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MATTHEW PONTING, HAIM GITLER & OREN TAL \*

## WHO MINTED THOSE OWLS ? METALLURGICAL ANALYSES OF ATHENIAN- STYLED TETRADRACHMS FOUND IN ISRAEL

*Abstract* – This paper uses the analytical results from inductively-coupled plasma atomic emission spectrometry (ICP-AES) and lead isotope analysis (Q-ICP-MS) of Athenian-style tetradrachms found in excavations in Israel, in order to investigate their origins. Some of these coins have been classified as Eastern imitations based on style, but the analysis suggests that many of these coins may actually be authentic Athenian issues. This is because they were in all probability produced from bullion that came from the silver mines of Laurion in Attica. Given the stylistic variability of the Athenian(-style) tetradrachms found in Israel, we can assume that they are representative of the ‘owls’ circulating in the East in Achaemenid times.

**F**URTHER TO A RECENTLY PUBLISHED PAPER presenting analytical results from inductively-coupled plasma atomic emission spectrometry (ICP-AES) and lead isotope analysis (Q-ICP-MS) carried out on a group of eleven Athenian-style tetradrachms found in the excavations of Tel Mikhal (Israel) (see plate I), <sup>[1]</sup> this paper presents new analytical results of nine other authentic Athenian or Athenian-style tetradrachms that have been retrieved from several controlled archaeological excavations in Israel. The sites that yielded the coins are Ashkelon, Athlit, Ḥorvat 'Eleq, Khirbet er-Rujum, Lachish, Mišpe Aphek, Samaria and Dalton (see plate II). <sup>[2]</sup> The

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The authors are grateful to Donald T. Ariel, head of the Coin Department at the Israel Antiquities Authority, for allowing us to analyze these coins.

[1] H. GITLER, M. PONTING & O. TAL, Athenian Tetradrachms from Tel Mikhal (Israel) : A Metallurgical Perspective, *AJN*<sup>2</sup> 21 (2009), p. 29-49.

[2] For a catalogue of these coins, see H. GITLER & O. TAL, The Coinage of Philistia of the Fifth and Fourth Centuries BC : A Study of the Earliest Coins of Palestine, *Collezione Numismatiche* 6, Milan 2006, table 2.1, no. 3, 7, 11, 13, 27, 30, 31, 36. The Dalton tetradrachm is part of the Dalton hoard which includes 15 Tyrian sheqels and is dated to 425-394 BC, see H. GITLER & O. TAL, A Hoard of Tyrian and Athenian Coins from Dalton (Israel), in A. LEMAIRE (ed.), *Phéniciens d'Orient et d'Occident*.

present study aims to present an archaeometallurgical study of the silver content and trace elements of all the Athenian owls discovered in controlled archaeological excavations in Israel, and to compare these with the contemporary indigenous Philistian coinage of the Persian period, in order to characterise their composition and discuss possible origins. Earlier studies have shown that the metallurgical composition of several Athenian tetradrachms usually taken as ancient imitations (of Buttrey STYLE B and M) <sup>[3]</sup> does not differ from that of genuine coins. <sup>[4]</sup> These analyses, however, were made on coins purchased in the antiquities market, where the place of retrieval is unknown.

### RESULTS

These nine new coins were analyzed by ICP-AES, in the same way as the previous coins from Tel Mikhal and alongside the same standard reference materials to ensure comparability. This is important, since ancient silver metal contains traces of other metallic elements that relate to the ore smelted and to the subsequent refining and/or recycling processes. It is therefore a more accurate estimate of the silver bullion content of ancient coins to regard the proportion of silver metal in an alloy as the combined total of elemental silver together with traces of the geochemically related elements gold, bismuth and lead. The silver bullion content (Ag + Au + Bi + Pb) of the coins analyzed here (*table 1*) is presented graphically in figure 1. The average silver bullion content for all the tetradrachms is 99,5% with a standard deviation of 0,6%, suggesting a well-controlled production, or at least a consistent source of supply. There is no significant difference in fineness between the coins.

Gold is the main trace contaminant associated with silver, but along with gold, bismuth and lead may also relate to the original ore. Other trace elements, such as copper, tin or nickel, may have been added to the metal

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[3] T.V. BUTTREY, Pharaonic Imitations of Athenian Tetradrachms, *ProclNC* IX, 1, Louvain-la-Neuve 1982, p. 137-140.

[4] Cf. Chr. FLAMENT, À propos des styles d'imitations athéniennes définis par T.V. Buttrey, *RBN CXLVII* (2001), p. 37-50; Chr. FLAMENT, Imitations athéniennes ou monnaies authentiques ? Nouvelles considérations sur quelques chouettes athéniennes habituellement identifiées comme imitations, *RBN CXLIX* (2003), p. 1-10; Chr. FLAMENT & P. MARCHETTI, Analysis of Ancient Silver Coins, *Nuclear Instruments and Methods in Physics Research*, B, 226 (2004), p. 179-184; Chr. FLAMENT, *Le monnayage en argent d'Athènes. De l'époque archaïque à l'époque hellénistique (c.550-c.40 av. J.-C.)*, Louvain-la-Neuve 2007.

as, or as contaminants within, the other major alloying components. In particular, in cases where copper is present at levels greater than 0,5-1%, it is likely that it was added as an alloying component and that any tin or nickel present would have come as contaminants within it. Only the gold and bismuth can be reliably regarded as associated solely with the silver source(s), while the lead relates to the technology and scale of the refining process. The gold levels are not significantly altered by smelting and refining, whilst the bismuth levels are altered only slightly. For these reasons the gold and bismuth traces are regarded as the most useful trace elements in ancient silver. In the coins analyzed here, the gold contents suggest two groups: one with a gold content of between 0,1 and 0,4%, and the other with gold contents below 0,1%.

