

**Electrum coins, currency exchange and transaction costs  
in Archaic and Classical Greece**

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*Abstract:* This paper is part of a more general investigation into currency exchange and transaction costs in the ancient Greek world. I will limit myself here to the issue of currency exchange connected with the use of electrum coinage. The electrum coinage of Western Asia Minor, perhaps introduced around 590-580 BCE, had all the advantages of monometallism and the lowered transaction costs associated with the use of money. However, it also had some drawbacks, and as early as the 550s a bimetallic (gold-silver), and later, a trimetallic system (with bronze) was introduced. This new system simplified the production of coins and alleviated users' mistrust of coins struck on an alloy like electrum. But multimetallic also introduced a new complexity and raised transaction costs linked to the use of money. The initial electrum coinage certainly made a major contribution to the success of money as a new means of payment. During the Classical period, the apparently paradoxical continued activity of some local or regional electrum mints (those of Phokaia, Mytilene, Lampsacus and above all Cyzicus) paradoxically helps explain monometallism's initial success.

In his famous book *Banques et banquiers dans les cités grecques*, R. Bogaert made some points about currency exchange in ancient Greece that are still fundamental, even though new documents have subsequently been published and further studies have been devoted to the topic<sup>1</sup>. I do not seek to replace this standard study. In the overall framework of research on currency exchange and transaction costs in the ancient Greek world, I will limit myself to the issue of currency exchange linked to the use of electrum coinage.

Why was currency exchange needed in the ancient Greek world? One might start from the contemporary situation. Today currency exchange usually involves several different currencies. Bureaux de change exchange foreign currencies for travelers. Banks perform the same task for large-value transfers in international payments. However, there is also a more ordinary activity of exchange, one which in Europe is commonly performed by banks and in the USA by specialized currency exchange agencies, *viz.* that of transforming values from one denomination to another within the same currency system. For example, retail shopkeepers

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<sup>1</sup> R. BOGAERT, *Banques et banquiers dans les cités grecques*, Leyden, 1962, p. 42-50, 308-331 and 397-398 (henceforth BOGAERT 1968). The texts relating to currency exchange have been gathered by J. R. MELVILLE JONES, *Testimonia Numaria: Greek and Latin Texts concerning Ancient Greek Coinage*, I: *Texts and Translations*, London, 1993, p. 375-399; II: *Addenda and Commentary*, London, 2007, p. 7-8 and 253-264.

transform their small change into banknotes or vice versa. Interestingly enough, in the USA these exchange agencies also cash checks, and this may give us as hint as to the way ancient moneychangers came to develop a banking activity.

In Antiquity, when did the activity of money exchange begin? Although our information is virtually non-existent for the earlier period, it seems likely that « currency exchange » is as old as the usage of precious metal as money –which means that it probably antedates the first coinage. The inauguration of coinage probably amounted only to the adoption of a new way of performing this old function.<sup>2</sup> Anyway, one could apparently hypothesize that in the first, « electrum only » phase of the history of coinage, currency exchange played a limited role as compared to later periods, that it was necessarily limited to interchange between coins of small and high value, and to exchange between coins of different standards. Is this hypothesis correct?

It now seems very likely that electrum coinage started in Western Asia Minor around 600 BCE or soon thereafter, possibly between 590 and 580<sup>3</sup>. First, it should be stressed that most of the electrum mints in this region used the Milesian (also called Lydo-Milesian) standard with a stater at c. 14.30-14.40 g. and its divisions. Only two cities had their own separate standard, Phokaia with a theoretical stater at 16.50 g., and Samos with a theoretical stater at 17.40 g.<sup>4</sup> The major states of the region, viz. the Lydian kingdom, Ephesus, Miletus, and several other unidentified cities also struck coins on the Milesian standard<sup>5</sup>. While this

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<sup>2</sup> On this point, G. LE RIDER, *La naissance de la monnaie. Pratiques monétaires de l'Orient ancien*, Paris, 2001, p. 16 should certainly be followed, *pace* R. BOGAERT, *Les origines antiques de la banque de dépôt, une mise au point accompagnée d'une esquisse des opérations de banque en Mésopotamie*, Leyden, 1966, p. 174. There has been a long debate among specialists as to whether the allusion to the money-changers of Byzantium concerned a date as early as the end of the sixth century BCE, since its mention by Ps.-Aristotle (*Econ*, II 1346b 24-28), which is placed between allusions to the tyranny of Lygdamis at Naxos and that of Hippias at Athens, suggests a date in this period – see discussion in R. BOGAERT, *op. cit.* (n. 1), p. 119-20 (with previous references); Bogaert favors an early date. However, what seems an allusion to exchange of coins does not make it impossible (if for instance croeseids were alluded to), but simply unlikely that the anecdote should be situated in the third quarter of the sixth century, more than one century before the inauguration of a mint at Byzantium.

