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Tout ce qui brille… Electrum and the Origins of Western Coinage

White Gold: Studies in Early Electrum Coinage, Peter VAN ALFEN, Ute WARTENBERG (eds.) with Wolfgang FISCHER-BOSSERT, Haim GITLER, Koray KONUK and Catharine C. LORBER, New York, The American Numismatic Society, and Jerusalem, The Israel Museum, 2020, Hardcover, x + 707 p., b/w and colour figures, charts, maps, and tables, $150. ISBN 978-0-89722-349-2.

As befits its lengthy gestation period, *White Gold* has achieved a healthy birthweight. Based on a conference that took place in Jerusalem in June 2012, which was then partially reprised in New York in 2013, the volume contains 21 chapters, mostly deriving from papers given at the conference (Chapters 1 by Kleber and 15 by Jones were not). One important paper that was given at the conference, by Robert Wallace, is not included, but has meanwhile appeared elsewhere.[1] It should be stated at the outset that the title raises an important question of definition. What do we mean by *early* electrum coinage? Of the 21 contributions, 12 are firmly oriented on the *earliest* electrum, which we might define as the coins produced in this metal before the advent of the first separate gold and silver coinages almost certainly during the reign of Croesus (on whose dates, see below). A further six deal with later instances of coinage in electrum from the late Archaic into the Classical period, and look at the time before coinage. And one encourages us to challenge this apparent divide and suggests that there is in fact a bridge between the earliest coins and those that have often been associated with a revival in the period of the Ionian Revolt in the late 6th or early 5th century BC. Nonetheless, there was clearly what we might term a 'late 6th century extinction', after which electrum 'was produced primarily by three mints: Cyzicus, Mytilene and Phocaea' (p. 10).

Needless to say, in a book of such heft and scope, a large number of major problems and questions are addressed. The origins and nature of coinage are explored. The choice and nature of the material from which these coins were produced are analysed. The chronological development of early coinage and its relationship to the political events and the economic history of the archaic and classical periods is tested. In what follows I attempt to give a sense of the remarkable achievement that this volume constitutes, and to explore some of its implications. If I have disagreements with some of the

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1. WALLACE 2016.

conclusions or suggest that more could be done, that is because it is now possible, perhaps for the first time, to gain an overview of this obscure period, the evidence for it, and the opportunities that exist. We owe the editors and contributors a huge debt for the work they have done, as well as the publisher for the care that has been lavished on its production. Colour plates abound, and these are crucial to the appreciation of the objects, the results of the analyses that are presented, and, especially, the complex archaeology at the heart of the book.[2]

Electrum

Given the title of the book, we may appropriately begin by considering the metal used for the earliest coinage. Four chapters are devoted to the question of electrum, the alloy, itself. Two offer analyses of series of coins, by two different methods. Chapter 10 by Blet-Lemarquand et alii presents the results of analysis of early electrum coins from the BnF collection, together with a sprinkling of coins from commerce, by Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) at the Centre Ernest Babelon. The presentation of this data includes a clear explanation of the method and its advantages, and comes with the *caveat* that this is not an attempt at systematic analysis, but rather a proof of concept for electrum. Chapter 11 by Gitler et alii presents the results of analysis of 209 electrum coins of various periods, assembled for the exhibition which the conference accompanied. This analysis was performed with a hand-held X-ray fluorescence (XRF) analyzer. We may tabulate some of their results as follows (figure 1).[3]

It should be noted at the outset that the XRF results are to be used with caution. This is a surface method of analysis, and surface enrichment of electrum coins certainly occurred (see below). Blet-Lemarquand et alii usefully provide some comparative analysis of the same specimens both by XRF and by their preferred method (LA-ICP-MS). The advantage of the latter is that it allows penetration of the coin up to 0.2 mm, and thus below the region affected by any enrichment. For the most part (though not always) XRF leads to an overestimate of gold levels. Nonetheless, as the table in figure 1 shows, there is some value in examining XRF analyses *grosso modo*, especially where no comparable LA-ICP-MS analyses are available.

2. Work on this article took place as part of the CHANGE project with funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Grant agreement No. 865680). I must state at the outset my gratitude to François de Callataÿ, Wolfgang Fischer-Bossert, Robin Lane Fox, Nino Luraghi, Keith Rutter, Rosalind Thomas and Ute Wartenberg for discussion of various points arising from this volume.

3. More types are analysed than are listed here, and are tabulated at pp. 350-354 and 382-405. For early electrum I have cited Weidauer 1975 groups (W), for the 6th century staters the groups and series treated elsewhere in the volume by Wartenberg (*White Gold*, Chapter 18), for Cyzicus the type numbers of von Fritze 1912 and for Phocaea the series of Bodenstedt 1981. Percentages cited are averages where multiple specimens are analysed.

Type	Gitler et alii (Chapter 11) XRF			Blet-Lemarquand et alii (Chapter 10) LA-ICP-MS		
	Au (%)	Ag (%)	Cu (%)	Au (%)	Ag (%)	Cu (%)
Striated (W2)	61.88	35.61	0.91	60.82	38.55	0.52
Lydia (W15-6)	55.97	41.77	1.15	53.98	44.36	1.40
Lydia Walwet (W17)	51.21	44.39	2.86	57.90	40.83	1.10
Lydia Kalil (W18)	53.11	44.27	1.41			
Lion paw				51.00	47.17	1.70
Boar (W13)	53.13	44.35	1.50			
Facing Lion (W31-2)	53.25	44.10	1.36	53.75	44.48	1.50
Phanes (W7-8)	45.48	50.89	2.52	46.65	51.15	2.00
Miletus (W20)	40.17	53.47	5.04	44.45	51.35	4.00
Scorpion (W33-4)	42.97	52.43	3.28	38.50	58.73	2.60
Horse (W25-6)				45.84	51.43	2.53
Samian (W49-50)	56.16	40.67	1.85			
Cow & Calf II.12	45.67	49.95	1.98			
Lact. Lioness III.8	47.36	49.13	1.96			
Ram III.9	44.52	52.12	2.33			
Cow III.10	42.45	53.75	2.00			
Winged lion III.11	48.38	48.62	1.85			
Cow III.14	46.25	50.55	2.00			
Roar. Lion III.15	44.39	51.64	2.63			
Chios IV.16	41.73	54.64	2.66			
Lampsacus VI.24	58.53	40.20	0.31			
Cyzicus (vF 11-221)	59.30	36.08	3.50			
Phocaea (B. Series 1)	57.00	37.31	4.55			
Phocaea (B. Series 2)	47.60	44.09	7.38			
Phocaea (B. Series 3)	44.85	45.91	8.12			
Mytilene	46.68	45.44	6.40			

Figure 1 - Summary of analyses presented in Chapters 10 and 11.

For the early electrum, the LA-ICP-MS analyses suggest that we seem to have two separate phenomena. The striated and Lydian coinages included more gold than silver. For the former, both methods yield similar results (61.88 % and 60.82 % Au). For the Lydian lion's head issues, the composition of 21 coins analysed by LA-ICP-MS

consisted of '55.3±1.6 % Au, 43.2±1.4 % Ag and 1.3±0.4 % Cu' (p. 348). On the other hand, the coinages more likely to be attributed to Greek cities, with the stag, recumbent lion and horse types, all have more silver than gold (38.50-46.65 % Au), again mirrored in the XRF (40.17-45.48 % Au). There also appears to be greater variability in gold content than with the Lydian issues (p. 355). The exception to this rule seems to be the early 'Samian' issues with 56.16 % Au (XRF only).[4]

This pattern of lower gold content appears to persist (or re-emerge) in the 6th century electrum staters studied by Wartenberg (Chapter 18). Again, only XRF analyses are available, but produce a range of 41.73-48.38 % Au. The exceptions to this pattern are provided by a short series of staters that are perhaps to be attributed to Lampsacus (Wartenberg VI.22) with 58.53 % Au and Cyzicus, where the content average across the entire series from the Archaic period to the 4th century is a comparable 59.30 % Au. In short, the Cyzicenes appear to be the electrum coinage with the most amount of gold since the striated electrum of the 7th century. However, at Phocaea we should also note the high amount of gold present in the earliest issues of the mint. In Bodenstedt's first series, this averages 57 % Au but, as Gitler et alii note, this seems to fall in the subsequent two series. In series 2 and 3 the averages are 47.60 % and 44.85 % Au, a range that straddles that of Mytilene (46.68 % Au), with which the city was in monetary alliance for at least part of the period of production (*IG* XII.2.1). As the authors note (p. 408), this drop in Au seems to be accompanied by a sharp rise in Cu.

To return to the earliest electrum, what emerges from its chemical analysis is that the issuing authorities were well in command of the metallurgy involved, and capable of manipulating the purity. It has been suggested in the past that the ability to refine gold (and so control purity) was a Lydian invention, and that this might somehow be part of the answer to the 'why here, why now?' question concerning the first coins and their metal. Kleber (Chapter 1) despatches this notion once and for all. Through a careful analysis of the textual evidence from Mesopotamia she convincingly demonstrates that the process of 'parting', whereby the silver that is naturally present (between 10 and 40 %) in native gold is removed through the addition of salts and the application of heat (between 600 and 800°C), can be traced back at least to the first half of the 2nd millennium. The Lydians and their neighbours were thus not metallurgical innovators; the nature of their revolution lies in the use to which they put an old technology.

The fourth chapter on electrum, by Cahill et alii (*White Gold*, Chapter 9), builds on these foundations of chemical analysis and metallurgical methodology in two separate parts. The first consists of a detailed analysis of two Lydian lion head *tritai* of Weidauer Type 16 by Energy-dispersive X-ray Spectroscopy (EDS) using a scanning electron microscope (SEM). The results show wide variation and, as comparison with the LA-ICP-MS results above show, significant over estimation of gold content. As the authors conclude, 'Such wide variation in the surface composition of a single coin belies the notion of a single "correct" proportion of gold to silver on the surfaces of

4. See further on these Kroll, *White Gold*, Chapter 16 (p. 538, n. 8).

Lydian electrum coins. Not only does the surface contain more gold than the core, but it also varies in composition at different spots on the coin.' (p. 310). Their conclusion, based partly on the fact that this enhanced gold layer was demonstrably worn away through ancient use, and partly on the fact that flecks of silver chloride were detected in cracks deep within both coins, is that the surfaces of these coins were deliberately enriched by their producers through a parting process to remove the silver from the surface of the finished coin (p. 311).

