

THE HEIGHT OF DENIER TOURNOIS MINTING IN GREECE (1289-1313) ACCORDING TO NEW ARCHAEOMETRIC DATA

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THE HISTORICAL AND NUMISMATIC BACKGROUND

This contribution proposes to disentangle and evaluate a particularly dense period of coin production in southern and central Greece around the turn of the fourteenth century¹. The two decades under analysis are characterised by multiple, at times rival, mints emitting large and varied silver-based (billon) penny coinages of the same overall French type (‘deniers tournois’). Such coins were central to the accounting systems of the area and were deployed in a range of economic, administrative, and military contexts. New archaeometric data, combined with numismatic information, and embedded in the historical sources, allow us now to attempt a year-by-year and blow-by-blow account of coin issuance of three major mints and polities. Our emphases are on the political and economic determining factors, and the fundamental pieces in this puzzle are the minting standard, that is to say the percentage of silver which each issue contains, accompanied by its trace elements. The first shows us whether an issuer was willing or able to sustain a good quality and to add responsibly to the monetary stock, or alternatively maintained or expanded the same while jeopardizing stability. Comparative trace elements provide us with hints of common or diverse bullion supplies, shedding further light on the context and purpose of the individual coinages.

After more than a millennium, the region under discussion returned to minting coinage during the so-called Latin or Frankish occupation, which began as a result of the Fourth Crusade (1204) (on the coinages see Schlumberger 1878-1882; Metcalf 1960; Tzamalīs 1981; Metcalf 1995; Baker 2011a-h; Baker 2015; Tzamalīs 2016). Through this and subsequent events, Greece was divided into a number of polities which existed under the umbrella of the Latin empire at Constantinople (for political histories: Longnon 1949 and 1962; for the relevant acts: Hendrickx 1988). After an interlude of lesser quality coinages produced at the Corinth and Thebes mint in the 1240s and 1250s, the vast majority, if not all, of the new deniers tournois of Greece are to be dated after 1267. The decadence and eventual demise of the Latin empire caused the last reigning Emperor Baldwin II to gradually pass the rights over parts of Greece to the principality of Achaia, and then in 1267 the suzerainty over all of Latin Romania to the powerful Anjou dynasty of Italy. From this point onwards Greece became politically orientated towards southern

¹ For the purposes of this article, ‘Greece’ denotes the area of Epiros, Thessaly, Central Greece, and the Peloponnese, with adjoining islands. Minting of deniers tournois was confined to a narrower geographical band from the Ambracian Gulf to the northern Peloponnese, Atticoboeotia, and the island of Tinos, with the exception of the more northerly Corfu. ‘Romania’ relates to the territory which had been Byzantine in the twelfth century, and which in the thirteenth continued to owe allegiance, in one form or another, to different Latin or Greek imperial authorities.

Italy (Dourou-Iliopoulou 1987 and 1993). From the second half of the thirteenth century the area also came to be ever more tightly integrated into international trading networks (on this and what follows, see especially Jacoby 2001 and 2015; Jacoby 2013 addresses many relevant topics but deals mostly with a slightly posterior phase in the Latin Greek economy; a general framework for trading relations, although with little direct reference to southern or central Greece, can be found in Laiou and Morrisson 2007 and 2011). In a general context of demographic and economic expansion which resulted in the so-called commercial revolution (Spufford 1988, 109-263), Greece offered foodstuffs (grain in particular), livestock (horses), and some specialist luxury raw and semi-manufactured products (silks), and arguably enjoyed a positive balance of payments. Trade was increasingly centred on Venice: the republic was officially overlord of all areas of Latin Romania and its citizens enjoyed free access to markets there. In the face of external pressures which mounted in this period, Venice tightened its grip on its direct colonies and protected trade routes. Private Venetian activity in particular also increased commercial contacts between Greece and southern Italy, especially Puglia, as we can glean from some rare private documents (Lombardo 1951). We rely on other more disparate sources such as ceramics (Skartsis 2009; Vroom 2011), and in fact coins (Baker 2001), to suggest that trading relations between the territories may also have been maintained by non-Venetians in diverse ways and along complex routes. In this context it is certainly of relevance that Achaia and other Greek locations had passed under Angevin rule. The symbiosis of political and commercial interests is powerfully symbolized by the new city of Clarentza in Elis, founded approximately at the time of the Angevin take-over, which developed into the main centre of trade of the principality of Achaia, and was the location of its denier tournois mint (Tzavara 2008; Athanasoulis 2013a).

From 1267, the princes of Achaia and the dukes of Athens (the title borne by the rulers of this polity after 1280), amongst a number of other Greek rulers, owed their allegiances and arguably their rights to mint to the kings of Sicily. Minting of the main medieval Greek silver denomination, the denier tournois, began at Clarentza (ancient and modern Kyllini) for Achaia around 1267, at Thebes for Athens ca. 1285, followed by a number of smaller mints. The coins of the Athenian mint had, like those of Clarentza, both political and commercial dimensions. The trading history of Thebes for the years ca. 1285-1311 is not particularly well documented, but we may infer from diverse and circumstantial evidence –the rich notarial documentation for the first half of the thirteenth century (Morozzo della Rocca and Lombardo 1940 and 1953), and Pegolotti's handbook describing the situation after a decade or two of Catalan rule (Evans 1936)– that it was the location of an important market, especially for silks, which Venetian and other traders could easily access from nearby Negroponte (on the trade of Thebes/Negroponte see Jacoby 2000; 2002; 2010). The fact that the rulers, later dukes, of the de la Roche dynasty chose it as the location of their mint even though their place of residence remained Athens, and the size of the denier tournois coinage itself, are powerful pieces of evidence in this respect. The scanty archaeological record, especially ceramics, available to date for this period also suggests a city with important Greek and international connections, whose commercial centre may nevertheless no longer have been within the fortified hill known as the Kadmeia (Armstrong 1993; Vroom 2006).

The first period of minting at Clarentza and Thebes, to 1289, has been addressed in a previous contribution on the basis of elemental analysis by inductively coupled plasma atomic emission spectroscopy (ICP-AES) (Baker and Ponting 2001). Therein, the date of first minting, the existence of multiple mints within single polities, the bullion supply, and the minting standards, were discussed. Achaia and Athens were found to have had only one mint each, Clarentza and Thebes, whereas other authors had

suggested multiple mints. Significant differences for these two mints were postulated: in the period ca. 1267 to ca. 1285/1289 Achaia minted at a standard of around 26% silver; after 1278/1279, when Charles I of Anjou became prince of Achaia in addition to king of Sicily, there was a significant flow of bullion from Italy to the Clarentza mint. Athens, meanwhile, minted at a standard of only ca. 23% silver, and without direct provisioning from Italy, in the period 1285-1289. These activities can be described and dated with some precision thanks to the typological classification system put forward by Metcalf (see above) and Tzamalīs (1990, 1994) which will also be relied upon in the present article. The early prolific Athenian issue is known as GR105. The same analyses also included, for the purpose of comparison, a later group from the Thebes mint (GR20B, dating to ca. 1305) which produced a standard of ca. 19%. This type will be further discussed below.

With these pre-conditions in mind, the present set of analyses targeted the subsequent years 1289-1313, that is to say the coinages which came chronologically after those of the previous analyses. Greek coinages in this period were conditioned by a number of political and economic considerations, which will be further elucidated in the main discussions. In a few steps after 1289, the Angevin King Charles II, son of Charles I, de-centralised but simultaneously tightened his control over Greece: rule over Achaia was devolved to a succession of princes, who in turn pretended allegiance from the dukes of Athens, which occurred under Angevin coercion. During the Wars of the Sicilian Vespers (1282-1302) against the Aragonnese, who had wrestled away this important island, Angevin activities in Greece formed part of a much broader struggle for supremacy in the central Mediterranean (Abulafia 1997; Sakellariou 2104). Greece itself was also directly threatened by the Aragonnese in this context, first in the 1290s (Airal di 1995). After 1300 the situation in Achaia itself took an unfavourable turn for the Angevins, who built up an alternative power-base on the other side of the Corinthian Gulf, around the town of Naupaktos (Lepanto), where a short-lived minting operation was launched. In the same period, in addition to Clarentza, Athens, and Naupaktos, there was also, under Athenian initiative, minting at Neopatra, to the west of Lamia (Baker and Galani-Krikou 2004; Baker 2011e), and at Salona, ancient and modern Amphissa (Baker 2011f), which occurred in smaller quantities than at the three main mints. The island of Tinos, which owed allegiance directly to Achaia and whose Ghisi rulers were otherwise closely linked to the Angevin authorities, minted in precisely these years (Baker 2011h), whereas the direct Angevin minting initiative on the island of Corfu certainly pre-dates 1300 (Baker 2011b). From 1308 this situation unfolded: there was a problem of succession in Athens, and then the eastern part of Central Greece came under severe threat from the Catalan Grand Company, which had previously devastated Thrace, Macedonia, and Thessaly. Prior to the decisive battle at Halmyros in 1311, Athens, Achaia, perhaps Neopatra, and perhaps Tinos, increased their coin production in preparation for the conflict, in order to make payments either to the Catalans or to their own combatants. The Catalans emerged victorious and became the rulers of the eastern Central Greece, in direct conflict with the Angevins. Thereafter, very little tournois mintage is attested in Greece: most mints were closed; the Achaian mint at Clarentza continued at a reduced rate under Prince Philip of Taranto during 1311-1313 (see below), after which its operation grinded to an almost complete halt for two to three years; and the Catalans themselves may have issued low grade tournois imitations at Thebes which cannot easily be confused with the established Greek billon coins (Baker 2003). Defeat to the Catalans caused a significant crisis, practical and moral, to Angevin ambitions in Greece and their political and economic involvement in the area was severely curbed. 1313, the year in which Philip of Taranto, son of King Charles II, ceased to be prince of Achaia is a logical point at which to stop the current enquiry.

THE ANALYSES

For the present analyses we sought to provide a good coverage of the main mints and issues of the period 1289-1313. The issues under analysis in this paper divide into three mints, Clarentza, Naupaktos, and Athens. The first is represented by four princes of Achaia. The main units which we will refer to are therefore the following:

- 1) Achaia, Clarentza mint – Princes Florent of Hainaut (1289-1297), Isabelle of Villehardouin (1297-1301), Philip of Savoy (1301-1304/6), Philip of Taranto (1304/6-1313).
- 2) Despot of Romania, Naupaktos mint, Philip of Taranto (1296/8-1314).
- 3) Athens, Thebes mint, Dukes Guy II de la Roche (1287-1308) or Walter of Brienne (1309-1311), obv. legend GVI.DVX.

The issues under discussion can be attributed to mints and rulers with some confidence on the basis of their legends. Yet even here some problems can arise, for instance at Thebes for Athens three successive dukes and an interregnum in 1308/1309 cannot be completely matched to the two main legends G.DVX and GVI.DVX. In order to be entirely clear about attributions and datings of individual issues, this article has sought to revisit some of the political and dynastic history of Greece during the period; it has sought to add some details to the established typologies, based on legends, the marks and stops which adorn them and which may relate to the administration of the mints, the shapes and methods used to put the letters together, as well as some orthographical differences; and it has also taken into consideration some ulterior archaeological information, especially dated hoards (Metcalf 1995, 241-346; Baker 2003, 313-316 for eastern Central Greece; Baker and Stahl 2013, 180 for the Peloponnese). In general terms, all established types are considered to be chronologically progressive, and we have dismissed any ideas brought forward by Metcalf and Tzamalís of multiple workshops or even different mints within Achaia/Athens, or other convoluted constellations, which have in recent years led enquiries into wrong directions (see, in addition to the already cited works, Tzamalís 2004). Apart from typological and archaeological consistency, any chronology is to be based on the standard at which a type was minted, with the implication that there was in medieval numismatics an almost natural tendency to debase billon currencies slightly, unless there were special circumstances which brought on more rapid debasement or even improvements in the standard, and finally on the aforementioned trace elements which link or separate types.

