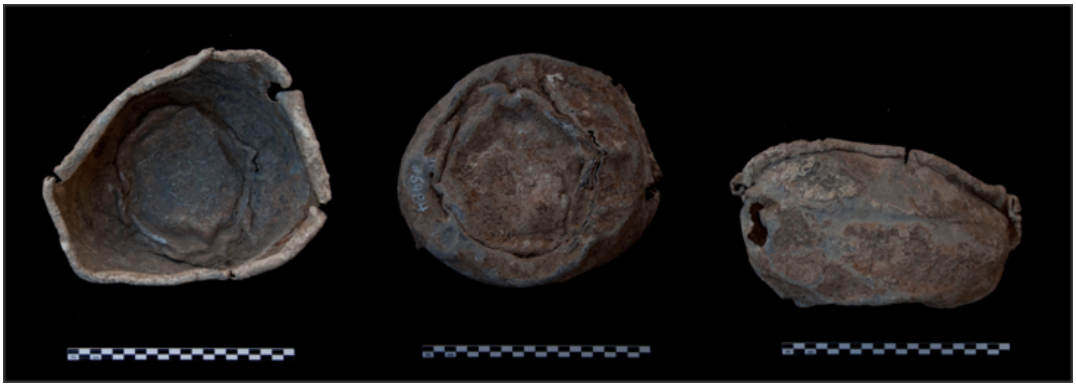
Container with a circular base, which is now concave. Original base Ø 20–21 cm. Walls flare open, with a curved rim. Similar vessel to no. 229.



Number 231

Dimensions: Ø 23.1 cm max., base Ø 18.0 cm; H. 15.5 cm; walls 4 mm thick
Lead, 3030g
Maritime Museum, Alexandria; Exc. no. H.2002.H4.3530 (SCA 588)
Provenance: Aboukir Bay, in the water just north of the temple in the port (H3) at the entrance of the Grand Canal.
Complete, but (large) holes in base, holes and cracks in walls. Surface is flaking off, outer surface is gone in large areas. Shape is distorted slightly.

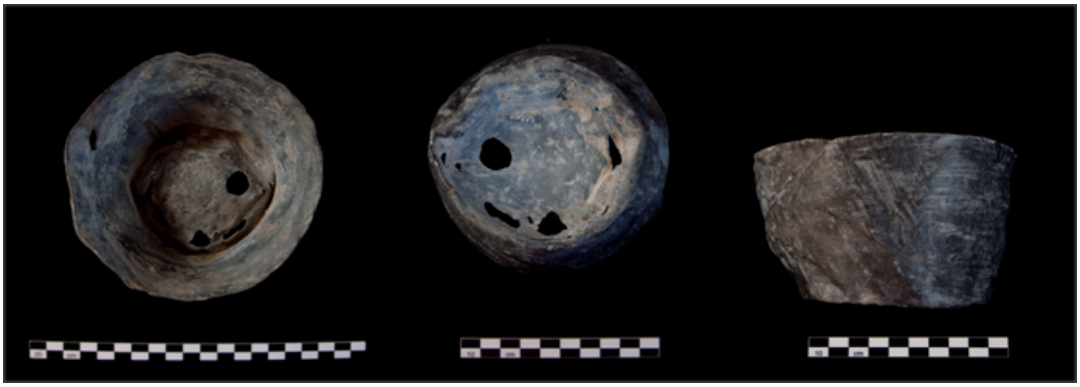
Round base, walls go straight up with rim curving up and back. Rim curving down for 1.6 cm.



Number 232

Dimensions: Ø 26.0 cm; H. 12.8 cm; walls 3 mm thick
Lead, 2792g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.6484
Provenance: Aboukir Bay, on the north bank of the north island.
Shape distorted, pushed down, top edges cracked with large gashes in the body under pressure and base was crumpled. There is one crack in the crumpled base, holes in body. The surface is flaking, inside there are marine encrustations.

Cylindrical container with flared walls and folded, curved rim. The diameter of base is difficult to reconstruct due to the crumpled folds, but possibly 13.5–15 cm, but definitely <20 cm. Curled rim.



Number 233

Dimensions: Ø 16.0 cm, base Ø 11.0 cm; H. 8.9 cm; walls 3 mm thick
Lead, 666g
Maritime Museum, Alexandria; Exc. No. H.2007.XX.10225
Provenance: Aboukir Bay, found in the southern part of the central basin near the temple island.
Shape distorted, holes in base, one hole in the wall, very much cleaned on the outside with traces of the modern tools used.

Base of vessel is now concave with lumpy walls due to the distortion. The walls taper out.

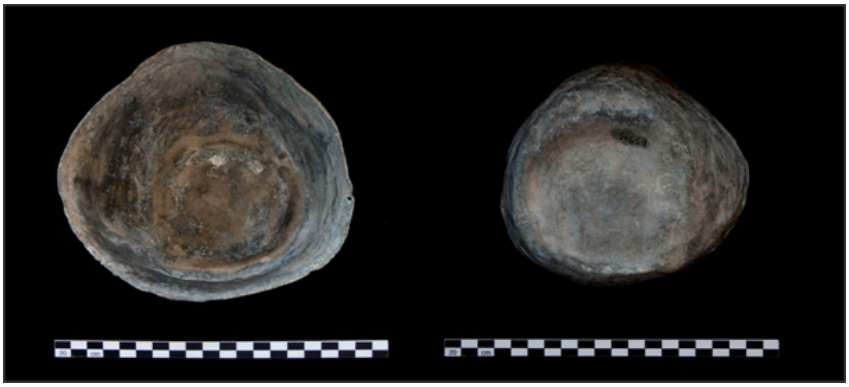
Similar to no. **238**.



Number 234

Dimensions: Ø 14.4 cm; H. 7.5 cm
Lead, 705g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6294 (SCA 922)
Provenance: Aboukir Bay, found towards the western end of the Grand Canal, near no. **214**.
Complete, lead crumpled downwards.

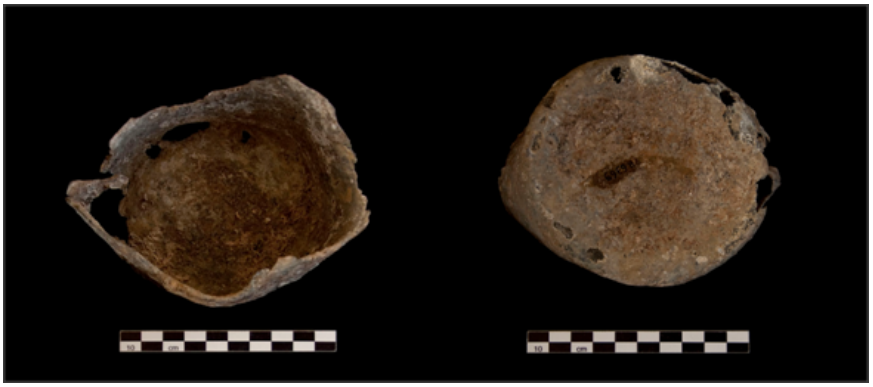
Bowl with possibly straight walls. Lead crumpled around base.



Number 235

Dimensions: L. 17.2 cm; W. 15.2 cm; H. 8.6 cm
Lead, 856g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.5975 (SCA 1150)
Provenance: Aboukir Bay, found near the bank of the temple island and the Grand Canal.
Complete, deformed and sloped to one side, two chips of the rim.

Thin walled bowl.



Number 236

Dimensions: L. 14.5 cm; W. 11.2 cm, max. Ø 10.9 cm, at base Ø 10.3 cm; H. 8.0 cm, walls 3.5 mm thick
Lead, 644g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6369
Provenance: Aboukir Bay, found on the temple island, in the middle towards the west of the temple.
Large fragments missing, no original edges, holes on one side of the vessel and around base.

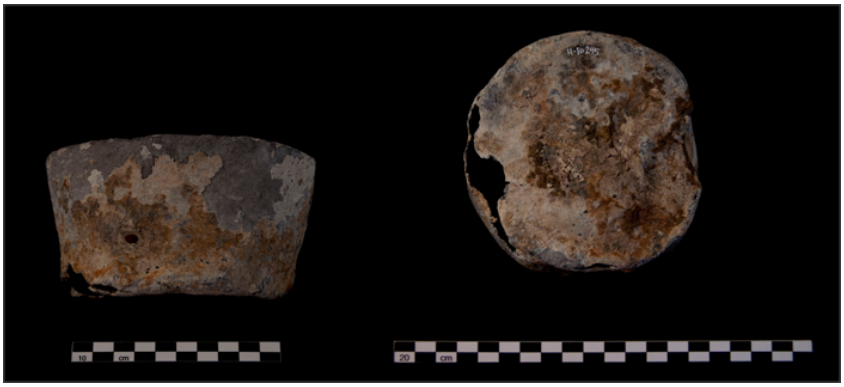
Cylindrical container, base slightly concave.