The second part of the paper starts from an analysis of flakes of natural gold from the Pactolus, two nearby streams, and an industrial excavation near the site of Sardis. Analysis by both SEM-EDS and LA-ICP-MS at the Field Museum in Chicago demonstrated all of these samples to be between 97 and 99 % pure gold. The long-standing *canard* that the earliest electrum coins were produced from naturally occurring electrum from the Pactolus must therefore be discarded. But Cahill et alii go further and question the extent to which Lydian gold was used at all in early electrum coinage. Drawing on the analyses of Blet-Lemarquand et alii in Chapter 10, and the wide variation they demonstrate in lead content in the Lydian issues, they argue that the early electrum was quite possibly not produced from a single source of gold, but rather from different sources with different levels of naturally included silver (p. 317). These sources, they suggest, were located to the north in the Troad and Mysia. The startling, but highly plausible picture that emerges is of a resource-hungry Mermnad kingdom expanding into gold rich areas in the 7th century BC, and transforming this mineral wealth into coinage (p. 320).

Early Electrum coinage and the Artemisium

We must thus turn to the heart of the book, and to consideration of what can now be said about the chronology and context of the invention and spread of these first coins. Crucial to our understanding of the nature and function of the earliest coins is their chronology. And crucial to our understanding of that chronology are the excavations of the earliest levels of the Temple of Artemis at Ephesus, first by the British Museum under David Hogarth from 1904-1905, and then by the Austrian Archaeological Institute under Anton Bammer from 1987-1991. Almost everything that has been written on the subject of the dating of early electrum has been based on the (at times understandable) misinterpretation of the site by these two missions. This emerges with eye-watering sharpness in the two chapters by Michael Kerschner (the first in collaboration with Koray Konuk), which surgically lay bare the mistakes made by earlier excavators. These are lucidly written and beautifully illustrated: rarely can a complex site have been so thoroughly presented, with a such a clear emphasis on understanding what can and cannot be said about the contexts in which coins were found.[5]

5. Even the definition of 'context', and the abuse of the term by previous excavators, is dissected (pp. 155-162).

Through careful re-examination of the photographic records and notebooks of the excavations, Kerschner and his colleagues have reconstructed a series of 6 successive temples (figure 2), expanding from an unmoving cult centre like 'the growth rings of a tree' (p. 197).

Phase	Construction date
Naos 1	ca. 660-640 BC
Naos 2	ca. 640-620 BC
Sekos 1	Late 7th century
Sekos 2	ca. 600 BC
Dipteros 1 ('Croesus Temple')	ca. 575-550 BC
Dipteros 2 ('Wonder')	Mid-late 4th century BC

Figure 2 - Phases of Temple construction at the site of the Artemisium.

The two initial phases (*Naos* 1 and 2) consisted of small *naoi*, perhaps intended to protect the archaic *xoanon* of Artemis, with a surrounding wall (and columns in the case of *Naos* 1, and a tile roof in the case of *Naos* 2). The precarious location of the *Naos*, apparently at the confluence of two rivers, made the area prone to flooding, and led to a succession of attempts to raise the ground level. Thus, the transformation of the sanctuary that took place with the much larger courtyard areas of *Sekos* 1 and 2 at the end of the 7th century also involved a significant amount of raising and levelling of the ground. These newly levelled areas subsequently formed the basis for the two famous marble dipteral temples built on the site: the archaic or 'Croesus' temple, and its successor, completed in the 4th century BC and one of the Seven Wonders of the ancient world. Throughout this period of growth, the sacred location enshrined in the earliest temple seems to have remained the focal point for later temples, and indeed the last two temples appear to have preserved the concept of the small, enclosed shrine at their centre, directly above the original location of a seventh-century *basis* (p. 88, fig. 3, with summaries at pp. 195-196 and 243-244).

It is on this *basis*, too, that much of Kerschner's exposition is centered. Chapter 6 presents the detailed, revisionist account of the archaeological reconstruction of the developments just described, while Chapter 5 focuses on the contexts within the excavation site where the early electrum coins have been found. Although this central *basis* occupies a key place in this investigation, a number of other contexts prove important. In summary, nine key locations emerge: the central *basis* itself, faced with green schist, at the centre of *Naos* 2; the compacted substrate under the floor of *Naos* 2 (when the floor level was raised); the floor of *Sekos* 1; a *basis* associated with both *Sekos* 1 and 2 ('the Western *basis*'); and beneath the southern inner wall of *Sekos* 2. Further away from the central basis area, coins have been found in a river bed and subsequent in-fill associated with *Sekos* 2 and a limestone *basis* (*basis* B) associated with *Sekos* 2, and finally in a somewhat disturbed 'ashy layer' (Trenches 408-409, 420-423) in the vicinity of another *basis* (D). This last context is probably to be interpreted as

'a secondary deposition of sacrificial residues and votives that accumulated over time in the sanctuary' dispersed in the building of *Dipteros* 1. Konuk provides a catalogue of coins (arranged by context)[6] and a useful table summarising the contexts, but does not organise them in the sequence of their likely deposition, and thus *termini ante quos*. If we do so, the following picture emerges (figure 3).

Context	***TAQ***	**Coin nos.**	**Types**[7]
Green schist basis (*Naos* 2)	640-620	1-24	Typeless (-); Striated (II); Lion-head r. (XV) (with letters (XVII)); Lion-paw; Horse-head l. (XXVI); Hawk-head; Griffin head; Seal-head
Pot hoard (*Naos* 2 substrate)	640-620	29-45	Striated (II); Goat-head r. (III); Two cocks (IV); Lion-head facing (XXXII)
Naos 2 substrate	640-620	46-48, 104-105	Two cocks (IV); lion recumbent (XX); Horse head l. (XXVI); Dolphin head
Floor (*Sekos* 1)	620-610	106	Lion-head facing
W. Basis (*Sekos* 1 / *Sekos* 2)	620-600	25-28	Lion head r. (XV); Stag forepart l. (VII)
River-bed	630-615	108	Lion-paw
River-bed in-fill (Basis B)	600	107	Lion-head r. (*kukalim*) (XVIII)
South wall (*Sekos* 2)	600	49-53	Lion head r. (XV); Lion-paw; Pegasus protome (XXVII)
Basis D environs	590	97-103	Horse head l. (XXVI); Lion head r.; Lion-paw; Mill-sail; Boars heads (*-late-*) (XIII); lion recumbent (XX);
Naos 1/2–*Dipteros* 1 uncert. findspot?	575	54-81	Striated (II); Goat-head r.; Two cocks (IV); Lion-head r. (XV); Lion-paw; Lion head l. and r. (*walwet* (XVII)); Horse head l.? (XXVI?); Seal-head;

Figure 3 - Contexts of electrum coins from the Artemisium.

6. I note the following errors and omissions. Coin 53 has a 'Pegasus' head not bridled horse on the obverse: see Fischer-Bossert 2016, no. P25g, correctly cited in the catalogue. On coins 79 and 103 the lion's head faces right not left. The reverse punches of coin 100 warrant a reference, as is provided for coin 101, to Hilbert 2018, p. 54, where the punch sharing identified by Spier 1998, pp. 331-332 is graphically laid out (this has now been further explored in Hilbert 2019-2020). Coins 100-101, despite their very different obverses (Two boars heads and Recumbent lion) appear to be products of the same manufacturer Spier 1998, pp. 331-332), as is coin 48 from the *Naos* 2 substrate, guaranteeing an early date for all these coins. For coin 100 Konuk appears, in printing *'[l]atew'*, to be following the reading of the legend of Karwiese 2008 (𐤋[𐤋]𐤀𐤕𐤋𐤀𐤁), followed now by Schürr 2019, p. 79, n. 19, which if correct would transcribe as *walwtalim*, not *walwetalim*, as Karwiese 2008, pp. 137-138) supposes. The traces on this coin, and other specimens helpfully assembled by Hilbert 2019-2020, p. 25, suggest rather the reading 𐤋𐤀𐤕𐤍: *-late-* if retrograde, so Spier 1998, p. 333; or *-etal-* if not. On the Ephesus specimen there are traces of a letter below the 𐤍 that may be a 𐤁, but there certainly does not seem to be room for three more letters before that. On a specimen that has now appeared in trade (Gorny & Mosch 151 (2006) 197), there are traces of a vertical hasta above the 𐤋, but this could be part of a number of letters. We might note also that if this legend reads right to left, as do the legends on the lion coinage, then Karwiese 2008's reading is completely impossible.
7. Roman numerals refer to the groups of Weidauer 1975.

The last line of Figure 3 requires some detailed comment. Coin nos. 54-81 have no precisely identifiable findspot and are described by Konuk (p. 92) as originating 'Inside *Naos* 2', and this is apparently accepted by Kerschner (p. 144). This is plainly not correct. Konuk (p. 93, n. 7) cites Head as his authority for this,[8] and quotes his summary: '13 pieces were found under the foundation of *Naos* 2, but were not identifiable later'. Head's statement was, in fact, clarified in a footnote on that page supplied by Hogarth himself: 'Thirteen of these were found under B foundations (see p. 63), but unfortunately these types were not recorded by me at the moment, and the coins were mixed with others from other parts of the W. Area before I had repaired my omission'.[9] The reference to 'B foundations', not the Basis of B (the green schist basis of *Naos* 2) suggests that he was admitting to a greater degree of vagueness here. Moreover, as Kerschner notes (p. 255, n. 25), 'Hogarth's "Temple B" cannot simply be equated with one of the temples as they are comprehensible now... "Temple B" rather comprises elements of the *Naos* 1, *Naos* 2 and *Dipteros* 1, perhaps even of *Sekos* 1 and 2.'[10] For the remainder of the uncontextualized coins, Head notes: 'Of the total of 87 specimens, the find-spots of the remaining 38 (for the most part very small coins) cannot be so precisely identified, as these coins came to light among the results of dredging operations, and in many cases were not detected till the slime had passed through the sieves. It may be accepted, therefore, as quite certain that all the coins recovered by Mr. Hogarth were found within the small area of what he calls the Primitive shrines (see Chapter IV), and at levels below - 4.00, i.e., in the bottom metre of deposit.' (p. 75). The 'primitive shrines' are Hogarth's Temples A, B and C, which, as is clear from Kerschner's exposition, correspond to remains of everything from *Naos* 1 or 2 through to *Dipteros* 1. In short, due to the vagueness of the description of their context, the *terminus ante quem* for this assorted group of coins (nos. 54-81) becomes, most probably, the foundation of *Dipteros* 1 (ca. 575 BC). They may, of course, have been deposited considerably before this.