To date, a limited number of analyses had been carried out on medieval Greek coins of the same varieties (Baker and Ponting 2001, 211-212):

- 1) In the early years of the last century Chrestomanos conducted some destructive (wet chemical) analyses on coins of Achaia (Florent, Isabelle, Philip of Savoy, Philip of Taranto) and Athens (Chrestomanos 1905).
- 2) In the 1970s Gordus analysed for Metcalf some Achaia and Naupaktos issues by an early form of neutron activation (Metcalf 1971; 1995, 261-265, 278).
- 3) In the 1990s Tzamalís also analysed specimens of all types listed above destructively (Tzamalís 1994).
- 4) As mentioned, Ponting analysed some specific Athenian issues by ICP-AES.

The new analyses divide into two sets of coins:

125 coins were sourced from the excavations at Ancient Corinth. Of this total some coins were discounted because they proved to be typologically or archaeometrically unsuitable, so that the presented data rest only on 92 specimens. During middle Byzantine and early Frankish times Corinth was a very significant town (Athanasoulis 2013b summarises the previous literature). This is amply testified by the American excavations in the area of the Roman forum in what would have been an extra-mural artisanal, commercial and monastic suburb to the main walled settlement lying to the east, in the position of the present-day village. These generally favourable demographic and economic developments either side of the Latin take-over after 1204, in this area and possibly in the town as a whole, were curbed by a Catalan raid in 1312. This had as a consequence also a strong reduction in coin usage and losses, which lasted for long stretches of the fourteenth century. For the period 1289-1312, however, there are literally hundreds of coins at Corinth, from which a selection could be made on the grounds of numismatic readability and scientific suitability. The data pertaining to these analyses is summarised in six tables, four for the Achaian princes and one each for Naupaktos and Athens (Tables 1-6).

The deniers tournois from Corinth were analysed in 2011 in a workroom at the archaeological site according to two methods, X-Ray Fluorescence spectrometry (XRF) and Laser Induced Breakdown Spectroscopy (LIBS) (Giakoumaki 2007). The portable milli-XRF was developed at 'Demokritos' in Athens (Karydas 2007). XRF is a technique which detects elements not compounds, and is used in archaeometry since it is non-destructive, detects a wide range of elements simultaneously and can provide quantitative results so long as the sample is homogeneous and unaffected by corrosion. The percentage concentrations of copper, silver, lead, zinc, gold, antimony and bismuth were determined. Each coin was analysed in at least two positions, some of which had been cleaned with alcohol and in some cases mechanically. The appearance of the surface areas could look quite different, and these were recorded.

Additional measurements were taken to determine the concentration of silver, using a portable LIBS spectrometer (LMNT-II) developed and constructed at IESL-FORTH, Herakleion, Crete (Westlake *et al.* 2012). The LIBS technique provides elemental composition data by recording the optical emission of a microscopic plasma induced by a laser pulse focused on the coin surface. A few pulses (typically 3-6) irradiating the same point enable layer-by-layer analysis through consecutive ablation steps, with the depth/pulse being of the order of 2-3 microns. In the context of this study, LIBS can be considered mainly as a surface analysis method. Silver, copper, lead and occasionally zinc were detected on the coins along with Ca, Al, Si and Mg, the latter signifying surface contamination that was found to decrease with the number of pulses. Quantitative analysis results, reported herein, focus on the content of silver (the values are included in Tables 1-6) and were based on calibration curves constructed by using concentration values for Cu and Ag measured during the XRF analyses on selected coins used as reference samples. Those coins used for reference were among those having clear surfaces; XRF analysis of these surfaces gave secondary K and L shell X-ray emissions which had a ratio close to 80 signifying homogeneity of the alloy.

It soon became apparent that the silver contents for the main mints and varieties established by XRF were up to c. 10% higher than those obtained in all the earlier analyses. For this reason we purchased in the UK coin trade eight Athenian coins of the same varieties. These were first analysed before and after (mechanical) cleaning by portable XRF at the University of Glasgow using a Niton XL3t 900 instrument (see Photos-Jones *et al.* forthcoming), and then sent to Demokritos where they underwent the same milli-XRF analyses that had been applied at Corinth (see Table 7). The results of the analyses of the Corinth and UK coins are given in Figure 1. The fifth and the seventh

box charts (Athens and UK respectively) represent the same issue from the two sources, confirming that the XRF analyses of the coins at Corinth did indeed determine silver contents which were too high.

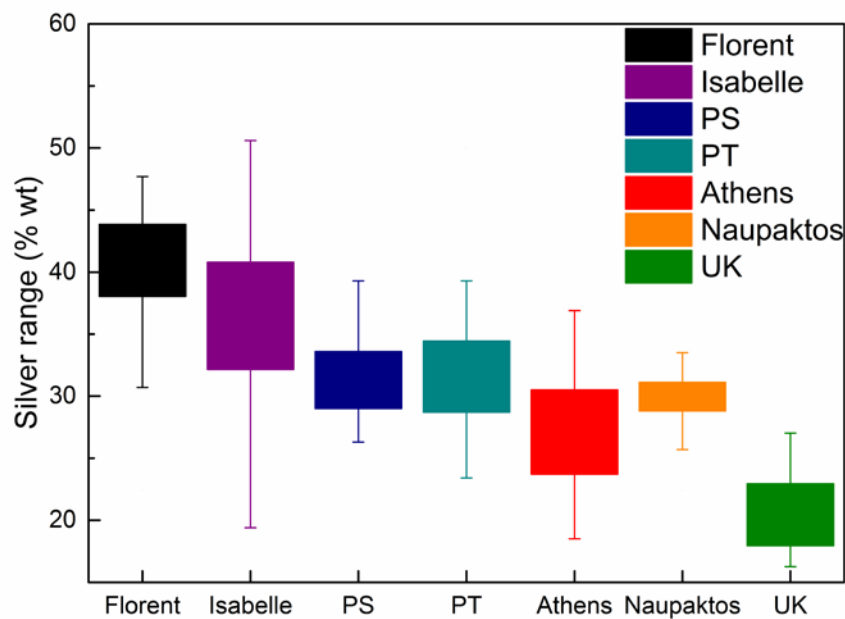


Figure 1: Box chart of the silver contents for the main issues according to the XRF analyses of the Corinth and UK samples. The box represents the inner quartile ranges and the whiskers the minimum and the maximum values.

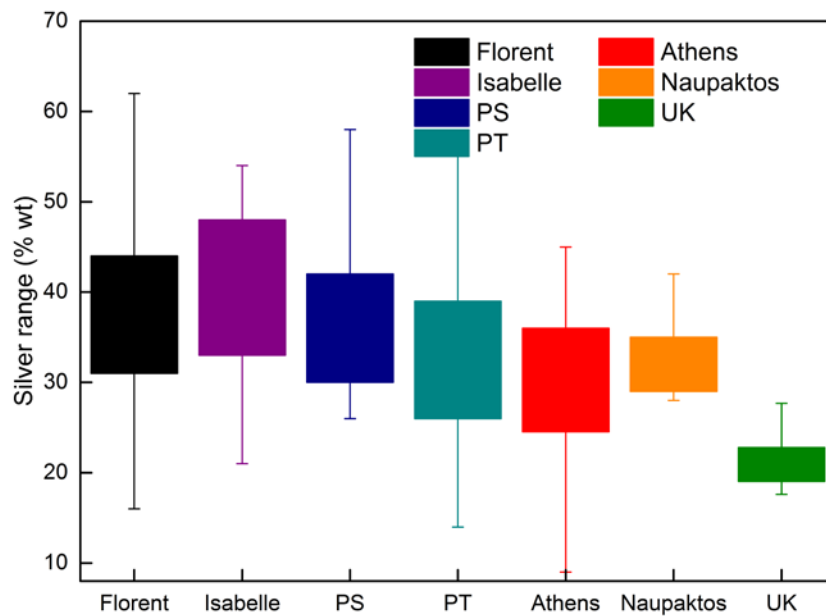


Figure 2: Silver contents for the main issues according to the LIBS analyses of the Corinth and UK samples. Presentation is as in Figure 1.

For the UK coins we were additionally interested to see whether there was any noteworthy surface enrichment which might have had a bearing on the milli-XRF analyses. Micro-XRF area scans were taken on both sides of the coins and of the bulk, that is to say the section, since for this body of material we were in a position to halve the coins in order to achieve more rounded results. The micro-XRF spectrometer that was used is a customised design based on a Bruker Nano GmbH, ARTAX model. Its high resolution (100 microns @ Cu-K α) combined with its ability to perform area and lines scans makes it suitable for detecting details on a surface of an artifact. In the case of silver coins micro-XRF analysis was already used to determine the scenario of silver enrichment (Kantarelou *et al.* 2011). During this study area scans were performed at the cross-section of the coins in an area that included the bulk and the surface of the coins. These showed, for different coins, a lack of homogeneity of the alloy, with the surface areas containing variously more or less silver. In fact it is not certain whether one can confidently speak of silver enrichment at all; even if there were enrichment, it would be marginal and unable to influence as drastically the outcome of the milli-XRF analyses as the Corinthian sample might suggest. Not only was the feature of silver heterogeneity also observed by Ponting (see SEM image in Baker and Ponting 2001, plate 44), but the silver contents in the UK samples determined by milli-XRF were similar to those he obtained by destructive analysis. As a methodological exercise, it was encouraging to find satisfactory agreement between the silver and copper determinations in the cleaned surface of the UK coins obtained by the two XRF systems; the R^2 values for the two metals were 0.9 and 0.86 respectively.

The silver contents determined by XRF of the Corinth coins were therefore exposed as anomalously high from more than one angle. A verification of this method of analysis became therefore important, and in fact LIBS readings obtained on the same Corinthian coins produced compatible results (Figure 2). Furthermore, the same Athenian coins purchased in the UK were also analysed using the portable LIBS instrument, providing similar silver contents with those obtained by milli-XRF analysis. However, it is noted that the silver contents for the Corinth coins measured by LIBS show a wider distribution of values than those obtained by XRF. This observation can be attributed to the difference of XRF and LIBS concerning the depth of analysis. In the case of LIBS, the layer probed is 2-3 microns thick and at about 10-15 microns deep from the coin surface. Thus LIBS analysis is expected to be more prone to surface roughness and heterogeneity effects in comparison to milli-XRF, in which the thickness probed is of the order of 40-50 microns (Kantarelou *et al.* 2011). On the other hand, the coins from UK were better preserved and appeared to be more homogeneous along the surface compared to the Corinth coins, producing more consistent and repeatable LIBS signal.

For all these reasons we suspect that at Corinth the heart of the problem was the sampled material rather than the method of analysis. The overall aspect of many of the analysed coins at Corinth was much more polished and silvery than the patinated Athenian specimens bought in the UK (compare Figures 20 and 21). Also striking were observations which could be made on certain specimens, that is to say a separation on the surface of coppery and silvery areas or even layers (Figures 3 and 4).



Figure 3 and 4: Close-up photographs of Florent#09 (see Table 1)

Evidently at Corinth copper had the propensity to be drawn to the surface, and this layer was eventually eliminated, mostly through conservation, leaving more silver on the surface. During the minting process itself a similar process might have occurred, when

the continuous kneading of the alloy caused copper to come to the fore, which was then taken off in the mint through a process called blanching. This form of silver enrichment was evidently practiced to some extent with the issues under investigation (Baker and Ponting 2001, 212), but in the specific case of Corinth a combination of burial conditions and human intervention subsequent to excavation resulted in particularly silver-rich specimens.

Archaeometrists, archaeologists, and historians may wish to consider multiple bullion compositions: the original alloy, the alloy as manipulated through minting, the alloy as changed through burial in the soil and subsequent treatment, and even the alloy as perceived or purported by contemporary issuers and users. Additionally one must factor in the method of analysis and the lack of homogeneity of the alloy, as we have just seen. There are no readings which must in themselves be considered authoritative, however a large sample of coins and multiple readings per sample provide the necessary conditions from which extrapolations can then be made. These were met at Ancient Corinth, and the results there were internally consistent. With respect to the minting standard, in the remainder of the contribution we have limited ourselves to *relative* silver percentages, and our discussions will not touch upon weight standards, which should be the subject of an extensive investigation in its own right, or absolute or official standards of value. Silver and copper sources reveal themselves through traces of gold and lead for silver, and arsenic, antimony, iron and nickel for copper (Baker and Ponting 2001, 215-216). With regard to copper, most of the relevant elements were below the detection level in the kinds of analyses which were conducted, so we confined ourselves to silver sources as revealed through gold traces.

