

Bronze Coinage of Ptolemaic Egypt in the Second Century BC

PLATES 18–22

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Drawing primarily on hoards, but also on metrological and metallurgical analyses, the authors propose a relative chronology and classification for Egyptian bronze coinage of the second century BC. This coinage is characterized by diverse obverse types that served as consistent denomination markers, even as the weights of the several denominations were reduced in piecemeal fashion. A debasement of the alloy introduced a metrologically stable currency that remained in circulation from before mid-century to 115 BC. The subtlety of the early weight reductions and the long period of stability raise doubt whether changes to the currency could have caused the much-studied price inflation of the second century.

Recent analysis of Egyptian hoards has advanced our understanding of the successive systems of Ptolemaic bronze coinage in the third century BC.¹ We summarize these findings using a new terminology developed by Olivier Picard and Thomas Faucher, which improves on the traditional but not altogether reliable practice of attributing Ptolemaic bronze coins to particular reigns.² Series 1 includes the earliest Ptolemaic bronze coins, which invariably depict the deified Alexander diademed and with the horn of Ammon. Hoard evidence shows that Series 1 remained in circulation after the introduction of the reformed bronze coinage of Ptolemy I (Series 2), whose principal denominations are larger than those of Series 1 and

¹ Lorber 2000.

² Picard 2005: 88–89; Faucher 2006.

bear the types laureate Zeus and Alexander in elephant *exuvia*.³ A major currency reform c. 261/0 introduced a further expanded bronze currency (Series 3) that featured the first impressively large Ptolemaic bronze denominations; a break in the hoards indicates that this reform also involved the withdrawal from circulation of the preceding coinage. Series 4 emphasized a different selection of denominations, most marked by the addition of a cornucopiae over the eagle's shoulder, and employed just a few controls, Λ, Ε, ΕΡ monograms, and an unmarked emission.⁴ In Series 5 the cornucopiae usually appears in the left field. This series includes the major controls ΧΡ monogram, ΛΙ, ΔΙ, Σ and ΣΕ (both as individual letters and as a monogram), followed by a number of minor controls. Control links to the precious metal coinage of Ptolemy III and IV establish the general historical context of Series 5. The hoard record shows that Series 3, 4, and 5 circulated together.

We have evidence for another major currency reform near the end of the third century. A large number of Egyptian hoards close with Series 5.⁵ To the extent that such hoards are provenanced, most have been found in the Thebaid, but a few have been reported from Lower Egypt. This is proof that the deposit of these hoards was not caused by the revolt of Upper Egypt, but rather by an act of demonetization. That this act was effective in the Thebaid is further proof that the reform was ordered while Ptolemy IV still exercised authority in the region. The *terminus ante quem* is the coronation of the native pharaoh Herwennefer between 13 October and 10 November 205.⁶ The quantity of coinage in these hoards implies that a great deal of currency was removed from circulation, while the predominance of Theban findspots may be a clue that residents of the rebel kingdom did not have access to mechanisms of redemption or compensation provided by the Ptolemaic state, such as countermarking to revalidate or retariff selected denominations.⁷

3 See the hoard from the Jerusalem market, before 1991 (*CH IX*, 485), Davesne and Le-maire 1996: 67–76.

4 New information about the sequence of controls is provided by the Tuna el-Gebel hoard (*CH X*, 448), which closed between the Elephantine and Anubeion hoards. It will be published by T. Faucher. In earlier publications Lorber (2000: 79–80; 2005: 138–140) posited an increase in the weight standard for Series 4 and a return to the previous standard for Series 5. This reconstruction is implausible from a practical point of view. Since hoards indicate that Series 3, 4, and 5 circulated together, existing denominations would have had to be revalued not only once, but twice, with each change in the weight standard. Such changes to the currency system would have caused unnecessary confusion.

5 To the hoards cited by Lorber 2000, we can now add *CH IX*, 686, of unknown provenance (Noeske 1998); Xoïs (Tell Sakha) 1995 (*CH IX*, 688); a hoard from Nag Hammadi (*CH X*, 453, Seif el-Din, Shahin, and Faucher 2008); two large hoards of 245 and 443 coins found in excavations at Karnak by the Egyptian and French missions, respectively (*CH X*, 451 and 452); and a hoard of 22 coins found in excavations at Tanis. The last three hoards are to be published by T. Faucher.

6 Veïsse 2004: 11–26. See also Pestman 1995 and Vandorpe 1986: 294–302 (where the accession of Herwennefer is dated to 206).

7 This lack of access was not absolute, as attested by the twelve countermarked bronzes of

A small group of hoards—*CH VIII*, 413 (= *CH X*, 455) and hoards from the Sacred Animal Necropolis at Saqqâra—provide a window on the situation that followed the great demonetization of Ptolemy IV.⁸ The first of these hoards contained Series 5 bronzes countermarked with a cornucopiae to authorize their continued circulation,⁹ as well as a sequence of newer issues with the types Zeus-Ammon/two eagles, which reflect a process of weight reduction from c. 40 to c. 30g. These Zeus-Ammon/double eagle bronzes, the largest denominations of Series 6, also occur in the Necropolis hoards, where we find as well some of the smaller denominations that circulated alongside them. A hoard found in 2010 in the underwater excavations at Herakleion samples the next and final phase of Series 6, which is not represented in the earlier hoards.¹⁰ Our purpose in this paper is to reconstitute Series 6 more fully, adding varieties not represented in the hoards, and to ascertain the sequence of the various emissions, in the sense of sets of related denominations released together into circulation; to clarify the transition from Series 6 to Series 7; and to analyze the features of Series 7. We shall also offer our ideas about absolute chronology and the face values of the bronze denominations.

CHARACTERISTICS AND CLASSIFICATION OF SERIES 6

Series 6 is defined by the introduction of many new obverse types, including Isis-Demeter, Heracles, Alexandria in an elephant headdress, a helmeted youth, and Athena. These new types supplemented the long-established type of Zeus-Ammon, which seems to have been the only type employed in the latter part of Series 5. Series 6 is also characterized by the nearly complete disappearance of control letters and monograms.¹¹ The only exceptions are the letters ΠΠ, which mark the earliest emission of Series 6;¹² the letter K, which marks an emission with five denominations;¹³ and a circled Δ (usually poorly rendered and unidentifiable) that appears on a single denomination otherwise identical to the largest denomination of the K emission.¹⁴ Series 6 is decisively distinguished from Series 7 by a break in

Ptolemy IV found by excavators in the North Bubastid door of the Karnak temple in 1972 (*CH X*, 454).

8 Huston and Lorber 2001; Price 1981.

9 Picard (2005: 89) reported that such countermarked coins have not been found in the excavations at Alexandria conducted by the Centre d'études alexandrines (CEAlex). The situation has since changed: three countermarked examples of Svoronos 1149 came to light in the Fouad Street hoard (*CH X*, 457), an assemblage found in the 2000–2004 excavations near Fouad Street in Alexandria. The Fouad Street hoard will be published by O. Picard and T. Faucher along with the other coin finds from the CEAlex excavations.

10 The Herakleion, 2010 hoard will be published by A.R. Meadows.

11 This is a general trend of Hellenistic coinages over time, see Faucher 2006: 188–192, and F. de Callatay, “Control-Marks on royal Hellenistic coinages” (forthcoming). The Seleucid and Cappadocian coinages provide notable exceptions.

12 Malter II, 23–24 February 1978, lot 232; Svoronos 1497.

13 Svoronos 1375–1379.

14 *SNG Milano* 310.

the hoards (see Appendix 1) and by a difference in metal content: Series 6 is of a fine bronze alloy like that of the preceding series, whereas Series 7 is of a debased alloy containing a significantly higher percentage of lead (see Appendix 3).

Metrological analysis of Series 6 (see Appendix 2) identifies ten distinct modules, all but two of them used for more than one variety.

Table 1. Approximate weights and diameters of Series 6.

Diameter in mm	Weight in g	Example(s)
35	38–40	Large-horn Ammon, ^a Sv. 1423
31–33	30	Sv. 1233, 1424A, ^b 1491
29–30	22–24	Sv. 1375, Herakleion hoard 1–4 ^c
27–30	17–20	Sv. 1234, 1492, 1497
27	15	Sv. 1493
24	11	Sv. 1376, 1494
21–23	6–9	Sv. 1154, 1173, 1236, 1377, 1495; Necropolis hoard F, 131–134
18–19	4–5	Sv. 1155, 1238, 1378, 1496
15–16	2.4–3.3	Sv. 1156, 1379
13	2	Sv. 1195

a A variant of Sv. 1423 in which the image of Zeus-Ammon features a large ram's horn rising above the forehead and obscuring the *basileion*. The variant was first singled out in Huston and Lorber 2001.

b Huston and Lorber (2001: 25–26) demonstrated that Svoronos' catalogue number 1424 actually conflates two distinct populations that differ slightly but significantly in diameter and weight.

c The Herakleion hoard coins are not included in our data base. The diameters recorded by Meadows are 28, 28, 30, and 30. The weights, recorded aboard ship, are precise only to the nearest gram: 22, 22, 23, 24.

Seemingly these ten modules represent ten bronze denominations, but this perception is somewhat misleading. A classification by module alone overlooks the significance of types and cannot account for the pattern of weight reduction in coins with the types Zeus-Ammon/double eagle, a combination that appears to have served as a marker for the largest denomination of the system.¹⁵ To gain a better grasp of the denominational system, it is necessary to place the various emissions of Series 6 in their proper sequence.

Establishing such a sequence is a challenge given the general absence of controls, but we have a few clues. The successive weight reductions and stylistic evolution of the Zeus-Ammon/double eagle varieties imply the sequence large-horn Ammon, Sv. 1423, and Sv. 1424A. This sequence is consistent with the wear estimates provided by Martin Price for the Zeus-Ammon/double eagle coins in the

¹⁵ Price 1981: 160.

Necropolis hoards, except that Price did not distinguish between the large-horn Ammon variety and Sv. 1423:

Sv. 1423: 4 specimens, including 2 large-horn Ammon bronzes, fairly fresh
Sv. 1424A: 35 specimens, all fresh

The remaining coins in the Necropolis hoards fall into three groups based on Price's wear estimates:

Sv. 1491 (Isis): 3 specimens, all worn
Sv. 1492 (Heracles): 3 specimens, worn or somewhat worn

Sv. 1493 (Alexandria):¹⁶ 5 specimens in hoards B–E, worn to fresh; 25 specimens in hoard F, all fairly fresh

Sv. 1154 (Isis): 16 specimens, fairly fresh
Sv. 1173 (Zeus-Ammon): 1 specimen, fairly fresh
Sv. 1375 (Zeus-Ammon): 1 specimen, fairly fresh
SNG *Milano* 310: 5 specimens, all fairly fresh

Sv. 1494 (Heracles): 3 specimens, fresh
Hoard F, nos. 131–134 (Zeus-Ammon): 4 specimens, fresh¹⁷

Price believed that his wear estimates were a clue to the relative chronology of the hoard coins, and he particularly insisted on the contemporaneity of Sv. 1424, Sv. 1494, and a smaller denomination omitted by Svoronos, Necropolis hoard F, nos. 131–134.¹⁸ While his wear estimates can be of considerable guidance in organizing the emissions of Series 6, such estimates are notoriously tricky. They are more reliable when significant numbers of coins are involved (as with Sv. 1493, 1154, and 1424A), but they may still be affected by unknown factors, such as different velocities of circulation for different denominations.

We therefore turn to the general principle that a currency system had to be practical. Users of the currency should have been able to recognize each denomination easily, from its size, types, or the combination of size and types, and to associate it with its face value. This will have been especially important for Series 6, which appears to have involved several unmarked emissions (denominational sets) that circulated together, according to the evidence of the hoards. Cumulatively, these successive emissions put a great many coins into circulation, some of them rather close in size, so that the types must have been critical for recognizing

¹⁶ Price (1981: 159–160) identified these coins as Svoronos 1495, but the reported diameters and weights match Svoronos 1493. The obverse type, described as Alexander by Price, lacks the horn of Ammon.