For a significant number of the Artemisium coins (97-103, 54-81), therefore, we can say no more than they predate the beginning of *Dipteros* 1 (The 'Croesus' Temple). Those that may be assigned a context may be divided into two groups. The 46 coins clearly associated with the construction of *Naos* 2 consist of a variety of types: Smooth; Striated; Lion-head r. (with letters) and Lion-paw; Horse-head l.; Goat-head r.; Two cocks; Lion-head facing; Hawk-head; Griffin head; Seal-head; Dolphin head; lion

8. Head 1908, p. 75.
9. The note is appended to Head's statement that 'the find-spots of the remaining 38 (for the most part very small coins) cannot be so precisely identified' (Head 1908, p. 75).
10. Konuk, *White Gold,* p. 93 n. 7, also cites Spier 1998, p. 328 for an observation made by Price in his unpublished paper on the subject that the 'unstratified coins belonged with the other coins. He further observed that the same variety of coins was distributed throughout the different levels of the early building structures.' In fact, Price, although working entirely within Hogarth's framework of analysis, seems to have drawn the right conclusion if, as Spier suggests, he observed that the all the unstratified coins 'were from either the B foundations or from Periods C-D'. These last two equate to *Sekos* 1 and *Dipteros* 1.

recumbent. Typologically, we might suggest that we have 12 different coinages here. By contrast the 11 coins that seem to be associated with *Sekos* 1 and 2 are all of just three coinages, the Phanes coinage, 'Pegasus' *protome* and the lion head and lion paw issues. The sample is meagre, but it might suggest a thinning down of variety of coinage at the sanctuary after ca. 620 BC.

So, when does coinage begin? The *terminus ante quem* for the flourishing phenomenon we see in the *Naos* 2 contexts is evidently 640-620 BC. However, the nature of this evidence is such that it is difficult to determine a *terminus post quem*. Some coins, notably the bridled-horse issues look very fresh (cf. nos. 16-17 and 104, all from a *Naos* 2 context). Others, for example the lion's head r. coins from the green schist basis (nos. 5-7), do seem to show signs of wear, perhaps consonant with a decade or two or sustained use. The beginning of coinage may thus have occurred as early as, say, ca. 660 BC or as late as ca. 630 BC. This brings us inevitably to consideration of the identity of the issuer of the lion's head issues with inscription. Coin 9, from the *Naos* 2 foundations (with a *taq* of 640-620 BC), bears traces of letters and is struck from a reverse punch used for coins on which the name 𐤅𐤀𐤋𐤅𐤕 (Walwet ←) is clearly legible.[11] If it is correct to equate this name with the Lydian name Alyattes known from Greek sources, then this potentially has chronological implications for the Lydian king-lists. This question is tackled elsewhere by Wallace 2016 in the paper he originally gave at the Jerusalem conference, and thus with broad knowledge of the earlier dates now being proposed by Kerschner.[12] Re-examining the text of Herodotus, Wallace has argued for an earlier date for the beginning of the reign of Croesus, in the mid 580s BC, and a general dismissal of the account of the Lydian kings offered by Herodotus.[13] If this is correct, then some fairly radical surgery is now imposed by the new Artemisium chronology. A fixed point in the chronology of the Mermnad dynasty is offered by the date of the death of Gyges, which emerges from Assyrian sources as ca. 645-643 BC.[14] Herodotus and the Eusebian tradition give the order of the Mermnads and their reign lengths as follows: Gyges (35-38), Ardys (37-39), Sadyattes (5-12), Alyattes (49-57). On the Eusebian chronology there are thus 91 years between the death of Gyges and the accession of Croesus, and on the Herodotean 108. Neither can be right, and the evidence of the coinage now becomes an important corrective. If Walwet is the Lydian for 'Alyattes', and his coinage predates ca. 640-620 BC, then we are forced to accept

11. Three further coins of Walwet (nos. 77-79) and one inscribed Kukalim (no. 107) have also been recovered from the Artemisium excavations, but their *termini ante quos* (ca. 575 and ca. 600 BC respectively), are less helpful. For the history of the reading of this legend see Dale 2015, pp. 151-153.
12. However, Wallace's discussion of the coin chronology does not precisely match the conclusions subsequently published in *White Gold*, and is thus best set aside.
13. The problems caused by Herodotus' sequence of kings and their regnal years have been widely noticed, of course. See, for example, Burkert 1995; Asheri et alii 2007, pp. 83, 86-87.
14. For detailed discussion see Spalinger 1978; for a summary and new editions of the *res gestae* of Ashurbanipal in which Gyges and his son feature, see Novotny, Jeffers 2018, pp. 18-19 with p. 16 for a tabulation of the relevant texts.

either a reign of between 35 and 55 years for Alyattes, and significantly compress the gap between him and Gyges, or, as the king-list preserved by Nicolaus of Damascus (*BNJ* 90 F63, probably drawing on Xanthus of Lydia: cf. *BNJ* 765 F39) has it, that Gyges' successor was named Alyattes, not Ardys.[15] If this Alyattes I had died around 620, this still leaves 40-45 years for the reigns of Herodotus' Sadyattes and the ruler who would now become Alyattes II. Furthermore, if this identification of Walwet with Gyges' successor is correct, then it almost inevitably follows that the Kukalim also attested on Lydian coins that are die-linked to those of Walwet, is to be identified with Gyges himself.[16] The *terminus ante quem* of Gyges' death ca. 644 BC for the Kukalim issues, and *post quem* for the Walwet issues, fits very snugly with the archaeological chronology (*terminus ante quem* of ca. 640-620 for both issues) now proposed. There is no proof here, but strong likelihood that, in Lydia at least, coinage began in the reign of Gyges for which the Assyrian sources provide us with approximate dates of ca. 668-644 BC.[17]

Returning to the Artemisium finds, what is also striking from seeing the pot-hoard coins presented together in clear and enlarged photographs is how heavily worn the dies became (see e.g., nos. 30-43). These were not small-scale prestige strikings, but rather a fully-fledged, mass-produced monetary medium from the outset.

This fact is reinforced by the excellent study of the 'Phanes' coinage produced by Fischer-Bossert in Chapter 12. As we have seen, we now have a *terminus ante quem* for the production of this coinage of ca. 600 BC.[18] With the certainty provided by his die-study we may summarise the size of this as follows (figure 4).[19]

15. A king Ardys is clearly recorded among the earlier Heraclid Lydian kings, both in Nicolaus (*BNJ* 90 F44a = Xanthos, *BNJ* 765 F34a), and in a newly published inscribed king list(?) from Sardis (*Sardis* II. 577). See Thonemann 2020 for discussion.
16. The issues inscribed [𐤊𐤅𐤊𐤋𐤉] (Kukalim) have been plagued by misreading and misunderstanding. For the reading and a possible translation 'I am (the seal) of Kukas' see Dale 2015, who, however, wrongly rules out Gyges on the assumption that the issues of Kukas and Walwet are contemporary. There has been dispute too about the significance of a punch-link between the two coinages. Thompson 1966, who first noted it, took their relative conditions to indicate that Kukas preceded Walwet. Weidauer 1975, p. 62, followed by Wallace 2006, p. 44, assumed the opposite. Thompson seems to have been correct, as will be demonstrated in a forthcoming die-study by Wolfgang Fischer-Bossert. What the die-link between these issues and the Walwet coinage certainly does suggest is that these coinages were struck either side of Kukas' death: see further below on the historical implications of this.
17. A *terminus ante quem* for his accession is provided by the record of the first contact between Gyges and Ashurbanipal, probably ca. 666-665, although 668-667 is also possible (Novotny, Jeffers 2018, p. 18, n. 112).
18. The fill of the western basis associated with *Sekos* 1 or 2 (p. 130). For a date around the same time on the basis of letter-forms and orthography, though noting the possibility of an earlier and later phase to the coinage, see Bresson in *White Gold*, Chapter 13 (pp. 477-485).
19. Die-estimates (D) are produced from Esty 2011 Formulae 3 and 4; confidence intervals from Esty 2006 Formula 4. Where a die is used for two denominations it is assigned 50 % to each.

Denom.	d	n	Sing.	D	Upper	Lower
Stater	4	17	2	6.8	9.8	3.8
1/3	5	29	1	6.2	7.7	4.7
1/6	4.5	37	0	4.5	5.2	3.8
1/12	8.5	72	1	9.6	10.8	8.5
1/24	6	102	0	6	6.4	5.6
1/48	6.5	34	0	6.5	7.9	5.1
1/96	2.5	7	1	4.1	7.4	0.7

Figure 4 - Estimated original numbers of dies for the Phanes coinage, by denomination.

In addition to the die-study, Fischer-Bossert provides a helpful set of weight tables for the different denominations.[20] If, for the sake of consistency, we take the range in which the 80th percentile falls, a neat arithmetic relationship emerges which we may then multiply by the estimated number of dies to produce an estimated output in gram / dies.[21] This in turn, more speculatively, may be multiplied by a possible number of coins struck per die (I assume a conservative figure of 10,000). Finally, we may go one step further and apply a silver: electrum ratio (for the sake of illustration I use 10:1)[22] in order to provide us with output figures that are comparable with later Greek silver coinages. The results (figure 5), which, it should be stressed, are to be treated as *minima*, not estimates, are impressive.