Number 237

Dimensions: Ø 13.7 cm, at base Ø 8.7 cm; H. 8.9 cm
Lead, 551g
Maritime Museum, Alexandria; Exc. no. H.2002.H4.3584 (SCA 606)
Provenance: Aboukir Bay, found at the edge of the temple island at the eastern end of the Grand Canal.
Flaky surface, small holes and cracks in walls, shape slightly distorted.

Container with a round base and walls that go straight up, or possible taper out slightly.



Number 238

Dimensions: top Ø max. 15.5cm; base Ø 12.5 cm max.; H. 8.5 cm, walls 4 mm thick (at rim)
Lead, 967g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10295
Provenance: Aboukir Bay, found in the middle of the central basin.
Fragments missing, surface flaking off, shape crumpled in areas and distorted.

Container, walls taper out slightly (but straight) and are 7.5 cm high.

Number 239

Dimensions: L. 20.4 cm; W. 10.2 cm; H. 9.4 cm
Lead, 1448g
Maritime Museum, Alexandria; Exc. no. H.2009.XX.11264 (no coordinates)
Provenance: Aboukir Bay, found during prospection.
Severely corroded, many marine encrustations and many shells on the inside, holes in body.

Dish. Very rough Ø 9.0 cm at base? Walls may be 9–10 cm high.

Number 240

Dimensions: L. 9.0 cm; W. 10.5 cm, base Ø 5.0 cm; H. 9.3 cm; walls 5-6 mm thick
Lead, 943g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9129
Provenance: Aboukir Bay, found in the northeastern part of the central basin.
Complete, corroded with many marine encrustations, three perforations one at the top two near the base on side.

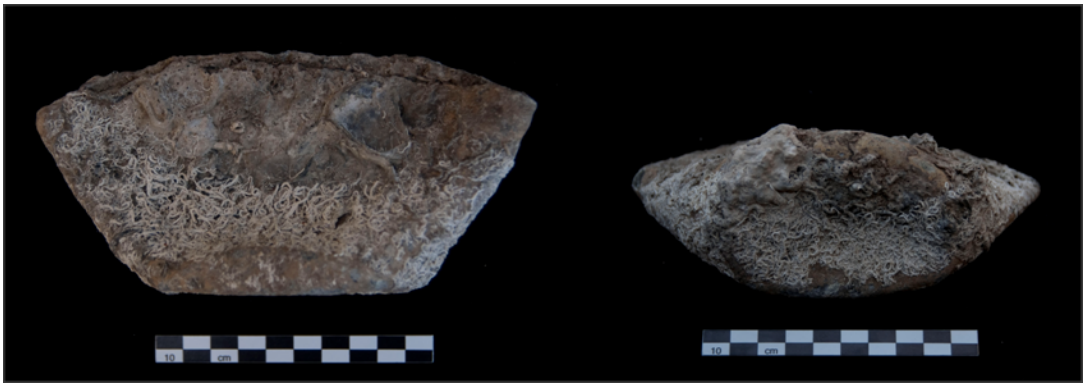
Relatively thick walled vessel, walls 10 cm high.



Number 241

Dimensions: L. 14.1 cm; W. 6.6 cm; H. 7.2 cm, walls 2 mm thick
Lead, 576g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9102
Provenance: Aboukir Bay, found in the northeastern end of the central basin near J5.
Complete, remains of marine encrustations (cleaned away), rim edge is a little distorted and folded together.

Dish, unarticulated round base, edges flaring out, edges folded together.



Number 242

Dimensions: L. 16.5 cm; W. 6.3 cm; H. 8.0 cm, inner Ø at base 8.3 cm
Lead, 683g
Maritime Museum, Alexandria; Exc. no. H.2009.L1.11288
Provenance: Aboukir Bay, found in the water near the jetty between the north and central basins.
Complete, with many encrustations, walls are folded from top.

Bowl originally (probably) with walls flaring out, walls folded in to form straight line.

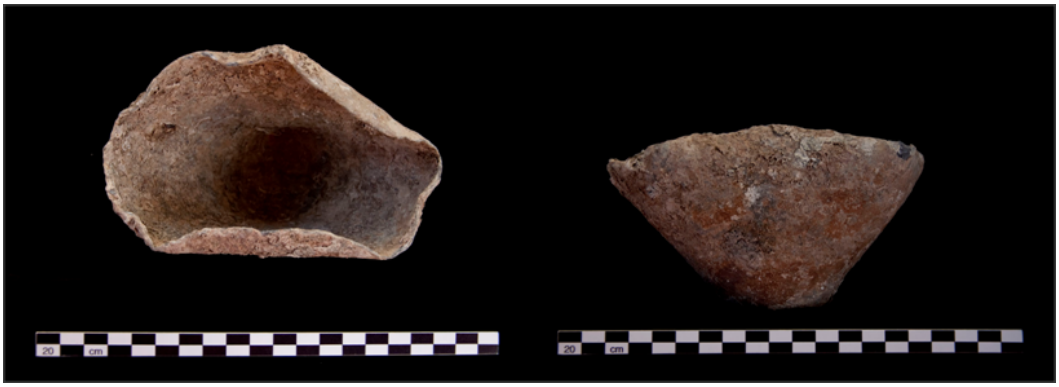
Walls originally were approx. 7.2 cm high.



Number 243

Dimensions: Ø 14.7 cm, base Ø 5.5-6.0 cm; H. 11.1 cm, walls 4 mm thick
Lead, 808g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9059
Provenance: Aboukir Bay, found during prospection.
One small hole and one crack. Shape distorted, surface corroded.

Roughly shaped pot, base and walls attached separately. Thicker roll of lead on inside at this joining point. Not made as one piece. Walls 10.5 cm high.



Number 244

Dimensions: L. 15.3 cm; W. 9.4 cm; H. 8.8 cm
Lead, 825g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9180
Provenance: Aboukir Bay, to the south of the islands in between the north and central basins.
Complete, remains of marine encrustations, shape distorted slightly at the top of the vessel only.

Bowl with a round base, the walls flare out, but straight. The top of the vessel curves inwards.



Number 245

Dimensions: L. 19.3 cm; W. 9.1 cm, base Ø 9.5 cm; H. 7.0 cm
Lead, 468g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.9905
Provenance: Aboukir Bay, found during prospection.
Complete, possibly small fragments, and crushed.

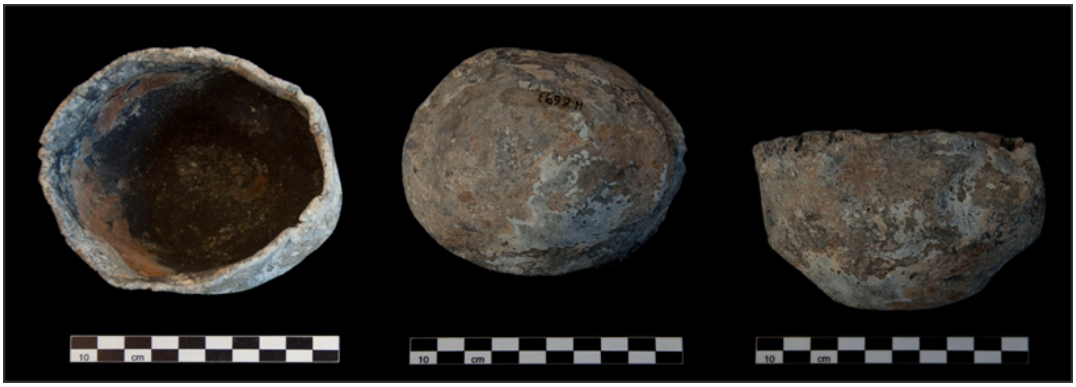
(Cylindrical?) bowl, base is articulated. Bowl is crushed with walls folded together.



Number 246

Dimensions: L. 16.7 cm; W. 7.7 cm; H. 5.0 cm
Lead, 738g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6678
Provenance: Aboukir Bay, found at the edge of a jetty between the north and central basins.
Some chips of rim, otherwise complete. Squashed flat and folded, walls form straight line.