Table 1 resumes the relevant data and numismatic observations of the coins studied in this article.<sup>[5]</sup>

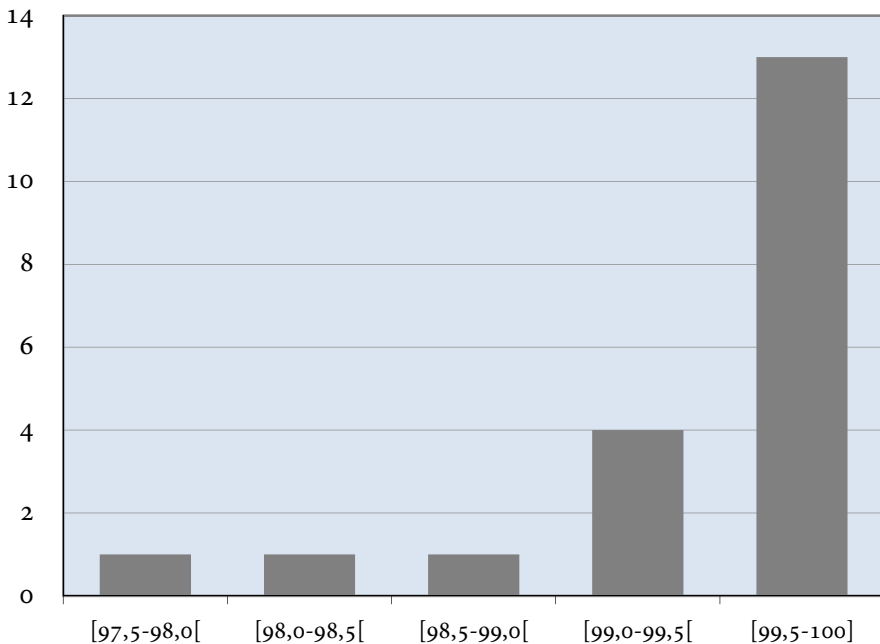


Fig. 1 – Histogram showing the % silver bullion (Ag + Au + Bi + Pb) contents of the 20 coins analysed; mean : 99,46% – standard deviation : 0,58%

<sup>[5]</sup> We are indebted to J.H. Kroll for his observations on these coins. For the dating of the *pi*-style issues (no. 17-18) to after 353 BC, cf. J.H. KROLL, The Reminting of Athenian Silver Coinage, 353 BC, *Hesperia* 80 (2011), p. 229-256.

Table 1 – Silver bullion (Ag + Au + Bi + Pb) content and numismatic observations of the Athenian-style tetradrachms found in controlled archaeological excavations in Israel

No.	Site	Weight (in g)	Axis	Reg. No.*	% Silver Bullion	Au/Bi	Numismatic Observations	Plate
1	Tel Mikhal	16.29	↑←	IAA 81274	99.0	0.31/0.01	Classic specimens of TYPE X. According to Flament, this type is truly Athenian	I-1
2	Tel Mikhal	16.09	↑←	IAA 81277	98.2	0.17/0.04	<i>Idem</i>	I-2
3	Tel Mikhal	16.25	↑←	IAA 81278	98.9	0.23/0.01	<i>Idem</i>	I-3
4	Tel Mikhal	16.66	↑←	IAA 81275	99.8	0.02/0.09	Authentic	I-4
5	Tel Mikhal	16.28	↑←	IAA 81283	99.4	0.14/0.08	?	I-5
6	Tel Mikhal	16.20	↑↘	IAA 81284	99.8	0.05/0.06	Eastern imitation	I-6
7	Tel Mikhal	16.71	↑←	IAA 81276	99.7	0.02/0.04	Classic specimens of TYPE M with its characteristic eye. Flament argues for this type authenticity, with some good backup from two late 5 <sup>th</sup> century BC hoards in Attica and metallurgical analysis of coins from the Tell el-Maskhuta hoard (IGCH 1649)	I-7
8	Tel Mikhal	16.85	↑↘	IAA 81280	99.9	0.17/0.16		I-8
9	Tel Mikhal	16.24	↑↘	IAA 81281	99.6	0.19/0.09	Authentic (folded Athenian coin, noticed only in about 5% of the coins which were produced between 454-415/413 BC)	I-9
10	Tel Mikhal	14.37	↑↘	IAA 81282	97.8	0.27/0.07	?	I-10

11	Tel Mikhal	16.41	↑↓	IAA 81279	99.4	0.04/0.05	Eastern imitation	I·11
12	Ashkelon	16.50	↑←	MC 30.945	99.6	0.05/0.14	Authentic	II·12
13	Ashkelon	15.96	↑←	MC 30.946	99.6	0.06/0.05	The palmette does seem irregular because of the two "eyes" above the five regular leaves	II·13
14	'Athlit	16.37	↑↖	IAA 72576	99.9	0.03/0.16	Probably authentic Athenian	II·14
15	Horvat 'Eleq	15.96	↑←	IAA 83440	99.8	0.01/0.02	Authentic? Imperfect form of lines of helmet	II·15
16	Khirbet er-Rujum	16.75	↑←	IAA 64573	99.9	0.02/0.02	Authentic	II·16
17	Lachish	17.08	↑↖	IAA 51362	99.8	0.01/0.08	Normal <i>pi</i> -style dated to after 353 BC	II·17
18	Mispe Aphek	16.97	↑↓	IAA 85121	99.9	0.02/0.09	Normal <i>pi</i> -style dated to after 353 BC	II·18
19	Samaria	17.82	↑↖	IAA 51357	99.5	0.07/0.11	?	II·19
20	Dalton	16.95	↑←	IAA 8598	99.8	0.04/0.04	Authentic Athenian	II·20