20. Stater 14.14 g, 1/3rd 4.72 g, 1/6th 2.35 g, 1/12th 1.18 g, 1/24th 0.58 g, 1/48th 0.29 g, 1/96th 0.15 g.
21. This approach, which is akin in purpose to the use of 'drachm die equivalents' for later silver coinages, allows us to produce an index of productivity for coin dies (whether observed or estimated) by multiplying the number of dies by the weight of the coin they were intended to produce. So, for example, the output of three 1/6th stater dies would be 3 × 2.35 g = 7.05 gram dies (gd). This allows us to compare output in bullion terms across different weight standards and denominations.
22. The precise ratio in the 7th century is difficult to estimate, partly because the documentary evidence does not exist, and partly because we do not have contemporary electrum and silver coinages from which relationships might be deduced. There is also the problem of the changing value of silver (it is often assumed that silver was rarer in the 7th than in the 6th century), and finally there is the problem of by how much the electrum coinage may have been overvalued against its intrinsic value. At intrinsic value the ratio may have been approximately 7:1: see Velde, *White Gold*, p. 511 for the assumptions. For fuller discussion see Melville Jones 1998, with pp. 260-261 for a possible ratio of 9:1 or 10:1 in the 6th century. Cf. Le Rider 2001, pp. 94-95. If, with Le Rider, we assume parity between the heavy gold Croeseid of ca. 10.7 g and the Milesian electrum stater of 14.1 g, and a gold: silver ratio of 13:1, then a Milesian electrum stater of 14.1 g would exchange for ca. 140 g of silver, giving an electrum: silver ratio of 10:1. This, we should note is somewhat higher than the conversion rate of the Cyzicene stater in the 5th and 4th centuries, which seems to have been in the range of 1:6 to 1:7.5, depending on the location. See Psoma, *White Gold*, pp. 72-74.

Weight	D	Gram Dies	Electrum	Coins	Silver
		(gd)	10000 c/d (g.)	10000 c/d (coins)	10:1
14.14	6.8	96.152	961520	68000	369.82
4.72	6.2	29.264	292640	62000	112.55
2.35	4.5	10.575	105750	45000	40.67
1.18	9.6	11.328	113280	96000	43.57
0.58	6	3.48	34800	60000	13.38
0.29	6.5	1.885	18850	65000	7.25
0.15	4.1	0.615	6150	41000	2.37
Totals		*153.3*	*1532 Kg*	*437000 coins*	*589.61 Talents*

Figure 5 - Output of the 'Phanes' mint in gram dies, electrum, coins and silver equivalent.

If the assumptions are broadly correct, then the Phanes mint produced close to half a million coins, with total weight of over 1.5 metric tonnes, and perhaps a minimum notional silver value of 590 Attic Talents. And this is just one production centre, the coinage of which forms less than 1 % of the finds from the Artemisium.[23] Stefan Karwiese has estimated that there may be as many as 300 typologically distinct early electrum coinages, a figure now endorsed by Wartenberg (pp. 574, 596) on the basis of the PHANES database, Kroll (p. 537) and Van Alfen (p. 548).[24]

For the sake of comparison, we can conduct a similar exercise with three other early electrum coinages that have recently received die-studies: the bridled horse, 'Pegasus' and early 'Milesian' series (figure 6).[25]

The relative sizes of these coinages are easily visualized in Figure 7, and it becomes clear that, large though the Phanes issue might appear to be, it is the smallest of these four earliest productions.

In every respect – their size, their metallurgy and metrology – these early coinages impress. These were large, well-regulated productions, clearly designed for their issuing authorities to make precise payments at a massive scale. Velde (Chapter 14) provides a nice overview of this. The ramifications will be considered in part 4 below.

23. Although, as Fischer-Bossert notes (*White Gold*, p. 439), the context of the Artemisium specimen (his 26d, no. 28 in Konuk's catalogue) is relatively late ('the Western Basis), and may suggest that the Phanes coinage is generation or so later than much of the electrum from the site.
24. See now also the comments of Wartenberg 2016, pp. 30-31.
25. For the first two see Fischer-Bossert 2016, for the last Hilbert 2018. Hilbert 2018, pp. 131-132 dates the first phase of 'Milesian' production ca. 615-600 BC, on the basis of a nexus of punches which create a link between a *hekte* of his first phase with a lion recumbent issue of the type attested in the Artemisium excavations. The coin he cites is Konuk's no. 48, which, as we have seen, derives from the 'rammed-earth' substrate of *Naos* 2. In Hilbert 2019-2020 this problem is acknowledged but essentially ignored. The implication of this must be that Miletus phase 1 was in production, in fact, before ca. 640-620 BC. Given that Miletus was at war with Lydia from the reign of Gyges down to its conquest by Croesus, it may well be that all three of Hilbert's *Prägephasen* belong to the years ca. 640-580 BC. See further below (n. 43).

Weight	D	Gram Dies	Electrum	Coins	Silver
		gd	10000 c/d (g.)	10000 c/d (coins)	10:1
Bridled horse					
14.30	12	171.60	1716000	120000	660.00
2.38	7.5	17.85	178500	75000	68.65
1.19	11.8	14.04	140420	118000	54.01
0.59	0.5	0.30	2950	5000	1.13
0.29	1	0.29	2900	10000	1.12
Totals		*204.1*	*2041 Kg*	*328000 coins*	*784.91 Talents*
Pegasus					
4.75	31.5	149.63	1496250	315000	575.48
2.35	6.0	14.10	141000	60000	54.23
1.19	7.1	8.45	84490	71000	32.50
0.60	8.4	5.04	50400	84000	19.38
0.30	11.7	3.51	35100	117000	13.50
Totals		*180.1*	*1807 Kg*	*647000 coins*	*695.09 Talents*
Miletus					
14.03	15.2	213.26	2132560	152000	820.22
4.66	12.8	59.65	596480	128000	229.42
2.33	8.9	20.74	207370	89000	79.76
1.16	3.0	3.48	34800	30000	13.38
0.58	2.0	1.16	11600	20000	4.46
0.30	3.0	0.90	9000	30000	3.46
Totals		*299.2*	*2992 Kg*	*449000 coins*	*1150.70 Talents*

Figure 6 - Output of the Bridled horse, Pegasus and early Milesian mint in gram dies, electrum, coins and silver equivalent.

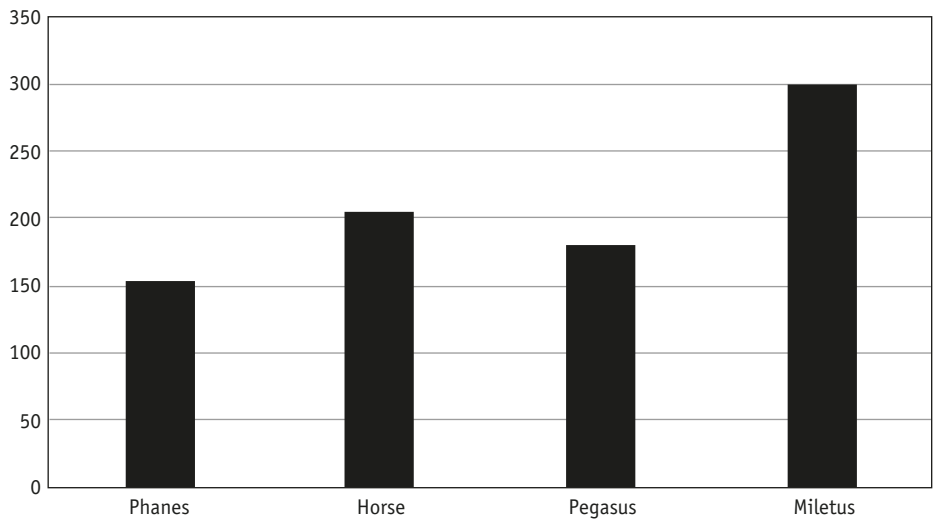

Figure 7 - Sizes of the Phanes, Bridled horse, Pegasus and early Milesian Phase 1 coinages in gram/dies

Later Electrum coinage

Although a case is made by Wartenberg for a sixth-century bridge from the early electrum to the later phenomenon (see further below), it seems clear that the later issues are, as the volume's editors acknowledge (pp. 10-11), a different phenomenon. They belong to a period when we can begin to talk of the city-state as agent (whether sole, or as at Phocaea and Mytilene, in co-operation), and have tended to attract explanations in terms of special purpose.

Sheedy (Chapter 8) addresses the electrum coinage probably to be attributed to Athens with obverse types of Owl, Wheel and Bucranium. His discussion is largely antiquarian, tracing the history of the scholarship on the attribution and authenticity of these coins. He concludes, on the basis of the unique shape of the incuse punch and the fact that we know suspiciously too much about their provenance, that the electrum owls are modern forgeries. In the meantime, a much more thorough treatment of the three issues in question has been produced by Davis.[26] That this is later electrum, almost certainly to be associated with the silver *Wappenmünzen*, has been all but proven by the discovery of a specimen in late 6th-early 5th century context in the Athenian Agora excavations.[27] In this context, one of the most interesting things about these coins is their weight standard.

	Owl / Wheel	Bucranium	Cyzicus
Mean	1.36	0.67	1.33
Median	1.35	0.67	1.34
Mode (ind)	1.35	0.67	1.35
Mode (range)	1.35-39	0.65-69	1.30-34
IQR	0.01	0.01	0.03
80%	1.366	0.672	1.35
SD	0.03	0.02	0.04

Figure 8 - Weight data, Athenian and Cyzicene electrum.

What is striking here is that the whole coinage (if taken as a whole) displays a remarkable degree of conformity to a standard with an 80th percentile at 1.37 and 0.68 g. *Pace* Davis,[28] this is clearly a single weight standard, and it matches, at the higher denomination, a 1/12th Cyzicene stater, where the 80th percentile falls at 1.35 g for a sample of 46 specimens of the earliest issues.[29] With regard to the authenticity of

26. Davis 2015.
27. Camp 2015, p. 472; Sheedy, *White Gold*, p. 269; Davis 2015, pp. 6-7.
28. Davis 2015, p. 5 opts for Attic / Euboeic for the Bucranium / Wheel coins and Phocaean for the Owl.
29. Figures are taken from Hurter, Liewald 2006.

the Owl series, this must give us pause. Did a forger in Athens in the 1810s really have both the understanding of Athenian and Cyzicene electrum and the technical ability to produce coins of this degree of sophistication? Whatever we make of the Owl issues, for the Wheel and Bucranium, we must note the fascinating fact that someone took the decision in late 6th century Athens to produce electrum on the standard in use in the north-east Aegean. As John Davies has pointed out, this was a period in which the great families of Athens were busy carving out future imperial corridors, and in which a certain blurring of personal and state interest still occurred, and one of these corridors led to the Black Sea.[30] Could we be looking here at a coinage struck at Athens, as part of the growing interest that was being shown by Athenians in economic integration in and exploitation of the region?

The next stage in this story is picked up in three chapters devoted specifically to the electrum coinage of Cyzicus. De Callataÿ (Chapter 19) provides a useful and up to date overview of the coinage which, to date, has only received overviews. In this case, at least, the overview is announced as *prolegomena* to a much-needed die-study and lays out the history of prior attempts to survey, date and explain this extensive and varied coinage.