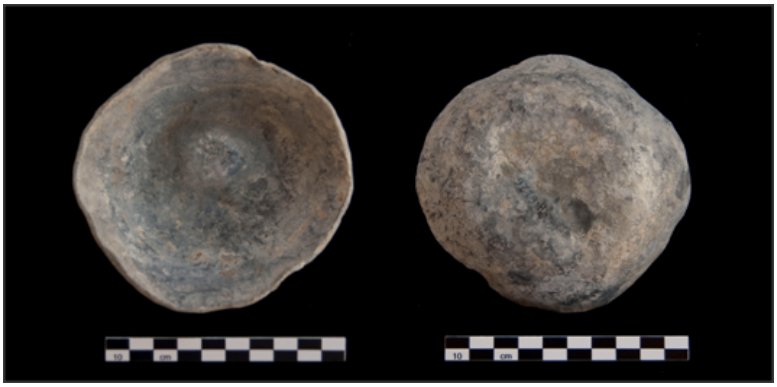
Thick walled dish, walls folded flat and forming a straight line.



Number 247

Dimensions: L. 11.2 cm; W. 8.7 cm; H. 6.9 cm
Lead, 546g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6693
Provenance: Aboukir Bay, towards the western end of the Grand Canal near the south shore of the island to the north of the Grand Canal.
Complete, some chips missing of the rim, deformed.

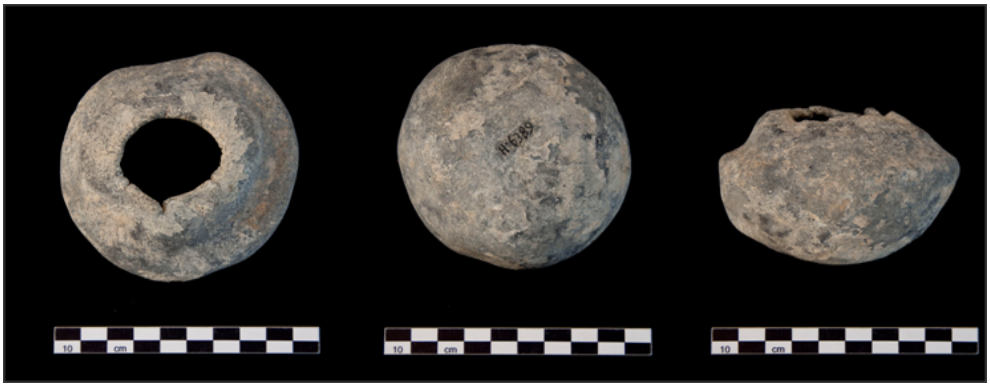
Bowl or cup, deformed, carination present halfway high then the walls go straight up.



Number 248

Dimensions: Ø 11.8 cm; H. 3.6 cm; walls 3.5-4 mm thick
Lead, 333g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6126
Provenance: Aboukir Bay, in the middle of the Grand Canal.
Complete, but distorted.

Rough thick walled shallow dish.



Number 249

Dimensions: Ø 10.0 cm; H. 6.5 cm
Lead, 421g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6389
Provenance: Aboukir Bay, at the western end of the Grand Canal.
Complete, smooth surface, not crushed.

Bowl or cup, carination present. Like no. **307**.

Containers (9-10 cm)



Number 250

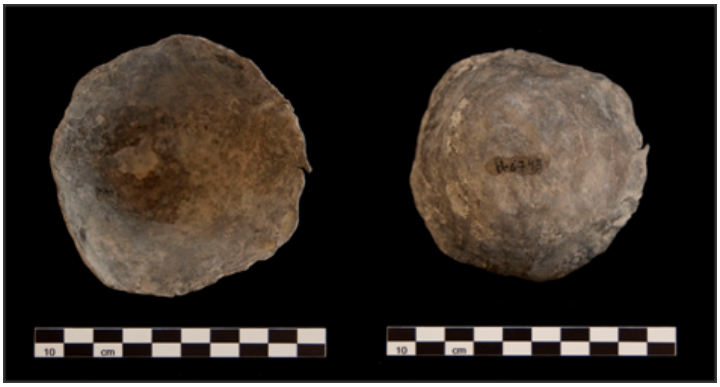
Dimensions: L. 14.5 cm; W. 14.2 cm; H. 4.6 cm
Lead, 1274g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9130
Provenance: Aboukir Bay, found in the northeastern part of the central basin.
Complete, but crushed flat.

Flattened cylindrical container?

Number 251

Dimensions: L. 13.6 cm; W. 8.5 cm, base Ø 7.7 cm; H. 2.3 cm
Lead, unknown weight.
Maritime Museum, Alexandria; Exc. No. H.2006.XX.9766
Provenance: Aboukir Bay, at the southern edge of the entrance of the temple harbour.
Complete, folded.

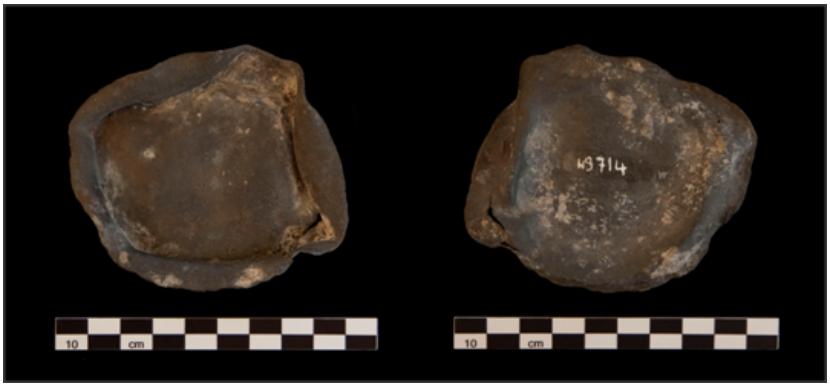
Dish with articulated base, walls from base 3.2 cm high.



Number 252

Dimensions: Ø 9.1 cm max.; H. 4.2 cm
Lead, 124.3g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6743
Provenance: Aboukir Bay, found to the south east of the jetty in the central basin.
Complete.

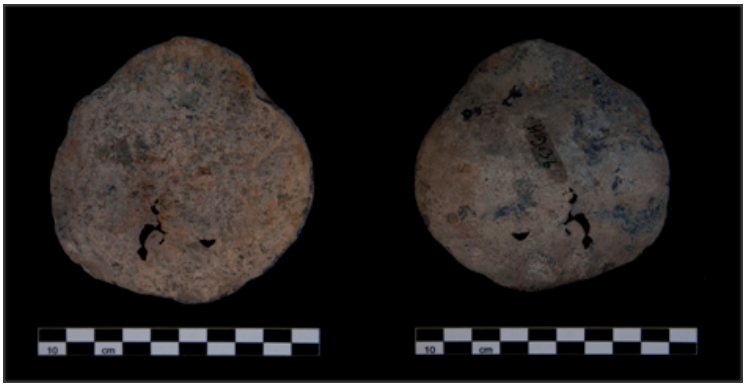
Small bowl, no articulated base.



Number 253

Dimensions: L. 8.3 cm; W. 9.2 cm, base Ø 5.5-7.0 cm; H. 1.8 cm
Lead, 78.8g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9714
Provenance: Aboukir Bay, found towards the tip of the jetty in the central basin.
Complete, some fragments missing.

Shallow dish, walls are approx. 1.5 cm high.



Number 254

Dimensions: L. 9.8 cm; W. 9.7 cm; H. 2.6 cm, walls 2.5 mm thick
Lead, 104.6g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9036
Provenance: Aboukir Bay, found in the northeastern part of the central basin.
Few holes, unclear if complete.

Shallow curved dish no articulated base, irregular edges and the body is also irregular.

Containers (4-7 cm) – Folded



Number 255

Dimensions: L. 6.2 cm; W. 5.6 cm; H. 4.1 cm, walls 1 mm thick
Lead, 101.5g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8539
Provenance: Aboukir Bay, next of a jetty on the side of the central basin.
Edges pushed inwards, some fragments missing.

No articulated base, rounded but stable with round, bulbous original shape.



Number 256

Dimensions: L. 6.8 cm; W. 6.7 cm; H. 1.6 cm
Lead, 82.1g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9041
Provenance: Aboukir Bay, found in the northeastern end of the central basin, near 9717.
Complete, but folded.

Round, flat container, aperture is roughly triangular.

