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The Byzantine gold coinage of *Spania* (Justinian I to Heraclius)

To the memory of Philip Grierson
on the hundredth anniversary of his birth
15 November 2010

Résumé – On publie ici les résultats de mesures du poids spécifique pratiquées par P. Bartlett sur 23 des 32 exemplaires connus de ces rares tremisses, frappés par les Byzantins, à Carthagène ou à Malaga, entre le milieu du VIe siècle et 625 environ. Ces résultats sont comparés à d'autres données en grande partie inédites du monnayage wisigoth de la même période. Le déclin du titre est plus ou moins parallèle depuis Justinien (env. 90 %) jusqu'à Héraclius (env. 72 %). Mais un examen attentif des données semble indiquer que les autorités byzantines se calquaient avec retard sur l'étalon visigoth. Il est probable qu'elles devaient tester les monnaies du royaume visigoth et en recyler probablement une partie afin de rendre leurs tremisses acceptables dans la zone de circulation sud-ibérique. L'analyse des coins, évidemment bien incertaine vu le petit nombre d'exemplaires, indique provisoirement des émissions dix fois supérieures dans la première période à celles de Phocas et Héraclius.

Summary – We publish the results of measurements of specific gravity by Peter Bartlett on 23 of 32 known coins of the rare Byzantine tremissis coinage minted in *Spania* at Cartagena or Malaga from the mid sixth century to about 625. These results are compared with other largely unpublished analyses of Visigothic coins of the same period. The fineness declined gradually over time from Justinian (c. 90 %) to Heraclius (c. 72 %). This decline followed, but was always behind, that of the fineness of the Visigothic coinage. It is likely that the Byzantines were measuring the gold content of the circulating Visigothic coins and adjusting their coinage alloy to make it acceptable in the area of Southern Iberia. Of course, they may have reminted Visigothic coins without adjusting the alloy. The estimation of the size of the coinage, obviously very uncertain due to the low numbers, suggests that is was much smaller that that of the Visigoths and that is was of the order of ten times larger in the period of Justinian to Maurice than it was later under Phocas and Heraclius.

Over 50 years ago Philip Grierson made the startling proposal that a series of gold coins minted in the names of emperors from Justinian to Heraclius, many of which had hints of a Spanish origin, were produced by the Byzantines, probably at Cartagena, in their province of *Spania*, an enclave on the Mediterranean coast

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they held from c. 552-625.[1] While numismatists have generally accepted Grierson's attributions and they are included in major catalogues,[2] some Spanish historians and archaeologists and others have expressed doubts.[3] While the first of us was collecting data on the metrology of Visigothic coins from the 6th and 7th centuries AD at the American Numismatic Society in 2001, it was decided to include the Byzantine coins which Grierson had identified as being from *Spania* and subsequently it was decided to include all available coins in other collections.[4] Hence the long gestation period for this paper.

Method

The specific gravity (SG) method for estimating gold content was chosen at the beginning of the project as it is the only method of analysis that can be carried out *in situ* in the relevant collections. It has the added advantage of being completely non-destructive. The measurement of specific gravity as a method of analysis for gold content depends on Archimedes' Principle[5] which states that 'any floating object displaces its own weight of immersion fluid'. There is, however, no evidence that the Greeks adapted this principle for the quantitative assaying of gold alloys, and the earliest reference to specific gravity analysis dates from the 6C AD.[6] Since the nineteenth century, specific gravity analysis

1. P. Grierson, Una Ceca Bizantina en España, *Numario Hispánico*, 4, 8, 1955, pp. 305-314 (henceforth Grierson).

2. E.g. *DOC*., *BNCByz*, *MIB, MIBE, MIBEC* and D. Sear, *Byzantine Coins and their values*, 2nd ed., London, 1987.

3. J. Vizcaíno Sánchez, *La Presencia Bizantina en Hispania (Siglos VI-VII) La Documentación Arqueológica*, Murcia, 2009, pp. 687-725 and in particular pp. 714-716 (henceforth Vizcaíno Sánchez); D. Bernal Casasola, Bizancio in España desde la prespectiva arqueológica, in *Bizancio y al Península Ibérica, De la Antigüedad Tardía a la Edad Moderna*, edited by I. Pérez Martín and P. Bádenas de la Peña, Madrid, 2004, pp. 61-99, at p. 84; X. Barral i Altet, *La circulation des monnaies suèves et visigothiques*, Munich, 1976, p. 66 (henceforth Barral i Altet).

4. Acknowledgments: P. Bartlett wishes to thank the many curators, scholars and private collectors who helped him collecting data: Duncan Hook and Richard Abdy, British Museum, London; Marta Campo, Gabinet Numismàtic de Catalunya, Museu Nacional d'Art de Catalunya, Barcelona; Matthias Ohm, Landesmuseum, Stuttgart; Martín Almargo-Gorbea, Director Gabinete del Antigüedades, Real Academia de la Historia, Madrid; Robert Hoge and Elena Stolyarik, American Numismatic Society, New York; Paloma Otero, Museo Arqueológico Nacional, Madrid; Bernardo Moll, Menorca; Josep Pellicer, Asociación Numismatica Española, Barcelona; Francisco Giménez Chornet, Alberic; D.M. Metcalf, Oxford; Jaime Vizcaíno Sánchez, Universidad de Murcia; Gonzalo Cores, Madrid; Ruth Pliego, Seville. The authors are grateful to Maryse Blet-Lemarquand (CNRS, IRAMAT, Orléans) for analyzing the only Spania coin in the BnF and for her helpful complements.

5. Discovered by the Greek mathematician and physicist Archimedes of Syracuse c.287-c.212 BC.

6. A brief history of gold assay can be found in A. Oddy, Assaying in Antiquity, *Gold Bulletin* 16 (2), 1983, pp. 52-59 and Idem, The assaying of gold by touchstone in antiquity and the medieval world, in C. Eluère (ed.) *Outils et ateliers d'orfèvres des temps anciens*, Antiquités nationales Mémoires 2, Saint-Germain-en-Laye, 1993, pp. 93-100.

has been used intermittently for the study of the debasement of a number of gold coinages, but the method was improved in 1970 when a new dense immersion liquid, perfluoro-1-methyl decalin, became commercially available. The improved SG method for measuring the gold content of coins has been described in detail by British Museum scientists who introduced the new immersion liquid.[7] The method is relatively simple and only requires an analytical balance with an accuracy of at least 1 mg which, when not available on site, can be easily transported to where the coins are located. In addition, a large body of SG data for the coinage of the Visigoths from the same period is now available for comparative purposes.

Another factor relating to the choice of analytical method is that preliminary research indicated that some of the coins of *Spania* have a gold content of less than 80 %, similar to those of the Visigothic regal period, where surface enrichment can be a major problem. When gold is alloyed with baser metals, surface enrichment may occur due to baser constituents, in this case mainly silver, being leached out by damp and acidic soil during burial, or by cleaning which is commonly performed by dealers and collectors in a weak acid, leaving a surface layer enriched in gold.[8] Because SG is a bulk analysis method, it samples the whole coin and gives a more accurate value for the gold content than surface methods (such as X-Ray fluorescence) that depend on the depth to which they penetrate below the surface of the coin and hence overcome the varying effects of surface enrichment.

Except for Grierson's original observation that the color, especially of later issues, indicated they were of low fineness similar to those of the Visigoths, no analytical studies have been made of the coinage attributed to the Byzantines in Spain. Several analytical studies have, however, been published for the Visigothic coinage of the period and results using surface methods have been reported using the Milliprobe or XRF method, [9] the PIXE method,[10] the EDAX

7. W. A. Oddy and M. J. Hughes, The Specific Gravity Method for the Analysis of Gold Coins, in E. T. Hall and D. M. Metcalf (eds.) *Methods of Chemical and Metallurgical Investigation of Ancient Coinage*, Royal Numismatic Society Special Publication no. 8, London, 1972, pp. 96-107 (henceforth Oddy and Hughes); A. Oddy, The Analysis of Coins by the Specific Gravity Method, in W. A. Oddy and M. R. Cowell (eds.) *Metallurgy in Numismatics: Vol.4*, Royal Numismatic Society Special Publication no. 30, London, 1998, pp. 147-157.

8. P. T. Kyser and D. D. Clark, Analyzing and Interpreting the Metallurgy of Early Electrum Coins, in M. S. Balmuth (ed.), *Hacksilber to Coinage*, New York, 2001, pp.112-113.

9. D. M. Metcalf and F. Schweizer, Milliprobe analyses of some Visigothic, Suevic and other gold coins of the early middle ages, *Archaeometry*, 12, 1970, pp. 173-188 (henceforth Metcalf and Schweizer).

10. D. M. Metcalf, J. M. P. Cabral and L. C. Alves, Sixth-Century Visigothic Metrology, Some Evidence from Portugal, *AJN* 3-4, 1991-1992, pp. 65-90 (henceforth Metcalf et al.); M. Gomes Marques, J. M. Peixoto Cabral and J. Rodriques Marinho, *Ensaios Sobre História Monetária da Monarquia Visigoda*, Porto, 1995 (henceforth *Ensaios*) and G. Cores, J. M. Peixoto

method,[11] and the Proton Activation method.[12] The only major published study using a bulk method are the specific gravity values reported for the Fitzwilliam Museum collections.[13] However, Lauris Olson working at the ANS in 1987 measured the specific gravity of some 300 Visigothic coins in that collection. Although he never published the results they were subsequently included in a doctoral thesis at the University of Toronto by Andrew Kurt.[14] The authors of this paper have also measured specific gravities of Visigothic coins over a number of years and during this study an attempt was made to include more Visigothic coins from the relevant period so a large data base would be available to compare with the postulated 'Byzantine' coinage of *Spania*.

While surface analysis using modern instrumental analytical methods has the advantages of being more precise for the area and depth of the coin that they measure, and is able to detect and measure the concentrations of other metals, they can vary greatly in their results due to the effects of surface enrichment when the gold content is low. The pseudo-imperial coinage of the Visigoths from its beginning in the reign of Anastasius until well into the reign of Justinian (527-565) was of relative high fineness.[15] However, the gold content of later Visigothic coinage fell below 90 % and by the end of the period being studied was in the 60-80 % range where surface enrichment can be a major problem.

Cores et al.[16] reported the analysis of 11 coins of Reccared II (621) using the surface PIXE method. Because the reign of Reccared II was very short and close to the date when the Byzantine enclave in Spain was finally overrun with

Cabral, L. C. Alves and P. Bartlett, Visigothic mint practice, March 621: What can the coins of Reccared II tell us?, in M. C. Hipólito, D. M. Metcalf, J. M. P. Cabral, M. Crusafont i Sabater (eds.), *Homenagem a Mário Gomes Marques*, Sintra, 2000, pp. 195-218 (henceforth Cores et al.).

11. J. Vico Monteoliva, M. C. Cores Gomendio and G. Cores Uría, *Corpus Nummorum Visgothorum*, Madrid, 2006, pp. 83-108.

12. M. Guerra, Em busca da origen do ouro dos Visigodos atraves dos seus elementos traço, in M. C. Hipólito, D. M. Metcalf, J. M. P. Cabral, M. Crusafont i Sabater (eds.), *Homenagem a Mario Gomes Marques*, Sintra, 2000, p. 223-251 (henceforth Guerra)

13. P. Grierson, Visigothic metrology, *NC* 13, 1953, pp. 74-87 and P. Grierson and M. Blackburn, *Medieval European Coinage: 1: The Early Middle Ages (5th – 10th centuries)*, Cambridge, 1986, pp. 436-451 (henceforth *MEC*). The differences in values reported by the two studies were due to improvements in the methods in the second study such as the use of the immersion liquid perfluoro-1-methyl decalin with double the density and very low surface tension compared to water. The analyses reported in *MEC* were carried out by Andrew Oddy.

14. A. Kurt, *Minting, State and Economy in the Visigothic Kingdom ca. 418-ca. 713*, A Dissertation submitted to the Faculty of Arts and Sciences in the Candidacy for the Degree of Doctor of Philosophy, Centre for Medieval Studies, Toronto, 2001, Appendix I, pp. 223-225 and pp. 238-247 (henceforth Kurt).

15. *Ensaios, op. cit.* n. 10, reports surface measurement of 20 coins of Justinian with an average of 95.6 % gold (table II, p. 60). The SG measurements of 7 coins of the Ashmolean Museum reported here (see below figure 3 and appendix II) and 8 coins from the Fitzwilliam collection in *MEC* averaged 92.9 % gold, indicating little difference (<3 %) in the two methods at this level of fineness and suggesting a standard between 93 % and 96 %.

16. Cores et al., *op. cit.* n. 10.

the recapture of Cartagena (c. 624), the Reccared II coinage serves as an end point for the comparison of the metal content of the two coinages. Ten of the original coins of Reccared II measured by the PIXE method were reanalyzed using the SG method and the differences compared (figure 1). The average gold content of the ten coins measured by the PIXE method was 74 % while that of the SG method gave an average of 64 %, a 10 % difference[17] with a range of 5-18 %. At the time the analysis of the coins of Reccared II was made using the PIXE method, a few other coins were also tested, including one 'Byzantine' coin (No. 30[18]) in the name of Heraclius of the type believed to have been minted in *Spania*. This measured 80.4 % gold, 18.7 % silver, 0.8 % copper, and 0.1 % of iron. At the beginning of this study, the same coin using the equipment at the ANS gave a specific gravity value of 15.5 which corresponds to a gold/silver alloy of 70.1 % gold, or again 10 % lower than that given by the PIXE surface method. This is a considerable discrepancy even taking into account a possible negative error of up to 3 % in the SG method.[19] The large mean difference and the wide variations (5-18 %) in gold content as revealed by the two analytical methods are undoubtedly due in large part to surface enrichment. Even different surface methods can give greatly varying results on coins with low gold content depending on how deeply they penetrate the coin's surface.[20] Coins of low fineness,

Mint	No.[21]	Weight, g	PIXE % Au	SG % Au	Difference
Acci	1	1.40	75	64	11
Acci	2	1.38	71	65	6
Toleto	3	1.51	81	63	18
Toleto	4	1.40	77	68	9
Barbi	8	1.40	72	59	13
Eliberri	9	1.52	66	60	6
Eliberri	11	1.37	69	64	5
Ispali	14	1.44	76	67	9
Emerita	15	1.49	78	68	10
Emerita	16	1.40	79	66	13
Average		1.43	74	64	10

Figure 1 - Comparison of PIXE and SG methods of measuring gold content of coins of Reccared II.

17. The difference in the means is statistically significant at the 99 % level.

18. This No. and following refer to the *Spania* coins as listed in the Plates at the end of this paper.

19. Oddy and Hughes, *op. cit.* n. 7.

20. M. F. Araújo, L. C. Alves, J. M. P. Cabrai, "Comparison of EDXRF and PIXE in the analysis of ancient gold coins," *Nuclear Instruments and Methods in Physics Research Section B* 75 1-4, 1993, pp. 450-453. The two surface methods showed a good agreement for coins containing more than 94 % Au and a discrepancy reaching up to 15 % fineness between the PIXE and EDXRF methods, for Suevic and Visigothic coins 50 % to 80 % fine.

21. Cores et al., *op. cit.* n. 9.

such as those of Reccared II, derived from hoards where the analyzed coin may have been located in the middle of the mass of coins in a container and not therefore subject to direct contact with the soil, and not subsequently cleaned, would undergo little enhancement while those coins intimately exposed to damp acid soil, or cleaned in acid, would undergo varying degrees of surface enrichment.

The SG method has a theoretical experimental error of 1 % but also a few practical problems which have been reviewed by Oddy and Hughes.[22] The gold content is obtained using a conversion table derived from measurements on metal alloys of accurately known composition, in this case mixtures of gold and silver, but the coins may, in reality, contain other elements, in particular copper.

The PIXE measurements of the 10 coins of Reccared II[23] and a single Byzantine coin of Heraclius from the Spanish mint (No. 29) gave concentration values for copper of 0.6 to 1.3 % (average of 0.9 %) for the Visigothic coins and 0.8 % for the Byzantine coin of Heraclius from *Spania*.[24] This amount of copper would result in a slight negative error but not affect the conversion significantly.[25] A second problem with the specific gravity method is that the coins need to be clean and any substance adhering to the surface such as dirt, encrustations, or dermatological grease from handling the coins, will lower the SG readings. All the coins in this study were examined for dirt, and lightly cleaned with soap and water when possible, although it is probably impossible to completely remove all foreign material without a harsher cleaning. The coins were degreased in acetone although the perfluoro-1-methyl decalin used as the immersion liquid is an excellent degreaser when the owners objected to using acetone.[26] In the case of the coin of Heraclius (No. 29) some minor surface encrustations were noted and toward the end of the study the coin was cleaned in a weak acid removing the encrustations and possibly other less visible material which resulting in an increase in is SG equivalent to 1.5 % (see below, p. 000).

22. Oddy and Hughes, *op. cit.* n. 7.

23. Cores et al., *op. cit.* n. 10.

24. João Peixoto Cabral performed the PIXE analysis on the coin of Heraclius (No. 29) at the Instituto Tecnológico e Nuclear, Sacavém, Portugal. Other studies of more than 300 Visigothic coins where Cu was measured rarely found concentrations greater than 2 % before 625. See *Ensaios*, Metcalf and Schweizer , Metcalf et al., and Guerra. *Ensaios* measured 99 coins from Leovigild to Reccared II with an average of 1.1 % (range 0.4 to 1.8 %) using the PIXE method, while Guerra measured 26 of from Leovigild to Sisebut with an average of 1.6 % (range 0.2 to 3.1 %) using the Proton Activation method, which penetrates deeper than the other methods, and hence may be more accurate than the PIXE method. The BnF coin of Heraclius from Spania (No. 28) was recently analyzed by Maryse Blet-Lemarquand (CNRS, IRAMAT, Orléans) using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) method which gave a concentration of 1.2 % for copper (see below, p. 000).

25. Oddy and Hughes *op. cit.* n. 7, p. 87, state that "it appears that the presence of up to 5 per cent of copper lowers the calculated gold content by about 3.5 percent, …".

26. To avoid problems of contamination and temperature effects on its density, the density of the liquid was calculated on each run from the dry weight and immersion weight of two 1/20 oz Canadian Maple leaf coins, 0.99999 fine, weighting 1.5945 and 1.5920 g.