The graphical presentation below consists of, first, the combined silver, gold and lead content (thus the bullion content), in individual coin issues, and, second, the silver-gold ratio plotted against the silver lead ratio. In the tables of compositions, the element contents are expressed as wt%; the detection limits are 0.5 (Zn) , 0.07 (Sb), 0.06 (Au), 0.022 (Bi). s.d. standard deviation; N/a = not analysed.

Achaia, Clarentza mint, Florent of Hainaut (1289-1297)



Figure 5a-f: Selection of analysed coins of Florent of Hainaut from Corinth Excavations. Compare Table 1

The denier tournois issues bearing the name of Florent of Hainaut –to judge by the hoards and particularly by the evidence from the large southern Greek excavations (for Athens: Thompson 1954; for Corinth see the summary in Baker and Stahl 2013, 182-183)– were produced in relatively fewer quantities than those of his predecessors and successors. For this reason, it has been proposed that these issues have to be distributed over only a part of the period of Florent’s princship (1289/90-1297), or indeed that some of the plentiful issues of his wife Isabelle were minted already during Florent’s lifetime (Tzamalīs 2004). These possibilities will be considered below. Tzamalīs and Metcalf, in combination, have created six main types for Florent²: FHA1 and 2 (Figures 5a and f) are characterised respectively by a flower, and by a lis and small B at the extremities of the legends. The closed round letters D, E, C and the swung foot of the Rs are typical. FHT (Figures 5b and c) is similar in many respects, also in the double dots which separate parts of the legends internally, and only the foot of the R is significantly different. F5 (Figure 5e) is a simple and rare type, unnoticed by Tzamalīs, which combines many of the previous features and is therefore difficult to place. The remaining FHB1 and 2 (Figure 5d) are by contrast very distinctive: the reverse legend is abbreviated D’CLARENCIA and the letters E and C are very open.

Stylistically speaking, one would wish to create a unified block, which is also numerically the strongest, consisting of FHA and FHT, around which to order the remaining types according to the available evidence. There are no published hoards which cut into the series in any significant manner, even the near contemporary Agrinio 1973 (Metcalf 1995, 342) cannot shed any further light on the chronological ordering. Figure 6 confirms the existence of this central block and places FHB at the end of the series in line with the established criteria. Gordus’ earlier results had suggested much the same. Our analyses would also indicate that F5 was in fact the earliest of the substantive types of Florent. To judge by Gordus’ figures, the types other than FHB might well have been minted on a similar standard to the issues of the Clarentza mint of the previous decade in the name of Charles.

² We illustrate the types with coins from the samples. Any ulterior descriptions and depictions can be found in the referenced literature, especially Metcalf 1995 and Tzamalīs 2016, the latter summarizing all the previous work of the same author.

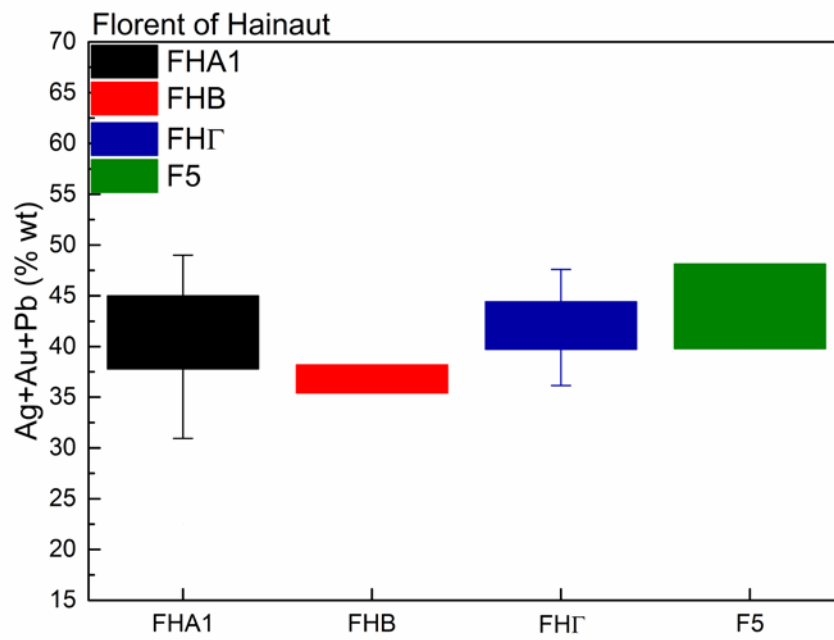


Figure 6: Box chart of the sum of silver gold and lead content for the types of Florent of Hainaut according to the XRF analyses of the Corinth sample. The box represents the inner quartile ranges and the whiskers the minimum and the maximum values

These general conclusions are also confirmed by the next figure, especially the neat separation into different areas of FHB and F5, chronologically the furthest from one another.

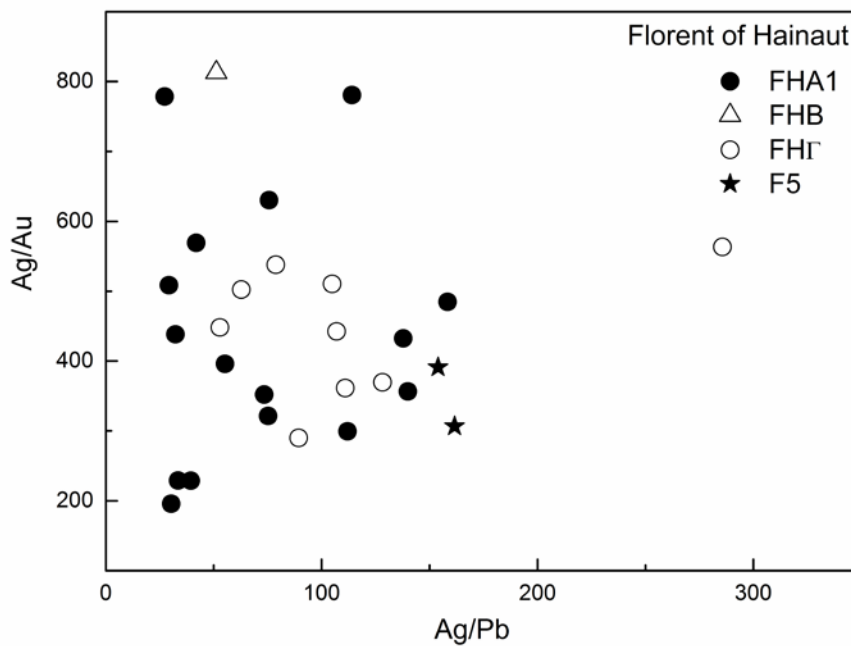


Figure 7: Ratio scatter plot of silver bullion for Florent of Hainaut according to the XRF analyses of the Corinth sample

Florent of Hainaut married Isabelle of Villehardouin, daughter of the late Prince William II, in September 1289, and he received the title himself on this occasion (Longnon 1949, 263). Charles II, recently released from Aragonese captivity, nevertheless continued to use the same until the following year (Bon 1969, 165; Dourou-Iliopoulou 1993, 48). The policies of the Angevin crown towards Greece in these years can be reconstructed with some confidence since narratives documenting Greek history are still available for this period (Bon 1969, 164ff), and the diplomatic sources from the Angevin archives have been admirably edited by Perrat and Longnon (1967). The settlement of 1289/1290 saw the establishment of a new prince with increased constitutional and political competences. Early on, he is commissioned to take over the reins of Angevin Corfu and Butrint from the Orisini family, although this endeavour was soon abandoned (Perrat and Longnon 1967, no. 15, 18 April 1290 = *Registri* 35, 111, no. 275; see also Asonitis 1999, 83). Much of Florent's princship was dominated by the involvement of Philip of Taranto, son of Charles II, in Greek affairs. Florent helped organise the latter's marriage to Tamar of Epiros, daughter of Nikephoros (Perrat and Longnon 1967; no. 21, 1 June 1291; no. 105, 24 July 1294 = Hopf 1867-1868, 337, n. 96), as a result of which Philip received certain fiefs in Epiros and Aitolokarnania, as much as the overlordship from his father over Achaia, Athens, Vlachia on the one hand, Corfu, Butrint, Albania, on the other (Longnon 1949, 268-269; 272-273; Nicol 1972, 193-194; Nicol 1984, 46ff). The homage was henceforth due not to Charles, but to Philip who assumed the role which had been set out for his grandfather Charles I in the 1267 settlement (Perrat and Longnon 1967, nos. 80-81, 12 May 1294). In this context the Angevins sought once more to clarify the relationship of Achaia and Athens in favour of a direct homage of the latter (and of the marquis of Bodonitza) to the former. As we shall see below, this was achieved in the final months of Florent's princship. The political restructuring under way, and the numerous trading concessions which were made to individuals bringing goods to Greece (Dourou-Iliopoulou 1993, 51-53), recall the earlier efforts of Charles I in 1278-1282 to strengthen the Greek holdings.

It is generally assumed that minting had ceased at Clarentza in Charles' name sometime in the mid-to-late 1280s. The Xirochori 1957 hoard, which was concealed in 1291 or soon thereafter, but does not contain issues of Florent, allows us to extend this inactivity into the early princship of Florent (Metcalf 1995, 341-342). The next hoard which is available to us is the aforementioned Agrinio 1973, concealed in ca. 1300 but quite mature in Florent's series. This evidence, combined with the political history, might in fact suggest that issues in the name of Florent were produced at Clarentza for little more than 2-3 years before his death in January 1297 (Kiesewetter 1996, 150). Also Tzamalīs was inclined to date the beginnings of Florent's coinage from ca. 1293/1294 onwards (2004, 72, n. 6). The lowering of the Achaian standard for FHB may well have been inspired by the lower Athenian standard, as we shall see, and this type may well date therefore to the period from the autumn of 1296 to the first month of 1297, when the situation with Athens was clarified. In later hoards the other types of Florent vastly outnumber FHB, giving further credence to our hypothetical model whereby F5, FHI, and FHA were successively minted from ca. 1294 to October 1296, followed by FHB. The rather brief period in which Florent's coins were effectively produced at Clarentza goes some way to explain their relative scarcity.

Achaia, Clarentza mint, Isabelle of Villehardouin (1297-1301)



Figure 8a-h: Selection of analysed coins of Isabelle of Villehardouin from Corinth Excavations. Compare Table 2

Isabelle of Villehardouin became princess upon the death of her husband Florent. Her sole rule was short, and the period during which the Clarentza mint emitted coins in her name even shorter (see below), but her coinage is typologically complex: IVA1 and IVA2 (Figures 8b and h), IVΓ (Figures 8a and e), and Y3 (Figures 8c and g), all display similar and harmonious, closed lettering with swung feet for the R. The individual groups are largely differentiated by the marks at the extremities of the legends. IVB1 (Figures 8d and f) has a very different system of lettering: Ss are constructed with a long central punch, the round letters are open, and the R is club-footed. The rare IVB2 sits typologically between IVB1 and the remainder of the groups.

The Agrinio 1973 hoard cuts into Isabelle's series and lacks IVB altogether, identifying it as the last of the groups. The hoard also suggests that Y3 is rather early in Isabelle's series since it lacks IVA2. Figure 9 identifies IVB1 as a concentrated coinage set apart from the rather wide scatter of the main type IVA1. Figure 10 on the other hand, which depicts the silver content for the three main types (IVΓ was not sufficiently well analysed to be included), is rather more intriguing in that Y3 is considerably baser than the other two groups.