Number 257

Dimensions: L. 7.0 cm; W. 6.5 cm, base Ø 5.3 cm; H. 3.3 cm
Lead, 307.1g
Maritime Museum, Alexandria; Exc. no. H.2004.J5.9056 (SCA 1077)
Provenance: Aboukir Bay, found in the northeastern end of the central basin at the edge of island J5.
Complete, some remains of marine encrustations.

Circular bowl, folded inward still enclosing a type of lid. Currently aperture is a triangular shape.



Number 258

Dimensions: L. 12.4 cm; W. 5.5 cm; H. 3.5 cm; walls 2 mm thick
Lead, 152.0g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9054
Provenance: Aboukir Bay, found in the northeastern end of the central basin, near 9415.
Fragments around the rim missing, the rest of the vessel is complete but folded.

Originally relatively flat container, folded slightly right over left.



Number 259

Dimensions: L. 8.2 cm; W. 3.4 cm; H. 2.5 cm
Lead, 109.4g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9717
Provenance: Aboukir Bay, found in the northeastern end of the central basin, near 9041.
Complete.

Dish with flared walls, circular articulated base, walls folded double together.

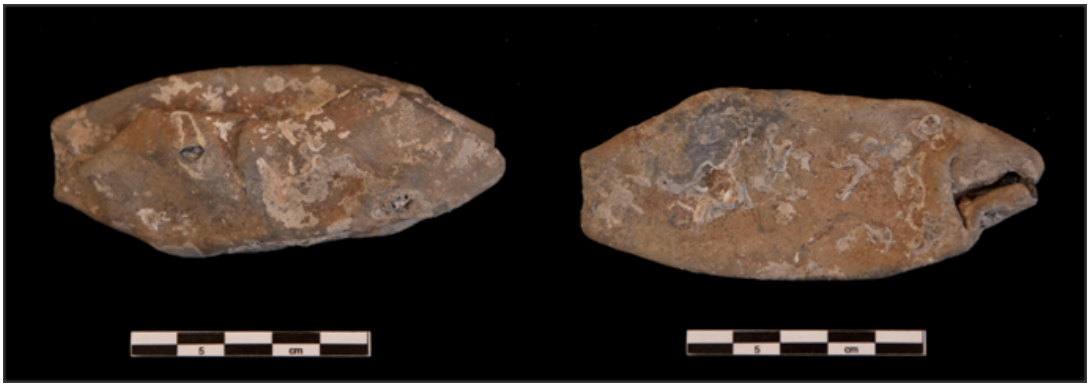


Number 260

Dimensions: L. 12.2 cm; W. 5.5 cm; H. 1.9 cm, walls 2–3 mm thick
Lead, 215g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9415
Provenance: Aboukir Bay, found in the northeastern end of the central basin, near 9054.
Complete with a smooth surface and some marine encrustations, folded.

Originally a relatively flat vessel, one side folded over the other.

No base visible. Like no. **261**.



Number 261

Dimensions: L. 9.7 cm; W. 4.0 cm; H. 2.2 cm
Lead, 123.3g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9122
Provenance: Aboukir Bay, found in the northeastern end of the central basin.
Unclear if it is complete, folded.

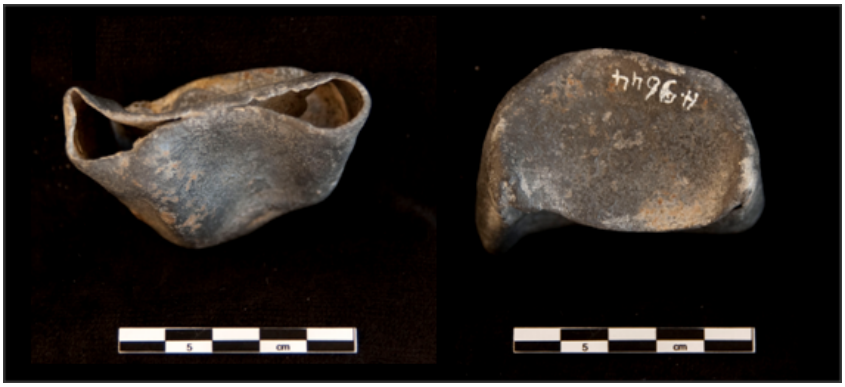
Folded relatively flat vessel. Like no. **260**.



Number 262

Dimensions: L. 8.4 cm; W. 6.5 cm; H. 3.0 cm
Lead, 71g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6718
Provenance: Aboukir Bay, in the water to the north of an island north and west of the Grand Canal.
Many small fragments missing squashed flat.

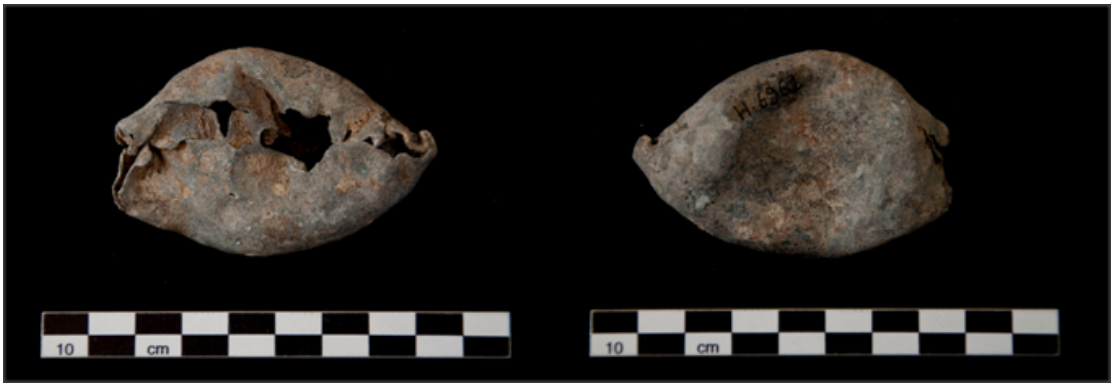
Cylindrical container. Walls folded inward, walls approx. 4 cm high originally.



Number 263

Dimensions: Ø 5.0 cm; H. 4.0 cm, walls 1.5-2 mm thick
Lead, 86.0g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9644
Provenance: Aboukir Bay, in the water of the port (H3).
Complete, but distorted.

Small, cylindrical, straight walled cup.



Number 264

Dimensions: L. 7.3 cm; W. 4.7 cm; H. 2.5 cm
Lead, 82.3g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6961
Provenance: Aboukir Bay, in the water of the port (H3) at the entrance of the Grand Canal.
Some fragments missing, deliberately crushed.

Circular bowl, walls of vessel crushed to form straight line.

Containers (4-6cm) – Non-folded



Number 265

Dimensions: top Ø 4.8 cm max, base Ø 3.2 cm; H. 5.5 cm
Lead, 134.5g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9764
Provenance: Aboukir Bay, found during prospection.
Fragments missing.

Container, without articulated base.



Number 266

Dimensions: L. 6.3 cm; W. 4.4 cm; H. 6.3 cm, originally approx. 5.4 cm
Lead, 123.3g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6593
Provenance: Aboukir Bay, found during prospection.
Complete, but three small holes.

Small cylindrical cup, no articulated base.



Number 267

Dimensions: L. 3.8 cm; W. 4.0 cm; H. 3.1 cm
Lead, 44.1g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9024
Provenance: Aboukir Bay, found during prospection.
Fragments missing, a hole in the body, the shape distorted.

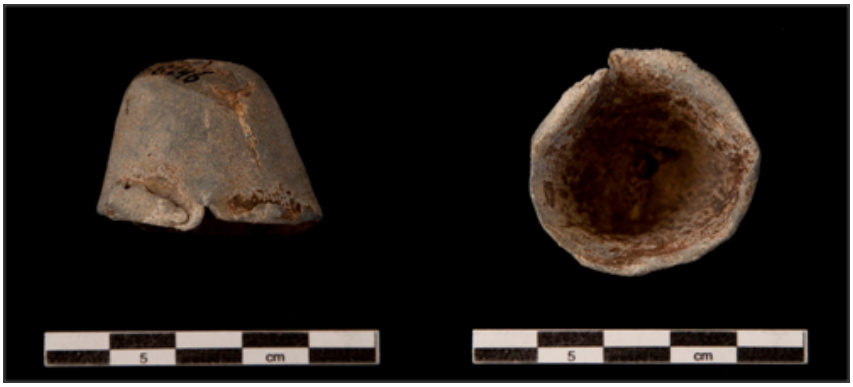
Small, distorted bowl or cup, no articulated base.