<sup>3</sup> G. LE RIDER, *op. cit.* (n. 2), p. 62-67. D. M. SCHAPS, *The Invention of Coinage and the Monetization of Ancient Greece*, 2004, p. 96.

<sup>4</sup> L. WEIDAUER, *Probleme der frühen Elektronprägung*, Fribourg, 1975, p. 13 for a general introduction; H. NICOLET-PIERRE, *Numismatique grecque*, Paris, 2002, p. 114-123, for a detailed presentation.

<sup>5</sup> K. KONUK, *Sylloge Nummorum Graecorum. Turkey 1. The Muharrem Kayhan Collection*, Istanbul – Bordeaux, 2002, no. 673-731; *Id.*, *Karun' dan Karia'ya - From Kroisos to Karia*,

was not the case for those of one or several unidentified mints, the gold-silver ratio in the alloy of the Lydian royal coins was maintained at the same levels<sup>6</sup>. This contrasts with Samian coins, where the gold content could vary considerably<sup>7</sup>. It would be highly desirable to determine what it was in coins of Miletus or Ephesus.

On the basis of the similarity of standard, G. Le Rider has postulated the existence of a kind of monetary union among these cities<sup>8</sup>. This issue deserves a close attention. It should be observed that notwithstanding long periods of conflict between these cities and the Lydian kingdom, all of them finally had to acknowledge Lydian supremacy, the last one to submit being Miletus at the time of Croesus<sup>9</sup>. Together, the minting states represented by far the greater part of the region's economic activity in terms of population, agricultural production or volume of trade. A monetary union has the advantage of lowering transaction costs connected with to payment in coin. With this standardization, a state's coins might well circulate beyond its borders. The coins of the Artemision were minted by several states, and this might suggest that at least at Ephesus the circulation of coins of various provenances struck on the Milesian standard was fully legal. In this collection of coins struck solely on the Lydo-Milesian standard, there are only two « seals » of Phokaia (on the Phokaian standard)<sup>10</sup>. It should be noted that the hoards of electrum coins we possess consist of coins struck on the Milesian standard from various cities and the Lydian kingdom alone, or coins from Samos alone<sup>11</sup>. If all the states striking on the Milesian standard had made the coins of the other states minted on this same standard legal tender (which would have avoided the need for

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*Early Anatolian Coins from the Muharrem Kayhan Collection*, Istanbul, 2003, 17-37; among these cities was possibly Erythrai (*ibid.*, p. 18).

<sup>6</sup> M. R. COWELL, K. HYNE, N. D. MEEKS, P. T. CRADDOCK, *Analyses of the Lydian Electrum, Gold and Silver Coinages*, in W. A. ODDY, and M. R. COWELL (eds.), *Metallurgy in Numismatics*, Vol. 4, Royal Numismatic Society Special Publication No. 30, London, 1998, p. 526-538 (p. 529-530: « The gold contents of the [Lydian royal] coins are very consistent (a desirable attribute for coinage), with all but two of the royal types within 1% of the average 53% »); M. R. COWELL and K. HYNE, *Scientific Examination of the Lydian Precious Metal Coinages*, in A. RAMAGE and P. CRADDOCK, *King Croesus' Gold. Excavations at Sardis and the History of Gold Refining*, Cambridge (Ma), 2000, p. 169-174.

<sup>7</sup> K. KONUK, *The Electrum Coinage of Samos in the Light of a Recent Hoard*, in E. SCHWERTHEIM and E. WINTER (eds.), *Neue Forschungen zu Ionien*, Asia Minor Studien 54, Bonn, 2005, p. 43-55.