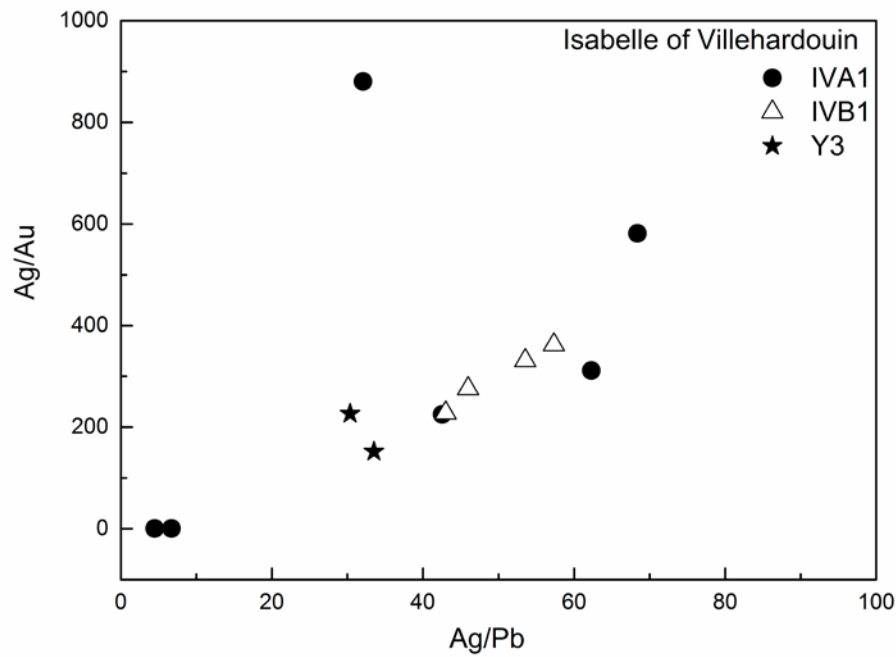


Figure 9: Ratio scatter plot of silver bullion for Isabelle of Villehardouin according to the XRF analyses of the Corinth sample

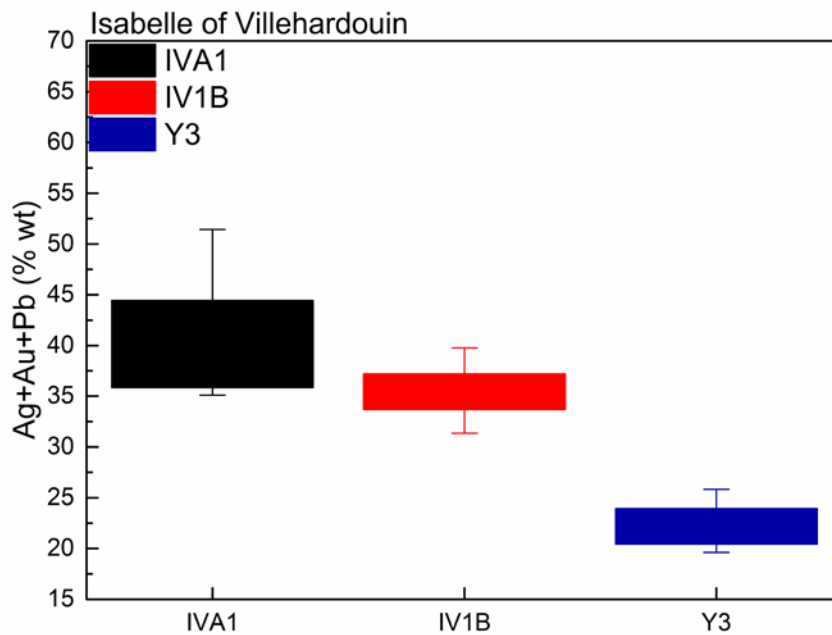


Figure 10: Box chart of the sum of silver gold and lead content for the types of Isabelle of Villehardouin according to the XRF analyses of the Corinth sample. The box represents the inner quartile ranges and the whiskers the minimum and the maximum values

This dichotomy played a role when in 2004 Tzamalís postulated that Isabelle's and Florent's coins were minted concurrently. Unfortunately, he failed to specify which types gave him readings as low as 12% silver, yet his analyses do confirm that our own figures

for Y3 are perhaps more than just a freak occurrence. Tzamalis noted also the apparent likeness of IVA1 and FHA2, but the other evidence presented here precludes that these respective issues in the names of Isabelle and Florent are chronologically related. On the other hand, the described style of IVB1, and the stars which adorn the reverse legend, provides a direct link with the coinages of Isabelle's second husband Philip of Savoy. All of these considerations suggest in the strongest terms the sequence Y3 - IVA1 - IVA2 - IVT - IVB2 - IVB1.

The coinage in Isabelle's sole name begins therefore with the perhaps surprisingly base Y3. We are also informed by the *Registri* that this minting only began more than two years after Florent's death, at an unspecified point in 1299 (Hopf 1867-1868, 350, n. 37; Schlumberger 1878-1882, 316, n. 1; Metcalf 1995, 263). As we shall see, it was in this year that Isabelle made significant steps towards a normalisation between the principality and Athens. As with the previous Clarentzan type FHB it is most likely that the explanation for the standard of the short-lived Y3 needs to be sought with the low quality of the Theban issues for the duchy. Thereafter, the Clarentza mint, and perhaps that of Thebes as well, adopted a higher standard. With respect to the surprise that has been voiced about Isabelle's apparently excessively large mint output, we may now offer other explanations, in addition to the rather shorter minting periods of her husbands Florent and Philip of Savoy than the traditional scholarship had suggested: perhaps the lowering of the Clarentzan standard caused more coinage to be re-minted in the name of Isabelle. Next, it may also be supposed that market forces simply brought more bullion to this mint; and finally Isabelle's key diplomatic initiatives may also have increased supplies from Angevin Italy: in fact, this is specifically attested on one occasion (Perrat and Longnon 1967, no. 203 = Hopf 1867-1868, 349, n. 21, 24 August 1298. See further Bon 1969, 170-173). Despite the discussed events of 1294, much of the decision-making was in the hands of King Charles II and not of his son Philip of Taranto (Kiesewetter 2001, 64), a fact which could only have been exacerbated when the latter was taken prisoner in Sicily in 1299 (Nicol 1994, 50). Isabelle negotiated, with constant deference to the king, the marriage between her daughter and Guy II de la Roche of Athens, (Metcalf 1995, 263. The relevant acts are Perrat and Longnon 1967, no. 211 = Hopf 1867-1868, 350, n. 28, 3 July 1299, and Perrat and Longnon 1967; no. 237 = Hopf 1867-1868, 350, n. 29, 20 April 1300) and a truce with Byzantine Emperor Andronikos II Palaiologos (Perrat and Longnon 1967, no. 218 = Hopf 1867-1868, 350, nn. 34 and 35, 31 July 1299, and Perrat and Longnon 1967, no. 236 18 April 1300).

Achaia, Clarentza mint, Philip of Savoy (1301-1304/6)



Figure 11a-f: Selection of analysed coins of Philip of Savoy from Corinth Excavations. Compare Table 3

The three types identified for Isabelle's next husband, Philip of Savoy, all adhere to the same lettering that has already been described for Isabelle's IVB1. The distinguishing features for PSA (Figures 11b and f), PSB (Figures 11c and e), and PSI (Figures 11a and d), are principally the symbols in the reverse field. Figures 12 and 13 underline the overall harmonious relationship of the types.

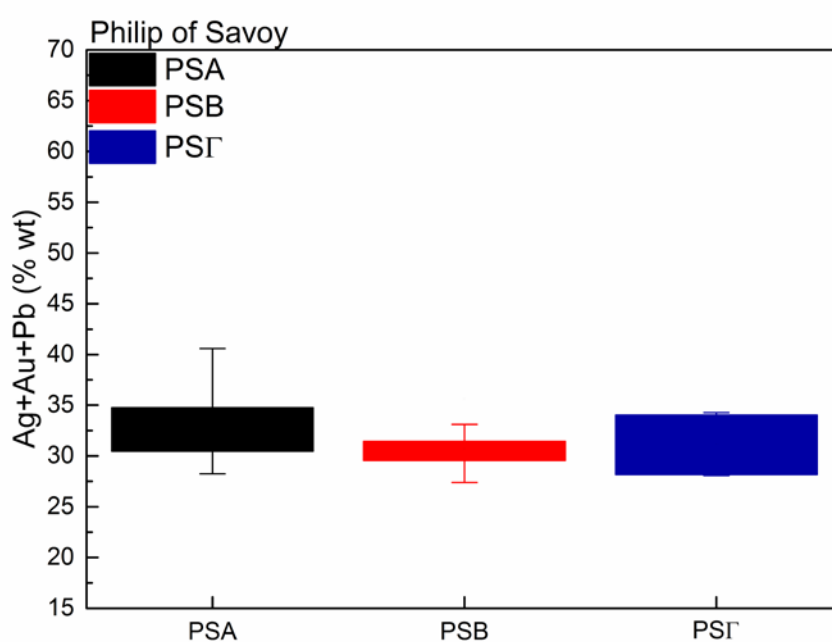


Figure 12: Box chart of the sum of silver gold and lead content for the types of Philip of Savoy according to the XRF analyses of the Corinth sample. The box represents the inner quartile ranges and the whiskers the minimum and the maximum values

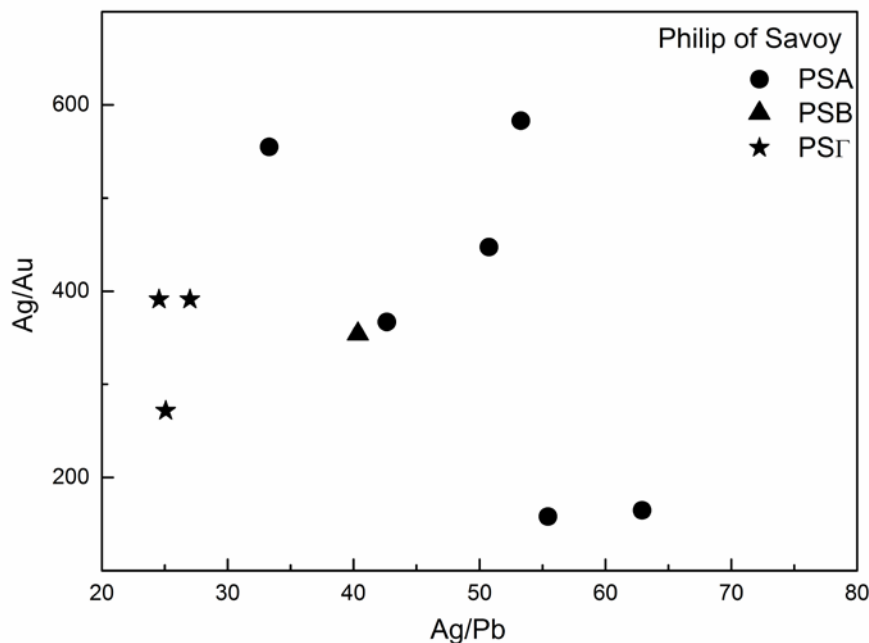


Figure 13: Ratio scatter plot of silver bullion for Philip of Savoy according to the XRF analyses of the Corinth sample

PSI shares common typological features with Philip of Taranto's first Clarentzan issue PTB, which would situate it late within the series. Nevertheless, hoards closing in Philip of Savoy's issues would place it with reservation towards the beginning. This is especially the case for an unpublished parcel now at Birmingham, and Delphi 1933 (Metcalf 1995, 343). The silver bullion sources for PTB are also rather different than those of PSI (compare Figures 13 and 16). The sequence for the three types cannot presently be resolved with complete confidence, although provisionally we may state that PSI came first, followed either by PSA or PSB.

Despite previously paying great heed to her Angevin overlords, Isabelle of Villehardouin married Philip of Savoy against their expressed wishes. Philip was nevertheless proclaimed prince in Feb. 1301 and arrived in Achaia more than a year later (Dec. 1302) (Kiesewetter 1996, 161). His rule in Achaia was characterised, in the eyes of contemporaries, by his eagerness to acquire large quantities of money by regular (the rigorous farming of taxes) and irregular means, the latter in the form of so-called donations from local administrative or feudal potentates (Bon 1969, 175, n. 1; also discussed by Kiesewetter). We know indirectly from an Angevin act that the mint of Clarentza was producing in order to meet the military needs of the principality, particularly in relation to the Epirote campaign of 1303 (Hopf 1867-1868, 352, n. 64; Schlumberger 1878-1882, 316, n. 2, see also below), and the somewhat earlier Skorta (Peloponnese) campaign (Kiesewetter 1996, 174, for the dating). It is therefore to be expected that this gathered wealth, to which we might add the 6,000 hyperpyra (NB: of account) which Philip received from Anna of Epiros as a kind of payoff or bribery (Kiesewetter 1996, 166), was at least partially re-minted at the Achaian mint. The grandiose Corinth parliament in spring 1304 was Philip's Achaian swansong (Longnon 1949, 287), soon after which he departed for Italy. It has been argued that Philip of Savoy was never officially deposed since his original receipt of the title was, as early as 1304, simply proclaimed as unlawful (Kiesewetter 1996, 167, n. 104). With regard to the end of the minting in the name of Philip of Savoy, some dates are of obvious interest:

Philip of Taranto's official investiture with the title of Prince of Achaia on 9 Oct. 1304 (Kiesewetter 2001, 76), and the departure of Philip of Savoy from Achaia in late 1304 (Kiesewetter 1996, 185). The traditional date of 1306 for the end of Savoy's and the beginning of Taranto's minting is due to the fact that Charles II repeated the previous act of 1304 on 5 June 1306, and that of Philip of Taranto arrived in Greece in the summer of 1306, and first used the Achaian title on 3 August 1306 (Bon 1969, 185; Kiesewetter 2001, 77).