The coin of Heraclius from *Spania* (No. 29) was used as a standard and measured in several locations, including an independent measurement by Duncan Hook at the British Museum. In addition, several Visigothic coins have been measured twice by different people. The repeated measurements of the coin of Heraclius before cleaning ranged from 69.6 % to 70.5 % with a mean of 70.2 % and the value reported by the British Museum was 70.2 %. After cleaning, the coin was measured on 8 occasions (as customary each with three repetitions) giving values ranging from 71.4 % to 71.9 % with a mean of 71.7 %. In 2001, while measuring coins of the mint of Emerita of Sisebut and Suinthila at the ANS without the knowledge that Lauris Olson had measured some of them previously, twelve of the same coins were measured again. The second measurement of the twelve coins using the same equipment and technique, except for the immersion liquid,[27] gave differences in gold values ranging from -1.1 % to +1.0 % gold with an average difference of 0.3 % gold (figure 2). We believe that on a practical basis the SG method gives consistent results that rarely differ by more than 1 % in the measured gold content. However, although the results are consistent, the measured value may result in a negative error up to 3 % because of problems such as incomplete cleaning and small concentrations of other elements mentioned above.[28]

			L. Olson[29] in 1987			P. Bartlett in 2001			Difference
Ruler	**Mint**	**HSA No.**	**Weight, g**	**SG**	**Au %**	**Weight, g**	**SG**	**Au %**	**Au %**
Sisebut	Emerita	8109	1.45	15.30	68.20	1.455	15.37	68.90	0.70
Sisebut	Emerita	16119	1.51	15.30	68.20	1.506	15.29	68.10	- 0.10
Sisebut	Emerita	16108	1.43	15.30	68.20	1.428	15.29	68.10	- 0.10
Sisebut	Emerita	16454	1.48	15.70	72.10	1.482	15.82	73.20	1.10
Suinthila	Emerita	16178	1.42	14.60	61.00	1.416	14.68	61.80	0.80
Suinthila	Emerita	16184	1.43	14.90	64.10	1.488	14.80	63.00	- 1.10
Suinthila	Emerita	16186	1.42	14.70	62.00	1.424	14.76	62.60	0.60
Suinthila	Emerita	16192	1.43	14.90	64.10	1.431	15.00	65.10	1.00
Suinthila	Emerita	16193	1.52	14.50	59.90	1.515	14.59	60.90	1.00
Suinthila	Emerita	16208	1.43	1.47	62.00	1.433	14.70	62.00	0.00
Suinthila	Emerita	16196	1.51	14.90	64.10	1.512	14.93	64.10	0.00
Suinthila	Emerita	16453	1.50	14.60	61.00	1.439	14.54	60.30	- 0.70
	Average		1.46	13.85	64.58	1.460	14.98	64.84	0.26

Figure 2 - SG Measurements of the same coins in the ANS at two different times by different people.

27. Olson used trifluorotrichloroethane, another fluorocarbon.

28. Oddy and Hughes, *op. cit.* n. 7, concluded that taking into consideration all possible sources of error, "the actual gold content of a cleaned coin, which can be assumed to contain little or no copper, probably lies between the results found from the silver-gold calibration data and a figure which is 3 per cent higher."

29. Kurt, *op. cit.* n. 13.

Comparison of the intrinsic values between the Byzantine coinage of *Spania* and the Visigothic coinages

From Catalogue	Summary of measurements of Byzantine coins of *Spania*				
Emperor	**Dates**	**No. of Coins**	**Au %**	**Weight, g**	**Intrinsic Value, g**
Justinian	552-565	3 of 5 for SG	89.8	1.48	1.33
Justin II	565-578	4 of 4	88.5	1.33	1.18
Maurice	582-602	5 of 5	83.1	1.41	1.17
Phocas	602-610	3 of 5 for SG	72.1	1.42	1.02
Heraclius	610-626	8 of 11 for SG	72.3	1.41	1.02

From Appendix I	Summary Byzantine coins from Constantinople				
Emperor	**Dates**	**Sample**	**Au %**	**Weight, g**	**Intrinsic Value, g**
Justinian	552-565	8	96.7	1.48	1.43
Maurice	582-602	10	97.2	1.44	1.40
Phocas	602-610	9	94.7	1.46	1.38
Heraclius	610-626	8	97.0	1.44	1.40

From Appendix II	Summary Visigothic coins				
Ruler	**Dates**	**Sample**	**Au %**	**Weight, g**	**Intrinsic Value, g**
Justinian	552-565	16	93.4	1.38	1.28
Justin II-Leovigild	565-573	32	88.8	1.41	1.25
C-3 Leovigild?	c. 573-576	15	91.5	1.30	1.19
Leovigild IR	c. 576-580	10	77.0	1.31	1.01
Leovigild COS	> 578-584	18	73.3	1.26	0.93
Leovigild FB	584-86	26	74.0	1.46	1.08
Reccared I	586-601	104	72.7	1.48	1.08
Liuva II	601-603	13	71.6	1.47	1.06
Witteric	603-609	31	70.8	1.46	1.03
Gundemar	609-612	20	69.2	1.44	1.00
Sisebut	612-621	105	66.4	1.44	0.96
Reccared II	621	12	64.8	1.44	0.93
Suinthila (< 625)	621-624	68	62.4	1.42	0.89

Figure 3 - Summary of measurements of specific gravity from catalogue and appendices I - II.

Justinian

During the later half of the reign of Justinian I (527-565) the Byzantines arrived in the Iberian Peninsula (c. 552.). Five genuine tremisses are reported for Justinian I for the mint believed to have been established in *Spania* as well as one suspected contemporary counterfeit.[30] The SG of the three genuine and

30. Vizcaíno Sánchez, *op. cit.* n. 3, p. 713, reports a tremissis of Justinian found in Fitero near Pamplona but we believe it may be of the type produced by the Lombards in Italy and similar to *MEC* 294 and do not include it here, however its SG should be tested as *MEC* 294 was 97 % Au, higher than the *Spania* coinage of Justinian (90 %).

one counterfeit were measured, giving a mean value of 90 % gold content for the genuine coins and 81 % for the suspected forgery.[31]

For the Visigoth coinage, *MEC* reports SG measurements for eleven tremisses (*MEC* Nos. 192-202) with the legends interpreted as reading Justinian, of which we have excluded three, two of which have Tomasini reference numbers from the calculations.[32] In addition to the nine remaining coins in the *MEC* sample, seven previously unpublished measurements of coins attributed to Justinian from the Ashmolean Museum are included (figure 3 and Appendix II). The gold content of the 16 Justinian coins averaged 93 %. The gold content as determined from SG measurements of eight tremisses of Justinian from the ANS collection attributed to Constantinople (figure 3 and Appendix I) averaged 96.7 % gold and the difference from the Visigothic coins is statistically significant at the 99 % level.[33]

The average gold content of the three Byzantine coins struck in *Spania* for Justinian is 7 % lower than those struck in Constantinople and 3 % lower than that of the contemporary Visigothic coinage. However, it is difficult to know whether the 3 % difference is significant, especially with results for only 3 coins, and it is not much greater than the standard deviation of 2.2 for the Visigothic coins or the theoretical error in the measurements. Furthermore, the comparison with the Visigothic coinage is difficult because it is not possible to distinguish the coins of the Visigoths in the name of Justinian for the period after 552 from the earlier ones. It is possible that there was a small reduction the fineness of the

31. Grierson, *op. cit.*, n. 1, pp. 310-311, believed this coin from the ANS collection to be a contemporary forgery which its low fineness confirms.

32. **W. J.** Tomasini, *The Barbaric Tremissis in Spain and Southern France. Anastasius to Leovigild*, ANSNNM 152, New York, 1964 (henceforth Tomasini), considered *MEC* 192 (Tomasini 213) as a JI 3 type of Justin I, *MEC* 201 (Tomasini 333) is suspected of being a contemporary forgery while *MEC* 202 has very blundered legends making its attribution difficult. Tomasini is the major study of the Visigothic Imitative or Pseudo-Imperial coinage of the VPW (Victory Palm Wreath) type which was the standard currency after their retreat from Aquitaine in c. 509. Tomasini based his study on 660 coins of the VPW type, dividing them into 94 groups first by name of the emperor (A = Anastasius, JI = Justin I, JAN = Justinian and JII = Justin II, C with CURRU in legends, IR with the name of Leovigild in the Obv. and INCLITUS REX in the Rev., and H with the name of Hermenegild) and then into groups with Arabic numbers and lettered subgroups based on style. The two types following the VPW issues were first the COS (with a cross on steps in the reverse) and then the FB (with facing busts on both Obv. and Rev.) both starting in the reign of Leovigild and the latter lasting through the other reigns covered in this study.

33. C. Morrisson, J.-N. Barrandon et al., *L'or monnayé* I. *De Rome à Byzance : purification et altérations*, *CEB* 2, Paris, 1985, p. 203, found that the gold content of the six Constantinople solidi from the Bibliothèque Nationale analyzed by proton activation averaged 98.25 %. Proton activation analyzes a deeper part of the coin than XRF (down to 240 micrometers instead of between 5 and 50 micrometers) but it has been recently observed on Merovingian coins that the fact that it still does not reach the core of the coin could result in too high gold values as in the present case (Maryse Blet-Lemarquand, M. Bompaire, Cécile Morrisson, Platine et plomb dans les monnaies d'or mérovingiennes: nouvelles perspectives analytiques, *RN* 166, 2010, pp. 185-187).

Visigothic coins by the time the Byzantines began minting in *Spania,* and that the Byzantines followed the Visigothic standard at that time. The Visigothic coins of Justin II (565-578) averaged 90 %.[34]

The five Spanish mint Byzantine coins of Justinian average 1.48 g which is the same as the average weight of the seven tremisses from the Constantinople mint in the ANS collection. The average weights of the largest groups of JAN coins, with more than 10 coins (JAN 2-6 and JAN 8) reported by Tomasini, were slightly lower being in the range of 1.43-1.44 grams.[35] Metcalf et al. suggest that there was a slight weight reduction of the Visigothic coinage c. 520 with the modal values dropping to between 1.41 and 1.45 from the previous values of c. 1.49.[36] The average weight of the 16 coins in the *MEC* and Ashmolean samples was 1.38 but may be biased by four coins in the range 1.21 to 1.28 g without which the average is 1.42g. Sometime into the reign of Justin II, there was a definite and significant reduction in the weight standard of the Visigothic coinage to 1.3 grams[37] and it may be the four lower weight coins reflect this change if it began close to the end of the Justinianic period or if some of the Justinian coins in the sample were minted in the early reign of Justin II when this change had occurred.

In discussing our attempts to understand the coinage of the Byzantines and Visigoths we must not confuse our attempts at weighing the coins and analysing gold content by Specific Gravity or the various radiation techniques with the ability of the merchants and officials who used the coins to determine their weight and fineness. The normal method of weighing in the 6C was a swinging balance of the type which continued in use into the twentieth century when it was replaced by electronic balances. Experiments with an eighteenth century swinging balance have shown that it can detect a change of 0.05g and thus is capable of weighing with an accuracy of +/- 0.1g (i.e. it can distinguish between, for example, 1.3g and 1.4g). Byzantine coin weights are well known [38] and were made to check the weight of the gold coins, so the smallest that has been identified is that for weighing a tremissis.

As far as assaying is concerned, the method used by merchants was a touchstone.[39] This is a black pebble of sedimentary rock containing some silica, of

34. See below, p. 000.

35. Tomasini, *op. cit.* n. 32.

36. Metcalf et al., *op. cit.* n. 10, pp. 71-72.

37. Grierson and Blackburn, *MEC,* n.11, p. 50, attribute this reduction to a change to the Germanic weight standard of 20 grains.

38. S. Bendall, *Byzantine Weights: An Introduction*, London, 1966; C. Entwistle, Byzantine weights, in A. E. Laiou (ed.), *The Economic History of Byzantium*, Washington, DC, 2002, pp. 611-614.

39. A. Oddy, Assaying in Antiquity, *Gold Bulletin* 16 (2), 1983, pp. 52-59; W. A. Oddy, The Touchstone: the oldest colorimetric method of analysis, *Endeavour* (New Series) 10 (4), 1986, pp. 164-166; W. A. Oddy, The assaying of gold by touchstone in antiquity and the medieval world, in Chr. Eluère (ed.) *Outils et ateliers d'orfèvres des temps anciens*, Antiquités nationales, Mémoires 2, Saint-Germain-en-Laye, 1993, pp. 93-100.

the types that would be classified today as tuffs, cherts and siltstone. These were often shaped into a flat or elongated tablet of stone.[40] When a gold object, such as a coin, is rubbed on the surface of a touchstone it leaves a streak of the yellow metal on the surface. The color of the streak changes as the composition of the gold changes, getting less and less yellow as the fineness of the gold object diminishes. Touchstones were accompanied by a set of 'touch-needles' which are small pieces of gold alloys of accurately known composition. To effect an analysis, the touch-needles were also rubbed onto the stone one by one until a color match with the original streak was obtained. The coin then has the same composition as the matching touch- needle. Pliny (XXXIII, 126), writing in the first century A.D. mentions the use of the touchstone and tells us that it could detect silver or copper in gold to "a difference of a scruple." As there are 24 scruples in a Roman ounce we can assume that a touchstone could distinguish between an alloy of, say, 20 carats (75%) and one of 21 carats (79.17%). According to Robert Halleux, who has also discussed the text of Pliny as well as that of Theophrastus, "the *scripulari differentia* can be understood as referring to the ounce as above but also as referring to the pound (12 ounces)" thus implying that, as Theophrastus indicated in another text, assayers could distinguish differences of 1/12th of a carat.[41] In his comment on Theophrastus, Oddy rejected this implied increased accuracy and sided with Eichholz[42] who thought that the text of Theophrastes is corrupt at this point. Support for an accuracy when using the touchstone of 1 part in 24 in the ancient and medieval world comes from a 13th century document describing the minting of coins in the Ayyubid mint in Cairo. This describes the manufacture of a set of touch-needles with gold content increasing by 1 carat from one needle to the next.[43] This text is interesting from another point of view as it seems to be the first to mention the application of acid to the streak to observe the fading of the streak as the base metal (silver and/or copper) is dissolved. How much earlier acid was used in not known but it later became a standard practice so that expert assayers in the twentieth century are reported to have been able to distinguish down to ½ carat.[44] Our opinion is that while in the outlying province of *Spania*, in the principal centers of Cartagena and Malaga well equipped and experienced merchants or mint employees may have been able to detect difference of down to 1/24 or 1 carat, the general population probably could not.

40. D. T. Moore and W. A. Oddy, Touchstones: Some Aspects of their Nomenclature, Petrography and Provenance, *Journal of Archaeological Science* 12, 1985, pp. 59-80.

41. Halleux in *CEB* 2, p. 42 with refs.

42. D. E. Eichholz (ed.) *Theophrastus. De Lapidibus*, Oxford, 1965. pp. 118-119.

43. M. Levey, Chemical Aspects of Medieval Arabic Minting in a Treatise by Mansur ibn Ba'ra, *Japanese Studies in the History of Science, Supplement no. 1*, Tokyo, 1971.

44. T. Bertelè, *Numismatique byzantine*, Wetteren, 1978, p. 42, n. 51. E. Oberländer-Tarnoveanu says that some specialists may even have distinguished down to 1/3 carat (*RN* 1996, p. 160, n. 26).

In summary the first coins minted by the Byzantines in *Spania* in the name of Justinian were similar in fineness to those being minted by the Visigoths at the same time, but had a weight standard close to 1.5 g and similar to that of the Constantinople mint. The Visigothic standard was about 1/24 lower. The resulting average intrinsic values[45] in the samples measured were 1.34 g for the Byzantine coins of *Spania* compared with 1.29-1.33 g for the Visigothic tremisses while the tremisses minted at Constantinople were significantly higher at 1.43 g. The Byzantine *Spania* coinages could probably have circulated along side the Visigothic without the difference in the intrinsic value being easily detectable.

It is noteworthy that a few solidi believed to have been produced by the Visigoths in the South of Spain, two of which are in the name of Justinian, are recorded in *MEC* (nos. 190 and 191) with specific gravity values corresponding to 98 and 99 % gold. Another solidus in the name of Justinian was reported to have a gold content of 98 % using the Induced X-Ray Emission method (PIXE).[46] The notable higher fineness of the solidi compared with the tremisses that were presumably minted at the same time has been interpreted as targeting different monetary needs with the solidi made for use by merchants engaged in long distance trade in the Mediterranean.[47] After Justinian, no pseudo-imperial solidi have been attributed to mints in Iberia and the Byzantines never struck this denomination in Spain, probably because it was no longer used in trade, and exchange between the two regions could have used the interchangeable tremisses.

Justin II and Tiberius

Four coins are known from the Byzantine mint in *Spania* under Justin II (565-578), all of which were analyzed giving a mean of 88.5 % gold. The average weight of the four coins was 1.33 g but there is wide variation with one of 1.47 g, similar to the coins of Justinian, two in the range of 1.37 to 1.38 g and the fourth with the very low weight of 1.10 g. This period falls during the last two years of the reign of the Visigothic king Athanagild (554-67), an interregnum of five months, the reign of Liuva I (568-571 or 573)[48] and the first half of that of his brother, Leovigild (c. 569-586). It was during this period that several major changes in the Visigothic coinage took place involving reductions in the weights and fineness, as well as changes in the design and the legends of the coins. The exact sequence of the changes in the Visigoth coinage has not been securely worked out and the dating for the first changes is uncertain, making a

45. Intrinsic value is the actual amount in grams of the gold contained in the coin (weight multiplied by gold content).

46. Metcalf et al., *op. cit.* n.10, pp. 80-83.

47. Metcalf et al, *ibid.*

48. Two different dates are recorded for the death of Liuva I in the Chronicles of Isidore of Seville and John of Biclar, 573 of Biclar is the preferred one.

comparison with the Byzantine coinage of Justin II somewhat difficult.[49] The first problem is to distinguish the coins in the name of Justin I from those of Justin II in those cases where the emperor's name is clearly readable as Justin and not Justinian. During the whole period of the Visigothic VPW (Victory Palm Wreath)[50] coinage there was a stylistic evolution in the obverse bust and the reverse victory as well as a gradual increase in the diameter of the flans, and Tomasini proposed to distinguish the coinage of Justin II from Justin I on stylistic grounds when the legends were legible. However, along with the stylistic developments, there was a degeneration in the legends and by the time of Justin II, many legends are severely blundered either out of ignorance on the part of the die sinkers or on purpose, thus making it difficult to distinguish between the late coins of Justinian and those of Justin II. Again based on stylistic grounds, Tomasini attempted to separate most of the coins in his sample.