¹⁷ Price 1981: 159–160. Price identified Necropolis hoard C, no. 46, and hoard F, nos. 131–134 as BMC 181, but there is no such number in the British Museum Catalogue. We owe this correction to Daniel Wolf.

¹⁸ Price 1981: 158.

the various denominations.¹⁹ The following table takes account of obverse types only, which were certainly easier to recognize at a glance than the various permutations of the Ptolemaic eagle on thunderbolt. In order to gain a broader perspective, our overview includes the final emission of Series 6, which is not represented in *CH* 8, 413 or in the Necropolis hoards, and the early emissions of Series 7. Varieties represented in *CH* 8, 413, are marked with an asterisk (*); those represented in the Necropolis hoards are marked §; and those represented in the Herakleion hoard are marked †.

Some uncertainty attaches to the positions of unmarked varieties for which we lack hoard provenances. In particular, the tiny and scarce Sv. 1195, with its Athena obverse and an anomalous right-facing eagle on the reverse, could belong equally to Series 6a, 6b, 6c, or 6e.

Our arrangement provides several noteworthy examples of continuity of obverse type across subseries. Zeus-Ammon is associated with the module of 30mm in Series 6d, 6e, 7a, and 7b; Heracles with the module of 24mm in Series 6c, 6d, and 7b; Alexandria with the module of 22–23mm in Series 6c and 6e; Zeus-Ammon with the module of 21–22mm in Series 6b, 6c, and 6d, replaced by Alexandria in Series 7a and 7b; and Isis with the module of 18–19mm in Series 6e, 7a, and 7b.

As against these consistencies we have a separate pattern of weight reductions associated with particular types. The case of coins featuring the Zeus-Ammon/double eagle typology has already been mentioned; the hoards indicate that the large-horn Ammon type, Sv. 1423, and Sv. 1424A circulated alongside one another. The helmeted youth varieties, Sv. 1155, 1379, and 1156, provide another example, and in this case the small difference in size makes it fairly plausible that they were regarded as a single denomination. We have proof from later hoards (see Appendix 1) that Sv. 1234, with Isis-Demeter obverse, remained in circulation after the introduction of Series 7 and it surely was regarded as equivalent to Sv. 1384. This example, in particular, demonstrates that the second-century Ptolemaic bronze currency system was tolerant of small differences in weight and diameter. This is hardly surprising, as imprecise metrology was an inherent feature of all ancient bronze coinage, resulting from the method of production; diameter was more reliable than weight as an indication of the denomination.²⁰

Table 3 is a reorganized version of Table 2, using obverse types as the main criterion. This rearrangement implies a system of eight denominations, one of which (denomination 1, Athena) was struck in only one series. The diameters and weights of the remaining seven denominations were stable in Series 6a and 6b but were subsequently subject to reduction. The reduction was not imposed on all denominations simultaneously. Instead, the process was piecemeal. The largest

¹⁹ For discussion of types as denomination markers, see Faucher and Shahin 2006: 138; Faucher 2006, 302–307.

²⁰ Faucher and Shahin 2006: 138–139, with the graphs on 139–141.

Table 2. Proposed subdivisions of Series 6.

D	W	Series 6a III Unmarked	Series 6b	Series 6c	Series 6d K, O, Δ	Series 6e	Series 7a	Series 7b
35	38–40	Large-horn Ammon* [§]	Ammon Sv. 1423* [§]					
31–33	30	Isis Sv. 1491 [§]	Isis Sv. 1233	Ammon Sv. 1424A* [§]				
29–30	22–24			Ammon Sv. 1375 [§] Milano 310 [§]	Ammon Herakleion 1–4† ^a	Ammon Sv. 1380	Ammon Sv. 1383	
28–30	17–20	Heracles Sv. 1497, 1492 [§]			Isis Sv. 1234†			Isis Sv. 1384
27	15	Alexandria Sv. 1493* [§]						Heracles Sv. 1385
24	11			Heracles Sv. 1494 [§] Alexandria Sv. 1495	Heracles Sv. 1376			
22–23	8–9			Ammon Sv. 1495	Alexandria Sv. 1236†			
21–22	6–7	Isis Sv. 1154 [§]	Ammon Sv. 1173 [§]	Ammon Sv. 1377	Ammon Sv. 1377	Alexandria Sv. 1381	Alexandria Sv. 1386	
18–19	4–5	Heracles Sv. 1496	Helmeted bu Sv. 1155	Necropolis hoard F, 131–134 [§]		Isis Sv. 1238†	Isis Sv. 1382	Isis Sv. 1387
15–16	2.4–3.3				Helmeted bu Sv. 1379	Helmeted hd Sv. 1156		
13	2			Athena Sv. 1195				

^a These coins are of the Zeus Ammon/double eagle type Svoronos 1424. Their stylistic inconsistency and poor manufacture link them with the earlier Sv. 1424A, while their diameters and weights match those of the later Sv. 1424B. We do not have metallurgical analyses for this newly identified transitional variety, but we would expect a low lead content consistent with other coins of Series 6.

Table 3. Proposed classification for Series 6.

Obverse Type	Series 6a III Unmarked	Series 6b	Series 6c	Series 6d K, Δ	Series 6e	Series 7a	Series 7b
8 Zeus-Ammon 1	Large-horn Ammon* \S 35mm 39.8g	Sv. 1423* \S 35mm 38.4g	Sv. 1424A* \S 32mm 30.1g	Sv. 1375 \S Milano 310 \S 30mm 22.6g	Herakleion 1-4 \ddagger 28-30mm 22-24g	Sv. 1380 30mm 23g	Sv. 1383 30mm 22.9g
7 Isis 1	Sv. 1491 \S 34mm 30.3g	Sv. 1233 33mm 30.3g			Sv. 1234 \ddagger 27mm 17.1g		Sv. 1384 27mm 15.1g
6 Heracles 1	Sv. 1497, 1492 \S 30mm 18-20.4g		Sv. 1494 \S 24mm 11.3g	Sv. 1376 24mm 11.2g			Sv. 1385 24mm 9.4g
5 Alexandria	Sv. 1493* \S 27mm 15g		Sv. 1495 22mm, 8.2g		Sv. 1236 22mm 9.1g	Sv. 1381, 21-22mm, 7.2g	Sv. 1386 21-22mm 7.5g
4 Zeus-Ammon 2		Sv. 1173 \S 21mm 6.2g	Necropolis hoard F 131-134 \S 22mm 6.0g	Sv. 1377 21mm 6.2g			
3 Isis 2- Nilus- Isis 2	Isis Sv. 1154 \S 22mm 7.2g			Nilus? Sv. 1378 19.5mm 4.7g	Isis Sv. 1238 \ddagger 18mm 4.2g	Isis Sv. 1382 17mm 3.7g	Isis Sv. 1387 17mm 4.5g
2 Heracles 2, helmeted bust or head	Heracles Sv. 1496 18mm 3.7g	Helmeted bu Sv. 1155 19mm 4.2g		Helmeted bu Sv. 1379 16mm 3.3g	Helmeted hd Sv. 1156 14-15mm 2.4g		
1 Athena			Sv. 1195 13mm 2.3g				

denomination (Zeus-Ammon 1) was reduced twice, first in Series 6c and again in Series 6d. The second denomination (Isis 1) was also reduced twice, first in Series 6e and again in Series 7b. Heracles 1 and Alexandria were both reduced for the first time in Series 6c and again in Series 7. One of the smallest denominations, marked by the changing types Heracles 2-helmeted bust-helmeted head, was also reduced twice, in Series 6d and 6e. Isis 2 was reduced only once, while Zeus-Ammon 2 was not reduced at all. (As in Table 2, varieties represented in *CH* 8, 413, are marked with an asterisk (*); those represented in the Necropolis hoards are marked §; and those represented in the Herakleion hoard are marked †.)

Series 6d presents some puzzles. It revives the use of control marks after three emissions of unmarked bronze coins. The type combination Zeus-Ammon/two eagles, associated with the largest denomination in the three preceding emissions, appears here on a denomination of medium size (Sv. 1377), whereas the largest denomination of Series 6d (Sv. 1375, *SNG Milano* 310) does not have a double eagle reverse. In the Necropolis hoards all examples of Sv. 1375 and *SNG Milano* 310 were countermarked with a cornucopiae in the reverse left field, and this countermark is also common on unprovenanced specimens.²¹ The similar countermark that appears on bronze coins of Ptolemy IV is understood to revalidate and perhaps retariff coins demonetized by his reform. But in the present case there is no supporting evidence pointing to a similar currency reform. One possibility is that users of the coinage were reluctant to accept Sv. 1375 and *SNG Milano* 310 as equivalent to the large double eagle bronzes, since the new coins were lighter, lacked the double eagle reverse type, and displayed a star in the reverse field (a symbol that was unfamiliar on Egyptian bronze coins). Under such circumstances the countermark could have been applied to confirm the equivalence of the new coins to the double eagle bronzes. It established an affinity to Sv. 1424A in particular, since that variety features a double cornucopiae in the reverse left field as part of its type.²² The Herakleion, 2010 hoard contains only coins of Series 6e and thus implies that the coins of Series 6a through 6d, including these countermarked varieties, were removed from circulation upon or before the emission of Series 6e.

CHARACTERISTICS AND CLASSIFICATION OF SERIES 7

After the complexities of Series 6, with its numerous emissions and its piecemeal weight reductions, Series 7 represents a stabilization of the bronze currency system. Its most visible characteristic is the continuation of the Zeus-Ammon/double

²¹ Jungfleisch (1948: 57–58) distinguished this episode of countermarking from the episode affecting the bronze coinage of Ptolemy IV, which he dated c. 200. He attributed the second episode of countermarking to Ptolemy VI and the early reign of Ptolemy VIII, but these dates are surely too late.

²² Price (1981: 160) also hypothesized that the cornucopiae countermark served to make Sv. 1375 equivalent to Sv. 1424A, but in his view, Sv. 1375 circulated as the half denomination of Sv. 1423 and the countermark doubled its face value.

eagle type of Series 6e, including its double cornucopiae in the reverse field, for the largest denomination of the system, while maintaining the new diameter and weight introduced in Series 6d. These dimensions were maintained (with only an imperceptible decline) for the duration of Series 7.

Table 4. Proposed classification of Series 7.

D	W	Series 7a Cleopatra & Ptolemy, 𐀀	Series 7b Ptolemy, 𐀀	Series 7c Ptolemy, no monogram
29-30	22-23	Ammon Sv. 1380 D 30 W 23	Ammon Sv. 1383 D 30 W 22.9	Ammon Sv. 1424B D 29 W 22.4
26-27	15-16		Isis Sv. 1384 D 27 W 15.1	Isis Sv. 1235 D 26 W 15.6
24	9		Heracles Sv. 1385 D 24 W 9.4	
22	7	Alexandria Sv. 1381 D 22 W 7.2	Alexandria Sv. 1386 D 22 W 7.5	
17	3-4	Isis Sv. 1382 D 17 W 3.7	Isis Sv. 1387 D 17 W 4.5	Alexandria Sv. 1239 D 17 W 3.2
13	2			Isis Sv. 1240 D 13 W 2

The first emission of Series 7 (Series 7a) is distinguished by an exceptional feature, an obverse legend naming Queen Cleopatra in the genitive, supplementing the conventional reverse legend, also in the genitive, naming Ptolemy the King. This first emission is additionally marked by a 𐀀 monogram on the reverse.

The second emission (Series 7b) abandoned the obverse legend and added two denominations, but retained the types and reverse monogram of Series 7a.

The third emission (Series 7c) does not carry any special identifiers and is tentatively reconstituted from other evidence. As noted earlier, the coins of Series 7 were struck in a debased alloy. Those of Series 7a and 7b have a lead content usually exceeding 20% and sometimes surpassing 30% (see Appendix 3). The largest denomination of Series 7c, Sv. 1424B, was apparently struck from a slightly improved alloy, with an average of about 20% lead. Metallurgical analyses of Sv. 1235, 1239, and 1240 revealed high lead content consistent with Series 7a and 7b,

but since these varieties are unmarked, they are listed in Series 7c.