The numismatic data go some way towards placing the end of Philip of Savoy's minting at Clarentza in 1304: the hoards dating to the period of the principship of Philip of Savoy which have already been mentioned, and slightly later ones, make it quite clear that the Clarentzan issues of Philip of Savoy and the issues of Philip of Taranto at Naupaktos (see below) were largely contemporary: consider for instance that the Birmingham parcel contains a specimen each of PSΓ and of the rare and early DR1a, while the Delphi hoard contains the Clarentzan series PSA-PSΓ, and DR1-2a from Naupaktos, in mature quantities. Only the Naupaktos issue DR2b, which bears to the Achaian title of Philip of Taranto, and which first appears in the archaeological record in a Theban hoard (Thebes 1987: Galani-Krikou 1997, 138-139), was presumably minted after October 1304, when the mint of Clarentza had possibly already ceased to, or was about to, issue coins in the name of Philip of Savoy.

Despite of the adversity which Philip of Savoy faced during his principship, and the fact that the mints of Thebes and latterly of Naupaktos, as we shall see, produced tournois in impressive quantities but lower qualities precisely in the early years after 1300, the new archaeometric data combined with the overall record of hoards and excavations suggests that the Clarentza mint nevertheless managed to maintain both the size and the quality of its production. This may indicate that it was either a genuinely commercial mint, supplied largely by bullion entering the Peloponnese for the purpose of acquiring local produce, or that Philip successfully maximised his revenue from the principality, which he then converted into new coinage. As in most cases, probably a combination of both of these factors applied, whereas it is much less likely that the mint would have been propped up by the Angevins during the same years.

Achaia, Clarentza mint, Philip of Taranto (1304/6-1313)

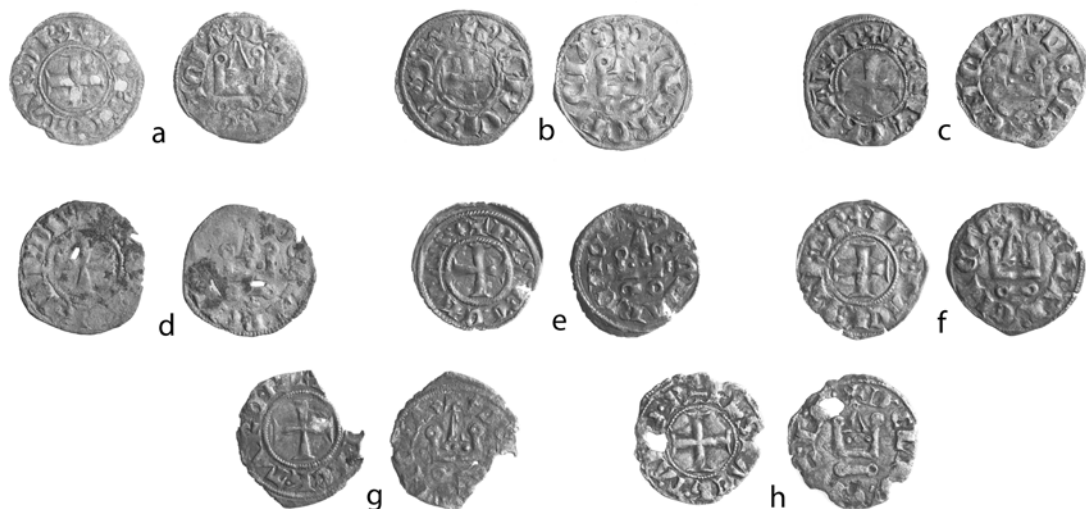


Figure 14a-h: Selection of analysed coins of Philip of Taranto from Corinth Excavations. Compare Table 4

The typology for the Clarentzan issues of Philip of Taranto, who as we have seen was the son of King Charles II and overlord of Latin Romania, and additionally prince of Achaia since the ousting of Philip of Savoy, is again tripartite. PTB (Figures 14c, d, g) is simple enough and minted in the tradition of that mint, with well-formed lettering and symbols in the reverse field. PTA (Figures 14a, b, f, h) with the abbreviated reverse legend D'CLARENCIA is by contrast very sloppy, with much of the lettering put together in an irregular fashion, with badly constructed or missing components, apparently random stops throughout, and occasional mistakes such as inverted letters. PTT (Figure 14e) is neat but different to PTB, with two Fs adorning the reverse, and the obverse legend reads PhSPACHTAR, omitting the DR (Despot of Romania) which the other two types bear. There is not much doubt about the sequence of the types: the many hoards which date ca. 1311 in line with the military events in eastern Central Greece, and the slightly earlier and well known hoard from Pylia (see Metcalf 1971 and Graff 1998, in addition to the other hoard lists which have already been cited), leave no doubt that PTB was followed by PTA and PTT. The silver content of the three main types (Figure 15) would also support the suggested sequence. The beginning of the last of these types, which is also considerably baser, dates very closely to 1311 itself according to this hoard evidence, corroborated further by the rareness of this type at Corinth, a site whose life was severely curbed in 1312 as we have said.

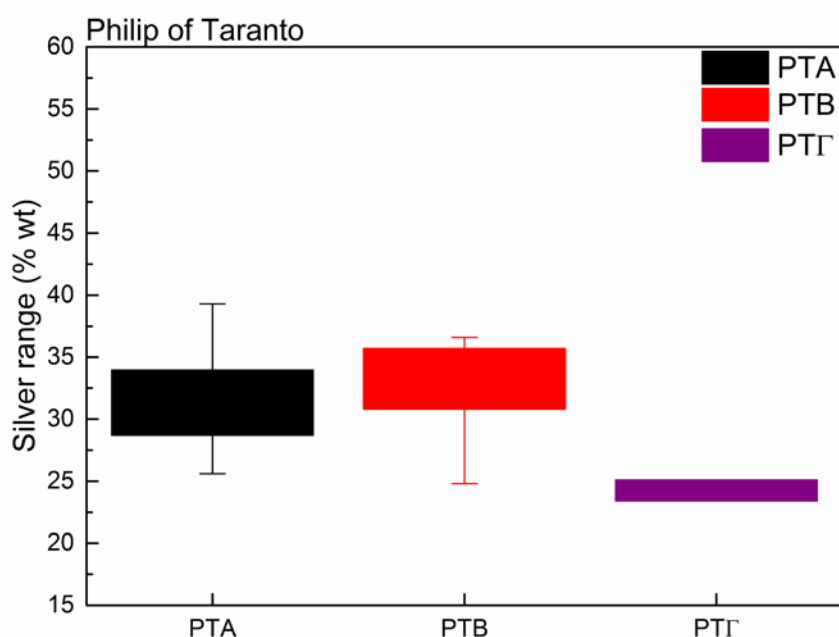


Figure 15: Box chart of the silver content for the types of Philip of Taranto according to the XRF analyses of the Corinth sample. The box represents the inner quartile ranges and the whiskers the minimum and the maximum values

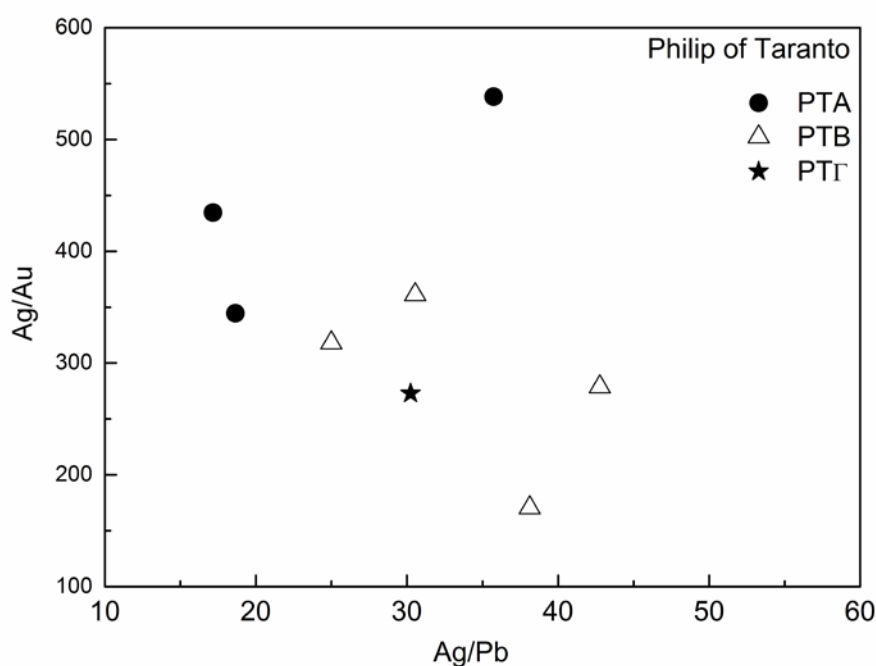


Figure 16: Ratio scatter plot of silver bullion for Philip of Taranto according to the XRF analyses of the Corinth sample

This information needs obviously to be related to the political events. Philip already held the title of despot of Romania by the time that minting in his name started at Clarentza (see below), yet it is probable that he ceded it while this minting was still ongoing. The sequence of events which led Philip to gradually relinquish his claims in Greece is relatively well documented (Kiesewetter 2001, 77-80; see also the earlier Kiesewetter 1997, 718-720): in 1309 Philip's attempt to marry his firstborn son Charles to Mahaut of Hainaut, daughter of Isabelle de Villehardouin and Florent of Hainaut, widow of the Athenian Duke Guy II, failed. The Catalan invasion of 1311 and the defeat of the Achaian-Athenian alliance further undermined Philip's interest in the area and led to an attempt to sell his Greek and Albanian holdings to the Aragonese crown of Sicily (Abulafia 1995). Next, in a double deal involving the houses of Anjou, Valois and Burgundy, Philip was to be betrothed to his second wife Catherine of Valois, and Mahaut of Hainaut was to marry Louis of Burgundy. The treaty was drawn up in April 1313, ratified in July, and at the end of the same month the resulting weddings took place. With these, Philip became Latin emperor of Constantinople; in October Louis of Burgundy was finally able to use the title of prince of Achaia. A year later, in July 1314, Philip ceded his claims in Aitolia and Akarnania, and the title of despot of Romania, to his son Charles (Asonitis 2005, 94, n. 164) and, following the death of the latter in August 1315, to his son Philip (II) (Kiesewetter 2001, 71, n. 52).

The presented data are obviously problematic: on the early groups PTB and PTA, Philip of Taranto is given the titles of prince of Achaia and despot of Romania, whereas on PTT the latter title is omitted. According to the diplomatic information, however, he relinquished the principality before ceasing to be despot. Since PTT dates numismatically to 1311 or later, we also cannot assume that Philip dropped the title of despot of Romania on his coins as an immediate reaction of his 1309 divorce from his first wife Thamar, from whom he had received many of these claims, and through whom he had obtained the title of despot of Romania upon the death of her father (Nicol 1984, 61-62). We are left with two possibilities: PTT was either issued from a certain point after

spring 1311 until October 1313, omitting the indicated title for reasons which cannot be reconstructed; or Clarentza continued minting in Prince Philip's name after October 1313 in the form of PTA, introducing PTF only in July 1314. One consideration which would favour the latter reconstruction is the fact that the Clarentzan issues in the names of Ferrand of Majorca and Louis of Burgundy probably date to 1316, or late 1315 at the earliest. On the other hand, the Corinth excavations have yielded at least three specimens of PTF, one of which analysed in the present project, which suggests that they were in production by 1312, as does the hoard evidence. For the purpose of this article we assume that 1313 is the endpoint of minting in Philip's name at Clarentza.