We are still largely in the dark about the chronology of this substantial coinage. It begins, probably in the late 6th century, with a phase of fractional coinage, before moving to a coinage predominantly of staters at some point in the 5th century. De Callataÿ profers the opinion that 'type 39 marks the turn in production... taken under Athenian denomination, that is after 478 BCE' (p. 649). Psoma downdates (implicitly at p. 691 and explicitly at p. 697) the beginning of the main stater production of Cyzicene electrum to 450 BC.[31] As to its end, Psoma (p. 696) links the famous 'ΕΛΕΥΘΕΡΙΑ' stater to the arrival of Alexander, as have others. For F. de Callataÿ, 'Nothing of this is very convincing' (p. 647).

The meat of de Callataÿ's contribution comes in his Table 2 summarising the contents of his database of Cyzicene electrum. Taking as his basis the typology of von Fritze,[32] and adding some (16 of 49) of the new issues identified by Hurter and Liewald,[33] while omitting all issues before von Fritze's no. 39, he summarises the denominations produced for each type and, in certain cases (from von Fritze issue 100 onwards) provides either exact or minimum numbers of dies utilized.[34] His Table 3, which should summarise

30. Davies 2013. Van Alfen (*White Gold*, Chapter 17) also provides an excellent discussion of the blurring of lines between concept of the 'State' and elites.
31. The date is far from convincing: the hoard evidence is in many cases entirely circular. The epigraphic evidence (the first appearance of Cyzicenes at Athens only coming in 454 BC) is surely conditioned by the fact that it is only from 454 that the tribute quota lists were inscribed and survive.
32. von Fritze 1912.
33. Hurter, Liewald 2002.
34. The table is not explained in the article, and I am grateful to the author for clarification *per epist*. Numbers of dies with an appended '+' are minima, those without are exact observation from the number of specimens given.

the number of dies, unfortunately has been populated (last column) with the totals of coins (precisely repeated from his Table 1), rather than the totals of dies. Expressed as stater or gram / dies (see below), this could have provided a basis for comparison, at least for minimal estimates of output. An alternative version might look like Figure 9.[35]

Types	St. (d)	1/6 (d)	1/12 (d)	1/24 (d)	St. (gd)	1/6 (gd)	1/12 (gd)	1/24 (gd)	Total (gd)
100-119	56+	33+	10+	2	901.6	89.1	6.7	2.7	**1000.1**
120-139	49+	29+	7+	1	788.9	78.3	4.69	1.35	**873.24**
140-159	47+	18+	7+	7+	756.7	48.6	4.69	9.45	**819.44**
160-179	45+	13+	7+	3+	724.5	35.1	4.69	4.05	**768.34**
180-199	50+	5	3	2	805	13.5	2.01	2.7	**823.21**
200-223	47+	6	3	3+	756.7	16.2	2.01	4.05	**778.96**
Total	294	104	37	18	4733.4	280.8	24.8	24.3	**5063.29**

Figure 9 - Numbers of dies in the de Callataÿ database with conversion to gram die (gd) equivalents.

The chronological significance of the groupings into von Fritze types remains to be seen. But we can say that this coinage, which was produced for roughly a century between the mid 5th and the third quarter of the 4th centuries produced a minimum of 5063 g/dies of coinage. If, for example, we think that each die produced 10,000 coins on average, this would amount to just over 50 metric tonnes of electrum at minimum. Or if we wish to think about this chronologically, and assume, say, a 120-year span for this coinage; annual output was on average 42 gd.[36] In reality, as de Callataÿ (p. 649) notes, production was almost certainly sporadic. But this sort of average allows us to make comparisons with likely output for the early electrum mints offered above.

What was all this coinage for? Explanations need to take into account not only the large size of this coinage, its exotic metal and its constant variation of typology, but also the fact that its denominational structure changes over time, with a gradual reduction in the number of fractions of the stater. This last fact suggests, perhaps, that purpose and function may be moving targets. For de Callataÿ, who rejects some of the wilder notions of the significance of different types (p. 648), the variety in appearance is the manifestation of 'a joyful creation stimulated by a spirit of freedom' (p. 648), the freedom being provided by the monopoly that Cyzicene electrum enjoyed in

35. Weights for each denomination are assumed as follows: Staters 16.10 g; 1/6th 2.70 g; 1/12th 1.35 g; 1/24th 0.67 g.

36. Assuming 10,000 coins per die, and a conservative ratio of electrum:silver of 1:6 (above n. 25) this equates to 100T of Attic weight silver per annum. Again this should be treated as indicative of a minimum (based on a 10,000 coins per die assumption, and minimal assumption of dies) rather than an estimate.

certain places, allowing, presumably, for dispensation with the normal guarantee provided by the *semata* applied to coins. We might contrast here the more sober assessment of Kroll that this changeability is 'essentially an electrum tradition' carried over from the earliest instances of coinage in the metal (p. 538), and caused by a need for accountability in the production process of high-value coinage. Psoma, in a chapter (21) devoted to the explanation of the coinage briefly surveys the literary, epigraphic and hoard evidence and comes to the belief that 'that the Cyzicene staters, which were issued with very few fractions, with changing types and with the tuna fish on the obverse, were minted at Cyzicus, as the tuna fish reveals, for the purpose not of fulfilling the city's need for currency, but for the currency needs of others, such as local satraps and Greek cities.' (p. 699). This may be a plausible theory, but it hardly emerges from the analysis that precedes, which elsewhere suggests that Cyzicene coinage, largely produced in periods of foreign domination of the city, is proof against the notion of a link between sovereignty and coinage. We are left with a Schrödinger's coinage which is simultaneously produced for others and a coinage of the city of Cyzicus. If the absence of fractions is really an aspect of this external influence (the mechanics are not clear), we are, moreover, left without an explanation for the beginning of the Cyzicene phenomenon wherein fractions play a major part, and indeed, for issues down to von Fritze 100, wherein, de Callataÿ's Table 2 suggests, 1/6 and 1/12 fractions may have played a significant part. Nonetheless, it is a virtue of Psoma's contribution that she asks the important question about the primary purpose of the Cyzicene electrum, i.e. what was it first produced by its issuing authority for?

Mielczarek, by contrast, (Chapter 20) starts in the opposite corner by asking, where does Cyzicene coinage end up? He provides a useful and updated survey of past surveys of the evidence of single and hoard finds of Cyzicenes in the Black Sea region.[37] Two regions of significant circulation in the northern Black Sea emerge: one zone between Istrus and Olbia in the north-west; and another centred in the Bosporan Kingdom, around the straits leading to the sea of Azov (pp. 666-673 with Maps 2-4). A clear distinction can be drawn between the types of coins that are found in these two areas, often interpreted as a shift in 'the center of gravity of the Pontic trade from Olbia' (p. 673). The mechanisms of this change remain obscure. Until we have a die-study of the coinage, a well-based sequence of issues and a firm absolute chronology, we have no way to map a clear archaeological pattern onto historical events. In more ways than one Cyzicene electrum is stranded. For now, potential answers must be sought in the literary evidence, which suggests, as Mielczarek lays out, a strong correlation between the grain trade to Athens and Cyzicene electrum. The problems here are twofold: almost our only evidence is Athenian so we have a strong bias; and this provides no explanation for the dominance that specifically Cyzicene coinage enjoyed in the process. Why Cyzicus? Why electrum? Why not Owls? One is left with the feeling that there is something that we are still not quite seeing here.

37. Accounts of past scholarship are provided by de Callataÿ (*White Gold*, pp. 647-648), while Mielczarek provides very useful summaries of the Russian and Ukrainian scholarship.

With Wartenberg's Chapter 18 on the 'Ionian Revolt' coinage we are led to consider the bridge between these issues and the earlier world. While her title alludes to a group of electrum coins that were attributed to this conflict in a famous article by Percy Gardner,[38] she presents a much broader spectrum of material than had hitherto been known. Rightly sweeping aside an approach dictated by a search for historical circumstances, she bases her analysis instead on three 'hoard' groups that seem to be related.[39] Discussion of these is then followed by a full die-study of the issues present in these hoards, as well as stylistically related issues, divided into 7 groups. The first of the hoards (*CH* 10.204) was said to have been near Söke in SW Turkey in the early 1990s. It contained at least 22 staters that display a development in reverse punch design from the three-punch arrangement well attested on 7th century coinages (Group I: an oblong punch flanked by two squares), through a rough square (Group II), rough oblong (Group III) punch, to the quadripartite square punch design (Groups IV-VII) that characterizes the issues of the 'Ionian Revolt' coinages present in her second hoard, from Vourla (*IGCH* 1167). The earliest coins in the Söke hoard are indeed the most worn, but this does not look like a century of wear (see p. 579, nos. 1-3). *Prima facie*, the Söke hoard might seem to suggest a period of production for Group I, series 1 no more than a generation before the remainder of the hoard, the condition of which appears fairly uniform. The date of Series 1 of Group I is unclear, although the types clearly resemble those of the gold and silver Croeseids, which were in production either side of the Persian sack of the city in the mid 540s BC.[40] In this respect, of course, the deposit date of the Söke hoard is crucial, but also independently unknowable. In the face of this uncertainty, Wartenberg works backwards from the Vourla hoard, first published by R. Jameson in 1911,[41] which turns out to be crucial. It contained four of Gardner's Revolt coins (Groups IV and V), a fifth related type (also Group IV, and which Wartenberg demonstrates is die-linked to one of Gardner's revolt issues), 21 electrum *hektai* all struck from the same die pair and 12 silver didrachms of the Protome of the flying-boar type generally attributed to Clazomenae (where the hoard was found). These last coins hold the key to the chronology. The earliest potentially dateable hoard to contain a specimen is from Sakha in the Nile Delta (*IGCH* 1639) and is usually assigned a burial date in the range ca. 500-490 BC.[42] Wartenberg (p. 590) opts for a date of 500 BC for Sakha and estimates twenty years of wear on the Clazomenean coin it contains (now in Berlin), and so arrives at a *terminus ante quem* of 520 for the Vourla material and ca. 530 for the deposit of the Söke hoard. Based ultimately on the

38. Gardner 1911.
39. One of these, the so-called 'Field in western Thrace hoard', is rightly demolished (pp. 591-595), both as a hoard and as evidence for a revival of Svoronos' belief in a north Greek electrum phenomenon.
40. Cahill, Kroll 2005, pp. 605-608 for the date of the sack and 609-613 for the implications of the chronology of the Croeseids.
41 Jameson 1911.
42. *IGCH* places it 500-470, but the evidence of the Asyut hoard shows that 470 is too late. For a date ca. 500-490 see e.g. Price, Waggoner 1975, p. 18; Kroll, Waggoner 1984, pp. 328, 337.

precise interpretation of a single hoard, this chronology is clearly fragile. For example, taking the slightly later date for Sakha (ca. 490), it would still seem possible to move the proposed chronology a decade later, and to date the Vourla type material (Groups IV and V) ca. 510-500 BC, and thus bring it into closer proximity with the Ionian Revolt. Moreover, given that Vourla and Söke both contain coins of Group IV in similar condition, there need be no long gap between their deposit. And whatever the precise date of their latest contents, we might note that both have Ionian findspots, which may thus suggest a horizon of crisis in this region.[43]

An undeniable corollary of the Söke hoard, whether its burial date be ca. 530 or ca. 500 BC is that there appears to be a gap in the 6th century production of electrum that it contains. There is a clear difference in wear, as Wartenberg notes (p. 584), between Group I and the later coins, as well as a marked stylistic difference in reverse punches, and it also remains unclear how long a gap intervenes between the seventh-century issues present at the Artemisium and Group I. We may be talking not so much about a continuous production through the 6th century, but rather a sporadic series of issues. If so, then the consistency of weight standard across the issues surveyed is all the more remarkable (chart opposite p. 600, and here figure 10).