As already implied by Tables 2 and 3, the types of Series 7 represent a subset of the types of Series 6, in most cases with reduced weights and/or diameters. Such reductions were initially very slight and probably imperceptible to casual users of the coinage. In Series 7c, Sv. 1239 and 1240 exhibit a sharper reduction with respect to their counterparts in Series 7a and 7b, and this tends to confirm that they were later.

Table 5. Transition from Series 6 to Series 7.

Type	Series 6	Series 7a	Series 7b	Series 7c
Zeus-Ammon/ two eagles	Sv. 1424A 34mm, 30.1g Herakleion 1-4 28-30mm, 22-24g	Sv. 1380 30mm, 23g	Sv. 1383 30mm, 22.9g	Sv. 1424B 29mm, 22.4g
Isis 1	Sv. 1234 27mm, 17.1g		Sv. 1384 27mm, 15.1g	Sv. 1235 26mm, 15.6g
Heracles	Sv. 1494, 1376 24mm, 11.2-11.3g		Sv. 1385 24mm, 9.4g	
Alexandria	Sv. 1495, 1236 22mm, 8.2-9.1g	Sv. 1381 22mm, 7.2g	Sv. 1386 22mm, 7.5g	Sv. 1239 17mm, 3.2g
Isis 2	Sv. 1238 18mm, 4.2g	Sv. 1382 17mm, 3.7g	Sv. 1387 17mm, 4.5g	Sv. 1240 13mm, 2g

These correlations of type and module indicate that Series 7 grew out of Series 6 and was fundamentally related to it, despite the debasement of its alloy. Indeed, the new coinage of Series 7 was supplemented by some older coinage of Series 6, apparently to a significant degree. Three relevant hoards are recorded in Appendix 1. The Tell Nowa hoard (*CH X*, 458) is an older hoard found near Mit Rahineh (i.e., Memphis) in 1930 and thus represents the Memphite region.²³ The Bains de Karnak hoard (*CH X*, 459) was unearthed in the Egyptian excavations at Karnak in September 2007.²⁴ A hoard recorded from commerce in May 2007 had similar contents but is of unknown provenance. In all three hoards, the largest component is Sv. 1424B and the second largest, by far, comprises Isis head bronzes representing a mixture of Sv. 1384 and 1234. Other occasional survivals from Series 6 include Sv. 1424A and 1236.

The hoard record suggests that Sv. 1234 was deliberately spared when most coins of Series 6e were removed from circulation in connection with the introduction of Series 7. The Tell Nowa hoarder actually set aside one more example of Sv.

²³ Faucher 2009.

²⁴ Boraik and Faucher 2010.

1234 than of 1384. Sv. 1234 appears strongly preponderant over Sv. 1384 in the commerce, May 2007 hoard, but no conclusions can be drawn because we cannot insure that this hoard was intact and we did not have weights to confirm the coin identifications. In the Bains de Karnak hoard, examples of Sv. 1234 are far outnumbered by Sv. 1384, consistent with a normal pattern of attrition of older coinage, or perhaps with a gradual process of coin withdrawal by the government. (As a matter of policy, it would have made sense for the Crown to recover as much earlier coinage as possible, so as to reclaim the more valuable elements of copper and tin from their alloy.) We assume that the different proportions of the Tell Nowa and Bains de Karnak hoards reflect the currency in circulation at different times and that the Tell Nowa hoard samples the currency of a slightly earlier period.

The hoard record generally attests to a break after Series 7. Sv. 1426/27, a smaller Zeus-Ammon/double eagle coin (16–22mm, 7–9g), seems to represent the principal bronze denomination of a later period. Sv. 1426/27 is absent from the Bains de Karnak and commerce, May 2007 hoards and is represented by just four (probably intrusive) examples in the Tell Nowa hoard.²⁵ The Tebtunis hoard of 1900 (*IGCH* 1705) contained 104 specimens of Sv. 1426/27 together with two of Sv. 1237 and one issue of Cyrene (Sv. 1158), but not a single coin from Series 7.²⁶ The Kom Trouga hoard of 1932 (*IGCH* 1707 = *CH* X, 456), published recently by Mona Shahin, consisted predominantly of Sv. 1426/27 (c. 490 out of 507 coins).²⁷ There were a number of intrusions, both earlier and later, of which several Zeus-Ammon/double eagle varieties may perhaps represent earlier types still in circulation at the time of the hoard's deposit, but this is far from certain.²⁸ We thus believe that Sv. 1426/27 served as the largest denomination of a new bronze currency that replaced Series 7 and likewise endured for a long period of time. Very likely there was a short-lived intervening coinage consisting of bronzes bearing regnal dates 3 and 4 (Sv. 1190–1191 and 1193–1194).²⁹ These dated bronzes would represent

25 Faucher 2010: "L'étude des autres trésors du II^e siècle nous a montré... qu'il existait une séparation entre les monnaies de la série 7 et les monnaies frappées ultérieurement (séries 8, 9 et 10). Il semble donc nécessaire de mettre de côté les monnaies Svoronos no 1426 et, par conséquent, les monnaies plus tardives (no du catalogue 407–412)."

26 The hoard was not contained in a vessel, so that intrusive coins are a possibility. We can cite no other instances in which Sv. 1237 is associated with Sv. 1426/27.

27 Shahin 2005, especially 97–106 on the bronze hoard.

28 For the clearly intrusive coins, see Shahin 2005: 97–98. The earlier Zeus-Ammon/double eagle bronzes that may belong to the hoard include no. 1 (a large horn Ammon coin of Series 6a) and nos. 2–13 (examples of Sv. 1424B of Series 7c), Shahin, following Svoronos, treated her nos. 14–17 (Sv. 1425, with a module of 25–26mm, c. 10–13.5g) as a separate denomination. We believe, however, that Svoronos' catalogue entry was based on a few exceptionally heavy examples of Sv. 1426/27. This assumption is consistent with the rarity of Sv. 1425 and the enormous production of Sv. 1426/27, which insured the creation of a certain number of outliers.

29 Faucher and Shahin 2006.

Series 8, and the system involving Sv. 1426/27 and associated coins would represent Series 9.

TOWARD AN ABSOLUTE CHRONOLOGY

Hoard evidence from Thebes, as noted above, fixes the end of Series 5 near the close of the reign of Ptolemy IV. In an earlier effort to elucidate the further development of Ptolemaic bronze coinage, Catharine Lorber proposed a high chronology that attributed all of Series 6 to Ptolemy V and all of Series 7 to Ptolemy VI.³⁰ That chronology is problematic because it leaves very little official coinage for the last century of Lagid Egypt. Its linchpin was the conventional attribution of Series 7a, with its double inscription, to the regency of Cleopatra I for Ptolemy VI, 180–176 B.C.³¹ That claim receives a certain support from the unique *mnaieion* in the British Museum that features the same double inscription, the portrait of Cleopatra I on the obverse, and the portrait of the young Ptolemy VI on the reverse, accompanied by the same \square monogram that marks our bronze Series 7a and 7b.³² But the large volume of Series 7b, especially Sv. 1384, argues that the \square monogram remained current for an extended period and is not in itself a precise chronological indicator. This is also the implication of the unique portrait tetradrachm of Ptolemy VI in the American Numismatic Society, which bears the \square monogram but depicts the king in late adolescence or young adulthood.³³ Possibly the monogram had the same significance as the letters ΠΑ (not in monogrammatic form) that appeared on all Alexandrian tetradrachms beginning in regnal year 27 of Ptolemy VI (155/4). The double inscription of Series 7a could refer to Cleopatra II and Ptolemy VI rather than the regency of Cleopatra I.³⁴ In that case, the introduction of Series 7 should be dated in or after 163, when Egyptian documents first attest the joint reign of Ptolemy VI and Cleopatra II.³⁵

The hoards cited by Lorber do not really support a high chronology and in fact suggest that at least some of her dates should be lowered. The Corinth hoard

³⁰ Lorber 2005: 141–146.

³¹ See Poole 1882: lix–lx and 78; Svoronos 1380–1838; Kromann and Mørkholm 1977: nos. 274–278.

³² BM CM 1978, 1021.1, ex Leu 20, 25–26 April 1978, lot 180.

³³ Kiang 1962. Hazzard (1995b: 415–419) argued that the portrait is a posthumous representation of Ptolemy V, contemporary with the portrait *mnaieion* of Cleopatra I and Ptolemy VI, but his theory has not found general acceptance.

³⁴ Although the British Museum's *mnaieion* appears to indicate that the obverse of the coin was the side of precedence, the Series 7a bronzes have another possible parallel in third century bronzes with the portrait of a queen on the obverse and a comparable legend configuration, i.e., a double inscription naming Queen Berenice on the obverse and Ptolemy the King on the reverse (Sv. 1047–1057). The monarchs have usually been understood as Ptolemy III and Berenice II (see most recently Lorber 2007b), though Ptolemy II and his mother, Berenice I, were proposed by R. Hazzard 1995a: 2–3.

³⁵ Hölbl 2001: 184; Pestman 1967: 50–52.

of 1948 (*IGCH* 264), with a reliable burial date of 146, contained one example of Sv. 1380, 31 of Sv. 1384, and purportedly two of Sv. 1424B. A review of Margaret Thompson's publication of the hoard reveals that the two double eagle coins were discovered in levels more than two meters above the other coins, casting serious doubt on Thompson's decision to associate them in the hoard. She provided no weights for these coins, but the one illustrated example is visibly smaller than the illustrated example of Sv. 1384 (as is indeed implied by Thompson's citation of Sv. 1424–1425). There is reason to suspect that the two Sv. 1424 coins are later issues, probably belonging to Series 9. At the very least the Corinth hoard informs us that Series 7a and 7b were in circulation before 146. It may also imply that Series 7c did not commence until after that date. But we cannot rule out the possibility that a consignment of coins was sent from Egypt at an earlier date and retained intact until the fall of Corinth, in which case the hoard would not be useful for absolute chronology. The Mazin, 1896 hoard (*IGCH* 644) contained five specimens of Sv. 1426/27 and was cited by Lorber as evidence that this variety was introduced before 146. However most scholars date Mazin and other Croatian hoards with similar contents far later, from the late second century to 75 B.C.; the present authority on these hoards, I. Mirnik, proposed that some of the contents reached Illyria with the Roman campaign of 119 and that the hoards must be dated somewhat later to allow for the foreign coinage to enter into local circulation.³⁶

We now attempt a fresh review of the evidence for the absolute chronology of Series 6 and 7. In publishing the Sacred Animal Necropolis hoards, Price noted that their strange hiding place and odd burial pattern were suggestive of hasty action.³⁷ He dated their deposit c. 170 and proposed that the invasion of Antiochus IV was the reason for their burial and loss.³⁸ Although we cannot agree with the numismatic arguments Price offered to date the Necropolis hoards,³⁹ his explanation for their loss is not implausible. If correct, it would provide a precise chronological context for Series 6d, and a *terminus post quem* for Series 6e.

Yet there are still reasons to question Price's date for the Necropolis hoards. There seems to be a break in the hoards. *CH* VIII, 318 and the Necropolis hoards overlap, with Series 6a–6c represented in the former and Series 6a–6d in the latter, while Series 6e alone is represented in the Herakleion, 2010 hoard. Most breaks in the hoard record can be associated with changes to the currency and this could be the case here, as well. Further doubts are inspired by the excessively rare bronzes of Ptolemaic type bearing the name of King Antiochus, issued in connection with

³⁶ Mirnik 1987a; 1987b.

³⁷ Price 1981: 157.

³⁸ Price 1981: 161.