<sup>8</sup> G. LE RIDER, *op. cit.* (n. 2), p. 91-92.

<sup>9</sup> Herodotus, I, 15-28.

<sup>10</sup> H. NICOLET-PIERRE, *op. cit.* (n. 4), p. 110-116.

<sup>11</sup> Samian coin only hoards: H. NICOLET-PIERRE and J.-N. BARRANDON, *Monnaies d'électrum archaïques, le trésor de Samos de 1894 (IGCH 1158) conservé à Paris*, in *RN*, 152, 1997, p. 121-135; K. KONUK, *art. cit.* (n. 7).

currency exchange), or lowered the exchange premium, this would have lowered transaction costs. So can it be presumed that within the « Milesian standard zone », coins could either circulate freely and be accepted at par in the several states, or with a standard and minimal exchange premium? This would be the ideal scenario. And this must have been partly true. But setting aside the royal Lydian coins, the variations of gold content between the several mints may have raised problem for traders and may have made it necessary to have recourse to moneychangers to examine the coins more closely<sup>12</sup>. All in all however, the hypothesis of a formal agreement to create a kind of monetary union (however imperfect it may have been) among the above-mentioned states remains attractive.

Admittedly, no text of this period allows us to illustrate this view. But, for a later period and in a similar situation, we know for certain that in cities belonging to a monetary union no exchange fees, or lower exchange fees, were exacted for using coins struck on the same standard by another city in the union. Two cities on the coast of Western Asia Minor, Mytilene and Phokaia, minted electrum from the fifth century to the 320s. Their *hektai* on the Phokaian standard (weighing c. 2.5+ g.) retained a certain regional importance.<sup>13</sup> From an inscription dating probably to the second half of the fifth century we know that the two cities minted alternately and that they had made a formal commitment to maintain a fixed proportion of gold and silver in the alloy of their coins<sup>14</sup>. An anecdote attributed to the fourth-century historian Kallisthenes provides a decisive bit of evidence. According to Kallisthenes, the poet Persinos, neglected by the tyrant Euboulos of Atarneus (in Aeolis, to the north of Phokaia), went to Mytilene and from there « wrote to him that he could exchange the Phocean

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<sup>12</sup> Beyond their differences and their conflicts, the cities minting on different standards also shared some common interests. Inevitably also, there must have been conversions between coins on the Milesian or Phokaic or Samian standard.

<sup>13</sup> F. BODENSTEDT, *Die Elektronmünzen von Phokaia und Mytilene*, Tübingen, 1981, p. 46-66 and tables p. 314-320. Summary in F. DE CALLATAY, *Recueil quantitatif des émissions monétaires archaïques et classiques*, Wetteren, 2003, p. 179-183, Mytilene, and 185-189, Phokaia. On the special place of electrum coins during the Athenian *arche*, see Th. FIGUEIRA, *The Power of Money. Coinage and Politics in the Athenian Empire*, Philadelphia, 1998, p. 92-109.

<sup>14</sup> *IG*, XII.2, 1 (Tod<sup>2</sup>, 112; J. R. MELVILLE JONES, *op. cit.* [n. 1 – 1993], p. 256-259, no. 348, with *op.cit.* [n. 1 – 2007], p. 199-200). See A. J. HEISSERER, *IG XII, 2, 1. (The Monetary Pact between Mytilene and Phokaia)*, in *ZPE*, 55, 1984, p. 115-132, with revision of the stone and full commentary, dates it to the second half of the fifth century, more precisely around 426 BCE, and not to the end of the fifth – beginning of the fourth century (perhaps in 394 or not long after) as privileged by F. BODENSTEDT, *op. cit.* (n. 13), p. 29-33, who anyway rightly stresses that the convention must have reproduced clauses of previous agreements.

coins he had brought with him more easily at Mytilene than at Atarneus »<sup>15</sup>. The poet thus ridiculed the tyrant, claiming that he too could defend his interests by going to Mytilene and avoiding a heavy exchange premium. The jest alluded to Euboulos' stinginess and to his past as a banker, mentioned by Strabo<sup>16</sup>. But it makes sense only in the framework of the monetary pact between Phokaia and Mytilene. It is thus clear that the monetary pact was still valid around 360 BCE, the time of the anecdote.<sup>17</sup> It is even likely that the pact was valid all during the classical period. This shows that outside such a union exchange heavy fees could be exacted, while within the union the cities benefited from lower transaction costs. It seems likely that, although not sharing the minting operation, the states striking on the Milesian standard in the first half of the sixth century did so on a similar basis, that of a monetary union between them.