\* IAA : Israel Antiquities Authority registration number – MC : Material culture  
(Registration number of the Leon Levy Expedition to Ashkelon)

Table 2 – Summary of weight and silver bullion data

	Weight	Ag + Au + Bi + Pb
Mean	16.43 g	99.46%
Minimum	14.37 g	97.8%
Maximum	17.82 g	99.9%
Std. Deviation	—	0.58%

The Au and Bi concentrations firmly place the nine new Athenian-style coins with the ‘low-gold’ group of coins, alongside four of the Tel Mikhal coins originally analysed for both chemical composition and lead isotope ratios (*fig. 2*). This suggests that these additional issues are also made of Greek silver, most probably from the mines at Laurion in Attica if the correlation between Au/Bi concentrations and Pb isotope analyses observed in the Asyut hoard coins and the Tel Mikhal coins is correct.

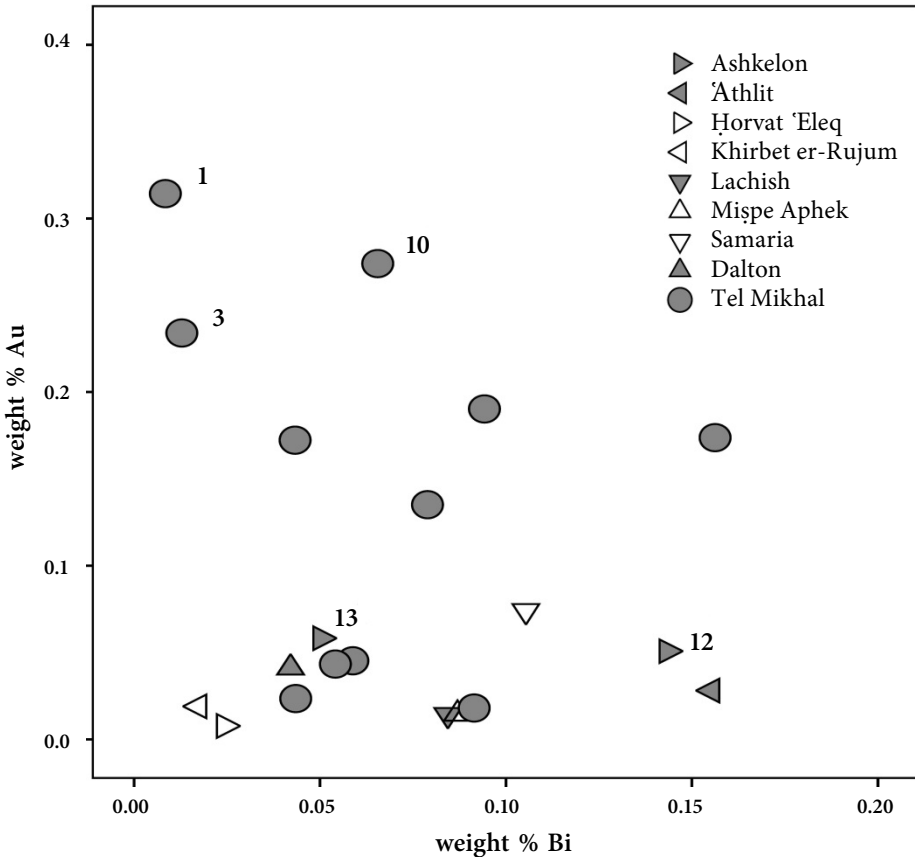
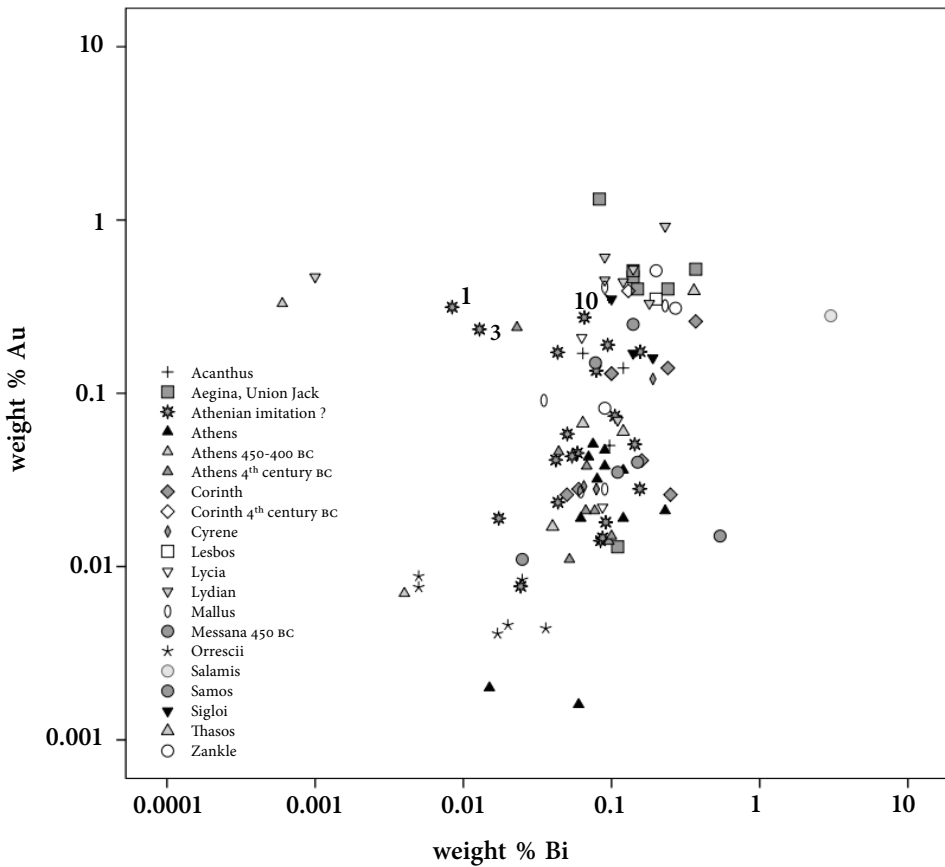