³⁹ For a critique of Price's numismatic arguments, see Huston and Lorber 2001: 28–29. We differ only in that we would no longer maintain that the absence of Sv. 1380 and 1384 from the Necropolis hoards dates their burial before 180.

the Seleucid invasions of 169–168.⁴⁰ Two of the three known examples are of the Zeus-Ammon/double eagle type, without a double cornucopiae in the left field. Their small size (24–26mm) tends to argue in favor of a model no earlier than Herakleion 1–4. This observation, if correct, would imply that Series 6e was introduced well before the Syrian invasions, because Antiochus IV would presumably have copied the most common Ptolemaic coins in circulation, those that played key roles in exchange and/or military pay. In view of the inconclusive evidence, we cannot date the end of Series 6 and the beginning of Series 7 with any degree of precision.

Shahin's publication of the Kom Trouga bronze hoard also included a silver hoard (*IGCH* 1719 = *CH* X, 464) that was discovered in the same 1932–1933 excavations and in the same layers of the Kom.⁴¹ Shahin reconstructed the two hoards from two boxes stored in the Graeco-Roman Museum at Alexandria, both containing a mix of silver and bronze coins and one of them explicitly labelled as finds from Kom Trouga with reference to the original publication by Achille Adriani. The silver hoard comprised 4 tetradrachms of Ptolemy VIII, 11 of Cleopatra III and Ptolemy IX, 1 of Cleopatra III and Ptolemy X, 2 of Ptolemy X (sole reign), 11 of Ptolemy XII, and one of Cleopatra VII. If we can assume that these tetradrachms were roughly contemporary with the coins of the bronze hoard, they would indicate that bronze Series 9 (*Sv.* 1426/27 *et al.*) circulated mainly from the joint reign of Cleopatra III and Ptolemy IX through the reign of Ptolemy XII.

We suggested above that the bronzes dated to regnal years 3 and 4 represent an eighth series that fell between Series 7 and Series 9. Thomas Faucher and Mona Shahin assigned these bronzes to the third and fourth regnal years of Cleopatra III and Ptolemy IX (115/4 and 114/3) based on their late style, the absence of Isis-Demeter types, and their association with tetradrachms of Ptolemies VIII–X in the Megadim shipwreck off the coast of Israel.⁴² These conclusions establish the probable date for the end of Series 7 and provide a *terminus post quem* for the introduction of Series 9.

THE DOCUMENTARY EVIDENCE AND THE COINAGE

Papyrologists studying documents from Ptolemaic Egypt have long attempted to systematize the economic data in their sources—prices for basic commodities, wages, and silver:bronze exchange rates—in the belief that major changes in these data reflect changes to the monetary system.⁴³ The documents originate in the

⁴⁰ Lorber 2007a.

⁴¹ Shahin 2005: 91–96.

⁴² Faucher and Shahin 2006: 148–152. For a full publication of the Megadim hoard, see Syon, Lorber, and E. Galili forthcoming, which follows the chronology proposed for the dated bronzes in Lorber 2005.

⁴³ Heichelheim 1930: 9–37, 56–72, 83–86; Segrè 1942; Reekmans 1948; Reekmans 1951; Clarysse and Lanciers 1989; Maresch 1995: 1–109; von Reden 2007: 70–78; Cavagna 2010:

Egyptian *chôra*, leaving us ignorant of conditions in Alexandria and the Delta. Still, there was only one currency system for the country, even if its circulation was uneven, so conclusions drawn from the documents are presumed valid for the currency as a whole.

Early in the reign of Ptolemy IV references to silver coinage disappeared almost entirely from financial documents, i.e., from the Egyptian countryside.⁴⁴ Some documents dated to this reign reflect a sharp rise in the value of the silver stater in relation to bronze currency.⁴⁵ There followed, in the second century, an extreme inflation in commodity prices expressed in terms of bronze. As early as the nineteenth century papyrologists hypothesized the introduction, under Ptolemy IV or V, of a bronze standard to replace the silver standard.⁴⁶ More recently this reform has been conceived as an accounting change, in which the value of bronze coinage was redefined in terms of a small theoretical unit.⁴⁷ Prices from the second century are expressed in talents and hundreds of unspecified units; since the talent was equivalent to 6,000 drachms, it can be inferred that the basic unit was a drachm, and this is finally confirmed in documents of the first century. We can also assume, from the preponderance of round figures in hundreds and in tens, that the new method of reckoning was based on a decimal system. A few documents dating from the late third to early second century attest to a sudden sixty-fold increase in wages; that is, work formerly remunerated at the rate of one obol per day now commanded 10 drachms per day.⁴⁸ This has inspired a widely held hypothesis that the former bronze obol was redefined as 10 bronze drachms, creating a silver:bronze ratio of 1:60.⁴⁹ The earliest undoubted attestation of the new system of reckoning, implied by an extremely high *epitimon* (penalty price), is *P. Tebt.* III, 2, 820, dated 201.⁵⁰ The older system was retained in the Thebaid during the years of its secession from Ptolemaic rule and perhaps also in demotic documents from other regions.⁵¹ The earliest demotic document to use the new system of reckoning is *P. Turin* 2129, a marriage contract dated 1 November 171.⁵²

For F. M. Heichelheim, Tony Reekmans, Willy Clarysse and Eddy Lanciers, the key dates for the second-century inflationary process are 183, 173/171–168, and

195–229. For a detailed history of the scholarship, see Cavagna 2010: 15–78.

44 Maresch 1995: 61, 117.

45 *UPZ* I 149, l. 32; Heichelheim 1930: 25; Milne 1938: 204; Segrè 1942: 178; Reekmans 1951: 65; Maresch 1995: 57–58, 72–73; Cadell and Le Rider 1997: 52–56; von Reden 2007: 71, 72–73.

46 Infelicitously termed the “copper standard” by Reekmans 1948 and 1951.

47 Gara 1984: 117–123; Hazzard 1995a: 83–84; Burkhalter and Picard 2005: 59–61, 63–64.

48 *P. Tebt.* III 2, 884 (around 200); *BGU* VII 1512 (210/5 or 193/83); *O. Mich.* I 7.

49 Reinach 1928: 169; Reekmans 1951: 70–71; Maresch 1995: 5, 18–19, 21–22, 48–49, 58, 82; von Reden 2007: 74–75.

50 Burkhalter and Picard 2005: 59, 72; von Reden 2007: 74.

51 Reekmans 1948: 22–23; Reekmans 1951: 80 n.1. See Gorre forthcoming b.

52 Gorre forthcoming a.

130–128. According to the influential theory enunciated by Reekmans in 1951, on each of these occasions the face values of all bronze coins were doubled, effectively halving the weight of the bronze drachm and introducing silver:bronze ratios of 1:120, 1:240, and 1:480, each of which persisted until the next change.⁵³ Klaus Maresch rejected the latter parts of this schema, citing evidence for lower ratios beginning c. 170.⁵⁴ The overviews of Heichelheim, Reekmans, and Maresch rest on a synthesis of different kinds of economic data, derived from different kinds of documents written for different purposes. This approach seeks to mitigate but cannot entirely transcend the many gaps in the documentary record. To a certain extent the periodization of price levels and/or presumed exchange ratios may simply represent the availability of records for certain dates and the absence of information for long periods between.⁵⁵

Hélène Cadell and Georges Le Rider attempted to overcome the methodological problems of earlier scholarship with a study restricted to grain prices and penalty prices from the third century to 173. After redating some of the documents, they found their first greatly elevated price level for wheat in 199, an approximate doubling of that price level in documents dated from 197 until 184 (after which there is a gap in the documentation), then another doubling in 173 implied by a penalty price in *P. Amh.* II 23.12.⁵⁶ They submitted that their price data reflected normal, if aggravated, inflation (5000% over forty years) rather than monetary changes, and they consequently argued that the value of bronze coinage was not suddenly redefined, but simply uncoupled from that of the silver and allowed to drift.⁵⁷

Alessandro Cavagna carried forward the work of Cadell and Le Rider from 173 to the end of the Ptolemaic dynasty, demonstrating that this later period was characterized by long spells of price stability punctuated by successive inflations.⁵⁸ However Cavagna rejected Cadell and Le Rider's conclusion that second-century prices reflected natural inflation. Instead he endorsed the majority view that the pattern of rising prices was caused by devaluation of the bronze coinage, suggesting that it was perhaps effected through episodes of countermarking in the years

53 Reekmans 1951.

54 Maresch 1995: 17, 19, 20n55. For the supposed pivotal time around 170 he found evidence for ratios of 1:60 and 1:120. According to his interpretations of other documents, the 1 : 120 ratio was still in effect c. 150 and ratios of 1:60 and 1:50 predominated in the period after 130. For Maresch, the ratio of 1:240 pertained only to the reign of Cleopatra the Great.

55 On the limits of the documentation, see Cadell and Le Rider 1997: 57; Manning 2009: 158; Cavagna 2010: 169–174.

56 Cadell and Le Rider 1997: 24–69.

57 Cadell and Le Rider 1997: 65–93. Cadell and Le Rider also criticized the term “copper standard,” insisting that silver remained the only true standard of value throughout Ptolemaic history.

58 Cavagna 2010: 169–195.

209–199 and possibly again in 183/2.⁵⁹ But he also observed that his assumed levels of retariffing were far from proportional to the price increases and invoked the likely influence of the repeated crises in Ptolemaic history that led to loss of territory and loss of revenues.⁶⁰ According to Cavagna, the production of bronze coinage contracted gradually in the second and first centuries, leading to a slow decline in monetization; in particular, he excluded any increase in the supply of bronze coinage in the crucial inflationary periods.⁶¹

Our own dossier of wheat prices and penalty prices for wheat (see Appendix 4) shows several price clusters separated by large gaps. Graph 1 includes the results already reported by Cadell and Le Rider down to 173. Documents from the mid-third century (257–250) attest to prices ranging from 1.16 to 3 drachms per artaba. However, the penalty price holds steady at 4 drachms per artaba in contracts ranging in date from 306 and 301 to 228, 223, and 221, reflecting a long period of stability that extended into the early years of Ptolemy IV. For the rest of his reign we have just two prices, 7.5 drachms (213) and 6 drachms (209). For the years 200–195 the dossier records prices of 80 to 180 drachms, with most in the range of 150 to 180 drachms; an isolated price of 120 drachms in 184 seems to represent a continuation of this same price level. The isolated penalty price of 500 drachms in 173 (*P. Amh.* II 43.12) is difficult to interpret in relation to actual wheat prices, but may represent an inflationary pulse that is otherwise unattested.⁶² A new price level is apparent in the years 162–159, when the documents record prices of 500 to 900 drachms per artaba. For the years 118–50, the documents record prices of 800 to 2200 drachms, with most in the range of 1000 to 2000 drachms.

A separate dossier, including wages and prices for gold *mnaiēia*, silver staters, and oil, is visualized on Graph 2 of Appendix 4. The prices for oil and for the silver stater show the same inflationary trends as wheat prices and penalty prices, though the data are much thinner. The wage figures illustrate a growing imbalance between wages and prices.

The introduction of Series 6 corresponds fairly closely to the first greatly elevated prices (c. 200) and the two should certainly be associated. We can be confident that the face values of the Series 6 bronze coins were denominated according to the new system of reckoning, since we demonstrated the continuity of obverse types and denominations over Series 6 and 7, covering most of the second century. The relative stability of grain prices for the years 200–184, reflecting transactions made when Series 6 was the circulating currency, implies that the ongoing weight reductions and the countermarking of the largest denomination of Series 6d had no significant impact on public confidence in the coinage.

⁵⁹ Cavagna 2010: 212–223.

⁶⁰ Cavagna 2010: 225–229.

⁶¹ Cavagna 2010: 231–234.

⁶² Manning (2009: 158) cautions that “the data derived from penalty clauses can also mislead, since they may not reflect anything meaningful in terms of commodity price; they may simply be arbitrary figures.”