In other words, in the form it took in the first half of the sixth century BCE, electrum coinage seems to have been the ideal form of commodity money. The majority of the states striking coins did so on the same standard, thus possibly avoiding or limiting exchange fees between states belonging to this « monetary union ». With many different denominations (although these were not represented in every single city minting on the Milesian standard), it allowed a very wide range of payments from the full stater to very small units of 1/96 and even 1/192 of a stater. Above all, striking on a single metal presented the advantage of avoiding the exchange of coins of different metals. Monometallism is the perfection of commodity money. These reasons, which do not explain why *coinage* was introduced, must however have strongly contributed to the initial success of *electrum coinage*.

Thus in the initial phase following the « big bang » represented by the invention of minting, a kind of perfection seems to have been achieved in the system of the electrum coinage. Nevertheless, over time, this apparently perfect system « deteriorated » into a bimetallic (gold-silver) and later even a trimetallic one (gold-silver-bronze) system. A few years before the Persian invasion of 546, Croesus' Lydian kingdom introduced coins of pure gold and of pure silver, the so-called croeseids<sup>18</sup>. At first, the Persians retained the croeseids

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<sup>15</sup> γράψαι διότι τὰς Φωκαίδας, ἄς ἔχων ἦλθεν, ἥδιον ἐν Μιτυλήνῃ μᾶλλον ἢ ἐν Ἄταρνεί καταλλάττει, Pollux, IX, 93, 5 (= Kallisthenes, *FGrHist*, 124 F 4; J. R. MELVILLE JONES, *op. cit.* [n. 1 – 1993], p. 454-455, no. 656, and *op. cit.* [n. 1 – 2007], p. 297).

<sup>16</sup> Strabo XIV, 1, 57; see also Diogenes Laertius [*Life of Aristotle*], V, 3. On Euboulos, F. STÄHELIN, *RE*, Suppl. III (1918), s.v., col. 444-445.

<sup>17</sup> This point has been made by J. HEALY, *Notes on the Monetary Union between Mytilene and Phokaia*, in *JHS*, 77, 1957, p. 267-268.

<sup>18</sup> For the date, N. CAHILL and J. H. KROLL: *New Archaic Coin Finds in Sardis*, in *AJA*, 109, 2005, p. 589-617. See also K. KONUK, *op. cit.* (n. 5 – 2003), p. 40-47.

but after 520, under Darius, they established a similar separate coinage with the silver siglos and the gold darics<sup>19</sup>. Meanwhile, the Greek continent saw the triumph of silver. Around 540 – 520 BCE, it seems, several cities began to strike silver, and silver alone. In the Greek world in general, the Greek cities that struck gold coins (for instance Cyrene in the fourth century or Rhodes in the late Hellenistic period) were rare, or did so only under exceptional circumstances (like Athens at the end of the Peloponnesian war). Only the most powerful states like the Macedonian monarchy in the fourth century or the Hellenistic kingdoms in the Hellenistic period could do so. With the separate coinage of gold and silver the uncertainty regarding the composition of the alloy was definitively resolved. This indeed was a great advantage. However, the new bimetallic system immediately had to face the question of the diverging development of the intrinsic value of the two metals. Indeed, bimetallicism makes it impossible to set a permanent ratio between silver and gold coins. Even if an official rate was set, one can easily imagine how real market prices could provoke serious difficulties in the conversion of a given amount of money in gold or in silver. The problem was famously highlighted by Carlo Cipolla for medieval Florence. There the variations of the gold-silver ratio provoked serious difficulties and even hampered trade<sup>20</sup>. In such a system, the problem of converting gold coins into silver coins and vice versa could only be resolved by a specialist. Even if most Greek city-states never struck gold, electrum coins from Cyzicus or Lampsacus and darics commonly circulated in the Greek world as a means of payment among traders and members of the elite<sup>21</sup>. Later, gold coins issued by the kings of Macedon or by Hellenistic kings were also commonly used for large payments. Variations in the gold-silver ratio made recourse to moneychangers all the more necessary, and led to the imposition of heavy exchange fees.