Fig. 2 – Gold/bismuth scatterplot for Athenian-style coins (see table 1 for numbers)



The fact that the newly analysed Athenian-style coins fit so closely with the 'low-gold' Tel Mikhal coins that have a Laurion lead isotope signature and a very similar range of bismuth contents suggest a similarity of bullion source. It is also interesting that similar 'low-gold' concentrations are a feature of the majority of the Athenian tetradrachms from the Asyut hoard and rather suggests that the trace element concentrations might serve to differentiate Laurion silver from other Greek silver sometimes better than lead isotopes (*fig. 3*).

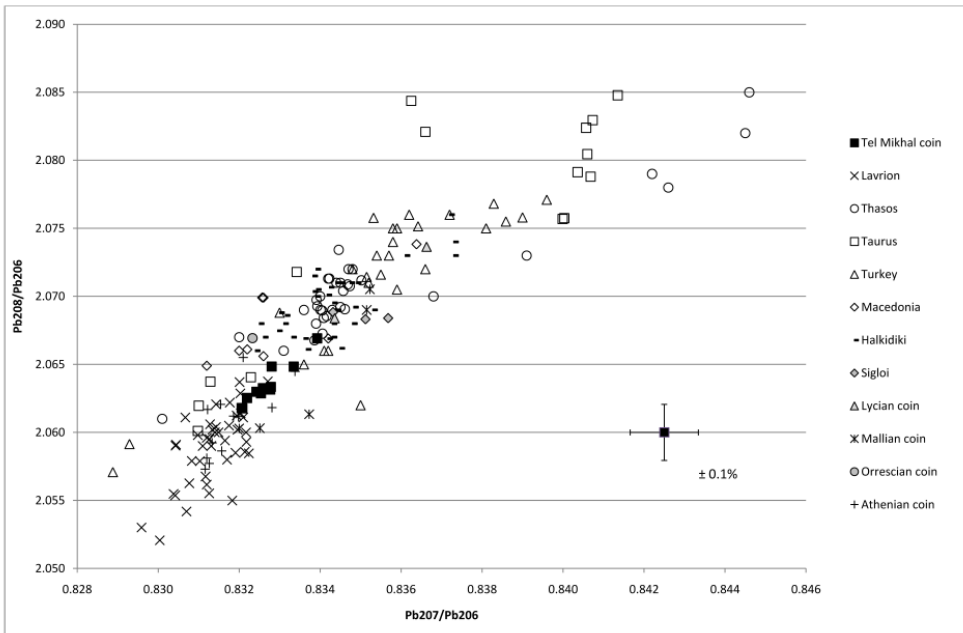


*Fig. 3 – Gold/bismuth scatterplot for Athenian-style coins and coins from the Asyut hoard (Asyut hoard data from GALE et al. 1980 <sup>[6]</sup>)*

<sup>[6]</sup> N. GALE, W. GENTNER & G. WAGNER, Mineralogical and Geographical Silver Sources of Archaic Greek Coinage, *Metallurgy in Numismatics* 1 (1980), p. 3-49.

Whilst lead isotopes are crucial in attributing silver metal to a Greek source, the fact that lead metal also from Laurion may well have been added to refine silver bullion from other sources causes problems. The added Laurion lead will, of course, impart a Laurion isotope signature to refined silver even if it was not originally from a non-Laurion source. The bismuth and especially the gold contents, however, are unlikely to have been significantly altered by this process and so will retain the potentially diagnostic signatures of the original ores. Obviously recycling and attendant mixing of sources is going to cause problems in the interpretation of both analytical approaches, but can also provide an explanation for rogue signatures that fall mid-way between known source fields.

With this in mind, it is worth considering that the three Tel Mikhal coins that sit on the edge of the Laurion lead isotope field (IAA 81274 [no. 1], IAA 81278 [no. 3] and IAA 81282 [no. 10]) and close to the Thasian and Halkidiki fields are also three of the seven Tel Mikhal coins with high gold contents (*fig. 4*).



*Fig. 4 – Lead isotope plot showing the main Greek and Anatolian fields against Asyut hoard coins (thermal-ionisation mass spectrometric lead isotope data from GALE et al. 1980<sup>[7]</sup>) and the Tel Mikhal coins (lead isotope data used here are previously unpublished MC-PIMS data)*

[7] *Ibid.*

On the basis of the lead isotope plot, this could indicate that these three coins are made of silver from mixed Laurion and Thasian/ Halkidiki silver. These coins, however, also share gold content levels with not only Corinthian coins, but also with Persian sigloi and East Greek issues from Mallus and Lycia. These same coins also have lead isotope ratios that place them within the Thasian/Halkidiki fields, but could also suggest Anatolian silver sources. Thus, the high gold contents could possibly indicate a non-Greek origin for silver that, in the case of the coins analysed for lead isotopes, is subsequently refined using lead metal from Greece that gives those particular coins a Laurion or other Greek source lead isotope signature.