The Visigothic coins of VPW type for the Justin II period for which we have fineness measurements are given in Appendix II and summarized in figure 3. There are some Visigothic VPW coins with clear legends reading Justin that can be attributed to Justin II with weights in the range 1.4 to 1.5 g and with fineness around 90 % suggesting that there were no major changes at the very beginning of the period.[51] This is supported by the eight coins of the JAN 8/C1 group with an average fineness of 96.6 % measured by the PIXE method,[52] because Tomasini considered that the JAN 8 group was the immediate predecessor of the C1 group that came at the beginning of the reign of Leovigild. There are many other coins that Tomasini assigned to the reign of Justin II on stylistic grounds that have legends difficult to read or legends that are clear enough to read but do not contain an identifiable name. It would appear that one of the first changes may have been the deliberate decision not to use the emperor's name which would have been a break with the *ius monetae* tradition. This would have been carried out by a strong ruler who was neither concerned about giving offence to the Byzantine Emperor nor had a need for his coinage to circulate outside his domains. Leovigild, after he became sole ruler in c. 573, seems the most likely candidate. In the years 570 and 571 Leovigild embarked on two important campaigns against the Byzantines and the fact that they were minting coins in the name of their emperor designed to circulate in the border areas may have been a factor in his decision to remove the name of the emperor from his

49. Our purpose here is not to rewrite Visigothic monetary history but to try to identify the major issues in circulation during the period of Justin II so as to have an idea of what the Byzantines in *Spania* would have seen as the weight and fineness of the coins in the adjacent kingdom. We will, in general, follow the only major published study by Tomasini, (*op. cit.*, n. 32) for the period, although we realize the chronology and sequences are tentative (see Metcalf et al. *op. cit.* n. 10 and J. Lafaurie's critical review in *RN* 67, 1966, pp. 336-338).

50. See n. 32.

51. e.g. Tomasini, Corpus Nos. 452, 502, 503.

52. Metcalf et al., *Ibid.*

own coinage and include his own.[53] The most notable early example is the coins designated by Tomasini as the "CURRU" type with legends commonly reading CVRRV clockwise starting at the bottom and often retrograde on the right side, which he classified into 5 subgroups, with the C-1 group of 19 coins and C-3 of 25 coins being the most prominent.[54] Other VPW coins have the clearly identifiable name of Leovigild in the legends and include:

(1) coins with the name of Justin in the obverse and Leovigild in the reverse legend,
(2) coins with Leovigild in both the obverse and reverse legends, and
(3) coins with Leovigild in the obverse and Victory in the reverse

all of which are considered transitional and believed to have proceeded or overlapped with Tomasini's important IR group of 28 coins bearing Leovigild on the obverse and INCLITUS REX on the reverse. To the IR coins of Leovigild can be added the four known genuine coins of very similar style with Hermenegild on the obverse and INCLITUS REX on the reverse. [55] Again, a deliberate decision must have been made to place the name of the Visigothic ruler in the legend. The changes in the legends could have been made in two steps; the first to exclude the emperor's name and later to include that of the Visigothic ruler. Possibly Leovigild began to remove the emperors name during the joint reign with his brother Liuva in 568-572 but did not use his ownname until 573 when Liuva died and he became sole ruler. A two step change is suggested by some of the major Tomasini groups, in particular those designated C-3 and IR which Tomasini believed were sequential and minted at Toleto. He also suggested that the C-3 may have followed the C-1 and C-2 which developed out of the JAN-8, but he

53. See L. García Moreno, *Leovigildo, Unidad y Diversidad de un Reinado*, Madrid, 2008, a recent book on this period. J. Huffstot, On the Possibility That Athanagild's Name Appears in the Visigoths' Coinage: Evidence from a late "Victory with Palm and Wreath" Coin and Tomasini's Corpus, *AJN* 19, 2007, pp. 145-168; proposed that Athanagild's name might have appeared on coins that have not yet been discovered. Athanagild is believed to have asked the Byzantine to aid him and, although he later fought them, he signed a treaty toward the end of his reign. Liuva only ruled a short time and then associated his brother with him and it could have been inconvenient for either to have placed their names on the coinage by themselves. Hence the change seems more likely to have occurred after Leovigild became sole ruler in 573. D. M. Metcalf, J. M. P. Cabral, and L. C. Alves, Sixth-Century Visigothic Metrology, Some Evidence from Portugal, *AJN* 3-4, 1991-1992, pp. 65-90.

54. Tomasini, *op. cit.* n. 32, pp. 165-166, suggested these were produced by Leovigild and dated groups C-1 and C-2 at the beginning of his joint reign with his brother in 568-573 and dated C-3 at c. 573 when he became sole ruler. For the C-3 type, several additional coins, including an unpublished hoard of some 20 coins, have appeared since 1964 and there are at least 50 now known with very little duplication of dies indicating it was a sizable coinage from a major or multiple mints.

55. R. Pliego Vázquez, *La Moneda Visigoda*, Vol. I, *Historia Monetaria del Reino Visgodao de Toleto* and Vol II, *Corpus*. Seville, 2009 (henceforth Pliego Vázquez), more recently catalogued 39 IR coins of Leovigild and 4 of Hermenegild with very little duplication of dies which indicates that it too was a significant coinage and from a major mint or multiple mints.

does allow for other mints being involved in the IR coinage as well as in the C-4 and C-5. Metcalf et al. suggested the IR coinage could have been struck in the south due to the similarities in style between the Leovigild IR and the Hermenegild IR coins which would most likely have been minted in Hermenegild's capital at Seville.[56] If this is correct, some of the IR coins of Leovigild could have been minted in Seville before the revolt started in 579, at which time Hermenegild could have substituted his name.[57] The large size of the IR coinage and its closeness in style to the C-3 would suggest it may have also been minted in other mints, including Toleto. What is certain is that it marked a distinct point in the Visigothic coinage when a new lower weight standard of 1.3 grams, present in the C-3 coinage, was combined with a lower fineness of 75 % (or 18 carats) and when the name of the ruler is clearly legible in the obverse legend. The introduction of a new standard was an important fiscal decision and more likely to have been made by a strong ruler in control of most of the kingdom, such as Leovigild in the years after 573 when he was sole ruler.

In the last of the victory coinage, known from one coin of Toleto and two of Cesaragusta, the mint name was placed in the reverse legend.[58] The victory tremissis was immediately followed by the COS (cross on steps) type (with the victory replaced by a cross on steps) and the name of the mint in the reverse legend, a change that would have taken place after the beginning of the reign of Tiberius (late 578-582) who introduced the Byzantine solidus with the cross on steps reverse. The final change to a facing bust on both sides is believed to have been introduced by Leovigild in 584 and continued through the rest of the period of the Byzantine enclave and up to 649. Toleto was the Visigothic capital and would have been the major mint for Leovigild, as indicated by the predominance of coins in his name from Toleto after the mint name was added.

56. Metcalf et al., *op. cit.* n. 10, p. 68; also Tomasini, *op. cit.* n. 32, p. 133, states these coins (his H 2) "exactly duplicate Leovigild's INCLITVS REX series"

57. Leovigild associated his two sons Reccared and Hermenegild in his rule in 573 but it is doubtful that Hermenegild would have used his name on the coinage until he actually revolted against his father in c. 578-9. There has been much written about this period and it has been proposed that another coin of Hermenegild with the reverse legend REGIA A DEO VITA came at the beginning of the revolt in 579 or 580 before any of the coins with his fathers name. See the recently published thesis of Pliego Vázquez, *op. cit.* n. 55, and Kurt, *op. cit.* n. 14, for detailed discussions. The coin type is extremely rare with only one genuine coin known (BM 1863-11-10-1), and its legend might more easily coincide with the religious legends of the cross on steps coins of Leovigild from Italica (dated c.583). The BM coin has a weight of 1.27 grams placing it in the period of the C-3, IR and COS coinages (see figure 4 below). The fineness of 87 %, as measured by Duncan Hook at the BM using the SG method, is a little low for the C-3 but high for the IR and COS coinages. However one rare coin that is hard to place is not of great importance for this study. That all the VPW coins with the name of Leovigild came in a period of just a few years before the cross on steps coinage was introduced is also difficult to explain.

58. Pliego Vázquez, *op. cit.* n. 55, Corpus nos. 26 and 41. There is also one transitional IR coin of Leovigild with the Cross on Steps instead of the Victory found with 19 COS coins of Leovigild in Merida, *ibid.* no. 18.

They then account for 30 % of the known coins, which rises to 46 % when combined with the mint of Elvora,[59] located 70 km down river from Toleto and whose coins with mint names are identical in style. Generally following Tomasini, one possible chronological scenario that might have occurred at Toleto from Justin II through Leovigild would be:

(1) late JAN 8 and possibly other early Justin II coins followed by C-1 and C-2 and,
(2) the C-3, followed by
(3) the IR victory coinage, immediately developing into
(4) the COS and finally
(5) the facing busts coinage.

Stage	Type	Weight	Au %[60]	Intrinsic V. (wt. x %Au)	Start date	End date
1	VPW – (JAN 8 to C-1&2)	1.4-1.5	96	1.305	c. 565	c. 573
2	C-3	1.3	92	1.183	c. 573	?
3	IR	1.3	75	0.975	?	c. 580
4	COS	1.3	75	0.975	after 578	584
5	Facing Busts	1.5	75	1.125	584	586

Figure 4 - Possible Standards in the Development of Visigothic Coinage
Justin II to Leovigild.

During the reign of Justin II, if the Byzantines in *Spania* wanted to imitate the Visigothic coins they would have struck coins varying in composition from 92-96 % gold and 1.4-1.5 g in weight during the first stage of the coinage to coins of 75 % gold and 1.3 g in weight in the third. There is no way of dating the four coins of Justin II in our sample from *Spania* to compare them with the stages of the Visigothic coinage which are not easily datable themselves. However, the weights of the coins from *Spania* in our sample do reflect a reduction from the time of Justinian in what could have been a response to the changes in the weight standard of the Visigothic coinage. Interestingly, the fineness and corresponding intrinsic values do not appear to have been significantly lowered to that of the third stage, the IR coinage. It is quite possible that the Byzantine coins of Justin II were minted in *Spania* before the Visigothic change to the IR coinage or before Byzantines observed the change.

Only one Byzantine coin is known for *Spania* for Tiberius (578-582); it is from the Gago collection now in the Municipal Archives of Seville. It was not possible to obtain permission to weigh and measure the specific gravity of that

59. *Ibid*., Corpus, Tabla 25, pp. 47-50.

60. Fineness is estimated based on the assumption that a system of units of 1/24 like the present carat system was in use and the values could be 23/24 (96 %) for the first stage and 22/24 (92 %) for the second stage.

coin. The Gago collection is published with a photograph of the coin and its weight is recorded as 1 gram.[61] While there is no reason to doubt the authenticity of the coin the weight is well below the average values of the Visigothic coins of this period and should be checked and the specific gravity measured before drawing any conclusions.

Maurice

For the reign of Maurice Tiberius (582-602), five coins are reported for the mint in *Spania*, all of which were analyzed giving a mean value of 83 % for the gold content and a mean weight of 1.41 g. For the corresponding Visigoths coinage, the COS (cross on steps) type was introduced by Leovigild sometime during the reign of Tiberius (578 to 582) and is then believed to have been changed again to the facing bust type in 584. This lasted throughout the rest of the period in which the Byzantines held *Spania*. The Visigothic facing bust coins minted from 584 to 602 would have been those in the name of Leovigild up to 586, followed by his son Reccared I who died at the end of 601 when his son Liuva II succeeded him (602-604). The fineness and weights of the cross on steps and facing bust coinages are summarized in figure 3 from the data presented in Appendix II. All five coins of Maurice from *Spania* are heavier than the weight standard of 1.3 grams of the Visigothic COS issue, as are three of the four coins of Justin II minted in *Spania*. It is possible they were all minted after 584 when the Visigoths began minting the facing bust type with a weight standard of 1.5 grams and the Byzantines in *Spania* were copying that standard. However they are slightly lower in weight than the mean of 1.47 g (believed to be from a standard of 1.51[62]) for our sample of 143 Visigothic facing bust coins circulating in Spain during this period (Leovigild to Liuva II) and it is possible that the Byzantines were using a standard of 23/24 (equivalent to a solidus of 23 siliqua). A sample of the 13 coins of Maurice from the mint of Constantinople in the ANS collection had a mean weight of 1.44 g which is also slightly less than the standard of 1.51 g (figure 3 summarized from Appendix I). Even if the Byzantines in Spania were using a slightly lower weight standard, individual coins in circulation by either side would have been very difficult to distinguish by weight alone. The mean gold content of 83 % is however 10 % greater for the Byzantine coins minted in *Spania* than our sample of 143 Visigothic coins of the facing bust type which averaged 73 % and the difference could have been detected with a touchstone. The sample of tremisses from Constantinople averaged 97 % Au which is, statistically, significantly higher than the *Spania* or Visigothic coinages. The combined fineness and weight results in intrinsic values of 1.17 g

61. F. Pérez Sindreu, *Catálogo de Monedas y medallas de oro del Gabinete Numismático Municipal de Sevilla*, Sevilla, 1980.

62. *MEC*, p. 54.

for the Byzantine Spania coins and 1.07 g for the Visigothic coinages, again a 10 % difference in values. Why the administrators of Spania did not notice or, if they did, why they did not copy the fineness of the Visigothic coinage and what effect this might have had on the commerce between the two regions during the reign of Maurice needs to be interpreted.[63]

Phocas

Five coins are reported for the mint in Spania in the name of Phocas (602-610), of which three were analyzed giving a mean gold content of 75 % and a mean weight of 1.42 g.[64] The equivalent Visigothic period is the reign of Witteric (603 to 609) and the very end of the rule of Liuva II and the first year of Gundemar (610-612). The fineness for the three Visigothic rulers averaged 72 % for Liuva, 71 % for Witteric and 69 % for Gundemar. The lowering of the fineness of the *Spania* coinage by 8 % between Maurice (83 %) and Phocas (75 %) was probably an attempt to approximate more closely that of the Visigoths but it was still about 5 % higher. The mean weight had not changed since Maurice and was 0.05 g lower that the sampled coins of Witteric (1.46) but only 0.03 g lower for the two mints (Hispali and Eliberri) closest to the border. Interestingly, while the fineness of the 10 coins of Phocas in the ANS attributed to Constantinople are still of near pure gold (97 % gold by the SG method),[65] they averaged 1.41 g, nearly the same as the coins of *Spania*. The resulting intrinsic values of 1.07 g for the *Spania* mint coins for Phocas and 1.03 g for the coins of Witteric are quite similar.

Heraclius

Eleven coins of Heraclius (610-641, c. 624 for *Spania*) are reported for the mint in *Spania* of which eight were analyzed giving a mean fineness of 72 % gold and a mean weight of 1.41 g. This period corresponds principally to the reign of Sisebut 612-621 but would also have overlapped with Gundemar (609-612) especially if *Spania* came under the control of Heraclius during his revolt in late 608 in North Africa. Sisebut, early in his rule, recaptured most of the remaining Byzantine enclave but then established a peace treaty with Cesario,

63. It may be hypothesised, as suggested by Jean-Pierre Callu (personal communication) that the Byzantines could have intended to be thus offering to the military a salary in a higher value coin as an incentive against defecting to the Visigoths. One case of defection is reported in the Chronicle of John of Biclar, 17, where Asidona was captured at night by treachery and the garrison put to the sword in 571.

64. Mean of 1.40 g if the recorded weight for No. 2, the Tolstoi coin, is included

65. The only solidus of Phocas analyzed in *CEB* 2 by PA resulted in 98 % Au, 1.62 %Ag, 0.4 % Cu. The average determined by Bertelè's and Grierson's SG analyses was 95.2 % (*CEB* 2, p. 205).

the *Magister Militum Spaniae*, in c. 615.[66] The fall of large areas of *Spania* in this period may account for the burial of the relatively high number of coins of Heraclius. The remaining areas of *Spania* were overrun in c. 624 by Suinthila (621-631). Reccared II, the son of Sisebut ruled for a few months after the death of his father in 621. From figure 3, summarized from appendix II, it can be noted that the sample of 31 coins of Witteric had an average fineness of 71 % gold which fell to 69 % for the sample of 20 coins of Gundemar and dropped further to 66 % for Sisebut and Reccared II. As was the case with Maurice and Phocas, the fineness of 72 % for the coins of Heraclius from *Spania* is slightly (3-6 %) higher than those of the contemporary Visigothic rulers to 621, but would have been difficult to detect with a touchstone. If there were any coins minted after 621 in Spania there is the possibility the Byzantines might have attempted to duplicate the intrinsic value of the first coins of Suinthila and, for that period, we have included a sample of coins of Suinthila from the hoard found at Las Fuentes de Andalucía buried early in his reign.[67] These have a mean of 62 % gold which is 10 % lower than the coins of Heraclius from *Spania*. The sample of eight of the nine coins of Heraclius from Constantinople had a mean fineness of 97 %, significantly higher than the Visigothic or Byzantine coins from *Spania*.

The mean weight for the Byzantine coins of Heraclius from *Spania* (1.41 g) is very similar to that of Maurice (1.41 g) and Phocas (1.42 g) from *Spania* as well as Sisebut (1.43 g), all of which are also similar to the sample from Constantinople (1.44 g). The resulting intrinsic value for the Byzantine coins of *Spania* for Heraclius (1.02), while similar to Witteric (1.03) and Gundemar (1.00), is some 7 % greater than that measured for the sample of coins of Sisebut and Reccared II (0.95). This could be explained if the coins were minted early in the reign of Heraclius or if the information the Byzantines used to adjust their coinage to that of the Visigoths was taken from a circulating sample of earlier coins. The two coins of Heraclius (Cat. Nos. 30 and 31) with the lowest intrinsic values (0.94; 0.91), with the latter approaching that of Suinthila (0.89), are each from different pairs of dies while the other nine coins (Cat. Nos. 21-29) are all from the same die set. The style of the die pair used for the nine coins is very similar to that of the single die set of Phocas, especially the obverse die, and they were presumably made by the same engraver at the same place, while the other two sets (Cat. Nos. 30 and 31) are noticeably cruder and might have come toward the end of the Byzantine presence in *Spania* when the enclave was under great pressure.

66. **M.** Vallejo Girvés, *Bizancio y la España Tradoantigua (ss. V-VIII): Un capítulo de la historia mediterránea*, Alcalá, 1993, pp. 298-303.