Apart from the original dislocation caused by the introduction of the new system of reckoning, it is entirely possible that second- and first-century prices reflect a natural inflationary process driven primarily by normal economic factors, such as the availability of goods and the money supply, including credit. One important influence was the ongoing decline of agricultural production throughout the second century, due to repeated disorders (revolts, foreign invasion, civil wars), bureaucratic corruption, poor management of the irrigation system, and widespread abandonment of the land. The problem is attested by various documents, e.g., *UPZ* 111, dated 164, which alludes to compulsory land leases, and *P. Tebt.* I 5 (*C. Ord. Ptol.* 53), dated 118, which collects ordinances intended to address a myriad of problems.⁶³ On the other side of the equation we do not see a contracting currency supply but rather an expansion of the total value of the currency in circulation, accomplished by repeatedly reducing the weights of the coins while maintaining their face values. In addition, the debasement of the alloy of the bronze coinage with admixtures of lead, associated with the introduction of Series 7, should have increased the volume of bronze available for coining, unless there was a significant loss of metal or part was diverted to other uses. The total volume of Series 7 coinage was certainly enormous, but it represents an output of several decades, making it difficult to estimate the actual impact of the debasement on monetary volume. We are thus reluctant to suggest a causal relation between the introduction of Series 7 and our second group of prices, from the years 162–159. Furthermore, because these prices represent such a narrow time frame, they may reflect temporary conditions in the economy rather than a sustained new price level. The introduction of Series 9 involved a large reduction in the weight of the currency—from 22–23g for the Zeus-Ammon/double eagle bronze of Series 7 to 8–9g for the equivalent coin of Series 9—which could have tripled the total value of bronze coinage in circulation, assuming that the old currency was recoined in its entirety. This might account for the approximate doubling in price levels reflected in the documentation and sustained until the end of the dynasty. The monetary supply in this late period was further enlarged by cast coinage. The widespread use of credit was a feature of the Ptolemaic economy at all times, and this expanded the money supply beyond the availability of coinage.⁶⁴

Cavagna has criticized papyrologists' longstanding emphasis on exchange ratios as a survival of eighteenth-century scholarship.⁶⁵ Our demonstration that weight reductions in Series 6 and 7 occurred in a piecemeal manner is at odds with Reekmans' theory of a stepwise depreciation of bronze coinage, pinpointed to particular dates and expressed in terms of changing silver:bronze ratios. A comparison of our bronze coin series against the periodization of silver:bronze ratios casts

⁶³ On the implications of the latter and other observations on problems of the Egyptian economy in the second century, see Bingen 2007: 194–205.

⁶⁴ Von Reden 2002; von Reden 2007: 151–252.

⁶⁵ Cavagna 2010: 15–78.

further doubt on the utility of such ratios for the monetary history of Ptolemaic Egypt. Our Series 6 probably overlaps two of the presumed silver:bronze ratios, the 1:60 ratio posited from the introduction of the new system of reckoning until 183, and the 1:120 ratio posited from 183 until c. 170—the only ratios and dates agreed on by Reekmans and Maresch. More damaging still, we failed to identify any physical changes to the coinage datable around 130, a time of pivotal change according both Reekmans and Maresch.

FACE VALUES OF THE BRONZE COINS

The consistent pattern of obverse types across Series 6 and 7 encourages us to believe that these types were denomination markers. From this we can infer consistent face values across the two series, with the implication that the new system of reckoning applied to Series 6 from its very beginning. Because the new bronze currency system was introduced with Series 6a, we assume that the most essential denominations will have been made available in that series. We shall consequently test several hypothesis with a primary emphasis on Series 6a.

Hypothesis 1: As a basis for proposing hypothetical face values for Series 6 and 7, we first adopt the common assumption, noted above, that the obol was retariffed at 10 drachms. In our view, the bronze coinage of Ptolemy IV was based on an obol of c. 12g, although the smallest denomination actually struck was a diobol. The equivalents of the tetrobol and diobol can be identified in our Series 6a, at slightly reduced weights.⁶⁶ Face values for the rest of Series 6a can be extrapolated from the weight relationships with varying degrees of confidence, and the face values of denominations introduced in later phases of Series 6 can then be interpolated into the system.

An obvious deficiency of hypothesis 1 is the lack of an obol in Series 6a; it may be relevant that this denomination was neglected in the bronze coinage of Ptolemy IV. On the other hand, the hypothesis does provide an equivalent of the Egyptian deben, probably a key denomination. (The standard demotic reckoning $hd = sttr 5$ is found in numerous documents and equates the deben with five staters (tetradrachms) and thus, by implication, with 20 drachms.⁶⁷) The denominations also include a pentadrachm, a coin considered to be the basis of the new Egyptian monetary system by both J. G. Milne and Alessandra Gara.⁶⁸ The existence of the pentadrachm is attested in the first century by Hiero of Alexandria.⁶⁹ Five drachms was the standard entrance fee to the public baths as early as c. 180, proving that the coin existed in the time frame to which we provisionally assign Series 6.⁷⁰

66 Huston and Lorber (2001: 24–25) compared the diameters and weights of these denominations.

67 See Maresch 1995: 16, 36–37, 82, etc; also Gorre forthcoming a and b.

68 Milne 1925: 273, 276; Gara 1984: 119–120.

69 Picard 2008.

70 Faucher and Redon forthcoming.

The face values proposed under this hypothesis present a practical problem. As noted above, prices from the second century are usually expressed in talents and minae.⁷¹ This set of denominations is not particularly well designed for the formation of such sums. It would have been necessary to combine at least three coins to reach a total of 100 drachms, and a talent would have required a minimum of 150 coins.

Table 6. Hypothetical face values for series 6 and 7 (Hypothesis 1).

Obverse Type	Weights Series 6a (rounded)	Equivalence to earlier bronze coinage	Face value in new drachms	Demotic equivalent	Denominations introduced later in Series 6	Series 7
Zeus-Ammon 1	40g	Tetrobol	40			40
Isis 1	30g	Triobol	30			30
Heracles 1	18–20g	Diobol	20	Deben		20
Alexandria	15g	Trihemibol	15			15
Zeus-Ammon 2		Obol			10	
Isis 2	7g	Tritartemorion	7.5			7.5
Nilus?		Tritartemorion			7.5	
Heracles 2, helmeted	4g	Hemiobol	5			5
Athena		Tetartemorion			2.5	

According to hypothesis 1, the theoretical unit at the base of the system (the bronze drachm) would have been equivalent to 1g bronze in Series 6a and 6b. If we consider only the largest denomination, we could conclude that it fell to less than 0.6g in Series 7. But the uneven process of weight reduction from one denomination to the next and the continued circulation of Sv. 1284 alongside coins of Series 7 both imply that it is probably wrongheaded to attempt to define the theoretical unit in terms of a weight of bronze.

Hypothesis 2. Lorber, followed by Cavagna, proposed a face value of 100 drachms for the large-horn Ammon bronze of our Series 6a, the largest coin of the reformed currency system in its first iteration.⁷² The basis for the hypothesis is a monetiform bronze weight found in a Levantine hoard of countermarked bronze coins of Ptolemy IV. It is marked Σ (200) on one side and bears two parallel strokes on the other; its weight is 80.14g, equivalent to two of the large-horn Ammon bronzes.

⁷¹ As in other matters, demotic documents were more conservative than those written in Greek. In demotic marriage contracts the earliest reference to a talent (*krkr*) dates from 130. This information comes from a lecture by G. Gorre, “L’usage de la monnaie d’après les sources papyrologiques,” presented in Paris on 16 March 2009 in the framework of the ANR Nomisma program.

⁷² Huston and Lorber 2001: 34–37; Cavagna 2010: 218–219.

A denominational system based on a coin of 100 drachms (and its subdivisions) bears no clear relationship to the former system based on the obol, so we omit the column of equivalents to the traditional monetary units.

Table 7. Hypothetical face values for Series 6 and 7 (Hypothesis 2).

Obverse Type	Weights Series 6a (rounded)	Face value in new drachms	Demotic equivalent	Denominations introduced later in Series 6	Series 7
Zeus-Ammon 1	40g	100			100
Isis 1	30g	75			75
Heracles 1	18–20g	50			50
Alexandria	15g	40			40
Zeus-Ammon 2				30	
Isis 2	7g	20	Deben		20
Nilus?			Deben	20	
Heracles 2, helmeted	4g	10			10
Athena				5	

A bronze coin with the face value of 100 drachms would have been equivalent to one bronze mina, echoing the gold *mnaieion*, the supreme coin of the Lagid currency system in both the third and second centuries. A bronze *mnaieion* would have been very convenient for making the payments in talents and minae that are mentioned in second-century documents. The tradeoff for assuming large face values, however, is that Series 7 no longer includes the pentadrachm, the only coin denomination whose existence is certainly attested.

Hypothesis 3. In his study of five accounts from Kerkeosiris, c. 114–112, Arthur Verhoogt noted that small payments were made in the amounts of 5, 10, 20, 50, 60, and 120 drachms and submitted that these corresponded to the coin denominations in use at the time.⁷³ We doubt that Series 7 was still current at that date and suspect that Series 9 provided the contemporary currency. However, Series 9 retained the Zeus-Ammon double eagle typology that characterized the largest denominations of Series 6 and 7, and this implies that the face value of these pieces remained constant, despite weight reductions. An assumed value of 120 drachms for the largest denomination of Series 6a yields the following hypothetical values, based on the proportional weights of the coins of Series 6a.

73 Verhoogt 2005: 13.

Table 8. Hypothetical face values for Series 6 and 7 (Hypothesis 3).

Obverse Type	Weights Series 6a (rounded)	Face value in new drachms	Demotic equivalent	Denominations introduced later in Series 6	Series 7
Zeus-Ammon 1	40g	120			120
Isis 1	30g	90			90
Heracles 1	18–20g	60			60
Alexandria	15g	45			45
Zeus-Ammon 2				30	
Isis 2	7g	20	Deben		20
Nilus?			Deben	20	
Heracles 2, helmeted	4g	10			10
Athena				5	

This exercise does not yield most of the face values posited by Verhoogt. As in hypothesis 2, the pentadrachm, whose importance is emphasized above, appears in only one sub-series of Series 6 and is lacking from Series 7. These unsatisfactory results suggest that one or more of the assumptions are unsound. In fact, a set of six bronze denominations seems excessive for Series 9, whose largest coin, Sv. 1426/1427, weighed only 7–9g. A payment of 120 drachms could easily be made with two 60 drachm coins or three 40 drachm coins, so there is no need to postulate the existence of a coin worth 120 drachms.

Hypothesis 4. Olivier Picard has identified the pentadrachm of the first century in small bronzes of c. 1g (Sv. 1732–1733).⁷⁴ Oliver Hoover has demonstrated that these bronzes were first struck under Cleopatra III and Ptolemy X Alexander.⁷⁵ But they probably continued in circulation (and production?) alongside the denominated Alexandrian bronze coins of Cleopatra VII Thea Neotera. The larger (Sv. 1871), with a diameter of 27mm and a weight of 18g, bears a letter Π indicating a value of 80 drachms. The smaller (Sv. 1872), with a diameter of 22mm and a weight of 9g, is designated by the letter M as a 40 drachm piece. Our discussions with Picard led us to the assumption that the largest bronze coin of Series 6 and 7 should be equivalent to both earlier and later bronze coins.⁷⁶ On the one hand, it should be equivalent to Cleopatra's largest bronze coin, implying a face value of 80 drachms. At the other end of the scale, the largest coin of Series 6 and 7 should be equivalent to the largest coin of the obol-based system of the third century,

⁷⁴ Picard 2005: 85–86; Picard 2008.

⁷⁵ Hoover 2008; Wright 2010: 256, no. 245.

⁷⁶ Personal communication, 3 July 2010, reflecting the text of the forthcoming publication of the coin finds from the excavations of the Centre d'Études Alexandrines.

namely the octobol. This implies the conversion rate of 1 obol = 10 drachms, also employed in hypothesis 1.