For silver, as for electrum, exchange consisted in the conversion between coins of different standards and conversion within the same standard or city of small change into

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<sup>19</sup> K. KONUK, *op. cit.* (n. 5 – 2003), p. 48-54.

<sup>20</sup> C. M. CIPOLLA, *Il fiorino e il quattrino. La politica monetaria a Firenze nel Trecento*, Bologne, 1982, p. 23-28 (English trans. *The Monetary Policy of Fourteenth-Century Florence*, Berkeley, 1983).

<sup>21</sup> D. M. LEWIS, *Persian Gold in Greek International Relations*, in *L'or perse et l'histoire grecque* [= *REA*, 91], Bordeaux, 1989, p. 227-236 ; M. F. BASLEZ, *La circulation et le rôle des dariques en Grèce d'Europe à la fin du V<sup>e</sup> et au IV<sup>e</sup> siècles Apport des inscriptions phéniciennes et grecques*, *ibid.*, p. 237-248; G. MANGANARO, *Darici in Sicilia e le emissioni auree delle poleis siceliote e di Cartagine nel V-III sec. a.C.*, *ibid.*, p. 299-317. These coins could also make their way to the treasures of the great cities (see E. KOSMETATOU, *A Numismatic Commentary of the Inventory Lists of the Athenian Acropolis*, in *RBN*, 147, 2001, p. 11-37).

larger denominations or the other way round. But the situation was now far more complex than for electrum because in the Greek world silver was from the outset struck in accord with a series of standards. In the course of time, all kinds of variations were introduced even within the same theoretical standard zone. With the exception of some rare coins like those of Aegina until the Peloponnesian war and those of Athens all through the fifth and fourth centuries, which set international standards of value, there was no easy interchange between these many coins and standards. This means that only specialists in currency exchange could perform the job, and that in this respect, as compared to the first, original (and short-lived) phase of coinage, transaction costs linked to the international use of money were comparatively higher in classical Greece. The situation may have been somewhat better in Hellenistic Greece, with the new international role of the alexanders, but the proliferation of closed monetary zones limited the unification of the Greek world. The adoption of bronze for all small-value coins, which began in the middle of the fifth century and was gradually adopted all over the Greek world, introduced a new complexity, with additional, heavy transaction costs for exchanging bronze against silver (or gold).

So the question must be raised as to why the apparently perfect system of electrum coinage was abandoned. In fact, the reasons are many and only some of them can be mentioned here. As for the electrum coins themselves (the only aspect of the issue considered in this paper), it had a series of drawbacks. Even setting aside their impracticability (a diameter of 2.5 millimeters and a weight of 0.08 gr for the smallest 1/192 of a stater), the high value of the alloy made even the smallest 1/96 or 1/192 coins unsuitable for the very small retail payments that were so frequent in the agora<sup>22</sup>. Above all, as is shown by metal analysis, minting states could manipulate the alloy. It has been suggested (with due care) that altering the proportions of gold and silver in the coins was a way of coping with variations in the respective values of gold and silver<sup>23</sup>. Insofar as silver probably tended to decrease in value at the end of the archaic period, one might apparently have expected a rise in the proportion of gold to compensate the loss of value of silver. In fact the opposite occurred, which might be explained by the reevaluation of gold as compared to silver. But using more silver and less gold has also been seen as a way for the state to make a profit by a process of devaluation.<sup>24</sup> It

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<sup>22</sup> 1/192 of stater: K. KONUK, *op. cit.* (n. 5 – 2002), no. 691, and (n. 5 – 2003), p. 33, no. 20. This does not mean, as too often admitted, that electrum coins could not be used on the agora.

<sup>23</sup> Th. FIGUEIRA, *op. cit.* (n. 13), p. 94.

<sup>24</sup> G. LE RIDER, *op. cit.* (n. 2), p. 96-99. However, this does not prove the validity of the hypothesis that making a profit was the reason for the introduction of coinage.

remains that these manipulations of the alloy certainly impaired confidence in electrum coinage. Interestingly, at the end of the Archaic period and at the beginning of the Classical period electrum coinage was abandoned almost everywhere<sup>25</sup>.