67. Cores et. al., *op. cit.* n. 10, suggested a terminus *post quem* of c. 622, p 197; A. Walker, Identification of the coinage of Reccared II in *Numismatics – Witness to History,* IAPN, 1986, gives a date of "ca. 625 at the latest", p. 77, fn. 16 and in a personal communication suggested 623.

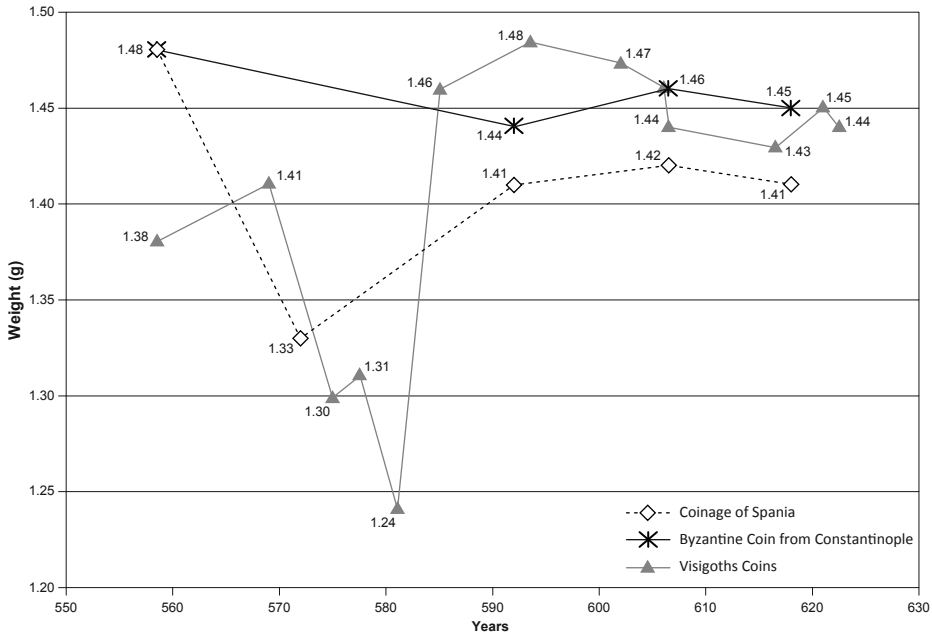

Figure 5 - The weight of the Spania coinage compared with the Visigothic coinage and that of the Byzantines from the mint of Constantinople.

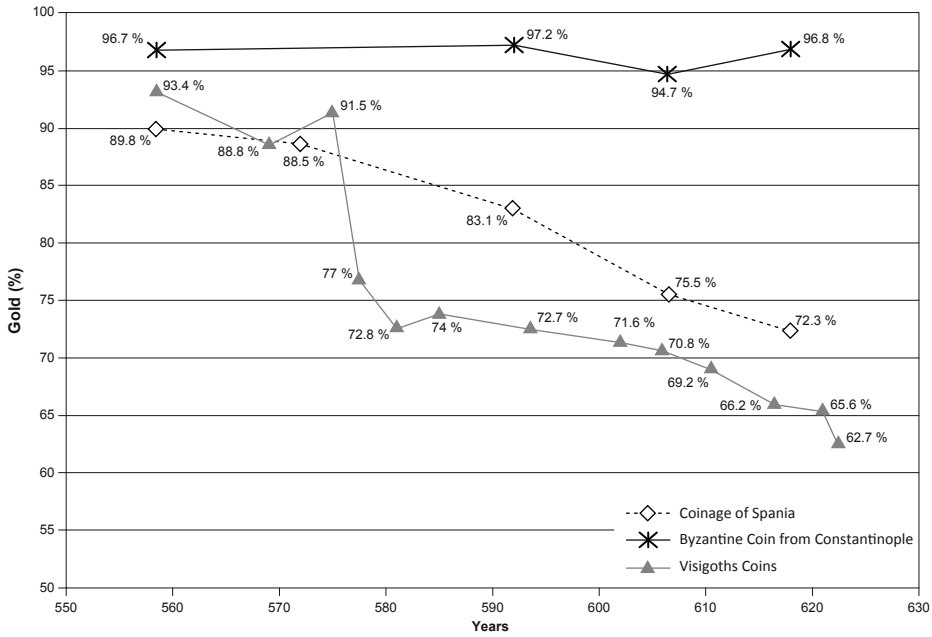

Figure 6 - The average gold content of the Spania coinage compared with the Visigothic coinage and that of the Byzantines from the mint of Constantinople.

Figures 5-7 shows the values of average weight, gold content and intrinsic value for the three coinages (Byzantines in *Spania*, Visigoths and Byzantine mint in Constantinople). They demonstrate that the *Spania* mint coins of Maurice, Phocas and Heraclius are 5-10 % finer than the contemporary Visigothic coins (10 % for Maurice, 5 % for Phocas, and 6 % for Heraclius). The fineness of the Visigothic coinage was falling at the same time. Apparently the Byzantines in *Spania* were tracking this decline but lagged behind. This can, in part, be explained if they were sampling Visigothic coins in circulation or were reminting Visigothic coins that had been minted somewhat earlier.

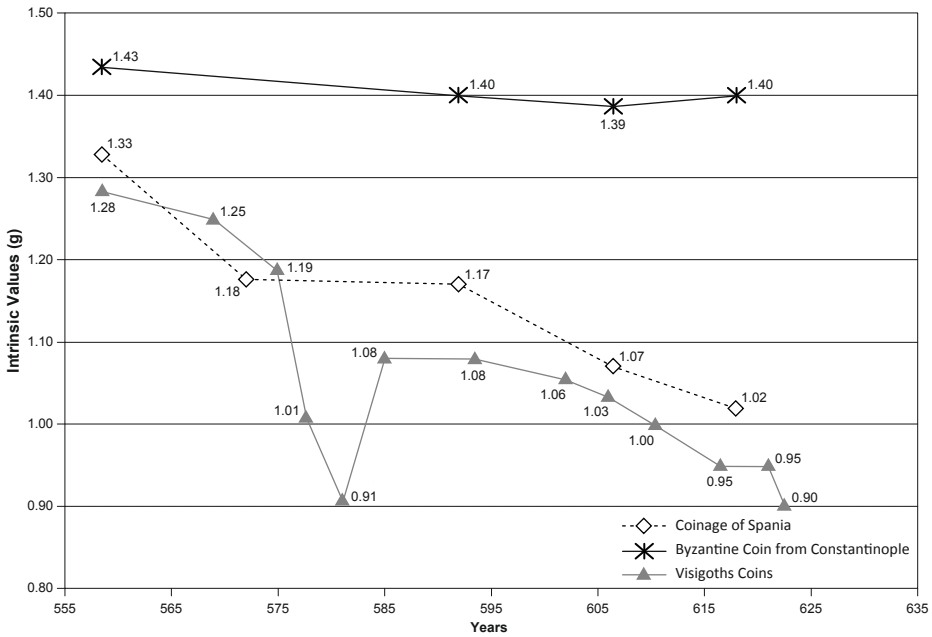

Figure 7 - The average Intrinsic Values in grams of the Spania coinage compared with the Visigothic coinage and that of the Byzantines from the mint of Constantinople.

Trace Elements

All metals and alloys produced in antiquity contain very small amounts of other elements whose presence was unknown at the time of production. These are known today as 'trace elements' and usually originate as impurities in the ore that was used. When two or more metals are mixed to make an alloy, the trace elements in the metals also pass into the alloy. Trace element patterns in newly smelted metal may, occasionally, be used to identify the source of the ore, but once a metal has been added to another to form an alloy, or has been used as scrap in making a new object, the mixing of trace elements almost invariably means that connection to a potential source becomes impossible.

Gold, silver and copper/bronze were continuously recycled in antiquity; thus unless there is a good reason to think that metal has come directly from smelting (as in the case of the Athenian silver coinage made with silver from the mines at Laurion), trace elements are mainly of interest for picking out artefacts where an unusual trace element pattern may signify a modern forgery. However, where a large number of analyses are available it is sometimes possible to use statistical methods to separate the artefacts into groups. The meaning of the groups can only be determined if other factors come into the equation, such as differences in coin legend or style.

Trace element analysis is available for only one of the *Spania* coins, a tremissis of Heraclius in the BnF (BNC 1 = Schlumberger 2580) (No. 28), which has been analyzed by Maryse Blet-Lemarquand at the CNRS, IRAMAT, Orléans, using Laser Ablation Inductively Coupled Plasma Mass Spectrometry.[68] The graph (figure 8) of the time of laser ablation verses fineness for the Heraclius *Spania* coin in Paris levels off at 77.8 % gold at 200 seconds, at a depth of about 0.2 mm, which is close to the SG measurement of 79 %. The initial part of this graph clearly demonstrates the effect of surface enhancement.

Coin No. 30 also of Heraclius from *Spania* was measured for Cu and Fe by J. M. Peixoto Cabral at the Instituto Tecnológico e Nuclear at Sacavém, Portugal in 1998. Guerra analyzed the trace elements of 12 Visigothic coins of Leovigild to Sisebut (see figures 9 and 10 below) from mints in the provinces of Baetica and Carthaginensis adjacent to *Spania*, as well as Emerita and Elvora in SE Lusitania which had close ties to Toleto and Baetica. The ranges of values for the trace elements in the 12 Visigothic coins are quite wide and may indicate varied origins[69] for the two principal metals, Au and Ag[70], that were mixed to produce the Visigothic coins. The values of the coins of Heraclius from *Spania* generally fall within that range. The platinum content relative to the gold of No. 28 (BNC 1 = Schlumberger 2580) fits well within the defined area of Visigothic coins (figure E) **???**

68. For more information on the method see: B. Gratuze, M. Blet-Lemarquand, J.-N. Barrandon, Caractérisation des alliages monétaires à base d'or, *BSFN* 6, 2004, pp. 163-169 and L. Dussubieux, L. Van Zelst, CLA-ICP-MS analysis of platinum-group elements and other elements of interest in ancient gold, *Applied Physics A 79*, 2004, pp. 353-356.

69. M. C. Díaz y Díaz, Metales y minería en la época visigóticas a través de Isidoro de Sevilla, in La minería Hispana e Iberoamericana I, León, 1970, pp. 261-274. Although there are some Visigothic reference to the mining of gold, it is generally believed that the extensive mines in Roman times had played out by the 6 century. The Visigoths had been amassing gold even before the sacking of Rome and recycling could have been significant. See also M. F. Guerra and T. Calligaro, Gold cultural heritage objects: a review of studies of provenance and manufacturing technologies, *Measurement, Science and Technology* 14, 2003, pp. 1527-1537. They believe that no new gold entered the Iberian Peninsula until the after the Islamic invasion based on trace elements in gold coins from the Visigothic and Islamic periods.

70. Although ancients appear to have used weight to make Au/Ag alloys, because silver is lighter, on an atom for atom basis it becomes the major component at < 75 % fineness and trace elements from the silver become significant.

major elements %			trace elements ppm										
Au	**Ag**	**Cu**	**As**	**Bi**	**Fe**	**Hg**	**Ni**	**Pb**	**Pd**	**Pt**	**Sb**	**Sn**	**Zn**
77,8	20,7	1,2	6	26	1310	69	6	332	14	160	6,6	741	271

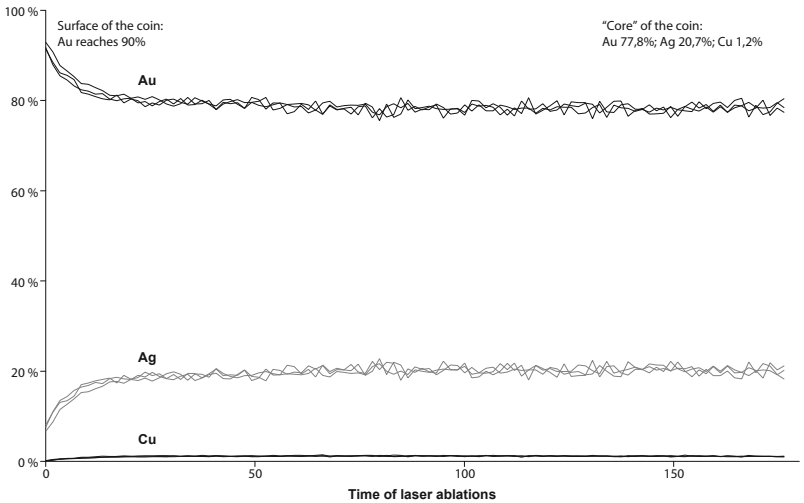

Figure 8 - Gold, silver and copper concentration versus time of laser ablation.

		major elements %			trace elements ppm							
Byzantine-*Spania*	Method	**Au**	**Ag**	**Cu**	**As**	**Fe**	**Pb**	**Pd**	**Pt**	**Sb**	**Sn**	**Zn**
Heraclius (No. 28)	LA-ICP-MS	77.8	20.7	1.2	6	1310	332	14	160	6.6	741	271
Heraclius (No. 30)	PIXE	80.4	18.6	0.8	nd	1000	nd	nd	nd	nd	nd	nd
Visigoths												
Leovigild-Elvora	PAA	67.6	30.0	2.1	22	1122	812	12	169	16	722	389
Reccared-I-Toleto	PAA	75.2	22.8	1.7	23	23	592	95	113	19	824	315
Reccared-I-Toleto	PAA	76.8	21.3	1.6	nd	946	336	nd	122	25	1071	304
Reccared-I-Ispali	PAA	76.4	21.7	1.6	12	877	483	nd	100	19	706	573
Reccared-I-Cordoba	PAA	75.8	22.4	1.5	nd	775	460	nd	156	26	788	335
Reccared-I-Eliberri	PAA	73.1	25.3	1.5	nd	706	296	nd	146	nd	356	255
Reccared-I-Emerita	PAA	82.3	16.3	0.9	26	26	384	68	33	13	2835	220
Reccared.-I-Elvora	PAA	77.0	20.9	1.9	19	1022	529	12	124	10	878	275
Reccared.-I-Elvora	PAA	75.6	22.0	2.2	14	14	558	43	136	nd	480	220
Liuva-II-Elvora	PAA	75.4	22.5	1.9	14	712	589	33	110	9	651	570
Gundemar-Elvora	PAA	73.0	24.9	2.0	6	394	687	17	165	6	471	126
Sisebut-Elvora	PAA	76.2	22.1	1.6	5	500	600	10	100	10	600	200
Average				1.7	12	593	527	36	123	15.3	865	315

Note: PAA values from Guerra excluding mints from Gallaecia and old Suevic areas, others unpublished

Figure 9 - Comparison of Trace Elements coins of Heraclius from *Spania* (Nos. 28 and 30) with those of Visigothic coins.

and is below that of other Byzantine mints. This would be consistent with a theory that the Byzantines in *Spania* reused Visigothic coins when making the blanks for their own coinage.

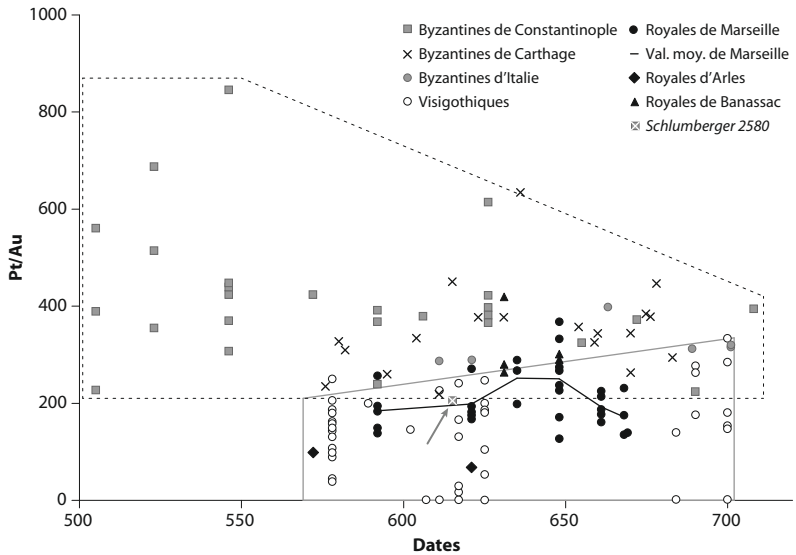

Figure 10 - Platinum content of Heraclius Spania coin (arrow) compared with that of Visigothic and Merovingian coins (after M. Blet-Lemarquand et al., *RN* 166, 2010, p. 193).

The Spania Coinage: distribution and production

The boundary of *Spania*, especially inland, was fluid and is poorly documented (See figure 11 for the area c. 589). It was fluid because from the beginning, although it is known that a written treaty between Athanagild and Justinian existed, copies were soon lost by both sides[71] and the area was disputed and continuously fought over. A few fortified cities were held by each side but the frontier of some 800 km was not defended and has been described as "the land of no one".[72] It is poorly documented because very few cities are referred to in the records as belonging to one or the other side leading to speculation by historians. As well as the Balearic Islands, it is generally accepted that most

71. E. A. Thompson, *The Goths In Spain*, Oxford, 1969, p. 332.

72. P. Díaz, En tierra de nadie: Visigodas frente a Bizantinos, Reflexiones sobre la frontera, in *Bizancio y al Península Ibérica, De la Antigüedad Tardía a la Edad Moderna*, edited by I. Pérez Martín and P. Bádenas de la Peña, Madrid, 2004, pp. 37-60.

of the coast of Baetica was held by the Byzantines from Carthaginensis south to Baesippo, and possibly as far as Portus Gaditanus. Inland in Baetica, both Asidona and Saguntia were fought over and the legend "VICTOR BARBI" on a coin of Sisebut (PLIEGO No. 268) suggests that the enclave extended inland as far as Barbi[73] but probably not much further because coins of Leovigild were minted at Roda which is 24 km to the north (Pliego No. 50). Eliberri was a common Visigothic mint from at least the time of Reccared I. In Carthaginensis the enclave is believed to have included the whole coast from Dianium (Denia) southwest to Baetica but how far inland is uncertain although the Chronicle of John of Biclar records a campaign of Leovigild in the area of Basti (Baza). We await the forthcoming publication of Professor M. Vallejo Girvés, entitled, *Bizancio e Hispania, Una relación desconocida* for updating the history.[74]

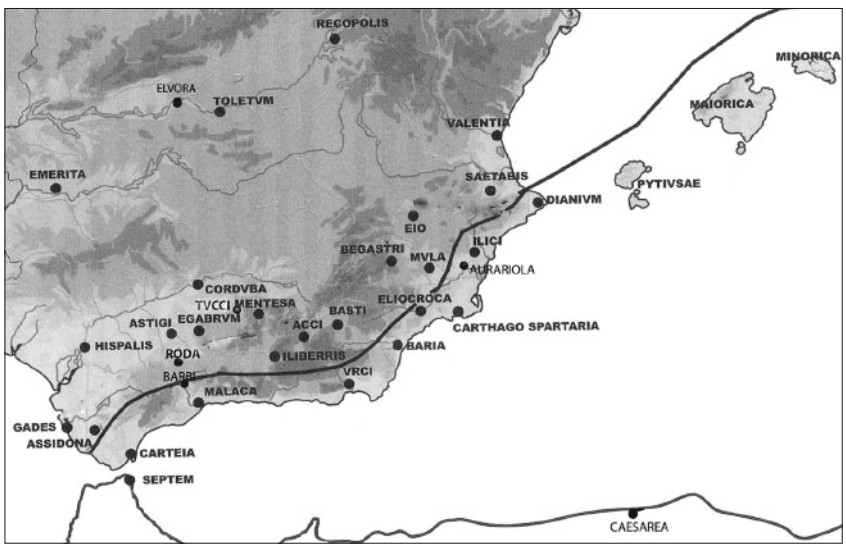

Figure 11 - Map of probable boundaries of Spania in c 589,
modified from J. VIZCAÍNO SANCHEZ.[75]

The coins of the Byzantine province of *Spania* are extremely rare with only 32 known for the three quarters of a century the Byzantines province existed as an enclave along the coast of eastern and southern Iberia. Pliego Vázquez catalogued some 2537 Visigothic coins with the names of rulers from c. 582 to 621,

73. P. BARTLETT and G. CORES, The coinage of the Visigothic king Sisebut (612-621) from the mint of Barbi, *GN*, 158/159, 2005, pp. 13-21.