The reemergence under Augustus of dichalka, obols, diobols, and triobols argues that Ptolemaic bronze coinage never lost its underlying relationship to these traditional monetary units.⁷⁷ Thus the most satisfying of our hypotheses is hypothesis 4, which assumes a continuity of values from the third century through Series 6 and 7 to the coinage of Cleopatra. The array of denominations meets the test of a practical currency system. While a minimum of three coins was required to form a mina, the 60 drachm (Isis 1) denomination, which is extremely well represented in hoards, would have been very convenient for amassing talents (100 x 60 drachms = 6,000 drachms). The expected pentadrachm denomination is present. The lack of an equivalent to the Egyptian deben in Series 7 is not a serious problem, because the deben is attested as an accounting unit, but not as an actual coin.

Table 9. Hypothetical face values for Series 6 and 7 (Hypothesis 4).

Obverse Type	Weights Series 6a (rounded)	Equivalence to earlier bronze coinage	Face value in new drachms	Demotic equivalent	Denominations introduced later in Series 6	Series 7
Zeus-Ammon 1	40g	Octobol	80			80
Isis 1	30g	Drachm	60			60
Heracles 1	18–20g	Tetrobol	40			40
Alexandria	15g	Triobol	30			30
Zeus-Ammon 2		Diobol		Deben	20	
Isis 2	7g	Obol	10			10
Nilus?		Obol			10	
Heracles 2, helmeted	4g	Hemiobol	5			5
Athena		Tetartemorion			2.5	

CONCLUSION

Relying mainly on hoards and metallurgical analyses, we have identified the bronze coins belonging to Series 6 and 7. Generally speaking, these series are characterized by the use of Zeus-Ammon/double eagle types for the largest denomination, and by several new obverse types including Isis-Demeter, Heracles, a personification of Alexandria in an elephant headdress, a helmeted youth, and Athena. These obverse types are denomination markers, most of which persist across Series 6 and 7, despite a pattern of weight reduction that affected different denominations at different times.

Series 6 represents the new currency introduced after a major demonetization of the bronze coinage in 205 or shortly before, which allowed only selected

⁷⁷ Maresch 1995: 110–113; Burkhalter and Picard 2005: 61–63; Picard 2005: 86.

denominations of the earlier coinage to remain in circulation. The introduction of Series 6 (c. 205–201) coincided with the introduction of a new system of reckoning, whose existence has been deduced from the study of financial transactions recorded in papyri and on ostraca. It is now clear that the authorities planned in advance for this transition and that the great demonetization of Ptolemy IV was intended to clear the way for the new system of reckoning and to provide the metal for a new bronze coinage denominated accordingly. Series 6 is subdivided into five sub-series. Series 6a through 6d circulated together, supplemented by the thinned-out older coinage; a break in the hoards may imply a currency reform before the introduction of Series 6e.

Series 7 was struck in a debased alloy with a significant admixture of lead. Its five denominations represent a subset of the eight denominations of Series 6. As with other currency reforms, most existing bronze coinage was withdrawn upon the introduction of Series 7, but one denomination of Series 6e was retained as an important part of the new currency system. Series 7 comprises three sub-series that exhibit stable types and modules, with a barely perceptible weight reduction in Series 7c. We cannot date the introduction of Series 7 with precision, but Series 7b was in circulation before 146 and Series 7 was replaced by a new, dated coinage in 115/4. The coinage of Series 7 thus represents a very stable currency in use for approximately half a century.

We hope that our demonstrations will inspire a closer collaboration between numismatists and papyrologists. Each field can provide critical evidence for the other, and together they can contribute to a better understanding of the economic history of Ptolemaic Egypt.

ACKNOWLEDGEMENTS

We are deeply grateful to Olivier Picard for reading and commenting on several iterations of this paper, and for ongoing, fruitful discussions about Ptolemaic bronze coinage. We have also profited from discussions with Andrew Meadows and we thank him for permission to cite the Herakleion, 2010 hoard. Our thanks go as well to Daniel Wolf for providing illustrations and information from his collection.

APPENDIX 1

HOARDS

The following bronze hoards containing coins of Series 6 and/or Series 7 establish the relative chronology of the series:

1. "Coinex" Hoard, 1992 (*CH VIII* 413 = *CH X*, 455), Huston and Lorber 2001
2. Necropolis Hoard B, Saqqâra, 1967 (*CH IX*, 693), Price 1981
3. Necropolis Hoard C, Saqqâra, 1967 (*CH IX*, 693), Price 1981
4. Necropolis Hoard D, Saqqâra, 1967 (*CH IX*, 693), Price 1981
5. Necropolis Hoard E, Saqqâra, 1967 (*CH IX*, 694), Price 1981
6. Necropolis Hoard F, Saqqâra, 1967 (*CH IX*, 692), Price 1981
7. Herakleion, 2010, to be published by A. R. Meadows
8. Egypt, 1922 (*IGCH* 1703)
9. Corinth, 1948 (*IGCH* 264), Thompson 1951
10. Fouad Street, 2002 (*CH X*, 457), Picard and Faucher forthcoming
11. May 2007, seen in commerce
12. Tell Nowa, 1930 (*CH X*, 458), Faucher 2010
13. Bains Karnak, 2007 (*CH X*, 459), Boraik and Faucher 2010
14. Kom Trouga II, 1934 (*CH X*, 456), Shahin 2005

With the exception of no. 9, the Corinth, 1948 hoard, all of these are Egyptian hoards. An Egyptian provenance is certain for the majority of the hoards, which were found in excavations, and is presumed for nos. 1 and 11 on the basis of their contents. Omitted from the list are Croatian hoards such as Vrankamen-Berg, 1887 (*IGCH* 643) and Mazin, 1896 (*IGCH* 644), which contained a few coins of Series 6 and/or 7 but are too late to be significant for their chronology.

In the following table the hoards are identified by number and their contents are listed below. The table shows a clear break between Series 6a–6d and Series 6e. The latest hoards contain mainly coins of Series 6e and Series 7, in most cases with a few survivals from Series 6a–6d.

Table of Hoards

Ser	Denomination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
6a	Large horn Ammon 36mm, 40g (Malter II, 232)	31														
	Isis 30mm, 30g (Sv. 1491)		3	1			1									
	Heraclēs 29mm, 20g (Sv. 1492)		3	1			2									
	Heraclēs 31mm, 20g (Sv. 1497)															
	Alexandria 28mm, 16g (Sv. 1493)	2	30		4	25							2		2	
	Isis 23mm, 8g (Sv. 1154)		16			16					3					
	Heraclēs 17mm, 4½g (Sv. 1496)															
	Zeus-Ammon 35mm, 38g (Sv. 1423)	5	4	1		2						1				1
	Isis 35mm, 31g (Sv. 1233)															
	Zeus-Ammon 33mm, 6.5(?)g (Sv. 1173)		2				1									
6c	Helmeted bust 18mm, 4.4g (Sv. 1155)															
	Zeus-Ammon 33mm, 29g (Sv. 1424-A)	163	35	10	7	1	15				1					
	Heraclēs 24mm, 10g (Sv. 1494)		3			2									1	
	Alexandria 22mm, 9g (Sv. 1495)															
	Zeus-Ammon 22mm, 6.5g (hoard 6, 131-134)		1	5			4									
	Helmeted Athena 12mm, 2g (Sv. 1195)															
	Zeus-Ammon 30mm, 20g (Sv. 1375, Milan 310)		6				6					1				
	Heraclēs 25mm, 12g (Sv. 1376)															2
	Zeus-Ammon 22mm, 7g (Sv. 1377)															
	Nilus 18mm, 5g (Sv. 1378)															
6e	Helmeted bust 16mm, 3g (Sv. 1379)															
	Zeus-Ammon 30mm, 24g (hoard 7, 1-4)							4								
	Isis 30mm, 20g (Sv. 1234)								8	2		69-81	67	8		
	Alexandria 22mm, 9g (Sv. 1236)														2	
	Isis 14mm, 2g (Sv. 1240)									5						

Table of Hoards (continued)

Ser	Denomination	1	2	3	4	5	6	7	8	9	10	11	12	13	14
6c	Isis 18mm, 5g (Sv. 1238) Helmets head 15mm, 2.2g (Sv. 1156)						1								
7a	Zeus-Ammon 30mm, 24g (Sv. 1380) Alexandria 22mm, 8g (Sv. 1381) Isis 17mm, 4g (Sv. 1382)							3		1	1	8	1	3	
7b	Zeus-Ammon 30mm, 24g (1383) Isis 27mm, 16g (Sv. 1384) Heracles 25mm, 12g (Sv. 1385) Alexandria 22mm, 8g (Sv. 1386) Isis 17mm, 4g (Sv. 1387)									3	6	4-7	5	11	
7c	Zeus-Ammon 30mm, 24g (Sv. 1424-B) Isis 25mm, 17g (Sv. 1235) Alexandria 16mm, 3-4g (Sv. 1239)									3	3	12-14	66	51	
										2	52	335-328	228	224	12
										9					

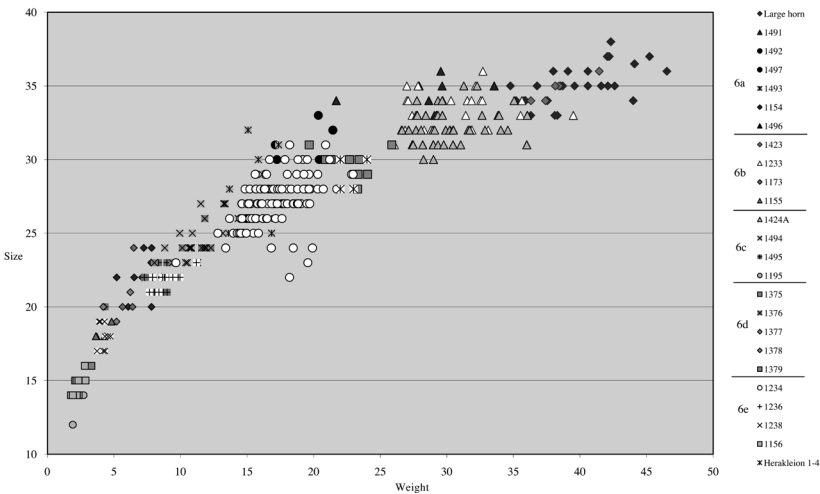
APPENDIX 2

METROLOGY OF THE SECOND-CENTURY BRONZE SERIES

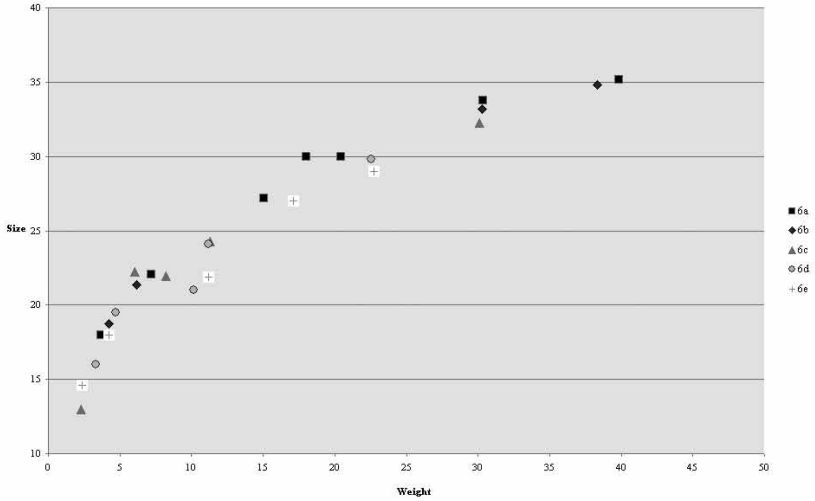
Together with the study of hoards and of the coins' metallic composition, metrology enables us to classify the coins, to distinguish one module from another within a single series and among several series. For silver coinage, the weight of the coin is often decisive because it is often close to the weight standard chosen by the authorities. For bronze coinage, on the contrary, the method of manufacture did not allow the moneyers to achieve a precise weight. Thus it is the type and the diameter, as much as the weight, that permit us to distinguish the different modules.