	I	II	III	IV	V	VI	VII	All
Mean	14.01	14.00	13.97	14.06	14.04	13.99	14.04	14.02
Median	13.99	14.00	13.99	14.06	14.04	14.00	14.06	14.01
Mode (ind)	13.96	13.95	13.99	14.06	14.01	13.98		13.99
Mode (range)	13.95-99	13.95-14.04	13.95-99	14.05-14	14.00-04		14.05-9	14.00-04
IQR	0.11	0.06	0.05	0.12	0.08	0.12	0.05	0.09
80%	14.08	14.03	14.02	14.12	14.09	14.07	14.07	14.08
SD	0.07	0.04	0.11	0.08	0.05	0.10	0.05	0.08

Figure 10 - Weight data, electrum staters of Wartenberg Groups I-VII.

Again, we should note the technical competence here, and the convergence of all of these coinages on a single standard. Is this a top-down, or a bottom-up phenomenon? Equally striking is the dominance in this body of evidence of the stater denomination. These coinages do not seem to be accompanied by a full suite of lower-value electrum denominations. However, as Wartenberg notes here (pp. 598-600) and elsewhere,[44] it is important to bear in mind that these issues are now part of a monetary system

43. I note in passing the absence from both hoards of any of the Milesian issues recently studied by Hilbert 2018. It seems most unlikely that they should be absent from two Ionian hoards if they were still in circulation, and this may be confirmation for a much earlier end-date for this coinage than the ca. 530 BC that he suggests (*ibid*., i. p. 134).
44. See Wartenberg 2016; 2018.

that also contains silver coinage. Within this system, these electrum staters appear to be a series of coinages produced to make high-value payments. This does not look like the more flexible seventh-century phenomenon. We may thus be justified in asking whether needs had changed by the late 6th century.

Conclusions

Between them, the papers of Van Alfen (Chapter 17), Kroll (Chapters 3 and 16), Cahill et alii (Chapter 9), Bresson (Chapter 13) and Velde (Chapter 14) allow us to triangulate towards a map of the dynamics that shaped early electrum coinage. They suggest that we must divide the world in two. On the one side we find an acquisitive royal dynasty working its way upwards to the status of regional inland power. This was, as van Alfen points out, a state with a wealthy elite, apparently united in a single goal. And, as Cahill suggests, one of those goals was the control of the gold resources of western Asia Minor. On the other side, there are the dynamic, wealthy individual communities of their Greek neighbours, under the control of their ambitious elites, whether as groups or with power invested in individuals (tyrants, and as Kroll, Chapter 16, reminds us, dynasts). A window onto the wealth of these communities is opened for us by the republication by Kroll (Chapter 3) of the Artemisium lead tablet. Here we seem to have records of deposits of precious metal (gold and silver) from a variety of sources, including 'spear revenue' (ἐκ ττῦ δόρατος), maritime revenue (ἐ[κ ττῦ] ναυτι[ρῦ]), salt revenue (ἐκ ττῦ ἁλός) and agricultural revenue (?: [ἐκ ττῦ κή]πο). Fragmentary though it is, and covering an unclear period of time, this records an income – at minimum – of the equivalent of 15T of silver (p. 57). A complex, extractive local bureaucracy clearly emerges from this text, quite possibly as early as the late 7th century.[45]

This divide between a wealthy Lydian kingdom and a similarly prosperous coastal Greek fringe plays out in the design choices of the coinages: an apparently substantial Lydian royal coinage, with static types based on lion imagery on the one hand, and multiple series of more varied types that can in some cases, and with varying degrees of confidence, be attributed to Greek cities such as Ephesus, Miletus and Phocaea on the other. But this divide also appears in the hoard evidence for the distribution and use of these coinages (Velde, p. 503),[46] and perhaps the archaeological evidence for their deposition (see above).

45. The question of date is addressed by both Kroll (*White Gold*, pp. 52-55) and Bresson (*White Gold*, p. 484). Its archaeological context's *terminus ante quem* appears more likely to be *Sekos* 1/2 (late 7th-early 6th centuries); palaeographically it might appear a little later. But, as Kroll points out, it apparently had fallen out of use as a current document before its deposit.

46. Not that coins did not cross this divide, of course. The Lydian coins from the Artemisium excavations, which constitute almost 50 % of the finds, are clear proof of that. Note, too, the observation of Weisser, *White Gold*, Chapter 7, on a striated electrum issue found at Miletus. These coins, even without an explicit indication of their guarantor, clearly circulated beyond their place of issue (p. 268).

This inland *vs.* coastal pattern was already centuries old by the mid 7th century BC, and indeed we can witness, in the archives of the Hittite kings' interactions with the coastal fringe, the prominence of two of the communities suspected to be issuers of early electrum: Miletus (Milawata) and Ephesus (Apasa). And the pattern would repeat, for example, in the stand-off between the Achaemenid and Athenian empires in the mid 5th century and, more immediately, and significantly for our purposes, in the growing tensions between the coastal cities and the Achaemenid administration in the late 6th-early 5th century. This would lead to the Ionian Revolt and this too, as we have noted, is a period in which we may see a re-emergence of electrum coinage.

But how and why could this fault-line lead to the innovation of (electrum) coinage? Cahill, as we have seen, has suggested the emergence of a Lydian expansion driven in part by the desire to annexe the gold sources of the Troad and Mysia. If right, then we might simply overlay the same model on the coastal communities. Where the Lydian kings were the minerally acquisitive, coercive power within their imperial space, so the elites of the coastal communities were in theirs. Van Alfen (p. 552), indeed, points to the literary evidence for the mineral interests of various individuals in the pages of Herodotus. In these cases, potentially, we see the *locus* for convergence between control of the mineral resources and the coercive influence necessary to ensure the acceptance of coinage. It is perhaps no coincidence that one of the individuals identified by van Alfen is Peisistratos, under whom coinage most probably began at Athens, nor that the earliest coinage that we might attribute to Ephesus explicitly bears the seal of an individual, Phanes.

What then was this coinage for? The great achievement of *White Gold* is that it brings us what the editors term (pp. 5-7) new 'hard evidence' with which to work. Much of the debate on the nature of the first ancient coinage has focussed on its use and the role it played in the economy of those places where it has been found. That coinage changed the nature of the economies it entered can hardly be doubted. But we cannot simply assume that its effects, discussed by Velde and Jones (Chapter 15), were its initial purpose. Once more we must draw a distinction between primary and secondary function. A major result of the most recent work on the early electrum, particularly by Fischer-Bossert, has been to allow us to glimpse the size of these early coinages. To take the case of the Phanes coinage, we have already noted its overall scale, with perhaps at least the equivalent of 590T silver value put into circulation. Just as striking is the fact, emphasised by Velde (pp. 511-512), that this is denominationally speaking a very high value coinage. If we take the 1/24th stater as representing a soldier's day's pay (ca. 5.8 g of silver value, and so apparently close in value to the later Persian siglos), then 99 % of the Phanes coinage was struck at this level or higher. This was not a coinage intended, or even likely, to transform day-to-day market transactions. Its primary purpose, the purpose for which it was originally struck, like almost all subsequent gold and silver coinage, was surely military.

If we accept this proposition, then we can perhaps begin to insert this coinage into its historical background in ways that make sense and fit with longer-term patterns. The model of Mermnad expansion posited by Cahill et alii on the basis of metal analysis cannot but remind us of Philip II three centuries later: a monarchy entering the virtuous

circle of conquest and expansion. Conquest of the mineral rich areas immediately to his east allowed Philip access to the metal with which to pay his new military machine, and the result was his innovative trimetallic system of coinage. So, the Mermnad rulers harnessed the gold wealth to their immediate north, to provide the resource for an innovative new means to pay their way to further power: electrum coinage. The coastal cities, in the face of this expansionist innovative power to their east, if they wanted independence, could not but follow suit, and early coinage such as that of Ephesus, Miletus and the other unidentified issuers would become evidence of an 'arms race'. The literary sources, for what they are worth, suggest a period of near constant hostility on the part of the Lydian kings towards the Greek cities of Ionia and Aeolis, as well as against Caria, from the reign of Gyges to Croesus.[47]

However, while such a period of growth and increased friction may have provided an ideal environment for the development of coinage, it does not immediately suggest a catalyst for the invention of coinage. There had, after all, been friction between major and minor powers before. Our new appreciation of the date of the first coins, almost certainly in the generation before 640 BC, provides us now with a firmer historical context for this development, which may suggest a further mode of explanation. If military pay was the driver of this new invention, why here and now? If we set aside the *logoi* of Herodotus in favour of the *res gestae* of Ashurbanipal, then the picture that emerges of Gyges is one of the ambitious *parvenu*, keen to take his place at the top table of international diplomacy, but at the same time locked in an existential and ultimately mortal conflict with Cimmerian invaders from the north. And while he did not survive this war, his son and the Lydian kingdom emerged victorious and newly empowered to conquer the Ionian cities and the rest of western Asia Minor in the course of the next two generations. Gyges and his son Alyattes I are the most likely candidates on the new chronology for the issuers of the earliest Lydian electrum.