74. M. VALLEJO GIRVÉS, *Bizancio e Hispania. Una relación desconocida*, to be published by Akal in 2011.

75. J. VIZCAÍNO SANCHEZ, *op. cit.* n. 3, p. 48.

and the actual number exceeds 5,000.[76] However this comparison of the number of specimens is misleading because the vast majority of these Visigothic coins, probably more than 90%, come from a few large hoards. Only one of the Byzantine gold coins of *Spania* is known from a hoard, that of Justin II (No. 10) found in Reccopolis with 90 mostly Visigothic VPW coins.[77] It is possible that some of the nine coins of Heraclius from the same dies could have been found together,[78] but the rest of the *Spania* coins appear to come from single or small finds. Aside from the coin of Justin II found in Reccopolis (Cat. No. 10), the only coins with definite provenances are the single find of a coin of Heraclius in Minorca (Cat. No. 32) and that of the coin of Maurice reported from Gades (Cadiz) (Cat No. 15). One obvious question is, if the coins were minted and circulated in *Spania* why are there not more finds documented from that area? One has only to look at Barral i Altet,[79] as reviewed by Metcalf,[80] which summarizes all the find spots for Visigothic coins up to 1976. Barral lists between 50 and 60 coins from small, mostly single, finds for the period of Justinian to Sisebut. Only one find location, that of a coin of Sisebut minted at Ispali (Seville) (his No. 86) found near Eliberri (Granada), is even close to the border of *Spania*. For the 31 Byzantine coins of *Spania*, only the coin of Maurice reported to have been found at Gades (Cat. No. 16) is from a find close to, but probably not in, mainland *Spania* at the time of minting. The coin of Heraclius found on Menorca was 400 miles from the coast. Three of the coins in the British Museum are reported to have been

76. Pliego Vázquez, *op. cit.*, n. 55. Three large hoards of Visigothic tremisses dominate the statistics for the for the first part of the seventh century: (1)The La Capilla hoard of some 1000 coins, (2) the Las Fuentes de Andalucía hoard with some 4300 coins and (3) a more recent unpublished hoard with a few coins first mentioned as possibly coming from the la Capilla hoard in, M. Gomes Marques, J. Da Costa, M. F. Araulo, Tremisses visigodos inéditos, *Actas del IV Congresso Nancional de Numismatica*, Lisbon, 1998, pp. 99-118. Altogether some 1000 coins appeared on the market from the third source none were later than Suinthila. The large number of coins from Visigothic hoards and the scarcity of single finds compared, for example, with the Merovingian coinage with their large numbers of small finds (e. g. see D. M. Metcalf, Monetary circulation in Merovingian Gaul, A propos Cahiers Ernest Babelon, 8, *RN* 2006, pp. 337-393) may well represent an important difference in the usages of the two coinages as well as the current culture of those reporting finds from the two regions.

77. See Tomasini and Barral i Altet for discussions of this hoard which was first catalogued by A. Cabré, El tesorillo visigodos de trientes e las excavaciones del plan nacional de 1944-1945 en Zorita de los Canes (Guadalajara), *Informes y Memorias de la Comisará General de Excavaciones Arqueológicas* 10, 1946.

78. The two coins of Heraclius in Stuttgart are suspect of belonging together as well as Nos. 28 and 30 coins which both have similar encrustations and possibly the three coins from the William Mark collection.

79. Barral, *op. cit.*, n. 3.

80. D. M. Metcalf, Some geographical aspects of early medieval monetary circulation in the Iberian Peninsula, in *Problems of Medieval Coinage in the Iberian Area 2*, edited by M. G. Marques and M. Crusafont i Sabater, Aviles, 1986, pp. 307-324, in particular Fig. 2, p. 312. A few more finds are in Vizcaíno Sánchez, *op. cit.*, n. 4.

purchased from the collection of William Mark, who resided in Malaga from 1823 to 1836, but it is not certain that the coins came from there.[81] The unique coin of Tiberius probably came from Baetica, but again there is no find data. There are several other coins that are undoubtedly from finds somewhere in Spain as they appear in Spanish collections like No. 21 in the Real Academia de Historia in Madrid, or in sales along with numerous Visigothic coins. The opposite case is not true; no Byzantine coins of *Spania* have been found outside the Iberian Peninsula and Balearic Islands. Despite the fact that thousands of bronze coins from other imperial mints are found throughout the Mediterranean world including Spain, gold coins from provincial mints which were much less productive than the metropolitan one, are rarely found out of the region where they were struck.[82]

Although there is no logical reason to believe the coins were not minted in *Spania*, the location of the mint is uncertain. It has been assumed by many writers to have been at Cartagena[83] because of its long and important history as the capital of the Roman province of Carthaginensis and they believed it continued as the capital and the administrative center for the Byzantine province. This is based on extensive archeological excavations and, in particular, an inscription of Comenciolus, *Magister Militum Spaniae*, recording that he repaired the city gates in 589.[84] Bronze Byzantine coins from other imperial mints have been found as well as what may have been a small locally produced anonymous 4 nummi denomination.[85] An alternative mint location that has been suggested is Malaga, an important port and episcopal see where much archeological material has been found recently as well as fortifications dating to the Byzantine period. As mentioned, it is possible that the three coins of the Mark collection came from there. Numerous bronze coins from other imperial mints and small anonymous nummi once attributed to the Visigoths that may have been produced locally have also been found.[86] The small denomination bronze coinages, possibly produced at Cartagena or Malaga, cannot be attributed to the official mint in *Spania*. It appears this mint only issued tremisses, undoubtedly at one location at a time

81. Grierson, *op. cit.*, n. 1.

82. See for instance the limited diffusion of gold coins from Carthage, compared to the less restrained one of its bronzes (C. Morrisson, L'atelier de Carthage et la diffusion de la monnaie frappée dans l'Afrique vandale et byzantine, *Antiquité Tardive* 11, 2003, pp. 65-84).

83. Known to the ancients as Carthago Nova and Carthago Spartaria.

84. *Corpus Inscriptionum Latinarum* II, 3420, J. Vizcaíno Sanchez, op. cit. n 3, pp. 735-743, pl. 94, p. 737.

85. T. Marot, Aproximación a la circulación monetaria en la península ibérica y las islas Baleares durante lo siglo V y VI, *RN* 1997, pp. 157-190 and *ibid* pp. 687-725 for recent update including finds in Menorca and El Tolmo de Minateda (Elo/Eio).

86. B. Mora Serrano, The Circulation of Bronze Currency in Málaga during the Sixth Century AD: new findings, *NC* 2009, pp. 424-430 and B. Mora Serrano and C. Martínez Ruiz, Un nuevo hallazgo de moneda bizantina en Malaca (Málaga): El conjunto monetario de calle Cañon-Postigo de los Abades, *Saguntum* 40, 2008, pp. 193-204.

judging from the similarities of style for the coins of Maurice, Phocas and most of those of Heraclius (see above) and with only one known die in the case of Phocas. This fits very well with what we know about the location of Byzantine mints[87] which were limited to a few major provincial capitals, unlike those of the Visigoths who minted in more than 100 cities. The Spania mint was an exception to the rule that reserved the issue of gold to the *praefecturae*. Logically *Spania* should have been supplied with coins from the mint of Carthage since it was part of the African prefecture and later exarchate. However Carthage did not produce the tremissis (or only exceptionally) and its solidi were of high fineness. Therefore a local mint was necessary to produce a gold coinage that would circulate along side that of the Visigothic coinage.

While we have made the case that it is not easy to compare the size of the *Spania* coinage with that of the Visigothic coinage on the basis of the number of extant coins, it still is important to have some idea of the relative sizes. The only way out would be to compare the number of dies used to produce the coinages. Some estimates of the die numbers have been made for Visigothic mints during the reign of Sisebut and, because of the large number of coins available, they give reasonable estimates for the order of magnitude of dies in use and high values for coverage (84-93 % for Ispali and Emerita).[88] The problem for the Byzantine mint is the small number of coins available. Combining the 31 known coins from *Spania* it might be possible to obtain some idea of the order of magnitude of dies in usage for the whole period. However looking at the number of dies and the number of coins known per die for the 31 coins there are two distinct diametrical opposed periods which lead to completely different results. In the 50 year period from Justinian to Maurice, with 15 known coins, there is only one die set which is represented by two coins among the 14 sets of dies. Coins of 13 of the dies are singletons. Applying Carter's formula modified by Esty[89] yields an estimate of 150 dies and Good's formula 105. In contrast for Phocas and Heraclius in the last 25 years, if the mint operated to the end of Byzantine rule, there are 16 extant coins produced by only four sets of dies with two singletons giving estimations of five total dies with the Good formula and 6 with the Esty formula. The order of magnitude for the number of dies per year are 10 times greater for the first 50 years compared with the final 25 years. However, given the small sample no firm conclusions can be made and we must

87. M. F. Hendy, *Studies in the Byzantine Economy (ca.300-1450)*, Cambridge, 1985, pp. 398-405; Id., From Public to Private: The Western Barbarian Coinages as a Mirror of the Disintegration of Late Roman Structures, *Viator*, 19, 1988, pp. 29-78 (= Id., *The Economy, Fiscal Administration and coinage of Byzantium*, Northampton, 1989, art. VII).

88. P. Bartlett, G. Cores Uria and M. C. Cores Gomendio, The use of dots as control marks in the coin legends at the Visigothic mint of Ispali during the reign of Sisebut (612-621*), XIII Congreso Internacional de Numismática*, Madrid, 2005, pp. 1127-1133 and Pliego, *op. cit*. n. 55.

89. W. E. Esty, Estimation of the size of a coinage: A survey and comparison of methods, *NC* 146, 1986, pp. 185-215.

wait for more coins to appear to see if the estimates are reasonable.[90] Even 100-150 dies for the first 50 years, is low compared with the Visigoths. For the small mint of Barbi, for example, it has been estimated that 13 obverse and 26 reverse dies were in use for the 9 year reign of Sisebut. Barbi is dwarfed by the estimates for the mint at Toleto of 166 obverse and 294 reverse dies for the same 9 years. Three dies per year used in the first fifty years of the Byzantine mint to a maximum capacity of 20-30,000 coins would have been able to supply in the order of 60-90,000 tremissis coins for a value of 20-30,000 solidi per year. One of the main expenses would have been the army and at 10 solidi per year per soldier,[91] less than 3,000 soldiers could have been paid without covering other expenses. If only 6 dies were in use for the final 25 years, very few expenses could have been covered by payments in gold.[92]

Conclusion

For all the uncertainties remaining, notably about the chronology of the Visigothic coinage, the analyses made over the last decade by the first of us, make clear that the fineness of the Byzantine gold from *Spania* was very close to that of the local and much more plentiful Visigothic issues. Two periods may be distinguished: the first, from Justinian to Tiberius II in which the Byzantine issues had a slightly greater intrinsic value and in which the issues were relatively larger than in the later period. In the second one, the Byzantine issues decline from some 83% under Maurice, to 73% under Phocas and 72% under Heraclius, regularly above the values for the Visigothic coins now safely dated from ca. 580 onward. Close examination of these variations suggests that the Byzantine authorities wanted to issue coins able to be accepted at par with Visigothic ones in the circulation area as happened a bit later in Italy when the Byzantine possessions were also isolated from the capital.[93]

90. See F. Füeg's observations in his comparison of the two stages of his corpus of nomismata (4,600 vs 1170 specimens) (F. Füeg, Vom Umgang mit Zufall und Wahrscheinlichkeit in der numismatischen Forschung, *Rev. Suisse de Num.* 76, 1997, pp. 135-160).

91. M. F. Hendy, *op. cit.*, n. 87, p 177 for references to the 12,000 d regular annual stipendium et donativum [ca 10 solidi] attested in 299/300. The regular annual annona was ca 4 solidi worth during the Early Byzantine period (T. Mitthof, *Annona militaris. Die Heeresversorgung im spätantiken Ägypten. Ein Beitrag zur Verwaltungs- und Heeresgeschichte des Römischen Reiches im 3. bis 6. Jh. n. Chr.*, Florence, 2001, p. 243).

92. Vizcaíno Sánchez, p. 692-3. Large denominations bronze coins from other imperial mints are known from the region but scarce and seem unlikely candidates for official payments. Of 14 folles and half folles with mint attributions tallied for Justinian to Heraclius from the mainland none are from Carthage which as mentioned above would have been expected to have supplied coins to *Spania*.

93. The special fonts used in this chapter for seal and coin inscriptions were first created by the late Professor Nicolas Oikonomides in 1986 and subsequently enriched by Glenn Ruby and the Publications Department of Dumbarton Oaks in Washington, DC. The editors are grateful to Dumbarton Oaks' Program in Byzantine Studies for graciously releasing these fonts for use in scholarly publications and databases.

PLATE I

The principal references are as given in the text. The coins are all gold tremisses. All dies are different unless noted.

In the name of Justinian Obv. Diademed bust right with half circle on top. Rev. Victory advancing right holding wreath in r. and gl. cr. in left. Star in field right.

1. Obv. DNIVCTINI ANVSPPAV Rev. VICTORIAAVCVSTORH Ex. CONOB
   1.486 g (SG 17.29: 86% Au) 18 mm. Grierson A(a),
   ANS 16-754 (ex Reinhart coll.), *MIBE* 27.2.
2. Obv. DNIVSTINI ANVSPPAV Rev. VICTORIAAVCVSTROH Ex. CONOB
   1.506 g (SG 18.28: 93% Au) 18 mm. Grierson A(a) as Justin II,
   BM-6754, *MIBE* 27.1. Same dies as 4.
3. Obv. DNIVSTINI ANVSPP[AV] Rev. VICTORIAAVCVSTORH Ex. COИOB
   1.456 g (SG 18.07: 92% Au). Grierson not included, Stuttgart 1582, *MIBE* 27.3.
   Double struck?
4. Obv. DNIVSTINI ANVSPP[AV] Rev. VICTORIA[AVCVS]TORH Ex. CONOB
   1.46 (SG not measured). Grierson not included, Galerie Moderne Bruxelles Sale,
   May 1974, Lot 40, *MIBE* 27.4. Sames dies as 1.
5. Obv. DNIVSTINI ANV[SPP]AV Rev. VIC[TO]RIAACVSTORH Ex. CONOB
   1.51 g (SG not measured). Grierson not included, NAC Sale 25, Lot 628,
   not listed in *MIBE*.
6. Obv. DNIVSTIИIANVƧPPAVC Rev. VICTONAVVCVSTORVИ Ex. CONOO
   1.45 g (SG 16.72: 81%Au) 16,5 mm. Grierson A as contemporary forgery,
   ANS-1956.25.43.

In the name of Justin II Obv. Diademed bust right. Rev. Victory advancing right holding wreath in r. and gl. cr. in left. Star in field right

7. Obv. DNIVƧTIII VƧPPAVC Rev. VI[CTORI]AAVCVƧT Ex. CONOB
   1.38 g (SG 17.70: 89%Au). DO BZC 2009.05, Stacks'sale 12 Jan 2009,
   from Füeg's collection, from MMAG 64, Jan 1984, 325, from Lindpaintner,
   MIBEC 19[1], this coin ill.
8. Obv. DИIYC[TI] ИVƧPPAC Rev. VICTORIQQCVƧT Ex. CONOB (retrograde)
   1.37 g (SG 17.61; 88%Au). J. Dwyer coll., ex CNG 61, 2002, no. 2171
   (as Justinian), ex MMAG 81, Sept. 1995, no. 907 *MIBEC* 19[2], this coin ill.
9. Obv. DИIVƧTIИVƧIPIV (sic) Rev. VICTORIΛΛVCVƧTCONO (Sic) No star.
   1.47 g (SG 17.23; 85% Au) 18 mm. MNAC 9857 (Amorós[94], no. 3). *MIBEC* 19.

94. J. Amorós and A. Mata Berruezo, *Catálogo de las Monedas Visgodas del Gabinete Numismático de Cataluña*, Barcelona, 1952.

10. Obv. DNIIVSTINTSPPAI Rev. VICTORIIVCV Ex. ONOI (sic)
1.10g (SG 18.00: 91 %Au) 20 mm. MAN (Cabré no. 5). Cited under *MIBEC* 19.