In considering the earlier history of the PT groups, we may now fall back on the three closely related hoards from the Argolis, which were discussed in 2011 at a conference in Argos (the hoards are Epidauros 1986; Epidauros 1891-1892; Mygiò 2006; Baker and Galani-Krikou; Baker and Tzekes, both forthcoming). The latest coin of Philip to be contained in these hoards is PTB, and Baker and Tzekes relate their concealment to a possible Byzantine incursion into the area after the empire's victory at the battle of 'Gerina' (perhaps Keryneia in Achaia), which took place in 1308/1309. The Achaian preparations for the confrontation with the Catalans a couple of years later are insufficiently recorded (Bon 1969, 187-188; Longnon 1949, 299-300). The hoard evidence suggests that PTA was begun at one point between ca. 1308 and 1311. This irregularly and rapidly struck group, which stands so much outside of the Achaian tradition in minting to that date, can only be considered in the context of the preparations for the campaign against the Catalans. The archaeological record demonstrates that production at Clarentza was significantly increased for a few years with PTA. According to new the archaeometric data, this did not significantly compromise the coinage's standard (Figure 15), which may in some measure be the result of specific consignments of bullion which may be the explanation for the distinctive profile of PTA in Figure 16. Typologically speaking, PTF must be viewed as an effort in restoring the coinage of Achaia in outwardly physical terms, even though this entailed a considerable compromise in the minting standard (Figure 15).

Despot of Romania, Naupaktos mint, Philip of Taranto (1296/8-1314)

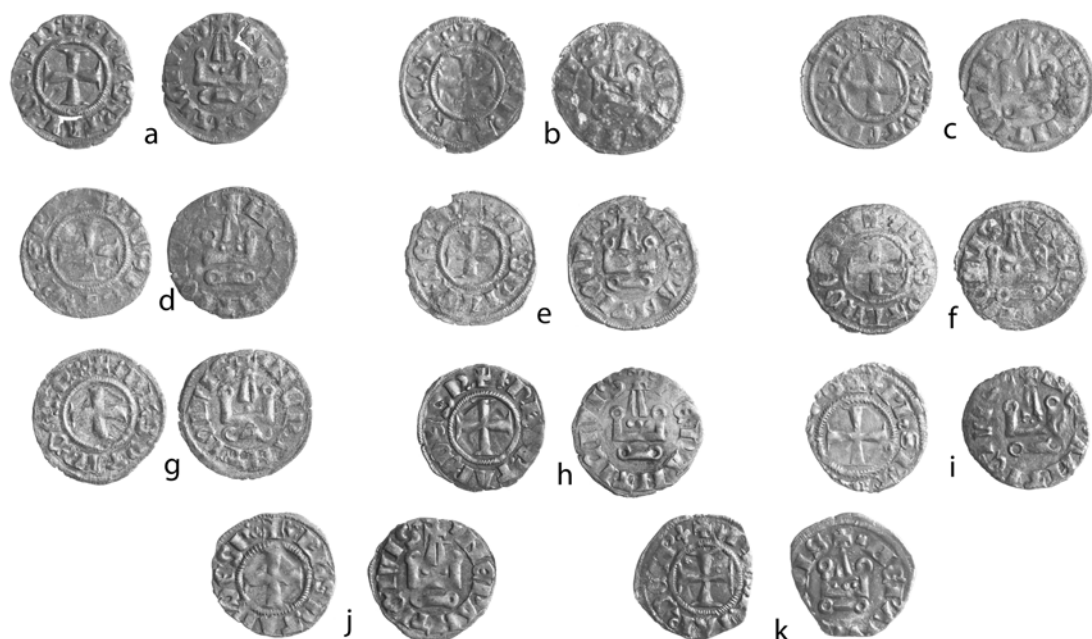


Figure 17a-k: Selection of analysed coins of the Despot of Romania from Corinth Excavations. Compare Table 5

Returning now in time, the same Philip of Taranto minted coins in his name at Naupaktos, in western Central Greece, at the northern entrance of the Gulf of Corinth. We owe the typology largely to Metcalf (1995, 278-279; completed in Baker 2001, 249 and 273; see also Baker 2011d). There is an overall division into two groups (DR1 and DR2) based on stylistic grounds, while DR2 is further sub-divided into DR2a and DR2b on epigraphic grounds. This new classification supersedes Schlumberger 1878-1882, pl. XIII.20 (= DR1 and DR2a) and pl. XIII.26 (= DR2b). The last of these bears Philip's Achaian title, which creates a link with the last discussion. As we have already said, to judge by the evidence of the hoards there was a short period during which Philip of Taranto issued coins at Naupaktos (DR2b) and Clarentza (PTB) contemporaneously. Also the stylistic affinities of the issues in question underline this, especially the open lettering and the club-footed R, and the decorations in the reverse field. Unfortunately, DR2b is excessively rare at Corinth Excavations and no specimens of the type were included in our analyses. DR2b provides a chronological fixpoint in the Naupaktos series, being apparently first minted at one point between October 1304 and August 1306. At the other end of the chronological scale, the Birmingham hoard confirms that the rare DR1a (Figure 17i) was the earliest Naupaktos issue, approximately contemporary with Philip of Savoy's PSF, and therefore dated on numismatic grounds ca. 1301. The singular construction style of the letter S for DR1a and the end of the obverse legend (DESPO) would also indicate that this was an early experimental piece. Many of the remaining DR1 varieties (DR1b: Figures 17a, e, h; DR1c: Figure 17f and g; DR1d: Figure 17j; added to Metcalf's typology by Baker is DR1e: Figure 17c) share neat and common lettering and can only be distinguished by the symbols at the beginning and end of the obverse and reverse legends. Only DR1f (Figure 17d), a second type created by Baker to augment Metcalf's classification system, shares with DR1a the form of the S. The DR2a varieties (Figures 17b and k) have, by contrast, a very different style of lettering and symbols in the reverse field. To judge by some of the hoards studied to the right level of detail, DR1b was the largest, followed by DR1c and DR2a ii and iii. Occasionally DR1e is

also well represented. DR2b is a lot smaller than DR1-2a combined. These hoards do not, however, allow one to place the groups in a sensible chronological order. The following chronological order suggests itself according to the present state of knowledge, largely by typology: DR1a - DR1f - DR1b - DR1c - DR1d - DR1e - DR2aⁱⁱⁱ - DR2aⁱⁱ - DR2bⁱ - DR2bⁱⁱ - DR2bⁱⁱⁱ. This is also an arrangement which can be supported by Figures 18 and 19: we note for instance an affinity of DR1a and 1f on both counts. DR1a launched the series at a substantially lower standard than the contemporary Clarentzan PSΓ (Figure 12), and, as we shall see, even lower than that of Thebes. The series from Clarentza and Naupaktos (compare Figures 13 and 19) may well have built on similar bullion sources during the period ca. 1301- ca. 1304. From D1b to DR1e there was a steady increase in the standard of Naupaktos, although it always fell short of the Clarentzan one and dropped off again with DR2a towards the time when the mint of Clarentza transitioned from the rule of Philip of Savoy to that of Philip of Taranto. As we have said, figures for DR2b would be very desirable in this respect.

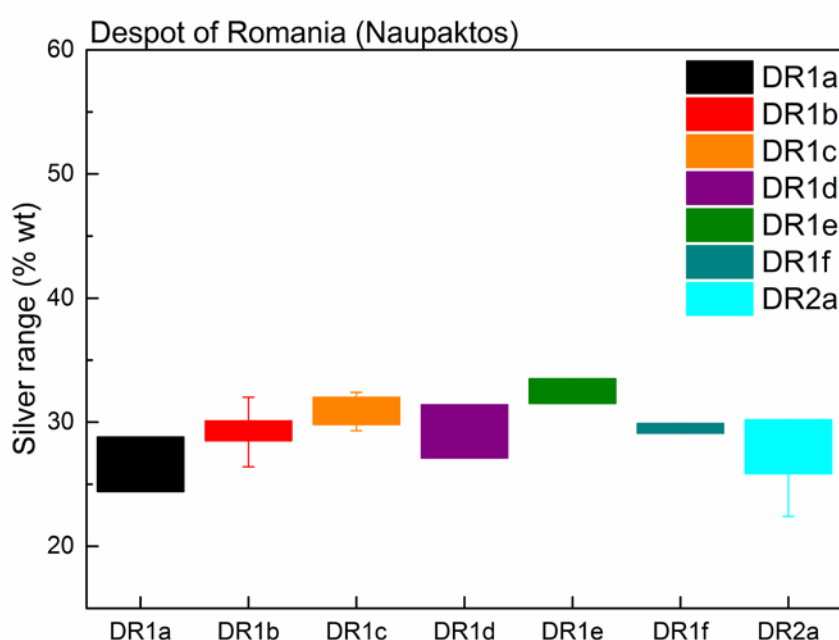


Figure 18: Box chart of the silver content for the types of Naupaktos according to the XRF analyses of the Corinth sample. The box represents the inner quartile ranges and the whiskers the minimum and the maximum values

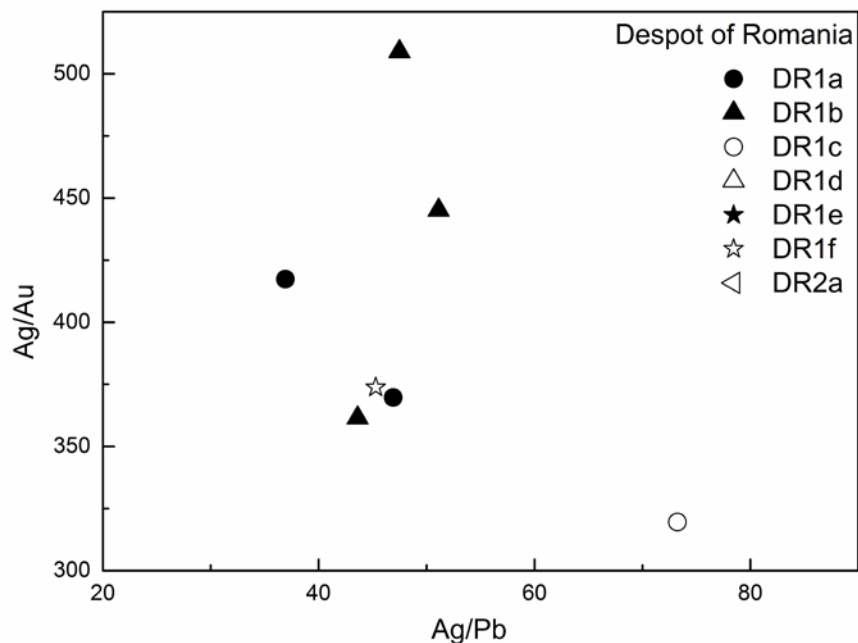


Figure 19: Ratio scatter plot of silver bullion for Naupaktos according to the XRF analyses of the Corinth sample