Against this Near Eastern, and particularly Assyrian background, we might look too for the dynamics that created the first coinage. Recent scholarship on Greek military development in the archaic period has emphasised the appearance of East Greek and Carian mercenaries in the service of Assyrian, Neo-Assyrian and Egyptian monarchs as early as the second half of the 8th century BC.[48] That Gyges himself was plugged

47. Gyges invaded the territory of Miletus and Smyrna and captured Colophon (Hdt. 1.14.4) and Magnesia (*BNJ* 90 F62); Ardys (Alyattes I) invaded Miletus; captured Priene (Hdt. 1.15); Sadyattes began a war against Miletus (6 years) (Hdt. 1.17.1, 18.2); Alyattes II captured Smyrna and invaded Clazomenae (Hdt. 1.16.2; Xanthus, *BNJ* 765 F40) and Caria (Xanthus, *BNJ* 765 F41a) and fought a continued war against Miletus (5 years) (Hdt. 1.17-25.1); Croesus attacked Ephesus and then made war on the other Aeolian and Ionian cities and made all the Greeks in Asia tributary (Hdt. 1.126-27.1; Aelian, *Hist. Misc*. 3.26, Polyaenus, *Strat*. 6.50), ultimately taking all of Asia Minor west of the Halys (Hdt. 1.28). For an overview see Roosevelt 2009, pp. 24-25.

48. For the background see e.g. Kearsley 1999, pp. 118-122 and Rollinger 2001. Luraghi 2006, especially pp. 37-42, emphasises the early existence of Greek mercenaries, noting the

into this mode of organised warfare is strongly suggested by his sending of a force to assist the Pharoah Psammetichus I in his revolt against Assyrian rule, most probably in the 640s.[49] It is highly tempting, as has been observed in the past, to see a connection between this intervention by Gyges and the story preserved in Herodotus that credits Psammetichus' success to his employment of Ionian and Carian 'bronze men from the sea'.[50] If we accept it, then we have a direct link between Gyges and the employment of Geek and Carian mercenary forces.[51]

But while Gyges can then be seen to be acting within an established framework of military resource, what is now new is the decision by the Mermnad kings to pay these men in coin, rather than with booty, as may have been the case with the Assyrians and other early employers.[52] Understanding why this was the case is perhaps the key to explaining the initial catalyst to issue coin. One possibility may be that Gyges was simply unable to reward his mercenaries with plunder. The principal foes faced by the Lydians in these years were the Cimmerians, who had no cities and royal treasuries to ransack. The Lydian king was forced to find another means to reward his hired help. But this form of explanation and the opportunity-push model of available gold-mines are not, of course, mutually exclusive.

The textual and archaeological evidence for these early mercenaries in eastern lands strongly links them with the regions of Ionia and Caria, the regions where we might most plausibly place the production and circulation of the early, non-Lydian electrum.

depiction of Greek hoplites on the 7th century Amathus bowl, and the dedications of booty, apparently from the royal treasury of Damascus, presumably captured in the Assyrian sack of the city in 732, at the Heraion on Samos and the sanctuary of Apollo at Eretria. On the possible circumstances of these acquisitions and dedications see Lane Fox 2008, pp. 116-118. For further development of the general picture see also Hale 2013.

49. The fact is recorded in the *res gestae* of Ashurbanipal. See Novotny, Jeffers 2018, text 11. ii.111-118: '[Gyges] allowed an interruption (in the sending of) his mounted messenger(s), whom he used to constantly send to inquire about my well-being. Because he did not honour the word(s) of (the god) Aššur, the god who created me, he trusted in his own strength and (his) heart became proud. He sent his forces to aid Psammetichus (I), the king of Egypt who had cast off the yoke of my lordly majesty, and (then) I myself heard about (this) and made an appeal to (the god) Aššur and the goddess Ištar, saying "Let his corpse be cast down before his enemy and let them carry away his bones." Just as I had appealed to (the god) Aššur, it as fulfilled...'
50. Hdt. 2.152: χάλκεοι ἄνδρες ἀπιγμένοι ἀπὸ θαλάσσης
51. We might note also two later traditions that suggest that Gyges rose to power with the help of the Carian mercenary Arselis and his men, and with (unspecified) hoplites: Anonymous, *De Caria BNJ* 742 F5 (Plut. *Quaest. Gr.* 45, 301F-302A) and Xanthus of Lydia, *BNJ* 765 F37.
52. In addition to the dedications from Assyrian booty adduced by Luraghi (above, n. 48), we might note also the remuneration of a gold crown and a 'polis' (presumably land) received by Pedon son of Amphinnes for his service to Psammetichus I (*SEG* 37.994): Πηδῶμ μ' ἀνέθηκε|ν ὠμφίννεω ⋮ ἐξ Αἰγ|γύπτὠγαγὼν ⋮ ὦι βα|σιλεὺς ἔδω' ὠιγύπ|τιος ⋮ Ψαμμήτιχο|ς ἀριστήϊια ψίλιο|ν τε χρύσεογ καὶ πόλιν ἀρετῆς ἕ|νεκα. The statue inscribed with this text found its way to Priene in Ionia and was therefore, me might note, set up in a land now awash with electrum coinage.

But another characteristic is important too: the potentially seaborne nature of these early mercenaries. This, of course, is precisely the context in which we encounter the Ionians in Herodotus' account of the Ionian Revolt. The Ionian cities by the end of the 6th century BC have become naval powers, and function, until their bid for independence is launched, as the Achaemenid Persian navy in the region. It has been suggested, indeed, that the emergence of another new technology, the trireme fleet, occurred at precisely this period, ca. 520-500 BC in Ionia, and was initially funded by the Persians.[53] This could only have come about after Cyrus' conquest of Lydia, and it is intriguing that it seems to be to this period that we can potentially attribute the re-emergence of the electrum stater, in the 'Ionian Revolt' coinages and their related issues. The shift still higher up the denominational scale of this coinage (largely of coins weighing 14.1 g of electrum and so worth ca. 140 g of silver), suggests a different purpose to the earlier issues, and may be connected with this new role of the Ionian cities. Whether we should see these coinages as 'imperial' (issued by the Persians to build the ships) or 'civic' (issued by the cities to man them) remains open to debate, as does their precise chronology.[54] One could, for example, read the apparently royal types of Wartenberg's Group I.1 as indicative of Persian agency and attribute them to an initial phase of trireme-building ca. 530, and the more varied later types as the product of local cities paying their crews. In this context we might regard the remarkable consistency of production to a single weight standard as suggestive. That this new burst of electrum coinage may be connected with another innovation, that of organised and co-ordinated naval power in the region seems highly plausible. And it is not impossible that the rising tensions between the cities and the Persian authorities that underlies Herodotus' colourful narrative was again the catalyst for coin production.

If this type of reconstruction is right, then we must regard the invention of coinage as part of a military revolution in western Asia Minor that saw a rising kingdom, with access to mineral resources, put those resources to use to purchase military heft. It is entirely plausible that this purchased military heft came in the form of outsiders to the kingdom, the Greek and perhaps Carian mercenary hoplites who had in the previous generations been employed in Egypt and the Levant. Coinage, on this model, may have been partly a response to an opportunity, but also, partly to the specific crisis posed by the existential threat of Cimmerian incursions. The knock-on effect, following the extinction of that threat, was a form of arms-race between the Lydian kingdom and its Greek neighbours, resulting in the conquest of the latter by the former in the late 7th and early 6th centuries, described by Herodotus as culminating in the reigns of

53. Ionian, Aeolian and Hellespontine ships in Persian service are first attested ca. 513 BC in the context of Darius' Scythian expedition (Hdt. 4.89.1); a fleet of 200 triremes is first clearly visible in 500 BC in the context of the attempted expedition of Artaphernes to Naxos (Hdt. 5.32). See Wallinga 1993, pp. 130-133. Van Wees 2013, pp. 33-34 and 147-148.

54. On the probable division of responsibility see Diod. Sic. 11.3.7: τὰ μὲν πληρώματα τῶν ἀνδρῶν παρεχομένων τῶν Ἑλλήνων, τὰ δὲ σκάφη τοῦ βασιλέως χορηγοῦντος (480 BC). Wallinga 1993, pp. 118-122; 2005, pp. 11-12.

Alyattes II and Croesus. This will require us to jettison notions of an evolution of coinage from such forms of silver use as we find in the chocolate-bar and other ingots of the Levant, or other instances of Hacksilber use.[55] Precious metal undoubtedly formed part of the secondary monetary economies of the Near East and Greece before coinage; and it may have smoothed the way towards the acceptance of coinage in secondary use in Asia Minor. But the invention of the medium, like its continuation for the following half millennium, was primarily driven by state military priorities, not subaltern economic activity.

And finally, to return where we started, why *electrum*? That this was a deliberate decision, and that the composition of this coinage was regulated not natural, are now, as we have seen, beyond doubt. Once again, it is difficult to conceive of this choice of alloy as an evolution from earlier use of bullion. Quite the contrary, in fact: it marks a radical departure from the use of a pure commodity of agreed value, towards a manipulated and, indeed, disguised amalgam of manipulated and disguised value. In this sense, the change in material mirrors the change in form of remuneration from precious metal booty towards regulated payment.

To see why the Lydian kings might have opted for such a monetary medium, and why their Greek neighbours followed suit, it may help to raise our eyes for a moment from the archaic period to the actions of a later monarchy that occupied a similar footprint. Some 500 years after the first coins had been produced in the region, the Attalid king Eumenes II took what appears to have been a similar sort of decision. Breaking with close to 200 of years of monetary habit, he took the core of his kingdom off the Attic weight standard that had come to dominate the coinage of the Greek world and reduced the weight of his tetradrachm from ca. 16.8 g of silver to ca. 12.6 g. His aim in doing this, it seems, was to stem the flood of silver from his kingdom eastwards.[56] It worked: while contemporary Attic weight coinage continued to travel to Syria, his new coins, *cistophori*, remained resolutely at home. In the same way, the electrum coinage of the Lydian kings is never found outside their lands. We cannot say for certain that this was the intention of Gyges and his successors, but it was certainly the result of their decision.[57] Where earlier generations of mercenaries may have taken land from their employers, and thus stayed to generate economic wealth, or accumulated precious metal and taken it home with them, and so out of the royal economy, the introduction of electrum coinage broke that cycle. In electrum, whether it was intentional or not, we are looking at the simultaneous birth of coinage and of closed monetary systems.