In the name of Tiberius II Obv. Diademed bust right. Rev. Cross potent

11. Obv. DNTIBERIV [SPPA]VCT Rev. VITORIAAVCI[ ] Ex. COИOB
1g reported (weight and SG not measured), Grierson not included, Sevilla 45, *MIBEC* VN14

In the name of Maurice Tiberius Obv. Diademed bust right with cross on half circle on top of diadem Rev. Victory advancing right holding wreath in r. and gl. cr. in left. Star in field

12. Obv. DNMAVRIC TIbEPPAV Plain diadem without cross. Rev. VICTORI AAVCVT Ex. CONOB Star in field left.
    1.42 g (SG 17.47: 87 %Au) 18 mm. Grierson A(a), BM-1904-0604-158, *MIBEC* 27b.
13. Obv. DNMAAVRIC TIbEPPAV Rev. VICTORIAAVCV Ex. CONOB
    1.41g (SG 17.45: 87 % Au) 19,5 mm. Grierson A(b), BM-7459, *MIBEC* 27a
14. Obv. DNMAVRIC TIbEPPAV Rev. VICTORIAAVCVTI Ex. CONOB
    1.44g (SG 17.02: 83.5 %Au) 20 mm. Grierson A(c), BM 7460. 15. *MIBEC* 27a.
15. Obv. DNMAVRI CTIbEPPAV Rev. VICTORIAAVCVT Ex. CONOB
    1.40 g (SG 16.74: 81 %Au) 19,5 mm. Grierson A(d),
    ANS 1956.25.23 (ex. Reinhart coll.), *MIBEC* 27a.
16. Obv. DNMAVRI CTIbEPPV Rev. VICTORAAVGVTI Ex. COMOB
    1.41g (SG 16.31: 78 % Au) 19 mm. Grierson not included, Gimenez[95] coll., *MIBEC* 27a, this coin ill.


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95. F. Giménez Chornet, Una acuñación bizantina en Spania, *Congreso Nacional de Numismátic*a, Madrid, 1989, pp. 463-465.

PLATE II

In the name of Phocas Obv. Diademed bust right with cross on circlet on top of diadem. Rev. Cross potent on base and three steps

17. Obv. DN FOCA SPPAVC Rev. VICTORIAAVCV Ex. CONOB
    1.39 g (SG 16.4: 78.5 % Au), 18 mm. Grierson A(a), BM-B.7462, *MIBEC* 36, this coin ill. Same dies as 18-21.
18. Obv. as last Rev. as last.
    Not measured. Grierson A(b). Hermitage, Tolstoi 167 (1.35 g, 18 mm). *MIBEC* 36. Same dies as 17 and 19-21.
19. Obv. as last Rev. as last. 1.46 g (SG 16.07: 75.5 % Au), 18 mm.
    Grierson not included, DOC 136 (Salton-Schlessinger sale, 22.XI.1955, lot 88) *MIBEC* 36. Same dies as 17-18 and 20-21.
20. Obv. as last Rev. as last. Not measured. Grierson not included. Gotha, *MIBEC* 36. Same dies as 17-19 and 21.
21. Obv. as last Rev. as last 1.42 g (SG 15.70: 72.1 % Au). Grierson not included, RAH 189 (Madrid. Gift from the Duke of Almodovar, 1785)[96], *MIBEC* 36, 5. Same dies as 17-20 but recut.

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96. A. Canto Garcia, I. Rodríguez Casanova, Un *tremissis* bizantino de Focas de la ceca de Cartagena, en la colleción de la Real Academia de la Historia, *Archivo Español de Arqueologia* 78, 2005, pp. 279-285. Idem, *Monedas bizantinas, vandalas, ostrogodas y merovingias* (Publicaciones del Gabinete de Antigüedades de la Real Academia de la Historia. II Monedas y Medallas 2.3) Madrid, Real Academia de la Historia, 2006, p. 119, no. 189.

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In the name of Heraclius : Diademed bust right with circlet on top (the central cross is now detached and breaks the inscription. Rev. Cross potent on one step with A *right and* Ω *on left*

22. Obv. DNЄRACL IYSPPAVT Rev. VICTORIAAV CVTI CONOB
1.37 g (SG 15.39: 69 %Au) 17 mm. Grierson A(a) BM-B7471
(De Salis donation, unknown origin) Same dies as 23-31.
23. Obv. as last Rev. as last. 1.38 g (SG 15.95: 74 % Au) 17 mm. Grierson A(b)
DOC 312 (Peirce coll. from Andronicus, Istanbul dealer). Same dies as 22 and 24-30.
24. Obv. as last Rev. as last. Not measured Grierson A(c). Collection Vidal-Quadras y Ramon 4998 (Barcelona). Same dies as 22-23 and 25-31 (if it is same dies as 22 it is also same as 23 and 25 etc.
25. Obv. as last Rev. as last. Not measured. Grierson A(d). From the collection Verworn (Münzen aus der Zeit der Völkerwanderung, Adolph Hess Nachf., sale of June 14, 1922 in Francfort, lot 243.) Same dies as 22-24 and 26-30.
26. Obv. as last Rev. as last 1.42 (SG 15.88: Au 74 %). Grierson not included.
Stuttgart S.U. 1697. Same dies as 22-25, 27-30.
27. Obv. as last Rev. as last. 1.49 g (SG 16.62: 80.5 % Au). Grierson not included.
Stuttgart S.U. 1698. Same dies as 22-26, 28-30.
28. Obv. as last Rev. as last. 1.40g (SG 16.48: 79 % Au), 16.5. Grierson not included,
BNC 10/Es/AV/01 (Schlumberger 2580). Same dies as 22-27, 29-30.
29. Obv. as last Rev. as last. Not Measured. Grierson not included, Baldwin FPL,
Feb 1993. Same dies as 22-28 and 30.
30. Obv. as last Rev. as last, 1.44 g (SG 15.49: 70 % Au), 17 mm.
Grierson not included, PB 251 (Aureo, May 16, 1995, lot 104). Same dies as 22-29.
31. Obv. (DN)ЄRACL IVSPPAVT Rev. VICTORIAA VCVTI, CONOB
1.42 g (missing edge) (SG 15.09: 66 % Au) 19 mm.
Grierson not included, PB 252 (Aureo May 28, 2002, Lot 2073).
32. Obv. DNЄRACLIVS PЬAVT Rev. VICTORAVAVTIC, CONO
1.39 (hole) (SG 15.04: 65.5 % Au) 20 mm.
Grierson not included, Moll 17[97] (found on Majorca).

97. B. Moll, L'Imperi romá d'Orient a Menorca: El testimony numismatic, *GN*, 157, 2005, pp. 5-44.

APPENDIX I
SG of Tremisses in ANS attributed to Constantinople

Justinian					
ANS No.	**Weight, g**	**SG**	**Au %**	**Intrinsic Value, g**	**Notes**
1968.131.19	1.508	18.80	96.7	1.46	
1968.131.20	1.494	18.84	96.9	1.45	
1948.19.1142	1.492	18.84	96.9	1.45	
1968.131.21	1.480	18.89	97.2	1.44	
1977.158.1033	1.492	18.80	96.7	1.44	
1977.158.1034	1.466	18.81	96.8	1.42	
1980.109.215	1.444	18.76	96.4	1.39	
1944.100.1896	1.274	18.73	96.2		1
Average	1.482		96.7	1.43	

Maurice Tiberius					
ANS No.	**Weight, g**	**SG**	**Au %**	**Intrinsic Value, g**	**Notes**
1956.28.21	1.457	18.91	97.4	1.42	
1944.100.13544	1.405	18.81	96.8	1.36	
1946.57.4	1.475	18.86	97.1	1.43	
1980.109.259	1.485	18.84	97.0	1.44	
1944.100.13545	1.407	18.75	96.3	1.35	
1944.100.13546	1.467	18.94	97.5	1.43	
1977.158.1030	1.423	18.92	97.4	1.39	
1977.158.1051	1.460	18.84	97.0	1.42	
1968.131.50	1.460	18.87	97.2	1.42	
1968.131.51	1.407	18.69	95.9	1.35	
1968.131.53	0.714	18.88	97.3		2
1968.131.49	1.298	18.71	96.1		1
1968.131.52	0.713	18.85	97.1		3
Average	1.44		97.2	1.40	

Phocas					
ANS No.	**Weight, g**	**SG**	**Au %**	**Intrinsic Value, g**	**Notes**
1977.158.1056	1.482	18.79	96.6	1.43	
1980.109.263	1.518	18.85	97.0	1.47	
1956.28.22	1.410	18.98	97.8	1.38	sm. hole
1944.100.13555	1.465	18.95	97.6	1.43	
000.999.1033	1.420	18.69	95.9	1.36	
1968.131.74	1.319	18.85	97.0	1.28	
1944.100.13553	1.407	18.77	96.5	1.36	
1944.100.13554	1.374	19.04	98.2	1.35	
1974.26.114	1.239	18.90	97.3		4
1968.131.75	1.448	18.21	92.7	1.34	6
Average	1.46	18.50	94.7	1.38	

Heraclius					
ANS No.	**Weight, g**	**SG**	**Au %**	**Intrinsic Value, g**	**Notes**
1968.131.107	1.499	18.85	97.0	1.45	
1968.131.108	1.397	18.82	96.8	1.35	
1907.408.1	1.469	18.83	96.9	1.42	
1944/100.135.72	1.450	18.88	97.2	1.41	
1977.158.1068	1.482	18.83	96.9	1.44	
1968.131.105	1.460	18.76	96.4	1.41	
1968.131.142	1.419	18.73	96.2	1.36	
1977.185.1067	1.393	18.85	97.0	1.35	
1944.100.13573	1.435	17.79	89.6		5
Average	1.44	18.32	97.0	1.40	

Notes

1	clipped	weight not included	4	low wt?	weight not included
2	odd style etc	weight not included	5	low Au?	Au not used
3	missing part	weight not included	6	low Au?	used

APPENDIX II
Specific gravity measurments of Visigothic Coins Minted from Justinian to Suinthila

Visigothic coins of Justinian							
Tomasini Group[98]	**Tomasini Corpus**	**Collection**[99]	**No.**	**Weight, g**	**SG**	**Au %**	**Intrinsic Value, g**
ToJAN-2	248	ASHM	160	1.355	NA	91.9	1.25
JAN-2	261	ASHM	161	1.425	NA	94.0	1.34
JAN-2a	278	ASHM	162	1.342	NA	91.0	1.22
JAN-2b	295	ASHM	163	1.211	NA	94.1	1.14
JAN-3	311	ASHM	164	1.444	NA	93.9	1.36
JAN-4	325	ASHM	165	1.433	NA	93.7	1.34
JAN-8	372	ASHM	166	1.370	NA	91.6	1.25
JI-3	213	MEC	192	1.460	18.87	97.0	1.42
JAN-1?	646	MEC	193	1.420	17.80	90.0	1.28
JAN-2	253	MEC	194	1.280	18.66	96.0	1.23
JAN-2	275 var	MEC	195	1.260	17.91	90.0	1.13
JAN-2a	281	MEC	196	1.440	17.91	91.0	1.31
JAN-2a	283 var	MEC	197	1.230	18.50	94.0	1.16
JAN-3	299	MEC	198	1.450	18.71	96.0	1.39
JAN-3	299	MEC	199	1.450	18.55	95.0	1.38
JAN-3?	645	MEC	200	1.440	18.56	95.0	1.37
Average				1.376		93.39	1.29

98. HAS (Hispanic Society of America), PB (Collection of Peter Bartlett), Cores (Collection of Gonzalo Cores part of which is now in MAN), MAN (Museo Nacional de Arqueología, Madrid), Yndias 2 (Sale of Aureo & Calico, Barcelona, June 2009), Oddy (unpublished data of WA Oddy), AM (Collection of Dr, Antonio Miranda, Santa Tirso, Portugal), ASHM (Ashmolean Museum, Oxford), BNP (Bibliotèque Nationale de Francia, Paris), GNC (Gabinete Numismático de Cataluña, Barcelona), MNA(Museu Nacional de Arqueologia, Portugal), MNP (Museu Numismático Portuguěs), UBP (Collection of the União de Bancos Portugueses S.A., now Banco Mello S.A.), Yndias (Col. Caballero de las Yndias, sale by Aureo and Calicó, Barcelona the 21 & 22 of October, 2009).

99. JAN = Justinian, J1 = Justin I, the succeeding number are groups which Tomasini arranged each coinage into.

Justin II – Leovigild / VWP Coins					
Tomasini Group	**Coin No.**	**Collection**	**Inventory No.**	**Weight, g**	**SG**
JII-1	408	HSA	16729	1.37	18.20
JII-1	Unknown	MNA	14	1.38	
JII-2	434	GNC	9853	1.37	18.44
JII-3	453	ANS	1956.25.8	1.09	18.30
JII-3	452	ASHM	169	1.37	NA
JII-3	Unknown	MNP	22	1.156	
Average					
JII-4	479	HSA	499	1.40	18.20
JII-4	484	MEC	203	1.43	18.19
JII-4	486	HSA	15590	1.31	15.70
JII-4	similar to 487	PB	17	1.27	16.4
JII-4		MNA	17	1.24	
Average				1.33	
JII-4a	495	HSA	519	1.13	16.70
JII-4a	498	ANS	1956.25.9	1.25	15.00
JII-4a	499	GNC	9862	1.20	17.73
JII-4a	660	MEC	204	1.36	18.61
Average				1.23	
JII-5	502	HSA	16665	1.49	18.10
JII-5	503	MEC	205	1.47	18.67
JII-5	504	AM	43	1.409	
JII-5	504	UBP	13	1.474	
JII-5	510	UBP	14	1.473	
JII-5	515	ASHM	170	1.49	NA
JII-5	516	HSA	500	1.18	16.90
JII-5	similar to 518	Yndias	1238	1.47	17.35
JII-5	similar to 518-519	MEC	209	1.300	17.37
JII-5	similar to 518-519	PB	18	1.293	17.51
Average				1.406	
JII-7	535	MEC	206	1.43	17.5300
JII-7	538	GNC	9866	1.37	15.3651
JII-7	535	MNA	16	1.410	
Average				1.40	

Au %	Other Au %	Method	Ref. Notes	Measured by
92.6			Kurt, 2001	Olson
	94.1	PIXE	*Ensaios* 23	Marques et al.
94.2			unpublished	Bartlett
93.3			Kurt, 2001	Olson
91.2	94.0	Milliprobe	Metcalf and Schweizer	Oddy (SG), Metcalf et al. (Other)
	94.9	PIXE	*Ensaios* 24	Marques et al.
92.3	94.5			
92.6			Kurt, 2001	Olson
93.0			MEC	Oddy
72.1			Kurt, 2001	Olson
78.5			unpublished	Bartlett
	96.4	PIXE	*Ensaios* 24	Marques et al.
84.1				
81.1			Kurt, 2001	Olson
65.1			Kurt, 2001	Olson
89.2			unpublished	Bartlett
95.0			MEC	Oddy
82.6				
91.8			Kurt, 2001	Olson
96.0			MEC	Oddy
	97.3	PIXE	*Ensaios* 26	Marques et al.
	97.1	PIXE	No.11 in	Metcalf et al.
	94.9	PIXE	No. 12 in	Metcalf et al., 1992
88.4	93.0	Milliprobe	Metcalf and Schweizer	Oddy (SG), Metcalf et al. (Other)
82.7			Kurt, 2001	Olson
86.4			unpublished	Bartlett
86.0			MEC	Oddy
87.6			same dies as MEC 209 UP	Bartlett
88.4	95.6			
88.0			MEC	Oddy
68.9			unpublished	Bartlett
	94.2	PIXE	*Ensaios* 28	Marques et al.
78.4				

CVRRV Coinage Justin II-Leovigild?					
Tomasini Group	**Coin No.**	**Collection**	**Inventory No.**	**Weight, g**	**SG**
C-1	549	HSA	8166	1.38	18.40
C-1	552	HSA	15975	1.42	18.60
C-1	553	HSA	15980	1.45	18.20
C-1	554	HSA	16731	1.46	18.10
C-1	same dies 550	PB	11	1.40	18.53
C-1	same dies 543	AM	41	1.44	
Average				1.42	
C-2	564	GNC	9865	1.22	18.37
C-2	560	HSA	15976	1.47	18.40
C-2	561	HSA	15977	1.44	18.40
C-2	562	HSA	15978	1.44	18.00
C-2	565	HSA	7891	1.37	18.40
C-2	566	ASHM	171	1.49	NA
Average				1.41	
Leovigild?					
C-3	569	HSA	15981	1.27	17.90
C-3	574	HSA	497	1.28	17.60
C-3	575	HSA	16756	1.28	18.40
C-3	577	ANS	1957.28.1	1.27	18.40
C-3	578	HSA	501	1.35	17.00
C-3	573	MEC	207	1.40	18.59
C-3	similar to 570	PB	13	1.32	18.60
C-3	same dies 583?	PB	14	1.24	17.90
C-3	var. 588	PB	15	1.26	18.10
C-3	similar to 586	Yndias	1234	1.26	17.49
C-3	similar to 589	Yndias	1235	1.35	18.01
C-3	similar to 589	Yndias	1236	1.35	17.85
C-3	570	GNC	9852	1.33	18.40
C-3	571	GNC	9855	1.41	18.64
C-3	572	GNC	9854	1.02	18.08
C-3	similar to 573-587	UBP	24	1.40	
C-3	similar to 588	AM	45	1.27	
C-3	NA	AM	44	1.28	
C-3	NA	AM	32	1.34	
Average				1.30	

var. ?