It is a complicated picture that can only be clarified through further work. On balance, however, what remains reasonably certain is that these Athenian-style coins from sites in Israel are made of silver from Greek sources, predominantly of Athenian silver from the mines at Laurion.

#### CONCLUSIONS

The preceding analyses of Athenian-style tetradrachms from controlled archaeological excavations in Israel present a complex picture of silver procurement in Persian-period Palestine. It seems clear that much of the silver for both the tetradrachms found in Israel and the indigenous Philistean and Edomite coinages, originated in the Greek world, especially in Athens (and Attica). There are close compositional links between the tetradrachms found on different sites in Israel and the Philistean and Edomite coins and it seems possible that the same sources of bullion were being used for both these coinages.<sup>[8]</sup> Both the chemical and lead isotope analyses reported here indicate that a significant proportion of this bullion came from the silver mines at Laurion in Attica, as original coins or bullion or in the form of recycled Athenian and other Greek city coins used for making the so-called Eastern owls.<sup>[9]</sup> Other Greek silver sources are also indicated,

[8] See H. GITLER, M. PONTING & O. TAL, Metallurgical Analysis of Southern Palestinian Coins of the Persian Period, *Israel Numismatic Research* 3 (2008), p. 13-27.

[9] Here one must refer to the *kršn* (*karsh*), *š* (*sheqels*) and *ḥ* (*hallures*) denominations used for the weighing of silver ores/bullion (?) carried in Ionian ships sailing to Egypt mentioned in the *Customs Account* of Elephantine, dated to year 11 of Xerxes I (= 475 BC) or of Artaxerxes I (= 454 BC). For the published edition, see B. PORTEN & A. YARDENI, *Textbook of Aramaic Documents from Ancient Egypt*, 3: *Literature, Accounts, Lists*, Jerusalem 1993, § c3.7. The information from this document concerns maritime trade, including the kinds of ships sailing to and from Egypt and the kinds of goods they carried, as well as the system of duty collection and royal accountancy in Egypt at the time; see A. YARDENI, Maritime

in particular Halkidiki and/or Thasos. However, the use of Greek silver is only part of the picture. The analyses of the coins also suggest that some of the silver may also have had its origins in the imperial coins of Persia and the earlier issues of Lydia. This is, of course, not surprising. It is rather the fact that so much Greek silver was finding its way into the Athenian-style issues from Palestine which is of interest and which corroborates the economic links with the Greek world already attested by the dominance of the Athenian owl as the prototype of choice.<sup>[10]</sup>

However, it should be stressed that, on the basis of the analyses presented here, it is also possible that all the coins found in Palestine are authentic Athenian coins and that the attribution of these coins on stylistic grounds might be erroneous. Table 1 includes an updated numismatic review of the twenty coins included in this study, which in a way differ from earlier attempts at identification.<sup>[11]</sup> The current numismatic identification shows that most of these tetradrachms are indeed authentic Athenian issues, in agreement with our metallurgical analyses. Two considerations support this notion. First of all, why would anyone melt-down an authentic Athenian tetradrachm in order to produce a tetradrachm that looked almost identical?<sup>[12]</sup> Secondly, the number of pre-Hellenistic coins

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Trade and Royal Accountancy in an Erased Customs Account from 475 BCE on the Aḥiqar Scroll from Elephantine, *Bulletin of the American Schools of Oriental Research* 293 (1994), p. 67-78; P. BRIANT & R. DESCAT, Un registre douanier de la satrapie d'Égypte à l'époque achéménide, in N. GRIMAL & B. MENU (eds.), *Le commerce en Égypte ancienne*, IFAO, Bibliothèque d'Étude 121, Cairo 1998, p. 59-104.

[10] For this we have Xenophon (*Poroi* 3.2) admiring the exportation of Athenian silver as a profitable investment; although dated to the 350s BC, is well applicable to earlier times. In other words, silver exported from Athens could have easily made its way east unmixed to be used in the production of local coinages.

[11] Cf. D.T. ARIEL, Coins from Tel Mikhal (Tel Michal), *Atiqot* 52 (2006), p. 73-78, 83-85, table 1; GITLER & TAL, *op. cit.* [n. 2], p. 23-26, table 2.1.

[12] One might note that the 17.2 g (17.28 g to be precise) theoretical weight of the Athenian tetradrachm is some 5% heavier than the average weight of our 20 coins – the mean weight of which is 16.43 g. See in this respect H. NICOLET-PIERRE, Métrologie des monnaies grecques. La Grèce centrale et l'Égée aux époques archaïque et classique (VI<sup>e</sup>-IV<sup>e</sup> s.), *Annali* 47 (2000), p. 41; J. ELSÉN, La stabilité du système pondéral et monétaire attique (VI<sup>e</sup>-II<sup>e</sup> s. avant notre ère), *RBN CXLVIII* (2002), p. 23; the Thorikos hoard (*IGCH* 134) mean weight of 17.14 g for best preserved (i.e. unworn) tetradrachms (61 out of 282 issues); M. OECONOMIDES, Contribution à l'étude du monnayage athénien à l'époque classique (suite) : le trésor trouvé à Ano Voula en 1979, *RN* 162 (2006), p. 73-76, a hoard containing 12 tetradrachms with an average weight of 17.29 g; L. ANDERSON & P. VAN ALFEN, A Fourth Century BC Hoard from the Near East, *AJN<sup>2</sup>* 20 (2008), p. 174-184 (the latter have analysed the *pi*-style tetradrachms). Many of the tetradrachms found (and probably circulated) in the Near East show weights below the theoretical Attic standard, as appear less frequently in Athens too, cf. e.g. J.H. KROLL, *The*