55. A point already made by Fischer-Bossert 2018, p. 17. The evidence for the near-eastern tradition is discussed by Gitler, Tal (*White Gold*, Chapter 2).
56. For an overview of the system and discussion of its nature see Meadows 2013.
57. This basic fact about the nature of the electrum monetary system is well observed by Osborne 2009, p. 242-243, although his arguments from differing weight standard probably should be rejected. What is intriguing about the early electrum is precisely the fact that so much of it clings so closely to the so-called Lydo-Milesian standard. This looks more like supra-state, regional integration, and surely requires deeper consideration.

Bibliography

BNJ = Brill's New Jacoby. Jacoby Online. Leiden, 2012 [https://referenceworks.brillonline.com/browse/brill-s-new-jacoby].

Asheri *et al*. 2007: D. Asheri, A. Lloyd, A. Corcella, *A Commentary on Herodotus Books I-IV*, Oxford, 2007.

Bodenstedt 1981: F. Bodenstedt, *Die Elektronmünzen von Phokaia und Mytilene*, Tübingen, 1981.

Burkert 1995: W. Burkert, Lydia between East and West, or how to date the Trojan War. A study in Herodotus, in *The Ages of Homer: A Tribute to Emily Townsend Vermeule*, J.B. Carter, S.P. Morris (eds.), Austin, 1995, pp. 139-148.

Cahill, Kroll 2005: N. Cahill, J.H. Kroll, New Archaic Coin Finds at Sardis, *AJA*, 109, 2005, pp. 589-617.

Camp 2015: J.M. Camp, Excavations in the Athenian Agora, 2008-2012, *Hesperia,* 84, 2015, pp. 467-513.

Dale 2015: A.T. Dale, WALWET and KUKALIM, *Kadmos*, 54, 2015, pp. 151-166.

Davies 2013: J.K. Davies, Corridors, Cleruchies, Commodities, and Coins: the Pre-history of the Athenian Empire in *Handels- und Finanzgebaren in der Ägäis im 5. Jh. v. Chr. Trade and Finance in the 5th c. BC Aegean World*, Byzas 18, A. Slawisch (ed.), Istanbul, 2013, pp. 43-66.

Davis 2015: G. Davis, Athenian Electrum Coinage Reconsidered: Types, Standard, Value, and Dating, *NC*, 175, 2015, pp. 1-9.

Esty 2006: W. Esty, How to estimate the original number of dies and the coverage of a sample, *NC*, 166, 2006, pp. 359-364.

Esty 2011: W. Esty, The Geometric Model for Estimating the Number of Dies' in *Quantifying Monetary Supplies in Greco-Roman Times*, F. de Callataÿ (ed.), Bari, 2011, pp 43-58.

Fischer-Bossert 2016: W. Fischer-Bossert, Horses with and without wings, in *Suadente nummo vetere. Studi in onore di Giovanni Gorini*, M. Asolati, B. Callegher, A. Saccocci (edd.), Padova, 2016, pp. 1-21.

Fischer-Bossert 2018: W. Fischer-Bossert, Electrum Coinage of the 7th Century B.C., in *Second International Congress on the History of Money and Numismatics in the Mediterranean World – Proceedings*, O. Tekin (ed.), Antalya, 2018, pp. 15-23.

von Fritze 1912: H. von Fritze, Die Elektronprägung von Kyzikos, *Nomisma*, 7, 1912, pp. 1-38.

Gardner 1911: P. Gardner, The Coinage of the Ionian Revolt, *JHS,* 31, 1911, pp. 151-160.

Hale 2013: J.R. Hale, Not patriots, not farmers, not amateurs: Greek soldiers of fortune and the origins of hoplite warfare, in *Men of Bronze: Hoplite Warfare in Ancient Greece*, D. Kagan, G. Viggiano (eds.), Princeton, 2013, pp. 176-193.

Head 1908: B.V. Head, The Coins, in *Excavations at Ephesos. The Archaic Artemisia,* D.G. Hogarth (ed.), London, 1908.

Hilbert 2018: R. Hilbert, *Die Elektronprägung von Milet*, (Nomismata, 9), Bonn, 2018.

Hilbert 2019-2020: R. Hilbert, Bemerkungen zu frühen Elektronprägungen', *JNG,* 69/70, 2019-2020, pp. 1-34.

HURTER, LIEWALD 2002: S. M. HURTER, H. LIEWALD, Neue Münztypen der Kyzikener Elektronprägung, *SNR*, 81, 2002, pp. 21-49.

HURTER, LIEWALD 2006: S. M. HURTER, H. LIEWALD, Die frühesten Typen der Elektronprägung von Kyzikos. Thunfische, Thunfischköpfe und -hinterhälften, *SNR*, 85, 2006, pp. 5-26.

JAMESON 1911: R. JAMESON, Trouvaille de Vourla, monnaies grecques des VI^{ème} et V^{ème} siècles avant J.-C.', *RN*, 15, 1911, pp. 60-68.

KARWIESE 2008: S. KARWIESE, Das Artemision von Ephesos und die „Er-Findung" der Münze, in *Die Archäologie der Ephesischen Artemis: Gestalt und Ritual eines Heiligtums,* U. Muss (hsrg.), Vienna, 2008, pp. 133-148.

KEARSLEY 1999: R. KEARSLEY, Greeks overseas in the 8th century B.C. Euboeans, Al Mina and Assyrian imperialism, in *Ancient Greeks West and East*, G. R. Tsetskhladze (ed.), Leiden, 1999, pp. 109-134.

KROLL, WAGGONER 1984: J. H. KROLL, N. M. WAGGONER, Dating the Earliest Coins of Athens, Corinth and Aegina *AJA*, 88, 1984, pp. 325-340.

LANE FOX 2008: R. LANE FOX, *Travelling Heroes: Greeks and Their Myths in the Epic Age of Homer*, London, 2008.

LE RIDER 2001: G. LE RIDER, *La naissance de la monnaie : Pratiques monétaires de l'Orient Ancien*, Paris, 2001.

LURAGHI 2006: N. LURAGHI, Traders, Pirates, Warriors: The Proto-History of Greek Mercenary Soldiers in the Eastern Mediterranean, *Phoenix*, 60, 2006, pp. 21-47.

MEADOWS 2013: A. R. MEADOWS, The Closed Currency System of the Attalid Kingdom in *Attalid Asia Minor: Money, International Relations and the State*, P. Thonemann (ed.), Oxford, 2013, pp. 149-205.

MELVILLE JONES 1998: J. MELVILLE JONES, The value of electrum in Greece and Asia in *Studies in Greek Numismatics in Memory of Martin Jessop Price*, R. H. J. Ashton, S. Hurter (eds.), London, 1998, pp. 259-268.

NOVOTNY, JEFFERS 2018: J. R. NOVOTNY, J. JEFFERS, *The Royal Inscriptions of Ashurbanipal (668-631 BC), Assur-etal-ilani (630-627 BC), and Sin-sarra-iskun (626-612 BC), Kings of Assyria*. Royal Inscriptions of the Neo-Assyrian Period 5.1, Pennsylvania, 2018.

OSBORNE 2009: R. OSBORNE, *Greece in the Making* (2nd ed.), London, 2009.

PRICE, WAGGONER 1975: M. J. PRICE, N. WAGGONER, *Archaic Greek Coinage: The Asyut Hoard*, London, 1975.

ROLLINGER 2001: R. ROLLINGER, The Ancient Greeks and the Impact of the Ancient Near East: Textual Evidence and Historical Perspective, in *Melammu Symposia 2: Mythology and Mythologies*, R. M. Whiting (ed.), Helsinki, 2001, pp. 233-264.

ROOSEVELT 2009: C. H. ROOSEVELT, *The Archaeology of Lydia, from Gyges to Alexander*, Cambridge, 2009.

SCHÜRR 2019: D. SCHÜRR, Sardes, Spelmos, Krösus und λαίλας im Lydischen, *Philia*, 5, 2019, pp. 75-83.

SPALINGER 1978: A. J. SPALINGER, The Date of the Death of Gyges and its Historical Implications', *Journal of the American Oriental Society*, 98, 1978, pp. 400-409.

SPIER 1998: J. SPIER, Notes on early electrum coinage and a die-linked issue from Lydia' in *Studies in Greek Numismatics in Memory of Martin Jessop Price*, R. H. J. Ashton, S. Hurter (eds.), London, 1998, pp. 327-334.

THOMPSON 1966: M. THOMPSON, Some noteworthy Greek accessions, *ANSMN*, 12, 1966, pp. 1-18.

THONEMANN 2020: P. THONEMANN, A New "Lydian History" from Sardis', *Zeitschrift für Papyrologie und Epigraphik*, 213, 2020, pp. 78-84.

VAN WEES 2013: H. VAN WEES, *Ships and Silver, Taxes and Tribute: A Fiscal History of Archaic Athens*, London, 2013.

WALLACE 2006: R. W. WALLACE, KUKALIM, WALWET, and the Artemision Deposit: Problems in Early Anatolian Electrum Coinage, in *Agoranomia: Studies in money and exchange presented to John H. Kroll*, P. G. Van Alfen (ed.), New York, 2006, pp. 37-48.

WALLACE 2016: R. W. WALLACE, Redating Croesus: Herodotean Chronologies, and the dates of the earliest coinages, *JHS*, 136, 2016, pp. 168-181.

WALLINGA 2005: H. T. WALLINGA, *Xerxes' Greek Adventure: The Naval Perspective*, Mnemosyne Supplement (264), Leiden, 2005.

WARTENBERG 2016: U. WARTENBERG, Die Geburt der Münze: Elektron als Geldmittel. Neue Wege der Forschung, *Mitteilungen der Österreichischen Numismatischen Gesellschaft*, 56, 2016, pp. 30-49.

WARTENBERG 2018: U. WARTENBERG, Archaic Electrum Coinage in Thrace and Macedonia in the Sixth Century: the Hoard Evidence', in *Second International Congress on the History of Money and Numismatics in the Mediterranean World – Proceedings*, O. Tekin (ed.), Antalya, 2018, pp. 25-39.

WEIDAUER 1975: L. WEIDAUER, *Probleme Der Frühen Elektronprägung*, Typos(1), Fribourg, 1975.