This makes it all the more surprising that in some regions electrum coinage was apparently able to maintain itself without difficulty. For large payments (frequently from mercenaries), and now in combination with gold, silver and bronze coins (no longer in a single currency), some electrum coinages were successfully used from the end of the sixth century to the first half of the third century BCE<sup>26</sup>.

I have already mentioned the mints of Phokaia and Mytilene in North-Western Asia Minor<sup>27</sup>. Their success in a limited region of the North-East Aegean was based on their allegedly fixed proportion of gold and silver. However, this does not mean that their gold content did not change over time, or even that this gold content did not vary somewhat from one coin to another.<sup>28</sup>

The electrum coins issued by Cyzicus (and by Lampsacus, though to a lesser extent) were in use during the same period. But these coins had a far broader geographical and economic impact. In fact, for two centuries the cyzicenes were the standard currency in the

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<sup>25</sup> Electrum was not abandoned *ex abrupto*. Miletus apparently continued to mint some electrum coins until the end of the Archaic period. Chios minted electrum between c. 525 and 510 (K. KONUK, *op. cit.* [n. 5 – 2003], p. 70). The Ionian cities might have minted an electrum coinage at the time of the revolt, but this is not certain (K. KONUK, *op. cit.* [n. 5 – 2003], p. 64-70). The Rhodian cities of Ialysus, Camirus and Lindus minted a limited electrum coinage, before or possibly in parallel to their silver coinage at the end of the Archaic period (B. HEAD, *Historia Numorum*<sup>2</sup>, Oxford, 1911, p. 636-637; Th. FIGUEIRA, *op. cit.* [n. 13], p. 87, and above n. 10; H. NICOLET-PIERRE, *Monnayage archaïque dans le Dodécanèse: un état des questions, Obolos*, 8, 2006, p. 45-64, esp. p. 50-51).

<sup>26</sup> H. NICOLET, *op. cit.* (n. 4), p. 194-196 for an overview. This was the case at Syracuse at the end of the fourth and beginning of the third century BCE, G. K. JENKINS, *Electrum Coinage at Syracuse*, in C. M. KRAAY and G. K. JENKINS (eds.), *Essays in Greek Coinage Presented to Stanley Robinson*, Oxford, 1968, p. 145-162 (with strong variations in gold content). See also G. MANGANARO, *art. cit.* (n. 21), p. 313-314 for the chronology. For Carthage, G. K. JENKINS and R. B. LEWIS, *Carthaginian Gold and Electrum Coins*, Royal Numismatic Society, London, 1963.

<sup>27</sup> See above p. 000 (à completer).

<sup>28</sup> Content of gold in the first electrum coins of Phokaia and Mytilene (F. BODENSTEDT, *op. cit.* [n. 13], p. 334-335, based on a X-Ray analysis): « 600-522 », c. 55.5% (Phokaia) ; « 521-478 », c. 46% (Phokaia) and 44% in Mytilene ; « 478-326 » c. 40-41% (Phokaia and Mytilene). A new study of the alloy of these coins by protonic activation analysis (PAA) would produce more reliable figures.

Straits region and all over the Pontic area.<sup>29</sup> The gold content of these coins appears to have decreased over time, although there may have been a slight increase toward the end of this period.<sup>30</sup> From the results of currently available analyses, it seems that the variation from one coin to another was not negligible<sup>31</sup>.

The variations in gold content probably quite imperfectly reflected the changes the value of gold; the ratio of silver to gold varied from a maximum of 14:1 in the mid-fifth century to a minimum of 9.5:1 in 329/8 in Athens<sup>32</sup>. Moreover, we should not neglect the fact that the price of gold and silver could vary from one region to another during the same period. The paradoxical survival of electrum coins may well have been based on their ability to solve the problem of defining an exchange rate between large gold and silver coins (those used in international trade) in a region like the Euxine where, owing to wide contact with a huge and unstable barbarian world, the gold-silver ratio may have been particularly unstable. If this hypothesis is correct, it would mean that in the Pontic area the advantage of not having to define an exchange rate between gold and silver was seen as outweighing uncertainties regarding the gold-silver ratio in individual coins.