With these considerations in mind, it will be necessary to analyse all the historical evidence afresh: according to the information presented above, Philip of Taranto married Thamar of Epiros in 1294. The Corfiot coinage demonstrates that for some time during his early Greek involvements Philip did not yet use the title of despot of Romania. This harmonises perfectly with the documentary sources: while Philip received in dowry from Thamar locations in western Mainland Greece (Vonitsa, Angelokastron, Eulochos, Naupaktos)(Kiesewetter 1994, 181-184; Kiesewetter 2001, 63-64), he was required to await the death of his father-in-law Nikephoros to become overlord of the remainder of the territories governed by the Angelodoukai of Epiros, and to assume the title of despot of Romania. Nikephoros' death can be dated, according to the extant Angevin documentation, between September 1296 and June 1298 (Nicol 1981). There is some evidence that during this period Naupaktos had slipped from Angevin control, or perhaps had never been successfully handed over in view of innate Greek resistance to the 1294 settlement: in July and October of 1295 King Charles II urged Prince Florent against the rulers of Neopatra in order to regain precisely that part of Aitolia (Asonitis 2005, 79). Perhaps the town was only conquered in 1300/1301 (Nicol 1984, 49 and 51). In 1300 the Greek bishop of Naupaktos appealed to the Angevin authorities in order to gain access to his see, which can be interpreted variously that the Angevins had either recently, or were about to take the city (Asonitis 2005, 240). We can surmise from an Angevin act that in December 1301 the Naupaktos mint was operational: Charles II gave Thomas III of Autremencourt, lord of Salona, the right to produce issues in his name there, perhaps on the very occasion of the opening of this mint (Schlumberger 1878-1882, 349-350; see also Baker 2011f). Earlier in the same year Clarentza had started striking in the name of Philip of Savoy, which may well have sparked the desire for a separate Angevin minting operation in western Greece, to capture the bullion which was reaching the area in great quantities. The aforementioned Agrinio 1973, devoid of coins of Naupaktos, demonstrates that such issues cannot have been minted earlier than 1300/1301. The position of Naupaktos remained precarious also thereafter: Nikephoros'

widow and son, Anna and Thomas, were especially aggrieved by the direct or indirect integration of the despot's territories into the Angevin empire (Nicol 1984, 56-57; Kiesewetter 1994, 188-190). After making overtures to the imperial Byzantine authorities, and being attacked by the joint forces of King Charles II of Anjou, Count John I of Orsini of Kephallonia and Zakynthos, and Prince Philip of Savoy in the early summer of 1304, they evidently managed to launch counter-attacks and to take Angevin positions. We know that also Naupaktos was in the hands of Thomas for a short while because in the summer of 1306, following a large-scale Angevin offensive, he agreed to relinquish it again (Nicol 1984, 67; Kiesewetter 1994, 199-201; Asonitis 2005, 91-92). It is difficult to judge when Naupaktos was taken from the Angevins: probably not before the summer of 1304, to judge by the content of the negotiations between the Angevins and Anna and Thomas in early 1305; possibly in the summer of 1305, when Thomas attacked again, leading to the treaty between Philip of Taranto and Orsini of October 1305 (Kiesewetter 1994, 192.); but most likely in the spring or early summer of 1306. On 10 February 1306 Philip of Taranto confirmed a number of benefits to the Neapolitan banker Adoardo Bisca, amongst which the profit from the Naupaktos mint, in return for a yearly loan of 31,000 hyperpyra (Hopf 1867-1868, 359, n. 59; Schlumberger 1878-1882, 388, n. 1; Asonitis 2005, 91, n. 134). We might assume that Naupaktos was then still in Angevin hands and that its mint was still emitting tournois until the spring or summer. Alternatively, perhaps the town had been intermittently taken by Anna and Thomas, and then Angevin minting resumed for a short while in early 1306.

Whereas the back end of the Naupaktos series of tournois in the name of Philip of Taranto remains unclear, with respect to chronology and metrological/archaeometric information, the early period from later 1301 to ca. 1304 has a very distinctive profile, and the complex typology can be arranged in a satisfactory sequence. The standard of these types was considerably lower than at contemporary Clarentza, and both mints built their issues on similar bullion sources. This suggests on the one hand that the Angevin authorities at Naupaktos were trying to offer particularly to incoming merchants a cheaper and, at least superficially, a more attractive product than the Clarentza mint (perhaps even that of Thebes), while putting pressure on the rival Philip of Savoy, and on the other hand that both of these mints were substantially commercially orientated. This is corroborated by other pieces of information. In the December 1301 letter of Charles II to a certain Raymond, perhaps the mint master at Naupaktos, in which he instructs him to oversee the minting of coins on behalf of Thomas III of Autrementcourt, he states twice the participation of Clarentzan merchants in this minting operation (see above). This is a concrete example of how the flow of bullion might have been changed to favour Naupaktos. Maybe the Venetian concerns with inferior tournois in 1305 related also directly to the issues of this mint (on the relevant act: Schlumberger 1878-1882, 476-477). It is possible that sometime into the minting at Naupaktos the profile of the mint changed somewhat: in August 1302, after the treaty of Caltabellotta, Philip of Taranto was released from Aragonese captivity and will have begun contemplating his succession to Despot Nikephoros. The threat to his territories from early 1303 by the new ruler John II at Neopatra, and then from Anna and Thomas of Epiros, added to the necessity to act. Consignments of bullion from the Regno are documented for the beginning of 1304 (Asonitis 2005, 84-85). One can only speculate whether the improvement of the minting standard for DR1c-DR1e needs to be seen in connection with this military activity, and whether the subsequent downturn for DR2 can be linked to the difficult fate of the city during the period 1304-1306. The same increase may also have brought the standards at Naupaktos and Thebes in line with one another, and may also have eased the pressure on the mint of Clarentza under Philip of Savoy, who was now actively supporting his overlords in the Epirote campaigns (see above), which may both have

been considerations for the Angevin authorities.

Athens, Thebes mint, Guy II de la Roche (1287-1308) or Walter of Brienne (1309-1311), obv. legend GVI.DVX

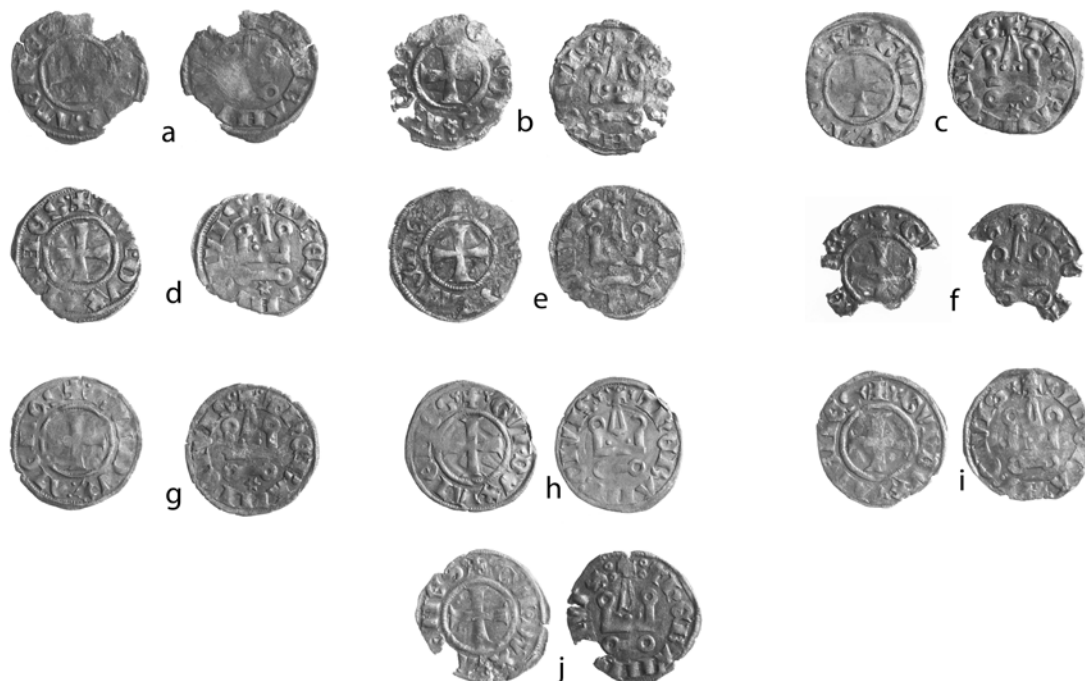


Figure 20a-j: Selection of analysed coins of Athens from Corinth Excavations. Compare Table 6



Figure 21a-f: Selection of analysed coins of Athens from the UK coin trade. Compare Table 7

We have already seen that the typological advances made by Metcalf and Tzamalis have freed the Athenian tournois series minted at Thebes from the previously rigid attributions of the specimens reading G.DVX to William de la Roche (†1287), and GVI.DVX to his son Guy II (1287-1308). Nevertheless, the two main legends are chronologically progressive. Between the early G.DVX type GR105 which we have encountered, and the beginning of the GVI.DVX series there are three substantive types of the G.DVX series (A3, A7, A8). Their ordering and that of the subsequent types of the GVI.DVX series relies on the same hoard evidence which has been discussed, specifically in this order: Xirochori 1957 – Agrinio 1973 – Birmingham – Delphi 1933 –

Mygiò 2006 – Epidauros 1986 – Epidauros 1891-1892 – Thebes 1987 – Pylia 1968/1969, followed by multiple hoards concealed in ca. 1311. The problem with the initial part of this chronology lies in the fact that nearly a decade separates the earliest Xirochori hoard from Agrinio, which was concealed in ca. 1300 but was quite immature in the Athenian series perhaps on account of its geographical origin. At the other end, the latest hoards underline that the regular Athenian series came to an end with the Catalan take-over of the city of Thebes in 1311. According to our present knowledge, the GVI.DVX series needs to be placed during the years ca. 1300-1311, whereas A3, A7, and A8 of G.DVX would have spanned much of the 1290s and been therefore largely contemporaneous to the Clarentzan series in the names of Florent and Isabelle. Our assumption that the standards of these two princes was lowered to accommodate that of these Athenian types rests on the standard of the later GVI.DVX varieties, but is otherwise hypothetical. Clearly, the analysis of the A3, A7, A8 varieties remains a priority for any future enquiries. It is also possible, though still to be proven, that the amelioration of the minting standard for Isabelle's IVA1 might have paralleled the introduction of the GVI.DVX series at Thebes, both occurring in ca. 1300. Within the GVI.DVX group, it is obvious from the hoards that GR20Z (Figure 20c, d, g, and Figure 21d) is the largest and latest of the substantive types, and that GR20B (Figure 21c) is also relatively late. Nevertheless, GR20Z was already in production in ca. 1307/1308 according to the same evidence. GR20A (Figure 20b, e, j, and Figure 21a) is early since it shares the style, and some reverses, with A8. GR20B and GR20Z share the same lettering, as does GR20E (Figure 21e), which is linked to the latter by the same spur rowel as GR20Z, and since it is small and late this type may well have been interrupted by the Catalan take-over. The intermittent types GR20Γ (Figure 20a, f, and Figure 21b) and GR20Δ (Figure 20h, i, and Figure 21f) are stylistically mixed, the second of these is perhaps the closer to the later varieties and the sequence GR20A – GR20Γ – GR20Δ – GR20B – GR20Z – GR20E suggests itself. Figures 22-24, which display the data from respective analyses of the Corinth and UK samples, are neither able to corroborate nor to contradict this arrangement.