Number 268

Dimensions: Ø 4.6 cm max., inner Ø 3.7 cm; H. 3.5 cm; walls 4 mm thick
Lead, 94.8g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10147
Provenance: Aboukir Bay, found during prospection.
Complete.

Thick walled cup, no base is articulated, although it is flat.



Number 269

Dimensions: Ø 3.5 cm; H. 2.8 cm, walls 2 mm thick
Lead, 41.2g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8146
Provenance: Aboukir Bay, found during prospection.
Complete, crack in the top, inside that area is rough.

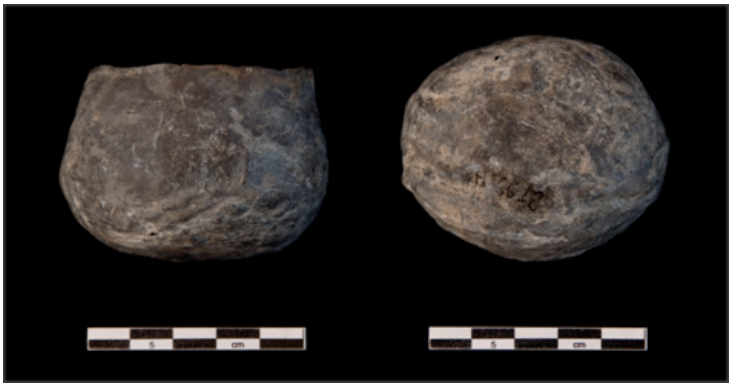
Large "thimble" shaped container, edges folded double, ragged/irregular edge.



Number 270

Dimensions: L. 7.2 cm; W. 4.0 cm; H. 4.7 cm, walls 2-2.5 mm thick
Lead, 90.8g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8561
Provenance: Aboukir Bay, found during prospection.
Squashed sideways, fragments missing with holes in the walls. Edge (carination?) breaking off.

Container with an originally round base (poss. ø 4.3 cm), a carination around 0.9 cm from the edge of the vessel. Possibly originally rounded/bulbous walls.



Number 271

Dimensions: L. 6.2 cm; W. 5.3 cm; H. 4.7 cm
Lead, 71g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6618
Provenance: Aboukir Bay, found during prospection.
Complete, very thin wall, some holes at the bottom of the vessel.

Small cup, no articulated base.



Number 272

Dimensions: L. 7.8 cm (due to distortion); Ø base 6.1 cm; H. 4.9 cm
Lead, 171.3g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6085
Provenance: Aboukir Bay, found during prospection.
Complete, but many marine encrustations.

Cylindrical container, walls are straight, possibly tapering out a little.

Base is slightly concave.

Number 273

Dimensions: Ø 5.5 cm max.; H. 3.6 cm; walls 2-3 mm thick
Lead, 97g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6485 (SCA 939)
Provenance: Aboukir Bay, found during prospection.
Complete, one small hole at the bottom wall edge.

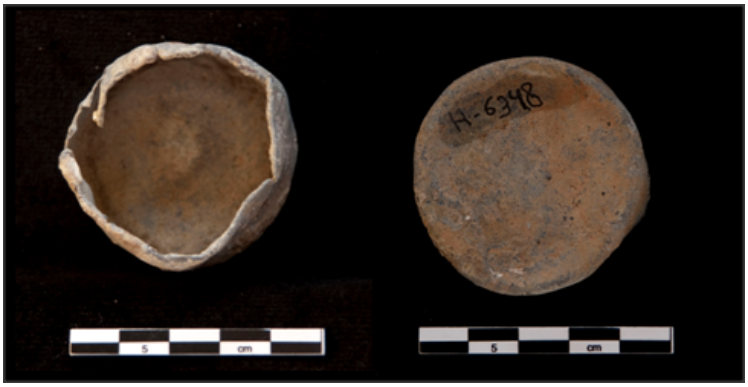
Cylindrical small container, base is slightly concave. See no. **287**.



Number 274

Dimensions: Ø 7.2 cm; H. 2.0 cm.
Lead, 8.4g.
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6717.
Provenance: Aboukir Bay, found during prospection.
Complete.

Lid, or shallow circular basin.



Number 275

Dimensions: Ø 4.7 cm; H. 2.7 cm
Lead, 42.5g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6348
Provenance: Aboukir Bay, found during prospection.
One fragment of wall missing.

Small, cylindrical, straight walled cup.



Number 276

Dimensions: Ø max. 4.0 cm, Ø base 3.0 cm; H. 1.9 cm
Lead, 52.4g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8105
Provenance: Aboukir Bay, found during prospection.
Top is completely missing, very rough surface on the interior and exterior.

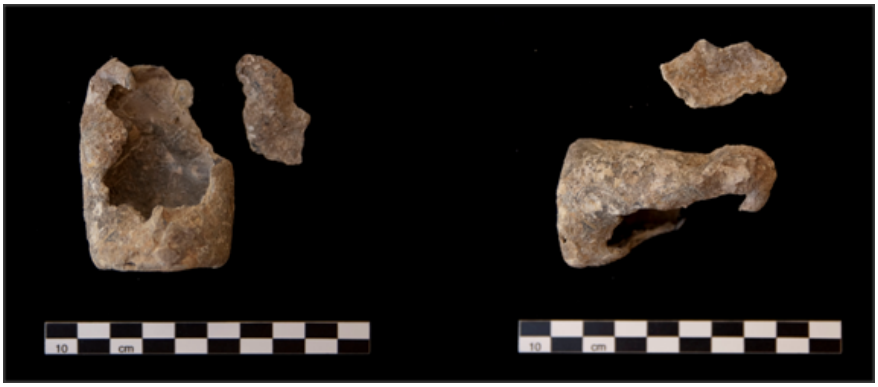
Container, it is the bottom half of container with articulated base.



Number 277

Dimensions: Ø 2.8 cm; H. 4.0 cm
Lead, 65.8g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8898
Provenance: Aboukir Bay, from the water in the north basin, north of J5.
Top of vessel is damaged.

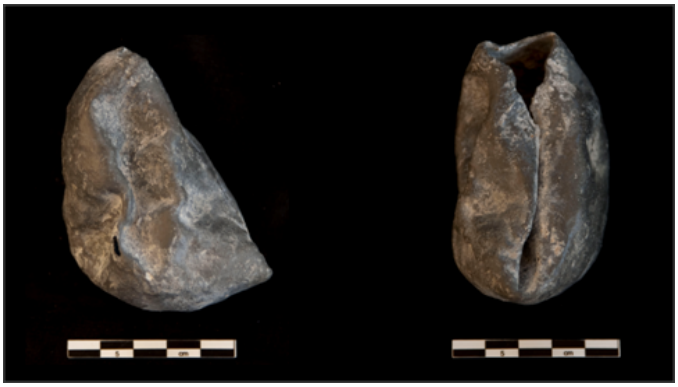
Cylindrical container sealed on top with hardened material, still fairly light.



Number 278

Dimensions: Ø 3.7-4.1 cm; H. 6.3 cm
Lead, 80.2g excl., 85.6g incl. fragment
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6228
Provenance: Aboukir Bay, towards the western end of the Grand Canal.
Fragmentary, rough surface and one loose fragment.

High cylindrical container, large part of body is missing, base is circular.



Number 279

Dimensions: L. 7.3 cm; W. 4.8 cm; unknown original height, walls 2 mm thick
Lead, 145.9g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9720
Provenance: Aboukir Bay, on the jetty between the north and central basins.
Complete, distorted with rims folded together.

Possibly originally a cylindrical container, no articulated base. One side of vessel pushed inside, the weighting of the object is now different, more similar to a bowl. Originally the walls are approx. 7.6 cm high.



Number 280

Dimensions: Ø 3.9 cm; H. 6.3 cm
Lead, 88g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6386
Provenance: Aboukir Bay, at the western end of the Grand Canal.
Complete, fragments of rim missing, possible restorations at the base of the vessel.

Small jar. Aperture max. Ø 1.9 cm, Ø 3.1 cm incl. rim.