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<sup>29</sup> L. MILDENBERG, *The Cyzicenes: A Reappraisal*, in *AJN*, 5-6, 1993-1994, p. 11-12; I. TOURATSOGLU, *Statères d'Alexandre et statères de Cyzique: le trésor du Pirée, 1882* (IGCH 47), in M. AMANDRY and S. HURTER (eds.), *Travaux de numismatique grecque offerts à Georges Le Rider*, London, 1999, p. 351-357; A. M. BUTYAGIN, and D. E. CHISTOV, *The hoard of Cyzicenes and shrine of Demeter at Myrmekion*, in *Ancient Civilizations from Scythia to Siberia*, 12, 2006, p. 77-131.

<sup>30</sup> T. N. SMEKALOVA and J. L. DJUKOV, *The Composition of the Alloy of Cyzicene Electrum Coins*, in *RBN*, 145, 1999, p. 21-35. Content of gold in the cyzicenes: period I « 600-500 », 60.8% ± 1.5; II 500-460, 56.3% ± 3.1; III 460-400, 53.2% ± 3.5; IV 54.2% ± 2.4. But see the revision by D. CAIRNS and T. P. HUTCHINSON, *Did the Gold Content of Cyzicene Electrum Coins Decline over Time? A Study Using Elaboration as a Statistical Survey*, in *RBN*, 147, 2001, p. 51-55 (the evolution pattern is far from clear; the variation was irregular and there was no steady decline). Again also, a new study of the alloy of the cyzicenes by protonic activation analysis would be most welcome.

<sup>31</sup> Apparently, there was for instance a 6.2 point difference between the coin with the highest gold content (56.4%) and that with the lowest gold content (50.2%), see T. N. SMEKALOVA and J. L. DJUKOV, *art. cit.* (n. 30), p. 35. Differences of the same range (11-12%) can apparently be observed for the *hektai* of Mytilene and Phokaia. Did these variations correspond to a deliberate will of cheating the user? This cannot be excluded. But one should not neglect that, in the technical conditions of Antiquity, alloying two metal of not perfect purity (and even three, as some copper was also added) inevitably raised the range of relative error for the final alloy.

<sup>32</sup> T. N. SMEKALOVA and J. L. DJUKOV, *art. cit.* (n. 30), p. 26; J. R. MELVILLE JONES, *The Value of Gold at Athens in 329/8 BC*, in *AJAH*, 3, 1978, p. 184-187, with S. D. LAMBERT, *IG II<sup>2</sup> 1471 and the Value of Gold at Athens in the 320s B.C.*, in *ZPE*, 110, 1996, p. 84-86.

This also means that the privileged status of electrum coins was fully acknowledged. A famous decree of Olbia settled (at least for a given period) an official exchange rate for cyzicenes at Olbia (one cyzicene for eight and half local silver drachmas). This avoided controversies regarding the gold-silver ratio. Given the uncertainty linked to the electrum in the cyzicenes and variations in the value of gold and silver, the city played its institutional role of limiting the possible conflicts over the exchange rate<sup>33</sup>. In all likelihood, the exchange rate favored those who brought cyzicenes, and this was a way to attract them to Olbia<sup>34</sup>.

For all its benefits in lowering transaction costs, monometallism in the form of the electrum coinage was short-lived in ancient Greece. A bimetallic (gold-silver) and, later, a trimetallic system (with bronze) was probably introduced within half a century. Multimetallicism alleviated mistrust of coins struck on alloys but introduced a new complexity and raised transaction costs connected with the use of money. As for the initial electrum coinage, it certainly made a major contribution to the initial success of coinage as a new means of payment. The later and broad success of some local or regional electrum mints during the Classical period (those of Phokaia, Mytilene, Lampsacus and above all Cyzicus) paradoxically helps explain the initial success of monometallism.

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<sup>33</sup> On this point, see A. BRESSON, *L'économie de la Grèce des cités*, II, Paris, 2008, p. 34-39.

<sup>34</sup> Text and discussion in L. DUBOIS, *Inscriptions grecques dialectales d'Olbia du Pont*, Genève, 1996, p. 28-39, no. 14, new date (c. 375-350), crucial new restoration of ll. 24-25 (following Y. Vinogradov and P. O. Karyshkovski), and bibliography.