retrieved from controlled archaeological excavations in Israel is relatively small, and the same can be said of stray finds in the region.<sup>[13]</sup> One might thus argue that too few Greek city coins reached the region to support the production of Eastern owls in any great quantity. Nonetheless, hoards containing relatively large numbers of early Greek coins have been found both in the southern Levant and Egypt,<sup>[14]</sup> and it may be that most of such coins were consigned to the melting pot to produce local coins before they had had a chance to circulate. Our metallurgical analyses cast some doubt on

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*Athenian Agora 26: The Greek Coins*, New Jersey 1993, p. 17, no. 8a-h [with an average weight of 15.95 g] and p. 19-20, no. 15a-g [with an average weight of 16.56 g]; M. OECONOMIDES, Contribution à l'étude du monnayage athénien à l'époque classique : le trésor trouvé au Pirée en 1977, *RBN CXLV* (1999), p. 17-20, a hoard containing 11 tetradrachms with an average weight of 16.70 g. Bivar has even suggested that these coins correspond to a different weight standard, that of the Babylonian *šql* of some 8.4 g, hence a Near Eastern tetradrachm (or an owl found in the Near East) would equal two Babylonian sheqels, cf. A.D.H. BIVAR, Achaemenid Coins, Weights and Measures, in I. GERSHEVITCH (ed.), *The Cambridge Ancient History of Iran*, 2, *The Median and Achaemenid Periods*, Cambridge 1985, p. 615. Indeed several documents (in cuneiform, Aramaic and Greek) found in the Near East maintain that the [Babylonian/Achaemenid] *šql* equals two (Athenian) drachms (or four Babylonian/Achaemenid *zuzin*, hence one drachm would equal two *zuzin*). The repeated  $\pm 16.8$  g in many of the tetradrachms circulated in the Near East (which would fit Babylonian weight standard), reported by ANDERSON & VAN ALFEN (above, p. 174-175) as the standard employed by those producing Athenian imitations in the Near East, has in fact 2% weight deficiency from the 17.15 g reported in Athens (above, ELSEN). However, the Babylonian weight standard, imperial as it may be, was hardly in practice in the Levant, where every region (e.g. Phoenicia, Samaria, Judah, Philistia, Edom) or even city (e.g. Sidon, Tyre) has a weight of its own for the basic unit of standard, that of a *šql* – which in certain regions has even changed over time. Therefore, it remained open whether underweight Athenian coins or Athenian imitations were oriented to functionality and/or target markets. The fact that more than a few tetradrachms found in the Near East weight over 17 g underestimates the possibility of a deliberate selection of coins sent to the East that would facilitate transactions based on the standard of the Babylonian *šql*. A deficiency of weight through post-depositional factors or poor cleaning/conservation as an explanation for weight differences may also be significant but not in all the cases known. Given the relative scarcity of Eastern owls found in controlled archaeological excavations or as strays in Israel (above n. 11), a difference of 2-5% would not have prompted the melting down of Athenian coins in order to produce lighter local coins with the same types, since the profit would be too low and is unlikely to have covered the cost of the procedure. In other words, the discrepancy between the ideal weight of the Attic tetradrachm and the so-called Eastern tetradrachm does not itself provide evidence for Eastern manufacture.

[13] ARIEL, *op. cit.* [n. 11]; GITLER & TAL, *op. cit.* [n. 2], p. 13-30.

[14] See e.g. H. GITLER, A *Hacksilber* and Cut Athenian Tetradrachm Hoard from the Environs of Samaria: Late Fourth Century BCE, *Israel Numismatic Research* 1 (2006), p. 6-7, table 1, *passim*.

the earlier identification of some of the tetradrachms as Eastern imitations and suggest that many of the owls that circulated in Palestine could in fact be authentic Athenian coins. It would be premature, however, to argue that the term Eastern imitations – and its derivatives, i.e. Eastern/Palestinian/southern Levantine owls – is an erroneous scholarly convention of mental rationalization based on their ‘non-canonical’ craftsmanship, given the relative small number of analyzed coins and their provenance in a region of modest size. Still, if we accept the idea of centrally produced copies of Athenian coins by Achaemenid authorities from recycled Greek silver, the fact is that they were produced from either Greek bullion or recycled Athenian and other Greek city coins; Palestine has no silver sources of its own and therefore all silver used in the region must have come from outside.