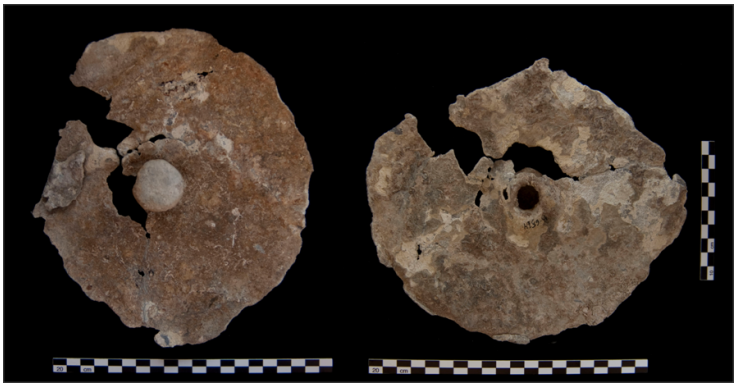


Number 281

Dimensions: L. 4.3 cm; W. 2.2 cm; H. 2.1 cm
Lead, 34.9g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9476
Provenance: Aboukir Bay, at the southern side of the temple harbour on the temple island. Unclear.

Hollow cylindrical shaped piece, tapered and shut on one end, pinched and shut at the other, something rattling inside.

Lids



Number 282

Dimensions: L. 21.8 cm; W. 19.2 cm; H. 3.0 cm

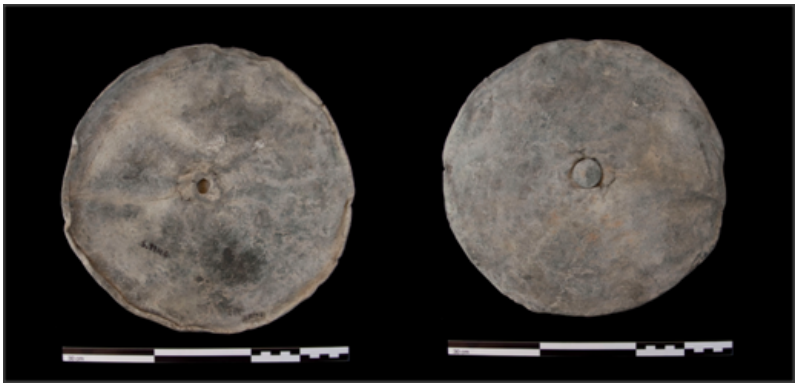
Lead, 521g

Maritime Museum, Alexandria; Exc. no. H.2003.XX.6514

Provenance: Aboukir Bay, towards the western end of the Grand Canal near the bank of the temple island.

Fragments missing and squashed flat.

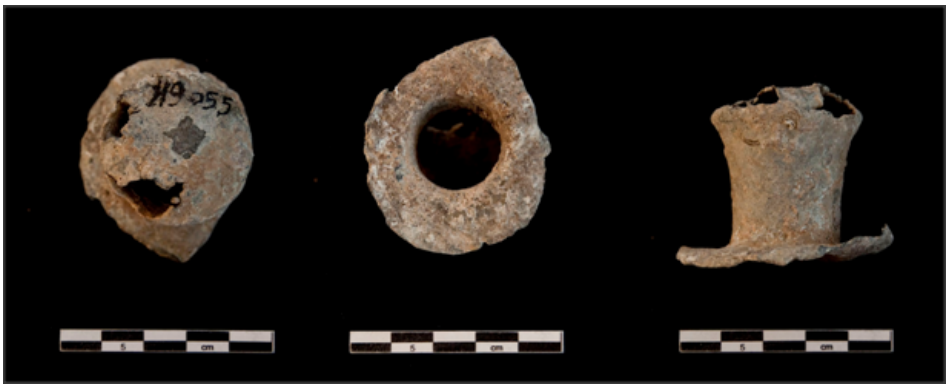
Lid. Base shows a hollow for the knob.



Number 283

Dimensions: Ø 31.3 cm; H. 2.4 cm, rim 1.2 cm high; knob Ø 3.1 cm
Lead, 1272g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8231
Provenance: Aboukir Bay, found near the pillars in the Grand Canal just north of the temple island, near 3005.
Complete, but shape is distorted.

Large lid with knob, squashed flat; rectangular lid with two parallel lines around the knob. The base has a hollow for the knob. Height of the rim is 1.2 cm.



Number 284

Dimensions: L. 5.3 cm; W. 4.4 cm; H. 4.4 cm; knob 3.7 x 3.6 cm
Lead, 78.1g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9055
Provenance: Aboukir Bay, found in the north-eastern part of the central basin, towards the south of the island J5.
Incomplete, body of lid is gone. Two holes, surface flaking.

Hollow knob as seen on other lids of a large dimension, compare no. **282** and **283**. Originally it was possibly a round bulbous shaped container, crushed flat from the side.



Number 285

Dimensions: L. 7.3 cm; W. 6.5 cm; H. 3.0 cm, rim 1.8 cm high
Lead, 89.0g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8118
Provenance: Aboukir Bay, found during prospection.
Fragments missing.

Circular lid with knob, height of rim is approx. 0.8 cm.



Number 286

Dimensions: Ø 7.2 cm max., Ø 6.4 cm min.; H. 2.8 cm
Lead, 80.0g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.5994
Provenance: Aboukir Bay, found during prospection.
Fragments of rim missing, deformed.

Lid with knob, rim of lid in/around the pot is deformed and flattened. Base shows a hollow for the knob.

Number 287

Dimensions: Ø 6.0 cm max.; H. 1.2 cm
Lead, 45.2g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6477 (SCA 938)
Provenance: Aboukir Bay, found during prospection.
Complete, apart from a missing fragment of the rim of the lid.

Lid. Indicated to be lid to SCA 939, however the fit is not good, the lid diameter is too large.



Number 288

Dimensions: L. 6.3 cm; W. 5.5 cm; H. 1.2 cm; knob Ø 1.3 cm
Lead, 44.0g
Maritime Museum, Alexandria; Exc. no. H.2010.XX.11769
Provenance: Aboukir Bay, found during prospection.
Complete, shape distorted with marine encrustations.

Lid with hollow knob, with a rim. Original diameter of the vessel is greater that 4.7 cm, possibly 5.0 cm. Height of rim 1.0 cm.

Number 289

Dimensions: L. 7.1 cm; W. 5.7 cm; H. 1.4 cm; rim 0.9 cm high
Lead, 41.6g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.unknown number, 2004
Provenance: Aboukir Bay, found during prospection.
Holes, marine encrustations and some fragments of rim missing, shape distorted.

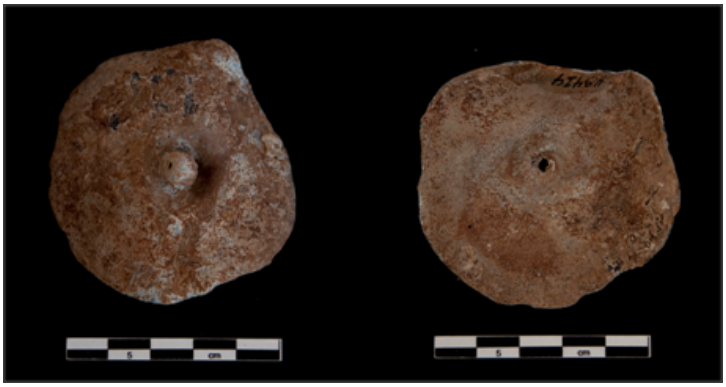
Lid with rim and knob, 1.5 mm thick.



Number 290

Dimensions: L. 6.5 cm; W. 5.9 cm; H. 2.7 cm
Lead, 39.3g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6942
Provenance: Aboukir Bay, found during prospection.
One hole in the body.

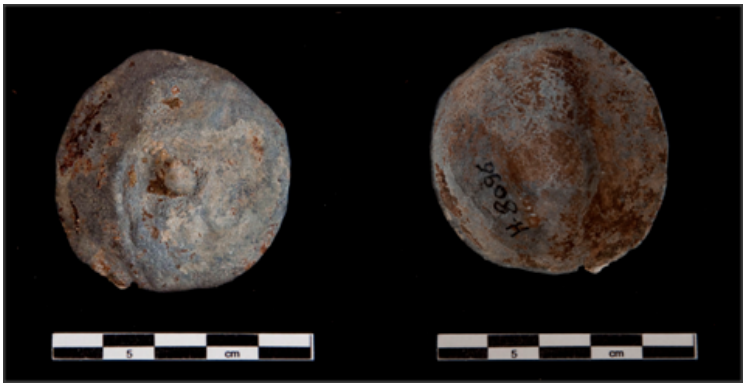
Circular lid with knob. The base shows a hollow of the knob.



Number 291

Dimensions: Ø 6.4 cm; H. 2.5 cm
Lead, 36.8g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.9414
Provenance: Aboukir Bay, found during prospection.
Complete? Shape distorted, no indication of rim and remains of marine encrustations.

Circular lid without rim, with knob. The base shows a hollow of the knob.