Au %	Other Au %	Method	Ref. Notes	Measured by
94.0			Kurt, 2001	Olson
95.3			Kurt, 2001	Olson
92.6			Kurt, 2001	Olson
91.8			Kurt, 2001	Olson
95.0			unpublished	Bartlett
	96.0	PIXE	*Ensaios* 29	Marques et al.
93.7				

93.79			unpublished	Bartlett
94.00			Kurt, 2001	Olson
94.00			Kurt, 2001	Olson
91.20			Kurt, 2001	Olson
94.00			Kurt, 2001	Olson
93.50	99	Milliprobe	Metcalf and Schweizer	Oddy (SG), Metcalf et al. (Other)
93.42				

90.5			Kurt, 2001	Olson
88.3			Kurt, 2001	Olson
94.0			Kurt, 2001	Olson
94.0			Kurt, 2001	Olson
83.5			Kurt, 2001	Olson
95.0			MEC	Oddy
95.3			unpublished	Bartlett
90.5			unpublished	Bartlett
91.8			unpublished	Bartlett
87.4			unpublished	Bartlett
91.3			unpublished	Bartlett
90.1			unpublished	Bartlett
94.2			unpublished	Bartlett
95.6			unpublished	Bartlett
91.7			unpublished	Bartlett
	95.5	PIXE	Metcalf and Schweizer	Metcalf et al.
	96.0	PIXE	*Ensaios* 30	Metcalf et al.
	92.5	PIXE	*Ensaios* 31	Metcalf et al.
	88.7	PIXE	*Ensaios* 32	Metcalf et al.
91.5	93.2			

CVRRV Coinage Justin II-Leovigild?					
Tomasini Group	**Coin No.**	**Collection**	**Inventory No.**	**Weight, g**	**SG**
C-4	593	HSA	16734	1.320	
C-4	594	HSA	16771	1.270	
Average				1.295	

C-5	602	HSA	513	1.460	18.6
C-5	599	MEC	208	1.300	18.21
C-5	599	PB	12	1.430	18.50
C-5	596	ASHM	172	1.400	NA
C-5	similar to 599	UBP	16	1.434	
Average				1.400	

IR(Inclitus Rex) Coinage- Leovigild & Hermenegild					
Tomasini Group	**Coin No.**	**Collection**	**Inventory No.**	**Weight, g**	**SG**
Leovigild	619	HSA	13002	1.29	
Leovigild	620	HSA	16003	1.31	
Leovigild	621	HSA	16781	1.31	
Leovigild	New	PB	19	1.27	
Leovigild	New	PB	20	1.31	
Leovigild	New	Cores	11(a)4	1.28	
Leovigild	625	GNC	9877	1.32	
Leovigild	626	GNC	9868	1.33	
Hermenegild	632	BNP	13	1.36	
Hermenegild	New	Cores	1	1.30	
Average			10 coins	1.31	

tc = this coin >>> no hay tc en estas tablas... normal?

Au %	Other Au %	Method	Ref. Notes	Measured by
66.2			Kurt, 2001	Olson
67.2			Kurt, 2001	Olson
66.7				

95.3			Kurt, 2001	Olson
93.0			MEC	Oddy
95.0			unpublished	Bartlett
93.9	98.0	Milliprobe	Metcalf and Schweizer	Oddy (SG), Metcalf et al. (Other)
	95.6		No. 22 in	Metcalf et al.
94.3				

Au %	Other Au %	Method	Ref. Notes	Measured by
70.1			Kurt, 2001	Olson
70.1			Kurt, 2001	Olson
73.0			Kurt, 2001	Olson
86.0				Bartlett
74.0				Bartlett
81.1				Bartlett
75.9				Bartlett
78.3				Bartlett
77.6				Bartlett
83.0				Bartlett
77.0				

COS - Cross on Steps Coinage of Lovigild > 578-84								
Mint	**Collection**	**Inventory No.**	**Weight, g**	**SG**	**Au %**	**Intrinsic Value, g**	**Pliego No.**	**Measured by**
Ispali	HSA	16004	1.24	16.1	75.8	0.94	45a1	Olson*
Ispali	HSA	15988	1.29	16.4	78.5	1.01	45b1	Olson*
Italica	HSA	16751	1.21	16.1	75.8	0.92	49 1	Olson*
Italica	PB	25	1.27	16.5	79.4	1.01	49 2	Bartlett
Reccopolis	HSA	16006	1.23	16.2	76.7	0.94	36a1	Olson*
Toleto	HSA	15993	1.3	15.6	71.1	0.92	42c1	Olson*
Toleto	HSA	15994	1.29	15.6	71.1	0.92	42c2	Olson*
Toleto	HSA	16000	1.24	15.9	73.9	0.92	42c3	Olson*
Toleto	PB	22	1.50	16.0	74.8	1.14	43c32	Bartlett
Elvora	HSA	15982	1.10	15.2	67.2	0.74	52b1	Olson*
Elvora	HSA	15987	1.36	15.5	70.1	0.95	52b2	Olson*
Elvora	HSA	15986	1.19	16.0	74.8	0.89	52e1	Olson*
Elvora	MEC	210	1.28	15.6	70.9	0.91	52b3	Oddy
Emerita	HSA	16498	1.26	15.4	69.2	0.87	54e1	Olson*
Emerita	ANS	56.25.12	1.29	16.0	74.8	0.96	54d1	Olson*
Emerita	HSA	F 4	1.17	15.7	72.1	0.84	54d2	Olson*
Emerita	PB	24B	1.26	15.8	73.0	0.92	54a2	Bartlett
Tirasona	HSA	16670	1.22	15.5	70.1	0.86	34 1	Olson*
Average			1.26	15.84	73.3	0.93		

* As published in appendix of Kurt, 2001.

Visigoth coinage of the facing bust type 584-c. 624							
Ruler Mint	**Collection[100]**	**No.**	**Weight, g**	**SG**	**Au %**	**Intrinsic Value, g**	**Pliego No.**
Leovigild							
Toleto	Stockholm	207340	1.50	16.28	77.4	1.16	42 c.4
Toleto	HSA	15992	1.45	15.90	73.9	1.07	43 c.1-4
Toleto	HSA	15996	1.49	15.90	73.9	1.10	43 c.1-4
Toleto	HSA	15998	1.48	15.70	72.1	1.07	43 c.1-4
Toleto	HSA	15991	1.53	15.80	73.0	1.12	43 d.1
Toleto	HSA	15995	1.49	15.60	71.1	1.06	43 c.24
Toleto	*MEC*	212	1.52	16.20	77.0	1.17	43 c.12
Toleto	PB	22	1.53	16.00	74.8	1.14	43 c.32
Hispali	HSA	8114	1.49	16.60	80.3	1.20	46 b.1
Hispali	HSA	16668	1.54	16.20	76.7	1.18	48 b.1
Hispali	PB	26	1.42	16.45	79.0	1.12	47 a.1
Emerita	Stockholm	207341	1.48	15.65	71.8	1.06	56 a.1
Emerita	HSA	F 5	1.33	15.80	73.0	Missing edge	56 b.2
Emerita	PB	24	1.54	16.20	77.0	1.19	57 2
Saldania	HSA	16001	1.36	16.20	76.7	1.04	39 1
Elvora	HSA	15984	1.49	15.70	72.1	1.07	53 b.1

100. HSA (Hispanic Society of America), PB (Collection of Peter Bartlett), Cores (Collection of Gonzalo Cores part of which is now in MAN), MAN (Museo Nacional de Arqueólogía, Madrid), Yndias 2 (Aureo & Calico sale, Barcelona, June 2009), Oddy (unpublished data of W.A. Oddy).

Ruler Mint	Collection	No.	Weight, g	SG	Au %	Intrinsic Value, g	Pliego No.
Elvora	HSA	16008	1.51	15.40	69.2	1.04	53 a.1-2
Elvora	HSA	16010	1.51	15.50	70.1	1.06	53 a.1-2
Elvora	HSA	15983	1.46	15.60	71.1	1.04	54 d.1-2
Elvora	HSA	16009	1.53	15.40	69.2	1.06	54 d.1-2
Elvora	*MEC*	211	1.52	15.47	70.0	1.06	53 a.13
Narabona	HSA	16005	1.44	15.50	70.1	1.01	19 1
Narabona	HSA	15989	1.48	16.30	77.6	1.15	22 1
Cesaragusta	HSA	16669	0.94	16.80	81.9	0.77	29 1
Rodas	HSA	16007	1.45	15.30	68.2	0.99	32 b.1
Amasia	PB	23	1.48	16.30	77.6	1.14	23 1
Average Leovigild		26 Coins	1.46		74.0	1.08	

Reccared I							
Toleto	Stockholm	207339	1.54	15.76	72.8	1.12	98 b.17-21
Toleto	Stockholm	207338	1.51	15.65	71.7	1.08	98 b.17-21
Toleto	Stockholm	207337	1.49	16.00	74.9	1.12	98 b.17-21
Toleto	HSA	16055	1.48	15.90	73.9	1.09	98 a.1
Toleto	HSA	16052	1.42	15.70	72.1	1.02	98 a.3
Toleto	HSA	16049	1.49	15.90	73.9	1.10	98 b.1-2
Toleto	HSA	16051	1.56	15.90	73.9	1.15	98 .3-10b
Toleto	HSA	16053	1.48	15.50	70.1	1.04	98 .3-10b
Toleto	HSA	16054	1.52	15.80	73.0	1.11	98 .3-10b
Toleto	HSA	16057	1.43	15.90	73.9	1.06	98 .3-10b
Toleto	HSA	16058	1.45	15.50	70.1	1.02	98 b.3-10
Toleto	HSA	16059	1.48	15.60	71.1	1.05	98 b.3-10
Toleto	HSA	16060	1.54	15.80	73.0	1.12	98 b.3-10
Toleto	HSA	16063	1.51	15.60	71.1	1.07	98 b.2
Toleto	HSA	8102	1.43	16.10	75.8	1.08	98 b.3-10
Toleto	HSA	F 17	1.51	15.80	73.0	1.10	98 b.37
Toleto	MEC	223	1.53	15.94	74.0	1.13	98 a.7
Toleto	PB	34	1.52	16.10	75.8	1.15	98(a)15
Ispali	HSA	F 11	1.46	15.60	71.1	1.04	105 b.5
Ispali	HSA	16037	1.48	15.70	72.1	1.07	105 h.2
Ispali	HSA	16041	1.51	16.00	74.8	1.13	106 a.1-2
Ispali	HSA	16509	1.49	15.70	72.1	1.07	106 a.1-2
Ispali	HSA	16038	1.49	15.60	71.1	1.06	106 b.1-2
Ispali	HSA	16036	1.52	15.90	73.9	1.12	106 b.1-2
Ispali	HSA	16039	1.50	15.70	72.1	1.08	106 d.1
Ispali	*MEC*	222	1.46	15.67	72.0	1.05	105 h.1
Ispali	*MEC*	221	1.55	16.06	75.0	1.16	106 e.38
Ispali	PB	32	1.46	15.90	73.9	1.08	106 b.11
Ispali	PB	33	1.50	16.00	74.8	1.12	106 d.10
Ispali	Yndias 2	1012	1.46	15.94	74.3	1.09	Not Included
Eliberri	HSA	16065	1.42	14.80	63.0	0.89	101 a.1
Eliberri	HSA	16023	1.39	14.70	62.0	0.86	101 f.1
Eliberri	HSA	F 10	1.41	14.80	63.0	0.89	101 e.1
Eliberri	*MEC*	216	1.47	15.19	67.0	0.98	101 c.1
Eliberri	PB	31	1.43	14.90	64.1	0.92	101 a.7
Emerita	HSA	16027	1.44	16.20	76.7	1.10	114 a.1
Emerita	HSA	16028	1.42	15.80	73.0	1.04	114 a.2
Emerita	HSA	F 13	1.50	15.60	71.1	1.07	114 a.28-30
Emerita	HSA	F 14	1.49	15.80	73.0	1.09	114 a.28-30
Emerita	HSA	F 16	1.46	15.70	72.1	1.05	114 a.28-30

Ruler Mint	Collection	No.	Weight, g	SG	Au %	Intrinsic Value, g	Pliego No.
Emerita	HSA	16029	1.51	15.80	73.0	1.10	114 d.1
Emerita	HSA	F 15	1.51	16.40	78.5	1.19	114 b.6
Emerita	HSA	16030	1.51	15.90	73.9	1.12	114 g.1-3
Emerita	HSA	16042	1.52	15.90	73.9	1.12	114 g.4
Emerita	HSA	16032	1.51	16.80	81.9	1.24	114 g.1-3
Emerita	HSA	16034	1.51	15.70	72.1	1.09	114 g.1-3
Emerita	ANS	69.222.78	1.52	16.10	75.8	1.15	114 g.14
Emerita	HSA	F 12	1.52	16.20	76.7	1.17	114 g.18
Emerita	HSA	16033	1.46	16.50	79.4	1.16	115 1.a
Emerita	HSA	16026	1.44	15.90	73.9	1.06	116 e.1
Emerita	HSA	16035	1.48	15.80	73.0	1.08	116 g.1
Emerita	HSA	16031	1.49	15.60	71.1	1.06	117 a.1
Emerita	*MEC*	220	1.46	16.14	76.0	1.11	114 b.2
Emerita	*MEC*	219	1.49	16.03	75.0	1.12	116 g.2
Emerita	PB	35	1.51	16.00	74.8	1.13	114 a.34
Emerita	PB	36	1.43	16.30	77.6	1.11	114 g.28
Emerita	PB	37	1.52	16.20	76.7	1.17	116 c.5
Elvora	HSA	16021	1.49	15.70	72.1	1.07	112 a.1-2
Elvora	HSA	16022	1.45	15.40	69.2	1.00	112 a.1-2
Elvora	HSA	16024	1.56	15.70	72.1	1.12	112 b.1-2
Elvora	HSA	16071	1.49	15.40	69.2	1.03	112 b.1-2
Elvora	HSA	16025	1.47	16.20	76.7	1.13	112 c.1
Elvora	*MEC*	217	1.51	15.89	74.0	1.12	112 b.6
Narbona	HSA	16043	1.51	15.70	72.1	1.09	63 b.1
Narbona	HSA	16044	1.43	15.90	73.9	1.06	64 a.1
Barcinona	HSA	10620	1.51	15.70	72.1	1.09	67 a.1
Barcinona	HSA	16067	1.47	15.60	71.1	1.05	67 d.1
Barcinona	HSA	16582	1.47	15.30	68.2	1.00	67 e.1
Cesaragusta	HSA	16015	1.50	15.90	73.9	1.11	70 a.1
Cesaragusta	HSA	16016	1.48	16.10	75.8	1.12	70 d.1
Cesaragusta	HSA	16018	1.46	15.50	70.1	1.02	71 b.1
Cesaragusta	HSA	NOT F 1	1.47	15.80	73.0	1.07	71 c.3
Cesaragusta	HSA	16069	1.46	15.50	70.1	1.02	72 c.1
Cesaragusta	HSA	16017	1.45	16.40	78.5	1.14	76 b.1
Roda	PB	27	1.48	15.78	73.0	1.08	79 a.1
Tarracona	HSA	16050	1.40	15.50	70.1	0.98	80 a.1
Tarracona	HSA	16046	1.46	15.40	69.2	1.01	81 b.1
Tarracona	HSA	16047	1.47	15.40	69.2	1.02	83 d.1
Tarracona	HSA	F 8	1.50	15.40	69.2	1.04	85 1
Tarracona	HSA	16056	1.51	16.00	74.8	1.13	86 b.1
Tarracona	HSA	16048	1.49	16.40	78.5	1.17	86 c.1
Tarracona	PB	28	1.45	16.30	77.6	1.13	96e
Tirasona	HSA	16072	1.45	15.20	67.2	0.97	91 .1f
Reccopolis	PB	29	1.49	15.80	73.0	1.09	96 e.1
Saldania	HSA	16045	1.55	15.90	73.9	1.15	97 1
Cordoba	HSA	16020	1.50	16.10	75.8	1.14	100 c.1
Cordoba	HSA	16019	1.41	15.30	68.2	0.96	100j
Cordoba	*MEC*	215	1.50	15.96	74.0	1.11	100c
Cordoba	PB	30	1.49	16.20	76.7	1.14	100 i.2
Eminio	*MEC*	214	1.48	15.44	70.0	1.04	120 b.1
Calapa	*MEC*	213	1.50	15.63	71.0	1.07	134 1
Vallegia	HSA	16064	1.48	16.00	74.8	1.11	154 1
Average Reccared I			1.48		72.8	1.08	

Ruler Mint	Collection	No.	Weight, g	SG	Au %	Intrinsic Value, g	Pliego No.
Liuva II							
Toleto	HSA	16075	1.51	15.60	74.8	1.13	160 c.1
Ispali	HSA	16076	1.51	16.00	74.8	1.13	163 b.1
Ispali	HSA	F 18	1.49	15.40	69.2	1.03	163 b.6
Ispali	*MEC*	225	1.48	16.17	76.0	1.12	163 b.3
Ispali	PB	38	1.53	15.89	73.0	1.12	163 b.14
Emerita	HSA	16077	1.49	15.40	69.2	1.03	165 a.1
Emerita	*MEC*	224	1.43	15.86	74.0	1.06	165 a.1
Emerita	PB	41	1.50	15.80	73.0	1.10	165 b.5
Tarracona	HSA	16074	1.47	15.2	67.2	0.99	158 b.1
Average Liuva II			1.49		72.4	1.08	
Witteric							
Toleto	HSA	16087	1.49	15.60	71.1	1.06	186 b.1-2
Toleto	HSA	16088	1.52	15.50	70.1	1.07	186 b.1-2
Toleto	HSA	F 23	1.46	15.80	73.0	1.07	186 b.10-11
Toleto	HSA	F 24	1.52	15.70	72.1	1.10	186 b.10-11
Toleto	MEC	229	1.50	15.71	75.0	1.13	186 b.5
Ispali	HSA	16082	1.44	15.60	71.1	1.02	190 a.1-2
Ispali	HSA	16086	1.32	15.20	67.2	0.89	190 a.1-2
Ispali	*MEC*	228	1.50	15.58	71.0	1.07	190 a.16
Ispali	Cores	18-9	1.50	15.93	74.2	1.12	No. Unknown
Ispali	Cores	18-10	1.48	15.87	73.7	1.09	190 a.22
Ispali	J.Vico, Sale118	429	1.47	15.90	73.9	1.09	190 c.25
Ispali	PB	45	1.49	15.86	73.6	1.10	190 e.20
Emerita	Cores	18-1	1.45	15.48	70.0	1.01	193 f.4
Emerita	Cores	18-2	1.46	15.93	74.2	1.08	194 c.10
Emerita	Cores	18-3	1.49	15.54	70.5	1.05	193 b.4
Emerita	Cores	18-4	1.44	15.70	72.1	1.04	193 e.2
Emerita	HSA	16083	1.45	15.30	68.2	0.99	194 c.1-2
Emerita	HSA	16084	1.45	15.60	71.1	1.03	194 c.1-2
Emerita	HSA	16085	1.43	15.80	73.0	1.04	193 d.1
Emerita	HSA	F 21	1.46	15.60	71.1	1.04	193 f.1
Emerita	*MEC*	227	1.51	15.71	72.0	1.09	193 b.3
Emerita	PB	47	1.51	15.90	73.9	1.12	193 f.7
Emerita	PB	48	1.49	15.70	72.1	1.07	193 c.6
Eliberri	*MEC*	226	1.44	15.10	66.0	0.95	189 a.7
Eliberri	PB	44	1.42	15.11	66.3	0.94	189 d.1
Narabona	PB	42	1.50	15.11	66.3	0.99	172, 1
Cesaragusta	PB	43	1.37	15.56	70.6	0.96	174 a.3
Cesaragusta	Cores	18-5	1.43	15.29	68.1	0.98	174 b.1
Tarracona	Cores	18-6	1.41	15.33	68.5	0.97	No.unknown
Tarracona	Cores	18-7	1.47	14.90	64.1	0.94	No.unknown
Mentesa	Cores	18-8	1.40	15.51	70.2	0.98	183 f.1
Average Witteric			1.46		70.8	1.03	
Gundemar							
Barcinona	Cores		1.42	15.40	69.2	0.98	216, 1
Cesaragusta	HSA		1.46	15.40	69.2	1.01	217 d.1
Cesaragusta	Cores	18-6-5	1.42	15.26	67.8	0.97	No. unknown
Tarracona	HSA	16759	1.46	15.10	66.2	0.97	219 a.1
Tarracona	J.Vico, Sale118	431	1.35	15.18	67.0	0.91	219 c.2
Tarracona	Cores	18-6-6	1.45	15.19	67.1	0.98	219 a.10