The mean silver content of all 20 tetradrachms is 99.5%, and the lowest silver content is 97.8%, which is still higher than the average silver content of the Philistian coinage analyzed by the same method (ICP-AES).<sup>[15]</sup> This suggests that the silver content of the Eastern owls was as strictly controlled as authentic Athenian tetradrachms and provides further evidence to support the view that these coins are either authentic Athenian products or some form of centrally minted eastern issues produced from Greek silver. Given the stylistic variability of the tetradrachms found in Israel and our metallurgical analyses, it seems that authentic Athenian and Eastern owls could barely be distinguished from one another, so that Eastern owls would be readily acceptable in Athenian and other Greek markets. Who then would benefit from the production of Eastern owls? Some have argued that the minting of silver bullion in the earliest stages of the monetary economy in the southern Levant was connected with payments to the army – that is, funding for the activities of the Phoenician fleet on behalf of the Achaemenids, or for the major urban centres responsible for supplies to

<sup>[15]</sup> Cf. GITLER, PONTING & TAL, *op. cit.* [n. 8] and table 1 above. This also appears to be true of southern Palestinian coinages analyzed by a different method (XRF); thus the average silver bullion (= Ag + Au + Pb + Bi) of the 271 Philistian issues analyzed in the course of Gitler and Tal’s work on the Philistian coinage (GITLER & TAL, *op. cit.* [n. 2], p. 329–334, *passim*) is 95.0%; the average silver content of the 66 Samaritan issues analyzed in Gitler and Tal’s work on new Samaritan coin types, cf. H. GITLER & O. TAL, Coins with the Aramaic Legend *Šhrw* and Other Unrecorded Samaritan Issues, *SNR* 85 (2006), table 1, is 92.5%; the average silver content of 24 Edomite ‘drachms’ (plated coins excluded) discussed in H. GITLER, O. TAL & P. VAN ALFEN, Silver Dome-shaped Coins from Persian-period Southern Palestine, *Israel Numismatic Research* 2 (2007), table 4, is 97.5%; and the average silver content of the 32 Persian-period *yhd* coins discussed in H. GITLER & C. LORBER, A New Chronology for the Ptolemaic Coins of Judah, *AJN*<sup>2</sup> 18 (2006), table 4, is 97.7%.

the army.<sup>[16]</sup> Others have claimed that the minting of Athenian-style Eastern issues was intended to address the lack of Athenian coinage in the markets of the Near East after the Peloponnesian War.<sup>[17]</sup> Both suggestions may well explain the high standard of production of the Eastern owls. If they were aimed at Greek markets (mercenaries and merchants), we may suggest that the Achaemenid authorities controlled their production and circulation in order to facilitate international interactions and trade. The Eastern owls were produced at the same time as the local Philistian, Samaritan, Judean, and Edomite (autonomous) coinages. Their function however differed: the latter formed part of an intra-city or intra-regional monetary system, for they are rarely found outside the political boundaries of the issuing authorities,<sup>[18]</sup> while the former formed an international currency since they are found well beyond the boundaries of the Fifth Satrapy.

The most relevant document concerning silver imitations of Attic coinage is the Nikophon law which is dated to 375/374 BC. It was found inscribed on stone in the Athenian agora and sheds light on one of the more unsettling aspects of ancient economic life: imitative and counterfeit coinage.<sup>[19]</sup> The decree shows that coin users in Athens at the time could expect to receive, in the course of monetary exchanges, a certified and approved (*dokimon*) coin that was made by the local Athenian mint (*Attikon*), whose acceptance was mandatory; a coin that looked Athenian and had good metallic value but was not made in Athens (*xenikon*), whose acceptance was optional; coin that looked Athenian but had poor metallic value (e.g. Athenian silver-plated bronze core issues) or other foreign coins of bad quality; the latter two were unaccepted and after been cut and confiscated they were removed from circulation.

The Nikophon law states that: “The *dokimastês* (‘certifier, approver, inspector’), who has been trained in the testing of suspect issues, is to examine coins which are brought to him, and confiscate coins which are

[16] Cf. E. BABELON, *Traité des monnaies grecques et romaines* II.2, Paris 1910, p. 671; J. ELAYI, Le phénomène monétaire dans les cités phéniciennes à l’époque perse, *Numismatique et Histoire Économique Phéniciennes et Puniqes*, *Studia Phoenicia* 9, Louvain-la-Neuve 1992, p. 21–31; D.T. ENGEN, ‘Ancient Greenbacks’ Athenian Owls, The Law of Nikophon, and the Greek Economy, *Historia* 54 (2005), p. 370–371.

[17] Cf. J.P. SIX, Observations sur les monnaies phéniciennes, *NC*<sup>3</sup> VII, part II, 1877, p. 177–239; J.G. MILNE, The Origin of Certain Copies of Athenian Tetradrachms, *Iraq* 4 (1937), p. 57–58; T. FIGUEIRA, *The Power of Money: Coinage and Politics in the Athenian Empire*, Philadelphia 1998, p. 529.

[18] GITLER & TAL, *op. cit.* [n. 2], p. 49–51.

[19] R. STROUD, An Athenian Law on Silver Coinage, *Hesperia* 43 (1974), p. 157–188; SEG 26-72; ENGEN, *op. cit.* [n. 16], p. 368, note 27, for the numerous studies of the inscription and the controversies surrounding it.

plated or of inferior composition (*kibdelon*).<sup>[20]</sup> Coins that were unsatisfactory were marked by chisel cuts and placed in the *Metroon* to remove them from circulation. Lines 8-10 read: “If anyone brings him (*x[e]n[i]kon*) foreign (?) coinage with the same stamp (*kharaktêr*) as the Attic (minted coinage?), let him return it to the one who brought it.”<sup>[21]</sup> Jones comments on these lines: “*It would be unfair to penalise traders whose only fault was they did not have enough expertise to recognise the small stylistic differences which were the only thing that distinguished the imitations from the genuine coins.*”<sup>[22]</sup> Indeed van Alfen classifies this group of coins as “anonymous imitations”, namely coins that differ only in very subtle ways from the Athenian prototypes, which most casual observers, and perhaps even the *dokimastês* in Athens, would fail to recognize.<sup>[23]</sup> In terms of the political reality, the Nikophon law is merely evidence that imitations were well-circulated in Athens in the early fourth century BC and Athenian authority lost a lot of profit because of it. The law also provides evidence that the average Athenian of the time could not always tell the difference between authentic and imitative (*xenikon*) coins – let alone modern numismatists – and that an expert (*dokimastes*) was needed to make the distinction. Given the stylistic variability of the tetradrachms found in controlled archaeological excavations in Israel and our metallurgical analyses, it seems that authentic Athenian and Eastern owls could barely be distinguished from one another, so there is no obvious reason to contradict the notion that Eastern owls would be readily acceptable in Athenian and other Greek markets.