The metrological study presented here involves more than a thousand specimens and permits certain conclusions, even if some varieties are represented by only a very few examples. We do not have diameters for all of these 1131 specimens, so that there is a discrepancy between the number of points displayed on the graphs and the number of coins in the tables. In consequence the study of the diameters is based on a more limited number of examples.

The monetary series of the second century are characterized by a large number of modules and denominations. This is especially true of Series 6. When the metrological data are placed on a graph, it is possible to discern groups. The conclusion that emerges is that coins having the same weight and the same diameter, bearing the same types, will have, in a given system, the same value.



Graph 1. Weights of the coins in Series 6.



Graph 2. Average weights of the coins in Series 6.

The weights and diameters of the coins do not present a net difference that would allow us to infer a difference in the technique of production. But our sample is far from complete. Certain varieties are represented by only one or two examples, precluding any solid conclusions about these particular issues.

Series 7 is more amenable to metrological study. In the first place, the number of varieties is smaller, in fact precisely half, 12 as opposed to 25 for Series 6. Thus the denominations show a better separation, making it easy to comprehend this system where the types alternate in regular fashion with the weights.

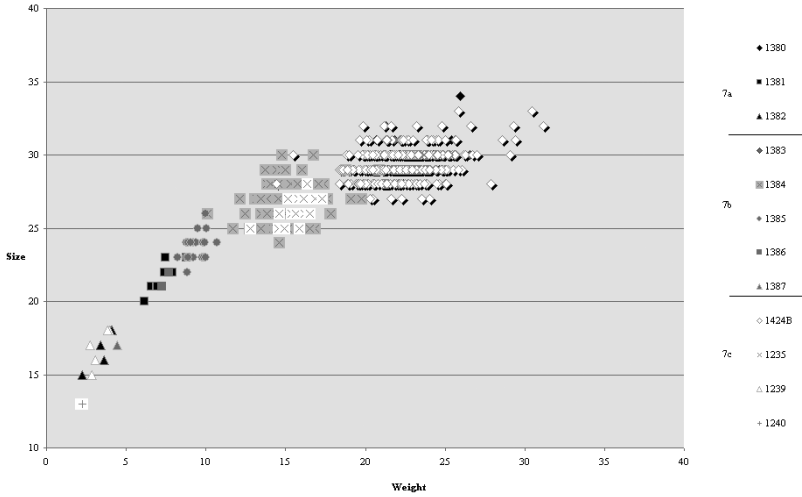
The introduction of Series 7 saw the appearance of 3 modules (Svoronos 1380–1382) which present the ratio $1 : 1/3 : 1/6$. The new Series 7b, where the second denomination is the preponderant module of the system, merely filled the voids in the preceding series by providing the missing modules. Series 7b is thus composed of five modules which present the ratio $1 : 2/3 : 1/2 : 1/3 : 1/6$. The selection of denominations changes slightly with Series 7c, where the ratio is $1 : 2/3 : 1/6 : 1/12$.

Table 1. Average weights and diameters of the coins of Series 6.

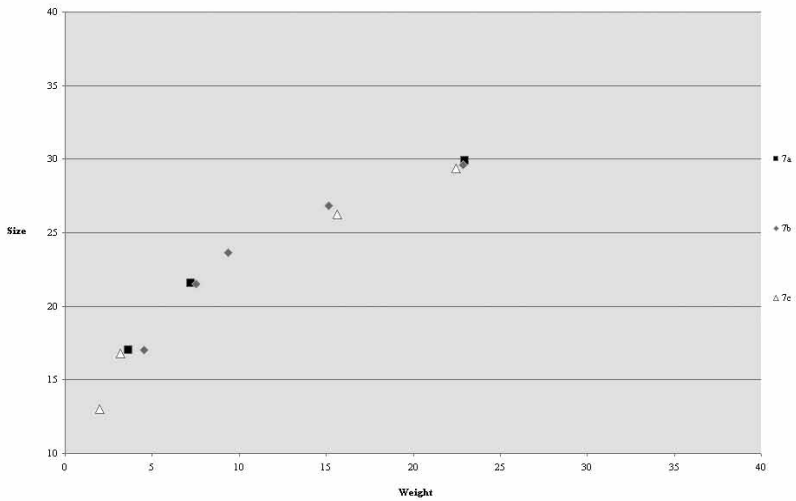
Series	Denomination	Specimen	Size	Standard Deviation		Weight		Standard Deviation	Weight (average)	Standard Deviation	Weight	%
				Weight	%	Weight	%					
6a	Large horn Ammon 35 mm, 40 g (Malter II, lot 232)	27	35.2	1.3	3.7	39.8	3.1	7.8				
	Isis 33 mm., 30 g (Sv. 1491)	12	33.8	1.4	4.0	30.3	4.5	14.8				
	Heracles 30 mm, 18 g (Sv. 1492)	10	30.0	1.9	6.2	18.0	2.2	12.4				
	Heracles 30 mm., 20 g (Sv. 1497)	1	30.0			20.4		0.0				
	Alexandria 27 mm, 15 g (Sv. 1493)	17	27.2	2.4	8.7	15.0	2.1	14.2				
	Isis 22 mm., 7 g (Sv. 1154)	12	22.1	1.2	5.6	7.2	1.0	13.3				
	Heracles 18 mm., 4 g (Sv. 1496)	1	18.0			3.7		0.0				
6b	Double eagle without cornucopiae 35 mm, 38 g (Sv. 1423)	5	34.8	0.8	2.4	38.4	1.9	5.0				
	Isis 33 mm, 30 g (Sv. 1233)	28	33.2	1.4	4.1	30.3	3.3	10.7				
	Zeus Ammon 21 mm, 6 g (Sv. 1173)	3	21.3	2.3	10.8	6.2	0.5	7.5				
	Helmeted bust 19 mm, 4 g (Sv. 1155)	4	18.8	1.0	5.1	4.2	0.6	13.9				
	Zeus Ammon 32 mm, 30 g (Sv. 1424-A)	46	32.2	1.2	3.7	30.1	2.5	8.4				
6c	Heracles 24 mm, 11 g (Sv. 1494)	17	24.3	1.2	5.1	11.3	1.5	13.1				
	Alexandria 22 mm, 8 g (Sv. 1495)	17	21.9	0.9	4.1	8.2	1.2	14.5				
	Zeus Ammon 22 mm, 6 g (Necropolis hd. F. 131-134)	4	22.3	0.5	2.2	6.0	1.0	16.8				
	Helmeted Athena 13 mm, 2 g (Sv. 1195)	2	13.0	1.4	10.9	2.3	0.6	24.7				

Table 1 (continued). Average weights and diameters of the coins of Series 6.

Series	Denomination	Specimen	Size	Standard Deviation		Weight (average)	Standard Deviation	
				Weight	%		Weight	%
6d	Zeus Ammon 30 mm, 23 g (Sv. 1375, SNG Milano 310)	2	29.8	0.9	3.1	22.6	1.8	8.0
	Heraclès 24 mm, 11 g (Sv. 1376)	10	24.1	0.9	3.6	11.2	1.5	13.4
	Zeus Ammon 21 mm, 10 ² g (Sv. 1377)	1	21.0			6.2		0.0
	Nilus 19 mm, 5 g (Sv. 1378)	2	19.5	0.7	3.6	4.7	0.7	15.0
	Helmeted bust 16 mm, 3 g (Sv. 1379)	1	16.0			3.3		0.0
6e	Zeus Ammon 30 mm, 24 g (Heraikleion 1-4)	4	29.0	1.2	4.0	22.8	1.0	4.2
	Isis 27 mm, 17 g (Sv. 1234)	119	27.0	1.6	6.1	17.1	2.2	12.9
	Alexandria 22 mm, 11 g (Sv. 1236)	11	21.9	0.5	2.5	9.1	1.0	9.2
	Isis 18 mm, 4 g (Sv. 1238)	9	18	0.9	4.8	4.2	0.3	7.6
	Helmeted bust 15 mm, 2 g (Sv. 1156)	13	14.6	0.7	4.5	2.4	0.4	16.0



Graph 3. Weights of the coins of Series 7.



Graph 4. Average weights of the coins of Series 7.

Table 2. Average weights and diameters of the coins of Series 7.

Series	Denominations	Specimen	Size (average)	Standard deviation	%	Weight (average)	Standard deviation	%
7a	Zeus Ammon 30 mm, 23 g (Sv. 1380)	24	29.9	1.8	6.0	23.0	1.7	7.2
	Alexandria 22 mm, 7 g (Sv. 1381)	17	21.6	1.0	4.4	7.2	0.7	9.9
	Isis 17 mm, 4 g (Sv. 1382)	15	17.0	1.2	6.8	3.7	0.6	17.5
7b	Zeus Ammon 30 mm, 23 g (Sv. 1383)	20	29.6	1.0	3.2	22.9	1.8	8.1
	Isis 27 mm, 15 g (Sv. 1384)	164	26.8	1.2	4.3	15.1	1.4	9.5
	Heracles 24 mm, 9 g (Sv. 1385)	21	23.7	0.9	3.8	9.4	0.6	6.2
	Alexandria 21 mm, 7 g (Sv. 1386)	8	21.5	0.5	2.3	7.5	0.7	9.9
	Isis 17 mm, 4 g (Sv. 1387)	3	17.0	0.0	0.0	4.5	0.2	4.9
7c	Zeus Ammon 29 mm, 22 g (Sv. 1424-B)	451	29.3	1.0	3.3	22.4	1.9	8.7
	Isis 26 mm, 16 g (Sv. 1235)	26	26.2	0.9	3.3	15.6	1.0	6.5
	Alexandria 17 mm, 3 g (Sv. 1239)	6	16.8	1.2	6.9	3.2	0.5	15.4
	Isis 13 mm, 2 g (Sv. 1240)	6	13.0	0.0	0.0	2.0	0.2	11.7

APPENDIX 3

ELEMENTAL ANALYSES OF SECOND-CENTURY PTOLEMAIC COINAGE

WITH MARYSE BLET-LEMARQUAND (CRNS, IRAMAT)

The earliest metallic composition analyses made on second century Ptolemaic bronze coins showed that the issuing authorities used massive quantities of lead in their alloy, often to the detriment of quality.¹ This can be seen on excavation coins which frequently show signs of a white corrosion, indicating a high lead content. In the framework of his PhD, Thomas Faucher carried out more than a hundred analyses on Ptolemaic bronze coins, showing the major tendencies of the minting techniques in Alexandria.² Fast Neutron Activation Analysis (FNAA) using a cyclotron was performed at the IRAMAT (Institut de recherches sur les archéomatériaux, UMR 5060, CNRS–Université d'Orléans). This method of analysis was preferred as it is the only strictly non-destructive method allowing us to get beyond the corrosion layer of the copper alloys. FNAA makes it possible to identify the presence of 10 elements in copper- and silver-based coins with detection limits as low as a fraction of a part per million (ppm).³

Since earlier analyses of second century coins had shown singular characteristics, the analyses focused on this period, at the very moment when the alloy was degrading. Thus, we present here 40 analyses carried out on the coins of the collection of the Bibliothèque nationale de France.⁴ Even though the Paris collection is one of the most abundant in Ptolemaic bronze coinage in the world (more than 800 coins), some coins of certain series are lacking; thus it was impossible to provide numerous analyses for some periods. Nevertheless, the outline of the evolution seems to be relatively solid in light of the results presented here.

Table 1 presents the results of the analyses for major elements like copper, tin, and lead. The analyses of minor elements did not give conclusive results; it seems that the same metal stock was used for the minting of this whole group of coins.⁵

Analyses show a clear difference between the metallic composition of coins of series 6 and those of series 7. For series 6, the lead content is mainly below 12% (excepting coin nos. 15 and 17), whereas the lead content is generally higher than 20% for series 7, or even more than 30% for some specimens.