Ruler Mint	Collection	No.	Weight, g	SG	Au %	Intrinsic Value, g	Pliego No.
Volotania	Cores	18-6-13	1.26	15.67	71.8	0.90	221, 2
Toleto	HSA	16089	1.40	15.00	65.1	0.91	224 a.1
Toleto	Cores	18-6-7	1.45	15.49	70.0	1.02	224 a.13
Mentesa	Cores	18-6-12	1.43	14.92	64.3	0.92	222 d.1
Mentesa	HSA	16096	1.42	14.90	64.1	0.91	222 a.1
Ispali	J.Vico, Sale118	430	1.37	16.00	74.8	1.02	227 h.2
Ispali	J.Vico Sale 120	352	1.55	15.98	74.6	1.15	227
Ispali	Cores	18-6-11	1.52	15.82	73.2	1.11	228 c.8
Ispali	PB	51	1.46	15.90	73.9	1.08	227 k.1
Ispali	PB	37	1.49	15.65	73.9	1.10	228 c.1
Elibrerri	PB	52	1.42	15.02	65.3	0.93	226, 5
Elibrerri	Cores		1.55	15.01	65.2	1.01	No. unknown
Eliberri	*MEC*	230	1.45	15.14	66.6	0.97	226 1
Cordoba	Cores		1.50	15.90	73.9	1.11	225 1
Emerita	PB	49	1.50	15.75	72.6	1.09	232 b.4
Average Gundemar			1.44		69.3	1.00	

Sisebut							
Cesaragusta	HSA	16100	1.41	14.9	64.1	0.90	247 a.1-2
Cesaragusta	HSA	16101	1.36	14.9	64.1	0.87	247 a.3
Cesaragusta	HSA	16102	1.42	15.1	66.2	0.94	247 a.1-2
Cesaragusta	HSA	16104	1.39	14.9	64.1	0.89	249 a.1
Cesaragusta	Cores	18-3-7	1.45	14.86	63.6	0.92	247 c.1
Cesaragusta	Cores	18-3-8	1.36	14.81	63.1	0.86	249 a.4
Tarracona	J.Vico Sale 118	435	1.41	14.50	60.0	0.84	255 g.1
Tarracona	HSA	16128	1.49	15	65.1	0.97	254 b.1
Tarracona	HSA	F 29	1.43	15.5	70.1	1.00	254 a.2
Tarracona	HSA	16115	1.40	15.1	66.2	0.93	254 e.1
Tarracona	HSA	F 30	1.44	15.1	66.2	0.95	254 e.2
Tarracona	HSA	16129	1.47	14.9	64.1	0.94	255 d.1
Tarracona	HSA	F 28	1.33	14.5	59.9	0.80	255 a.2
Tarracona	MEC	233	1.43	14.65	62.0	0.89	255 c.3
Tarracona	PB	53	1.37	14.79	63.0	0.86	255 a.9
Tarracona	Cores	18-3-10	1.48	14.81	63.1	0.93	254 a.3
Tarracona	Cores	18-3-11	1.36	14.98	64.9	0.88	254 d.4
Tarracona	Cores	18-3-12	1.41	14.79	63.0	0.89	255 a.7
Sagunto	Cores	18-3-9	1.38	14.70	62.0	0.85	253 1
Saldania	PB	58	1.51	15.24	67.4	1.02	266 1
Mave	PB	56	1.55	16.00	74.0	1.15	261 1
Reccopolis	PB	57	0.80	13.83	63.3		265 1
Acci	HSA	16013	1.40	14.5	59.9	0.84	257 f.1
Acci	PB	54	1.41	13.17	51.6	0.73	257 c.5
Acci	Cores	18-4-1	1.29	14.45	59.0	0.76	No.unknown
Acci	Cores	18-4-2	1.44	14.90	64.0	0.92	257 c.1
Acci	Cores	18-4-3	1.42	14.95	64.6	0.92	258 1
Mentesa	HSA	16127	1.03	14.7	62.0		262 a.1
Mentesa	PB	55	1.41	14.90	64.1	0.90	263 a.6
Mentesa	Cores	18-4-4	1.40	14.94	64.5	0.90	263 a.3
Mentesa	Cores	18-4-5	1.42	14.93	64.4	0.91	NA
Mentesa	Cores	18-4-6	1.42	14.91	64.2	0.91	NA
Mentesa	Cores	18-4-7	1.42	14.87	63.7	0.90	NA
Mentesa	Cores	18-4-8	1.38	14.97	65.0	0.89	NA

Ruler Mint	Collection	No.	Weight, g	SG	Au %	Intrinsic Value, g	Pliego No.
Mentesa	J.Vico Sale 118	434	1.37	14.93	64.4	0.88	264c
Toleto	PB	59	1.47	14.91	64.2	0.94	267 a.8
Toleto	PB	62	1.51	15.03	65.4	0.99	267 a.45
Toleto	PB	61	1.47	15.25	67.7	0.99	267 d.4
Toleto	PB	60	1.52	15.13	66.5	1.01	267 h.2
Toleto	HSA	16116	1.52	14.6	61.0	0.93	267 a.1
Toleto	HSA	16132	1.49	14.7	62.0	0.92	267 a.2
Toleto	HSA	16133	1.44	14.9	64.1	0.92	267 a.3
Toleto	HSA	16135	1.44	14.8	63.0	0.91	267 a.45
Toleto	HSA	F 31	1.51	15.1	66.2	1.00	267 a.15
Toleto	HSA	NOT F 2	1.46	15.3	68.2	1.00	267 a.16
Toleto	Oddy	74	1.39	15.18	67.0	Broken not used	267 a
Toleto	*MEC*	234	1.42	14.95	65.0	0.92	267 a.19
Cordoba	HSA	16105	1.52	16.2	76.7	1.17	271 c.1
Cordoba	Cores	18-4-12	1.50	15.43	69.5	1.04	271 j.2
VictorBarbi	PB	67a	1.43	15.16	66.8	0.95	268 1
Barbi	PB	67b	1.46	14.48	60.0	0.88	269 d.1
Barbi	PB	68	1.39	14.85	63.5	0.88	269 a.4
Barbi	PB	72	0.87	14.83	63.0	Broken not used	269 a.15
Barbi	PB	70	1.45	14.85	64.0	0.93	No.unknown
Barbi	PB	71	1.43	14.94	64.0	0.92	269 a.6
Barbi	PB	69	1.42	14.87	64.0	0.91	269 a.8
Eliberri	PB	65	1.45	14.86	63.6	0.92	273 d.3
Eliberri	PB	63	1.38	14..91	64.2	0.89	272 a.7
Eliberri	PB	64	1.39	14.79	62.9	0.87	272 n.4
Eliberri	PB	66	1.45	14.86	63.6	0.92	273 b.1
Eliberri	HSA	16106	1.47	15.08	66.2	0.97	272 b.1
Eliberri	HSA	F 26	1.32	14.58	61.0	Broken not used	272 a.3
Eliberri	HSA	F 27	1.33	14.78	63.0	0.84	272 0.1
Ispali	HSA	16121	1.46	15.5	70.1	1.02	274 a.1
Ispali	HSA	16244	1.49	15.2	67.2	1.00	275 a.2-4
Ispali	HSA	16376	1.48	15.3	68.2	1.01	275 a.2-4
Ispali	HSA	16418	1.47	15.4	69.2	1.02	275 a.2-4
Ispali	HSA	16120	1.45	15.3	68.2	0.99	274 d.1
Ispali	HSA	16124	1.49	15.5	70.1	1.04	274 d.2-3
Ispali	HSA	16426	1.54	15.4	69.2	1.07	274 d.2-3
Ispali	MEC	232	1.48	15.54	71.0	1.05	274 d.4
Ispali	BnF	40	1.47	15.08	65.9	0.97	275 d.12
Ispali	PB	73	1.43	15.70	72.1	1.03	274 a.55
Ispali	PB	74	1.46	15.45	69.7	1.02	274 a.36
Ispali	PB	75	1.47	15.31	68.3	1.00	275 d.35
Ispali	PB	76	1.41	15.35	68.7	0.97	274 f.2
Ispali	J.Vico, Sale118	433	1.47	15.59	71.0	1.04	No. unknown
Ispali	J.Vico, Sale118	432	1.50	15.33	68.5	1.03	No. unknown
Emerita	*MEC*	231	1.45	15.4	69.0	1.00	285 c.5
Emerita	PB	79	1.47	15.17	66.9	0.98	284 a.4
Emerita	PB	78	1.50	15.48	69.9	1.05	286 h.5
Emerita	PB	80	1.47	15.39	69.1	1.01	284 c.4
Emerita	PB	77	1.48	15.17	66.9	0.99	285 c.36
Emerita	HSA	8109	1.46	15.37	68.9	1.00	285 a.1-2
Emerita	HSA	16119	1.51	15.29	68.1	1.03	285 a.1-2
Emerita	HSA	16108	1.43	15.29	68.1	0.97	285 c.1-2

Ruler Mint	Collection	No.	Weight, g	SG	Au %	Intrinsic Value, g	Pliego No.
Emerita	HSA	16545	1.48	15.82	73.2	1.08	285 c.1-2
Emerita	PB	81	1.60	16.03	75.0	1.20	286 f.2
Emerita	Cores	18-9	1.49	15.59	74.7	1.11	NA
Emerita	Cores	18-10	1.48	15.57	70.8	1.05	NA
Eminio	HSA	16109	1.48	15.9	73.9	1.09	289 a.1
Eminio	PB	82	1.41	15.47	70.0	0.99	289 a.2
Eminio	PB	83	1.46	15.53	70.4	1.03	187 a.2
Egitania	BnF	39	1.33	15.61	71.2	0.95	281 d.1
Egitania	PB	85	1.34	17.66	89.0	1.19	281 b.2
Elvora	PB	84	1.48	14.91	64.2	0.95	283 a.20
Laetera	HSA	16112	1.38	15.70	72.1	0.99	310 a.1
Lucu	HSA	16113	1.54	15.70	72.1	1.11	313 1
Pincia	HSA	16114	1.24	15.10	66.2	0.82	319 1
Bracara	PB	87	1.44	15.74	72.5	1.04	300 b.2
Tude	HSA	16117	1.50	14.90	64.1	0.96	325 b.1
Tude	PB	86	1.54	15.00	65.1	1.01	325 a.2
Tude	Cores	18-1	1.50	15.06	65.8	0.99	285 c.1
Average Sisebut			1.44		66.4	0.96	

Reccared II							
Acci	Cores	2	1.40	14.90	64.0	0.89	330(a)1
Acci	PB	88	1.39	15.00	65.1	0.90	330((b)1
Toleto	Cores	5	1.40	15.00	65.0	0.91	331(b)1
Toleto	PB	90	1.51	14.80	63.0	0.95	331(a) 4
Eliberri	Cores	6	1.52	14.48	60.0	0.91	333(c)1
Eliberri	Cores	1	1.37	14.90	64.0	0.88	333(b)2
Ispali	Cores	9	1.44	15.23	67.0	0.97	224, 1
Ispali	PB	91	1.43	15.40	69.2	0.99	224, 2
Barbi	PB	92	1.40	14.45	59.0	0.83	332, 2
Emerita	PB	93	1.44	15.20	67.2	0.97	335, 9
Emerita	PB	94	1.51	15.10	66.2	1.00	335, 8
Emerita	Cores	8	1.49	15.30	68.0	1.01	335, 1
Average Reccared II			1.44		64.8	0.93	

Suinthila Las Fuentes							
Emerita	MAN-Cores	218	1.49	14.44	59.2	0.88	393 b.49* o 51
Emerita	MAN-Cores	219	1.50	15.14	66.6	1.00	393 d.5*
Emerita	MAN-Cores	220	1.49	15.40	69.2	1.03	393 j.9
Emerita	Cores	5-4	1.45	15.05	65.6	0.95	NA
Emerita	MAN-Cores	221	1.35	14.54	60.3	0.81	393 n.1*
Emerita	Cores	4-9	1.50	15.47	59.5	0.89	NA
Emerita	MAN-Cores	223	1.45	15.35	68.7	0.99	394 a.12*
Emerita	MAN-Cores	222	1.34	14.19	56.5	0.76	393 o.1*
Emerita	Cores	18-16	1.45	15.34	68.6	0.99	NA
Emerita	Cores	18-17	1.51	14.89	64.0	0.97	NA
Barbi	MAN-Cores	175	1.46	14.85	63.6	0.93	366 d.44.
Barbi	MAN-Cores	176	1.41	14.83	63.3	0.89	366 e.10
Barbi	MAN-Cores	177	1.46	14.53	60.2	0.88	366 f.31-35
Barbi	MAN-Cores	178	1.46	14.65	61.5	0.90	366 f.31-35
Barbi	MAN-Cores	179	1.46	14.49	59.8	0.87	366 f.31-35
Barbi	MAN-Cores	180	1.47	14.60	61.0	0.90	Pliego 366 f.31-35
Barbi	Cores	18-6	1.43	14.76	62.6	0.89	NA

Ruler Mint	Collection	No.	Weight, g	SG	Au %	Intrinsic Value, g	Pliego No.
Barbi	Cores	18-7	1.43	14.80	63.0	0.90	NA
Barbi	Cores	18-8	1.45	14.63	61.3	0.89	NA
Barbi	Cores	18-11	1.47	14.72	62.2	0.91	NA
Barbi	PB	125	1.46	14.59	60.9	0.89	366(f)130
Cordoba	Cores	18-9	1.48	14.91	64.2	0.95	NA
Cordoba	Cores	18-10	1.44	15.33	68.5	0.99	NA
Cordoba	PB	117	1.47	15.30	68.2	1.00	371b8
Eliberri	MAN-Cores	188	1.36	14.89	64.1	0.87	374 a.2*
Eliberri	MAN-Cores	189	1.41	14.87	64.1	0.90	374 c.1
Eliberri	MAN-Cores	190	1.45	14.75	63.0	0.91	375 b.10
Eliberri	MAN-Cores	191	1.41	14.76	63.0	0.89	375 c.1*
Eliberri	MAN-Cores	192	1.37	14.66	62.0	0.85	375 h.3* o 4
Eliberri	MAN-Cores	193	1.43	14.87	64.1	0.92	374 f.1*
Eliberri	MAN-Cores	194	1.41	14.80	63.0	0.89	Pliego 377 a.4.
Eliberri	MAN-Cores	195	1.36	14.70	62.0	0.85	Pliego 378 d.1
Eliberri	Cores	18-11	1.45	14.74	62.4	0.90	NA
Eliberri	Cores	18-12	1.39	14.77	62.7	0.87	NA
Eliberri	PB	131	1.31	14.80	63.0	0.82	375 b.10
Ispali	MAN-Cores	196	1.50	15.25	67.7	1.02	381 a.58 o 56*
Ispali	MAN-Cores	197	1.43	15.24	67.6	0.97	381 a.58 o 56*
Ispali	MAN-Cores	198	1.36	15.23	67.5	0.92	381 e.1
Ispali	MAN-Cores	199	1.47	15.25	67.7	0.99	381 l.8
Ispali	MAN-Cores	200	1.49	15.22	67.4	1.01	381 m.2*
Ispali	MAN-Cores	201	1.48	15.35	68.7	1.01	381 i.1*
Ispali	Cores	18-14	1.44	15.27	67.9	0.98	NA
Ispali	PB	139	1.48	15.40	69.2	1.03	381 l.6
Tucci	MAN-Cores	202	1.42	14.69	61.9	0.88	383 a.1*
Tucci	MAN-Cores	203	1.36	14.74	62.4	0.85	383 g.4*
Tucci	MAN-Cores	204	1.42	14.30	57.7	0.82	384 a.14*
Tucci	MAN-Cores	205	1.39	14.32	57.9	0.81	384 h.6
Tucci	MAN-Cores	206	1.32	14.44	59.2	0.78	384 i.1*
Tucci	MAN-Cores	207	1.41	14.25	57.1	0.81	386 d.1*
Tucci	MAN-Cores	208	1.42	14.62	61.2	0.87	387 n.4*
Tucci	Cores	18-15	1.37	14.53	59.8	0.82	NA
Tucci	Cores	18-4	1.39	14.76	62.6	0.87	NA
Tucci	PB	148	1.32	14.79	62.9	0.83	383 a.5
Acci	MAN-Cores	209	1.35	13.72	50.8	0.69	347 c.1*
Acci	MAN-Cores	210	1.39	13.81	51.8	0.72	349 b.1*
Acci	MAN-Cores	211	1.39	14.28	57.4	0.80	349 f.1*
Mentesa	MAN-Cores	212	1.38	14.44	59.2	0.82	350 f.1
Mentesa	MAN-Cores	213	1.33	14.50	59.9	0.80	350 i.1*
Mentesa	MAN-Cores	214	1.38	14.54	60.3	0.83	350 j.1*
Mentesa	MAN-Cores	215	1.32	14.32	57.9	0.76	351 b.1*
Mentesa	Cores	18-3	1.23	14.17	56.1	0.69	NA
Mentesa	Cores	18-4	1.35	14.44	59.2	0.80	NA
Mentesa	Cores	18-5	1.31	14.40	58.8	0.77	NA
Mentesa	PB	111	1.51	14.39	58.7	0.88	352 e.6
Toleto	PB	104a	1.40	14.73	62.0	0.87	361 e.3
Toleto	MAN-Cores	216	1.52	14.86	64.1	0.98	361 e.5
Toleto	PB	104b	1.43	14.88	63.8	0.92	NA
Toleto	PB	104c	1.48	14.73	62.3	0.92	NA
Average Suinthila Las Fuentes			1.42		62.4	0.89	