Elsewhere we have argued that much of the silver for the Philistian and Edomite coinages originated in the Greek world, most probably from Athenian coins.<sup>[24]</sup> It would thus be reasonable to suggest that the Philistian minting authority was one of the production centres that could have made the Eastern owls for the Achaemenid and Greek markets, while at the same time producing a local coinage with lower silver bullion content. If a proportion of the tetradrachms analysed here are truly not authentic Athenian issues, one should bear in mind that the earliest issues of indigenous Philis-

[20] ENGEN, *op. cit.* [n. 16], p. 368-369.

[21] The function of the public slave in Nikophon’s law was to place the coins presented to him into one of two general categories: *dokimon* or *adokimon*; only true Athenian products were *dokimon*, everything else was *adokimon*.

[22] J.R. MELVILLE JONES, *Testimonia Numaria, Greek and Latin Texts Concerning Ancient Greek Coinage II: Addenda and Commentary*, London 2007, p. 79.

[23] P. VAN ALFEN, Problems in Ancient Imitative and Counterfeit Coinage, in Z. ARCHIBALD, J. DAVIES & V. GABRIELSEN (eds.), *Making, Moving, and Managing: The New World of Ancient Economies, 323-31 BC*, London 2005, p. 333.

[24] GITLER, PONTING & TAL, *op. cit.* [n. 8].



tian coinage show a high degree of similarity in weight, flan, fabric, and even in some of the motifs shown, to the Eastern owls. This observation may suggest that some of the latter were locally produced and may be regarded as the forerunners of local Philistian types or contemporary counterparts. Palestine had a long tradition of using silver in trade, as the ingot and *Hacksilber* hoards found at biblical sites in Palestine attest.<sup>[25]</sup>

#### ANALYTICAL APPENDIX

The coins selected for analysis were first sampled by drilling into the edge of the coin with a 0.6 mm diameter drill and collecting the turnings. The first millimetre or two of metal was always discarded to avoid contamination by corrosion products and unrepresentative surface metal. Approximately 10 mg of the sample was weighed into a glass vial and dissolved according to the procedure devised by Hughes *et al.*<sup>[26]</sup> The dissolved sample was made up to a final 10 ml volume with purified water (18.2 MΩ) and centrifuged to ensure that all the precipitated silver chloride settled out. Silver was calculated by difference and checked by atomic absorption spectrometry using a separate sample dissolved in only nitric acid. Analysis was conducted on a Perkin Elmer DV3000 series inductively coupled plasma atomic emission spectrometer (ICP-AES) which was calibrated using matrix-matched multi-element standards. Instrumental drift and analytical precision were monitored by specially prepared quality control solutions which were measured after every ten samples. Accuracy was checked by the use of two certified standard reference materials (SRMS): Bundesanstalt für Materialprüfung No. 211 and Silver standard Gliwice AG5-chem. The relative accuracy based on two analyses of both SRMS at the beginning and at the end of the analysis is better than 8% for all major and minor elements (copper < 1%), with the exception of lead (9.2% error at a concentration of 0.74%). The relative accuracy of the trace elements is better than 10%, again with the poorer values occurring when the concentrations approach the limits of detection (i.e., manganese with a 13.5% error on a certified value of 0.0019%). Instrumental precision (coefficient of variation across three replicate analyses of the same sample) is generally better than 3%, while analytical precision (coefficient of variation of two analyses of the same SRM across all analyses) is generally better than 3% for major, minor and trace elements over all analyses, with the exception of manganese, antimony,

[25] GITLER & TAL, *op. cit.* [n. 2], p. 9-12.

[26] M.J. HUGHES, M.R. COWELL & P.T. CRADDOCK, Atomic Absorption Techniques in Archaeology, *Archaeometry* 18 (1976), p. 19-37.

and bismuth, which are poor because the certified values are close to the limit of detection (LOD). The LODs for the analysis (expressed as parts per billion), calculated at  $3\sigma$ , are:

Ag	As	Au	Bi	Co	Cr	Cu	Fe	Mn	Ni	Pb	Sb	Sn	Zn
1	39	5	13	2	1	41	1	0.4	3	13	29	29	2

Lead isotope ratios were determined by Dr. Jane Evans and Dr. Vanessa Pashley at the NERC Isotope Geochemistry Laboratory at The British Geological Survey, Keyworth, Nottinghamshire (UK) using a multicollector quadrupole plasma induced mass spectrometry (MC-PIMS) system. Estimated reproducibility of the data presented here is better than 0.006%  $2\sigma$  ( $^{208}\text{Pb}/^{206}\text{Pb}$ ) compared to 0.04% typically obtained for thermal ionization mass spectrometry (TIMS) used to measure the ore field samples available in the published data.

PLATES



I-1



I-2



I-3



I-4



I-5



I-6



I-7



I-8



I-9



I-10



I-11





II-12



II-13



II-14



II-14BIS



II-15



II-16



II-17



II-18



II-19



II-20