Number 292

Dimensions: Ø 4.8 cm; H. 1.8 cm, 1mm thick
Lead, 19.9g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.8096
Provenance: Aboukir Bay, found during prospection.
Complete, one chip of rim missing, shape distorted.

Circular lid with knob, domed shape.



Number 293

Dimensions: L. 7.6 cm; W. 7.4 cm; H. 1.4 cm
Lead, 237.2g
Maritime Museum, Alexandria; Exc. no. H.2007.H1.10125
Provenance: Aboukir Bay, found during prospection.
Big fragment, around a fifth of the object missing.

Square lid with knob.



Number 294

Dimensions: Ø 5.8 cm max.; H. 2.3 cm, knob Ø 1.6 cm
Lead, 175.7g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10254 A
Provenance: Aboukir Bay, found during prospection.
Complete.

Round lid with knob. Base is convex.

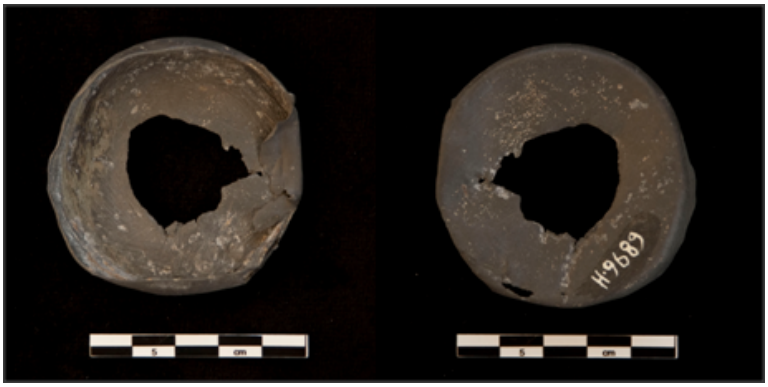


Number 295

Dimensions: W. 6.5 cm max., Ø 5.0 cm; H. 2.1 cm
Lead, 70.8g lid; 27.3g for remains of vessel
Maritime Museum, Alexandria; Exc. no. H.2003.E6.6612
Provenance: Aboukir Bay, found during prospection.
Fragmentary.

Lid and remains of the body of a (probably) cylindrical vessel.

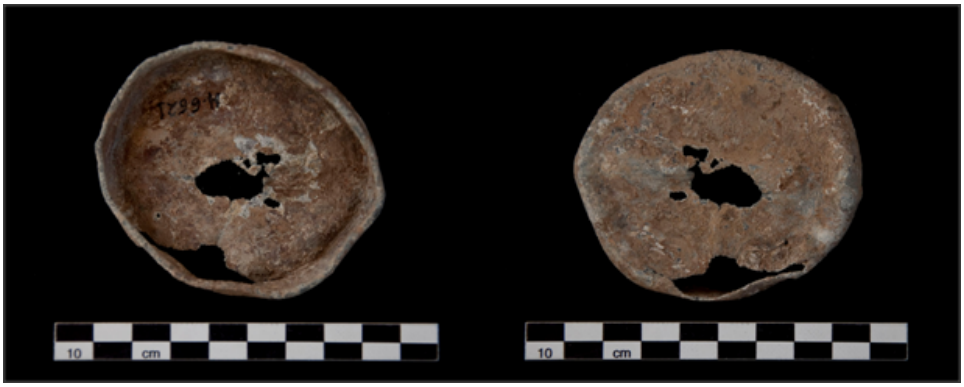
No knob present on the lid.



Number 296

Dimensions: Ø 5.8 cm, 6.1 cm incl. distorted rim; H. 1.8 cm
Lead, 31.2g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9689
Provenance: Aboukir Bay, found during prospection.
Fragmentary.

Lid of container, hole in the centre and fragments of the rim missing.



Number 297

Dimensions: L. 7.7 cm; W. 6.5 cm; H. 2.3 cm
Lead, 70g
Maritime Museum, Alexandria; Exc. no. H.2003.E6.6621
Provenance: Aboukir Bay, found during prospection.
Fragmentary, pieces missing of base, remains of marine encrustations.

Shallow bowl or lid of a container.

Number 298

Dimensions: L. 6.3 cm; W. 5.8 cm; H. 4.1 cm (body) H. 7.1 cm (incl. lid); lid: Ø 5.6-5.8 cm
Lead, 149.4g + 77.6g (lid)
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6150 (SCA 914)
Provenance: Aboukir Bay, found during prospection.
Complete, shape of the lid distorted, knob present on the lid.

Cylindrical container, with a lid that fits and is of similar size. Rim of lid overlaps 1.0 cm with the body, lid Ø 1.1 cm and 1.3 cm high.

Number 299

Dimensions: L. 6.4 cm; W. 6.1 cm; H. 0.8 cm
Lead, 32.4g
Maritime Museum, Alexandria; Exc. No. H.2004.XX.unknown number, although 2004
Provenance: Aboukir Bay, found during prospection.
Hole in centre, marine encrustations.

Round disc of lead, looks like part of a container, possibly a lid. No rim present. 1.5–2 mm thick.



Number 300

Dimensions: L. 9.2 cm; Ø 8.7 cm, Ø base 4.0 cm; H. 3.0 cm; walls max. 3 mm thick
Lead, 127.4g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6905
Provenance: Aboukir Bay, found during prospection.
Complete, but one chip of edge missing.

Bowl with circular articulated base and flaring walls, which 3.4 cm high.



Number 301

Dimensions: L. 6.4 cm; W. 5.8 cm, inner 1.3 cm; H. 2.2 cm
Lead, 65.5g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6082
Provenance: Aboukir Bay, found during prospection.
Complete, but squashed flat. Fragments restored to the base and one crack.

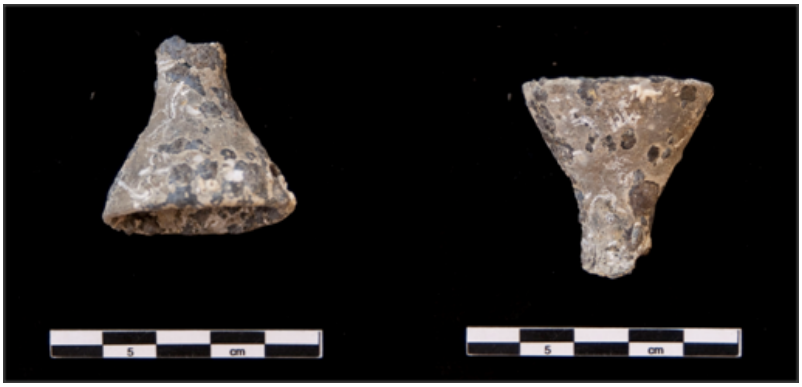
Circular container, rim applied to base, the body is squashed flat and hollow.

Carinated line visible on body of vessel. Raised lip of rim.

Number 302

Dimensions: L. 7.8 cm; W. 5.1 cm; H. 2.9 cm
Lead, 69g
Maritime Museum, Alexandria; Exc. No. H.2003.XX.6796
Provenance: Aboukir Bay, found during prospection, no coordinates recorded.
Fragments missing of body.

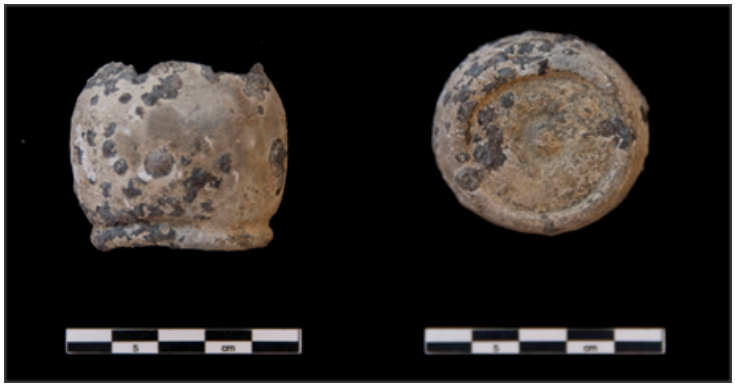
Oval bowl?



Number 303

Dimensions: L. 3.6 cm; W. 2.9 cm; H. 3.7 cm; walls 1 mm thick
Lead, 13.6g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6387 A
Provenance: Aboukir Bay, found during prospection.
Fragments missing.

"Funnel" (?), broken at the bottom.