The difference in lead content for coins belonging to the same sub-series (as in

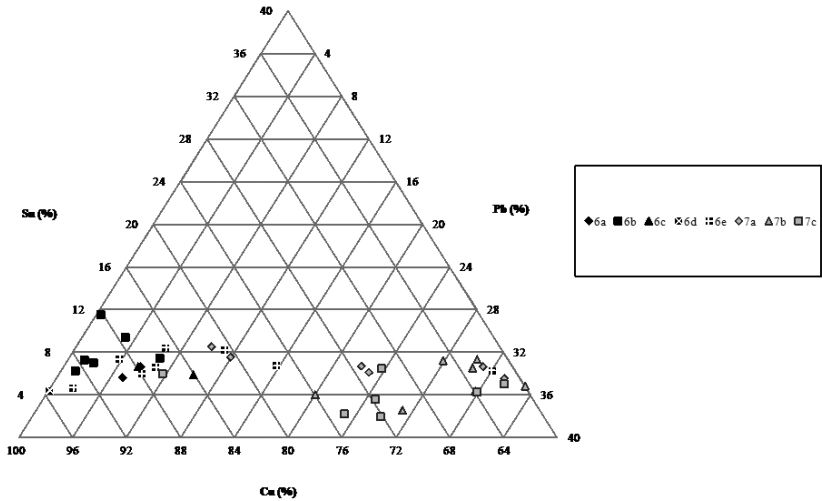
1 Brazener 1934: 119–120; Caley 1939: 96–99.

2 Faucher 2006.

3 Beauchesne et al. (1988): 187–197.

4 We wish to thank Michel Amandry, Director of the Department of Coins and Medals of the Bibliothèque nationale de France in Paris, for his interest in analyses and for allowing access to the collection.

5 Faucher (2006) shows that the metal used to strike Ptolemaic bronze coins came mainly from Cyprus until the reign of Cleopatra VII. Her coins appear to have been produced with copper from a different source.



Graph 1. Major elements in coins of Series 6 and 7.

the case of series 7a) should not be of great concern, since studies of a very large sample of Hellenistic coins have shown that great differences could exist within the same series.⁶ There can even exist a difference within coins from a single melting process because poured lead does not spread itself in the monetary mould in either a homogeneous or a random way.⁷

The very high lead content of a series 6e coin may require comment. This coin bears the head of Isis-Demeter on the obverse and an eagle with spread wings on the reverse (Sv. 1234), as the other modules of the series. We find many of these coins in hoards also containing denominations from series 7a, 7b and 7c. As we can see from excavation finds as well as hoards, this coin was used as a model for the fabrication of cast coins. Coin no. 15 must be one of these cast pieces (when the moulded coin is of good manufacture, it is very difficult to distinguish it from a struck one). It is in the interest of the counterfeiter to cast coins using an alloy with a high lead content. The cost of raw materials is lower, since lead is relatively cheap compared to tin. When added to copper and tin, lead also allows the melting point of the alloy to drop significantly, leading to lower consumption of combustibles and higher productivity. Finally, lead offers a greater fluidity to the alloy; it is then easier to pour into the clay moulds used in Egypt at that time.⁸

⁶ Barrandon and Picard 2007: 34 (a series of coins bearing a head of Athena and a tripod containing from 10 up to 35% lead).

⁷ Deraisme et al. 2005: 219–226.

⁸ Jungfleisch and Schwartz 1956: 209–219.

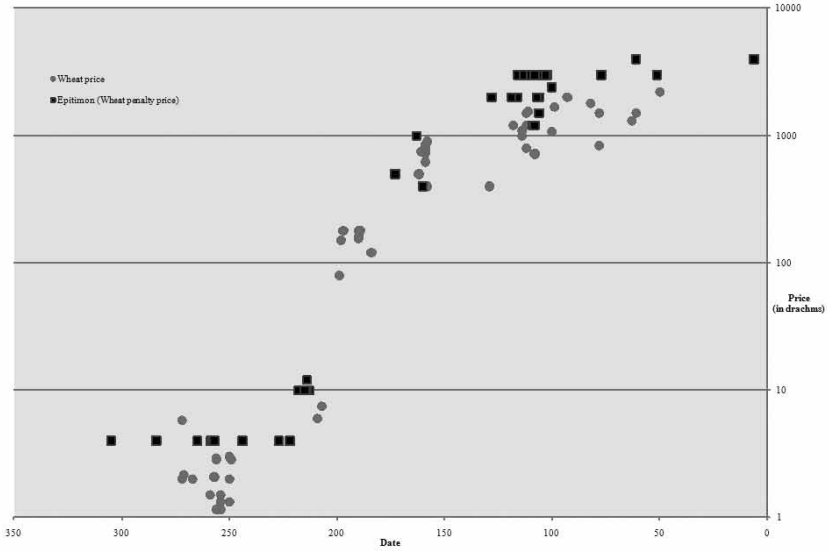
Table 1. Elemental analyses.

Series	No.	Pb (%)	Sn (%)	Cu (%)	Svoronos	Weight	Reference
6a	1	4.9	5.6	88.4	large horn	37.97	Luynes 3601
	2	5.7	6.6	86.7	1154	7.24	Maspero (7.24)
6b	3	1.2	7.2	90.5	1423	35.52	BAB 11
	4	0.3	11.4	87.5	1233	21.2	Maspero (21.20)
	5	1.1	6.1	91.5	1233	29.91	BnF 665
	6	2.0	7.0	90.0	1233	27.13	BnF 662
	7	3.2	9.3	86.6	1233	28.81	BnF 661
	8	6.7	7.4	85.3	1233	33.11	BnF 664
	6c	9	5.5	6.6	86.8	1494	14.12
10		9.9	5.8	83.3	1495	9	Luynes 3598
6d	11	0.1	4.3	92.7	1376	11.59	BnF 656
6e	12	1.7	4.7	93.0	1234	14.6	BnF 668
	13	6.1	6.0	86.9	1234	22.96	BnF 666
	14	6.5	8.2	82.2	1234	19.91	Seymour de Ricci (19.91)
	15	31.8	6.3	61.4	1234	16.9	BnF 667
	16	6.8	6.5	85.7	1236	8.84	BnF Y79 709B
	17	15.6	6.7	76.8	1236	9.42	Seymour de Ricci (9.42)
	18	3.7	7.3	87.9	1238	3.73	BnF 678
	19	11.1	8.1	79.6	1156	1.96	Delepierre 56
	7a	20	33.1	5.6	60.9	1380	23.3
21		21.8	6.7	70.3	1380	22.29	Luynes 3592
22		30.8	6.6	61.6	1380	23.15	Seymour de Ricci (23.15)
23		11.9	7.5	79.9	1381	6.12	BnF 389
24		9.9	8.5	80.7	1381	6.58	BnF 390
25		22.7	6.1	70.4	1382	3.62	BnF 412
7b	26	35.0	4.8	59.7	1384	17	BnF 670
	27	26.9	2.6	69.4	1384	14.96	BnF 673
	28	34.8	4.8	70.2	1384	16.2	Delepierre 68
	29	27.6	7.1	64.3	1384	17.15	BnF 676
	30	19.9	4.0	75.5	1385	8.91	BnF 653
	31	30.1	7.3	61.8	1385	7.88	Delepierre 70

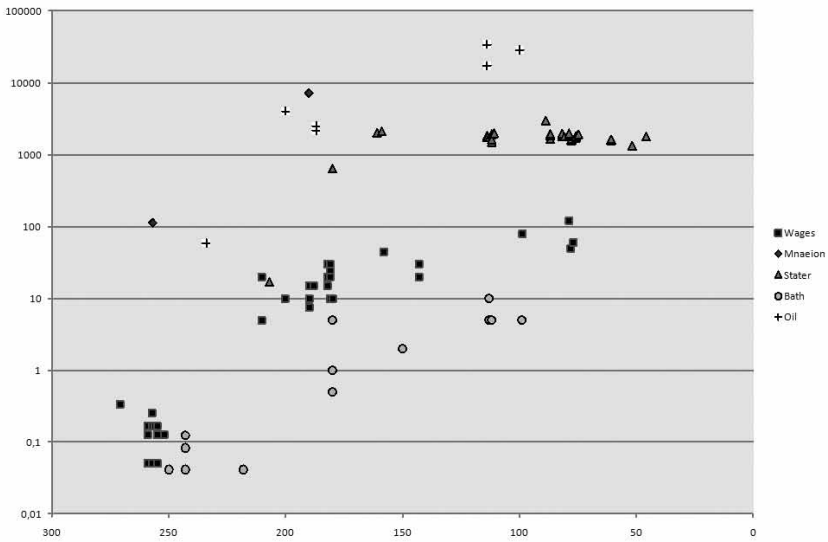
Table 1 (continued). Elemental analyses.

Series	No.	Pb (%)	Sn (%)	Cu (%)	Svoronos	Weight	Reference
7b	32	30.2	6.5	62.6	1386	7.25	Seymour de Ricci (7.25)
7c	33	7.7	5.9	85.6	1424B	22.25	BAB 09
	34	23.5	6.4	69.2	1424B	22.93	BAB 12
	35	24.4	3.6	71.1	1424B	20.35	Maspero (20.35)
	36	22.9	2.2	74.2	1424B	23.59	BnF 580
	37	31.5	4.2	63.1	1235	14.53	Seymour de Ricci (14.53)
	38	25.6	2.0	71.5	1239	2.84	BNF 709C
	39	33.3	5.1	61.0	1240	2.25	BNF 680

APPENDIX 4 PRICES



Graph 1. Wheat prices and penalties.



Graph 2. Other prices.

LIST OF ILLUSTRATIONS

Plate 18

Series 6a

1. Large horn Ammon, BnF Seymour de Ricci.
2. Svoronos 1491, CNG Electronic Auction 141 (7/6/2006), lot 103.
3. Svoronos 1492, BnF 651.
4. Svoronos 1493, BnF Maspero.
5. Svoronos 1154, BnF Maspero.
6. Svoronos 1496, Athens 531.

Plate 19

Series 6b

7. Svoronos 1423, BnF Luynes 3601.
8. Svoronos 1233, BnF 660.
9. Svoronos 1173, D. Wolf GAE 313.
10. Svoronos 1155, Athens 536.

Series 6c

11. Svoronos 1424A, BnF 435.
12. Svoronos 1494, BnF Seymour de Ricci.
13. Svoronos 1495, BnF Luynes 3598.
14. Necropolis 131-4, D. Wolf GAE 358.
15. Svoronos 1195, Athènes 31.

Plate 20

Series 6d

16. Svoronos 1375, R. N. Draskowski.
17. Svoronos 1376, BnF 656.
18. Svoronos 1377, BnF 446.
19. Svoronos 1378, Rosenblum Coins.
20. Svoronos 1379, ANS 1944.100.77345.

Series 6e

21. Herakleion 2.
22. Svoronos 1234, BnF Seymour de Ricci.
23. Svoronos 1236, BnF 709B.
24. Svoronos 1238, BnF 691.
25. Svoronos 1156, BnF Cousinery 710.

Plate 21

Series 7a

26. Svoronos 1380, BnF 566.
27. Svoronos 1381, <http://www.acsearch.info/record.html?id=36584>.
28. Svoronos 1382, BnF 412.

Series 7b

29. Svoronos 1383, <http://www.acsearch.info/record.html?id=9850>.
30. Svoronos 1384, BnF 676.
31. Svoronos 1385, <http://www.acsearch.info/record.html?id=101416>.
32. Svoronos 1386, BnF Seymour de Ricci.
33. Svoronos 1387, BnF 413.

Plate 22

Series 7c

34. Svoronos 1424, BnF Seymour de Ricci.
35. Svoronos 1235, BnF Seymour de Ricci.
36. Svoronos 1239, Athens D329A.
37. Svoronos 1240, Athens 1074^a.

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Ptolemaic Bronze of the Second Century BC



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Ptolemaic Bronze of the Second Century BC

Plate 20



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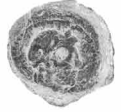
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Ptolemaic Bronze of the Second Century BC



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Tiberius Claudius Drusus