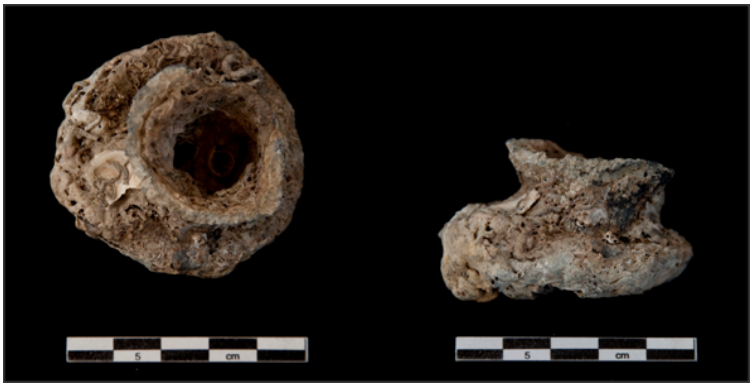


Number 304

Dimensions: L. 4.6 cm; W. 4.2 cm; H. 3.8 cm
Lead, 46.8g
Maritime Museum, Alexandria; Exc. no. H.2004.XX.6387 B
Provenance: Aboukir Bay, found during prospection.
Fragments missing.

Circular container with separate articulated base, body rounded, top is missing.

Base with protrusion in the centre.



Number 305

Dimensions: Ø 5.5 cm; H. 3.3 cm
Lead, 138g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6396
Provenance: Aboukir Bay, found during prospection.
Complete, extremely eroded surface with marine encrustations.

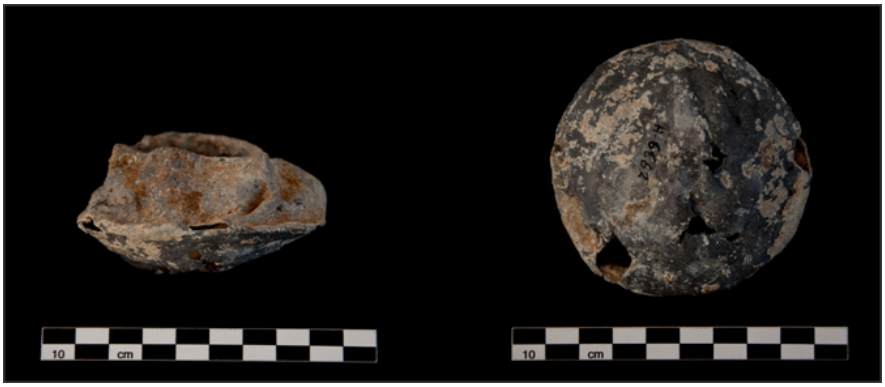
Small vase. Compare no. **306** for a similar shape.



Number 306

Dimensions: Ø 4.4 cm; H. 1.5 cm
Lead, 55g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6226
Provenance: Aboukir Bay, found during prospection.
Fragments missing, squashed flat from the top.

Small vase squashed flat, the rim is folded back on the body of the vessel. Elongated ovoid perforation on the base. Part of the neck of the vessel visible where the rim is lost. Originally the body was bulbous. Compare no. **305** for a similar shape.



Number 307

Dimensions: Ø 7.8 cm; H. 4.5 cm
Lead, 165g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6662
Provenance: Aboukir Bay, found during prospection, no coordinates recorded.
Fragments of body missing, deformed/crushed.

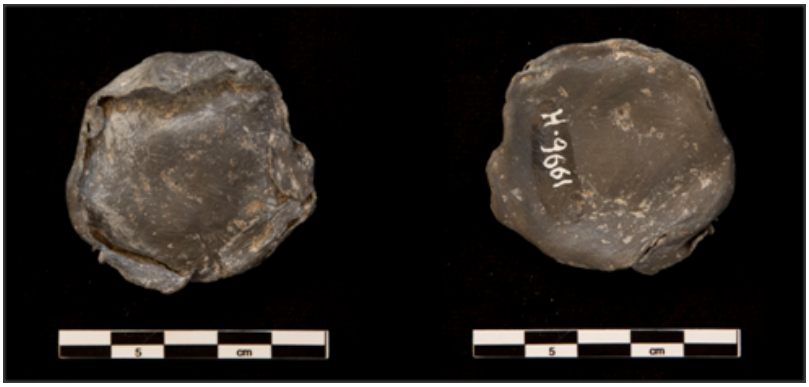
Bowl or cup, a carination present. The top part of the vessel is crunched/crushed.



Number 308

Dimensions: L. 5.2 cm; W. 4.6 cm; H. 3.4 cm
Lead, 75.6g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6634
Provenance: Aboukir Bay, found during prospection.
One crack near the base, slightly distorted, and no material is missing.

Small cup, slightly oval in section, a carination is present along the upper third of the vessel.



Number 309

Dimensions: Ø 4.7 cm; H. 1.2 cm
Lead, 21.7g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9661
Provenance: Aboukir Bay, found during prospection.
Fragmentary, squashed flat.

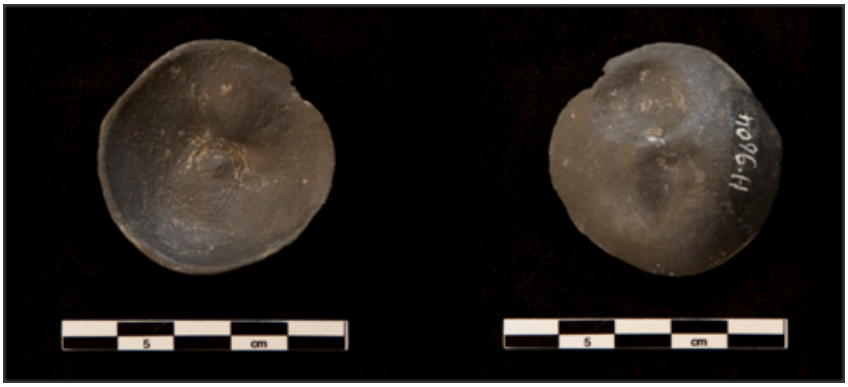
Circular disc of lead, 1 mm thick, with rim or walls remaining, max. 0.9 cm.



Number 310

Dimensions: Ø 4.4 cm max.; H. 0.6 cm; walls 1 mm thick
Lead, 10.5g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9628 (no coordinates)
Provenance: Aboukir Bay, found during prospection.
Fragments missing and the shape is distorted.

Container (?) or a disc appliqué. Thin sheet, raised out rim, raised disc in the centre, raised rim around.



Number 311

Dimensions: Ø 4.1 cm; H. 1.0 cm
Lead, 16.8g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9604
Provenance: Aboukir Bay, found during prospection.
Chip missing.

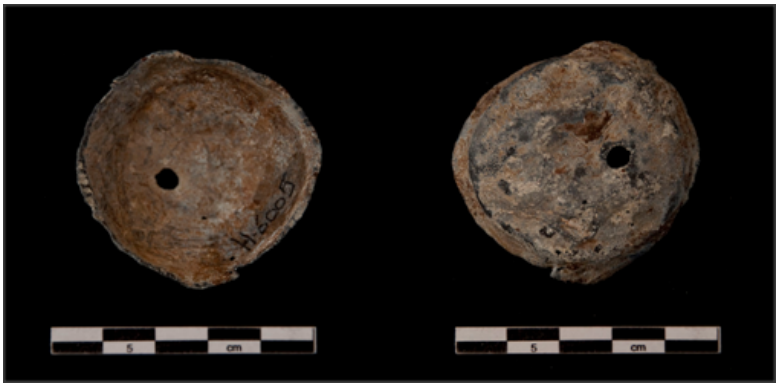
Distorted bowl?



Number 312

Dimensions: L. 6.6 cm; W. 4.8 cm; H. 2.1 cm
Lead, 52.5g
Maritime Museum, Alexandria; Exc. no. H.2007.XX.10128
Provenance: Aboukir Bay, found during prospection.
Fragmentary.

Shallow bowl or cup.



Number 313

Dimensions: L. 5.0 cm; W. 4.4 cm; H. 1.7 cm
Lead, 17g
Maritime Museum, Alexandria; Exc. no. H.2003.XX.6005
Provenance: Aboukir Bay, found during prospection.
Complete, except for a few small holes and one larger round hole.

Small bowl or a lid, carination visible.



Number 314

Dimensions: L. 25.7 cm; W. 4.8 cm; H. 3.8 cm
Lead, 303.8g
Maritime Museum, Alexandria; Exc. no. H.2006.XX.9580
Provenance: Aboukir Bay, found during prospection.
Complete, one crack in base.

Rectangular vessel with thin straight walls.