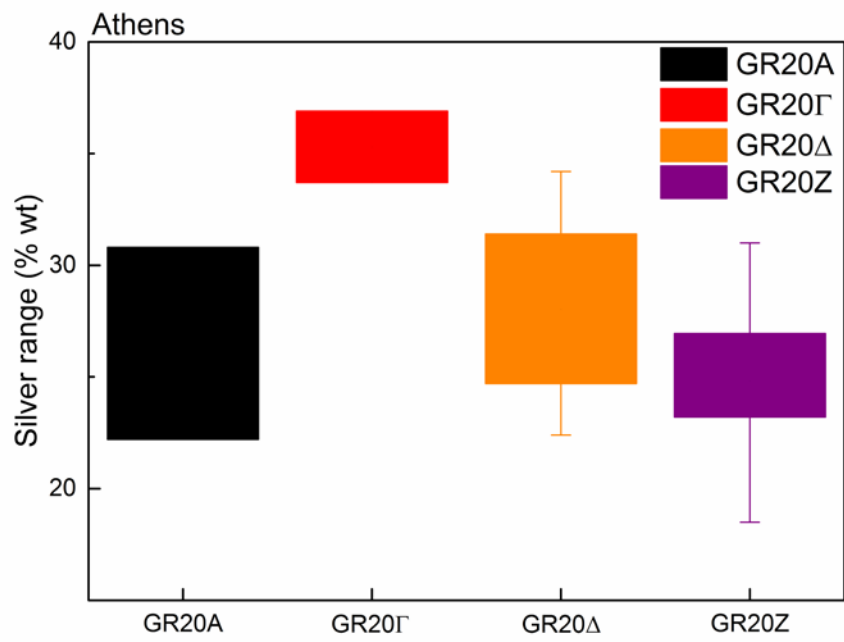


Figure 22: Box chart of the silver content for the types of Athens according to the XRF analyses of the Corinth sample. The box represents the inner quartile ranges and the whiskers the minimum and the maximum values

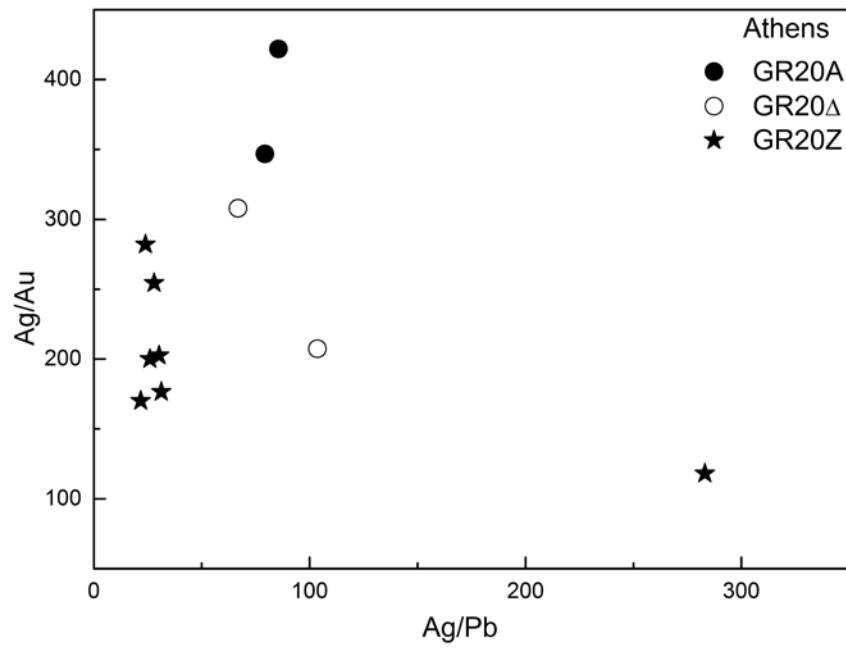


Figure 23: Ratio scatter plot of silver bullion for Athens according to the XRF analyses of the Corinth sample

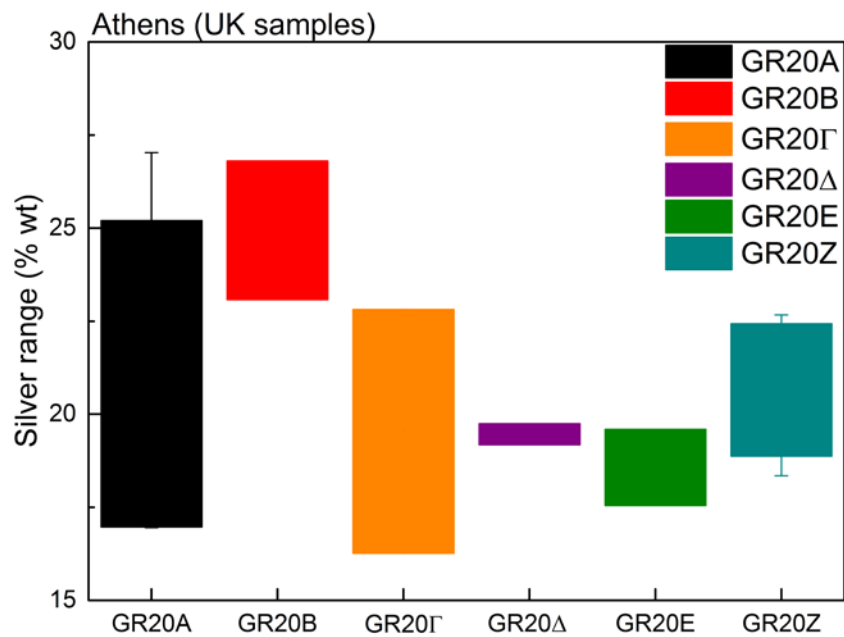


Figure 24: Box chart of the silver content for the types of Athens according to the XRF analyses of the UK sample. The box represents the inner quartile ranges and the whiskers the minimum and the maximum values

Figures 22 and 24 are able to reveal that throughout much of the period ca. 1300-1311 Athens maintained overall a consistent standard, lower than that of Clarentza but evidently not succumbing to the pressures of the newly established Naupaktos mint and its early and baser issue DR1a. In fact perhaps, as Naupaktos raised its own standard towards ca. 1304, the issues of these two mints may have become adjusted to one another. The most remarkable aspect of Figure 23 is the very distinctive metallurgical concentration of the silver sources that went into the striking of GR20Z.

As we have seen, during the princships of Florent and Isabelle the relations between Achaia and Athens normalised. Subsequently, Guy II paid homage to Prince Philip of Savoy in 1302/1303, supported him in his military endeavours in Epiros and the Peloponnese, and attended his parliament at Corinth in 1304 (Longnon 1949, 283-287; Longnon 1962, 266-267). Between May 1307 and October 1308, the date of his death, Guy II was also bailie of the principality for the new prince, Philip of Taranto (Longnon 1949, 293; Longnon 1962, 268). His Theban types GR20B and partially GR20Z were minted contemporaneously to the Clarentzan PTB and then PTA. We can be fairly confident from our figures that Thebes would have minted at a lower standard than Clarentza despite of Guy's new official role. Only in Figure 24 there is a slight hint in the shape of GR20B that the two standards might have been rather closer to one another for the duration of that type (compare also the respective figures achieved by Ponting and Gordus of ca. 19% for GR20B and 18.3% for PTB). There was an interregnum during October 1308 – April 1309, after which Walter of Brienne was duke, until his death at the battle of Halmyros in March 1311. His reign was marked by the preparations for the encounter with the Catalans. There are no diplomatic sources illuminating the events leading up to the arrival in Thebes of Duke Walter of Brienne, the count of Lecce and the son of the late Hugh of Brienne, in April 1309 (Bon 1969, 186, n. 2). His invitation of the Catalan Company into Boiotia brought the downfall of the duchy in 1311, prior to which he had paid the large army, according to Muntaner's account,

“...quatre unces lo mes per home a cauall armat, dos per cauall alforrat et una unça per hom de peu” (Muntaner, chapter 240; see Hendy 1985, 15, on these salaries). We know furthermore from Muntaner the length of the payment, namely two months, and we have a fair idea that an ounce might have been the equivalent of about 1,000 tournois, since in 1299 there were 32 tournois to the tarì (Baker and Ponting 2001, 238), 42 in 1337/1338 (Longnon and Topping 1969, doc. II (1337), 53, lns 6-10, 127), that is to say respectively 960 and 1260 tournois to the ounce (at 30 tarì to the ounce). While we ignore the size of the army, this still gives us a vivid picture of the extent of the payment. There is also evidence for a substantial loan which Walter received in 1310 from Sienese bankers (Jacoby 2001, 224).

There are a number of rare anonymous issues of Thebes which have been variously interpreted (Metcalf 1995, 274). Tzamalis’ proposal that these are to be dated to the interregnum seems to be quite correct (Tzamalis 1990, 130.), and these issues would therefore have to be inserted into the production of GR20Z, which pre-dates October 1308 as much as post-dating April 1309. The sudden need for new dies following the death of Guy in October 1308 and the uncertain succession can account very well for the incongruous style of the anonymous issues, while their anonymity and perhaps their even lower finenesses according to Gordus’ figures reflect the political stalemate. There is every reason to believe, particularly in the light of the payments to the Catalans, that the duchy emitted tournois until the end of its existence. Such minting activity cannot be covered by the anonymous types, or by arguably the earliest of Walter’s issues (G.DVX.ATENAR, Metcalf 1995, 274), nor even by GR20E, which was quite possibly the last of the regular series. We can also witness in the hoards a final boost in GR20Z production until 1311. We must therefore assume that the decision was taken, by or on behalf of the new Duke Walter, to resume the traditional GVI.DVX series at one point between spring 1309 and spring 1311 in the form of GR20Z. This might have been inspired by the fine tradition established by groups GR20A-Z, and by the existence of dies for both GR20Z and GR20E, which had presumably been cut in good number by the time of Guy’s death. The Thebes mint was never stretched for dies in the same way as the Clarentza mint, in the shape of PTA discussed above, in the run-up to the engagement with the Catalans. Both mints appear to have been able, but in different ways (direct consignments and loans, amongst others), to tap into extra-ordinary bullion resources in these times of crisis, and managed thereby to avoid compromising the quality of their outputs.

CONCLUSIONS

The period under analysis, 1289-1313, saw remarkably intense silver minting in southern and central Greece, notably at the three main mints of Clarentza, Thebes, and Naupaktos. This was the middle phase of denier tournois production in Greece, which was preceded by an earlier phase from ca. 1267, and followed by another prolific but different kind of minting activity in the 1320s - 1340s, when coin production was largely confined to Clarentza and Arta for the rival Anjou and Orsini dynasties. This final flourish of Greek coin production is in many respects the least known and understood.

The intensity of the minting in the decade before and after 1300 mirrors that which took place at many other European silver mints in exactly the same period. Like many contemporary pennies, the Greek series bears a typological diversity which numismatists have come some way to describe and explain, especially in chronological terms. Hoards are particularly useful in this process, as are narrative and diplomatic sources.

Our aim was here to introduce another potentially powerful source and to test it for internal consistency and applicability to the problems at hand. It became clear that the main method which we chose, X-Ray Fluorescence spectrometry, could provide us with useful data provided that it was undertaken within a controlled environment, and could be carried out on a large enough sample from the same source, with multiple readings per specimen. LIBS provided additional supporting data. The extrapolations made from the findings were clearly defined and relied on strong archaeological and historical contexts in order to give them meaning. However, once approached in such a circumspect manner the information which could be gathered was absolutely invaluable, in the sense that no other evidence could possibly have provided similar insights which allowed one to further define and explain the nature of the coinages in question. Because of the complexity of the typology of these coinages one would evidently, after this first attempt of its kind, wish to delve ever deeper into the series and to submit more specimens of the same types, and additional types (notably DR2b for Naupaktos; A3, A7, A8 for Thebes), to analysis. Since the chosen method is both non-destructive and relatively inexpensive, it would be realistic to roll out this enquiry to wider samples of ever more tightly defined sets of numismatic types, for instance in the context of the many and large hoards under the authority of the Hellenic Ministry of Culture. It may well be imagined that increasing our sample of 125 coins three- or fourfold could truly allow one to get to grips with the coinages of the chosen period 1289-1313. The weight system of the same coins should ideally also become a major point of enquiry. Meanwhile, the study of typology and hoards, as deployed in this paper, may well exhaust itself soon and future scholars may wish to undertake die studies in order to understand matters of sequence, chronology, quantification, and the like. At that point one may decide that XRF readings for specimens produced by a single pair of dies, for instance, might be desirable, although we remain in many respects far off such possibilities.

As it stands, we have attempted to put the multiple groupings and their sub-varieties in relative and absolute orders. All of these were chronologically progressive. The silver sources at Clarentza, Naupaktos, and Athens could at times be different, and there is variously evidence that these were commercial mints which, in crucial periods, relied on extra-ordinary cash injections. These mints were largely reluctant to compromise the overall standard. They were always aware of one another and lowering this standard could either entail a hostile position (initially of Naupaktos to Clarentza from ca. 1301), or an acknowledgment of realities and alliances (for instance Clarentza and Thebes around 1300; Naupaktos and Clarentza towards ca. 1304; Clarentza and Thebes ca. 1307). The issuance of coins was clearly an important and well thought-out matter to the main Greek protagonists during the years under consideration.

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ABSTRACT

The years 1289-1313 witnessed particularly prolific minting activities at different southern and central Greek mints on behalf of different polities. The coin issues are of great economic and political relevance, and therefore of interest to modern historians. Our understanding of these is based on traditional sources, either numismatic (types and finds), or historical. This paper aims to investigate the possibilities of adding further details to the picture through archaeometry. Specifically, tournois pennies of the three main mints of the region (Clarentza, Thebes, Naupaktos) excavated at Ancient Corinth were analysed according to two different non-destructive methods, XRF and LIBS. The resulting relative silver percentages and the fingerprints of the trace elements have supported our attempts to put the different coin types in chronological order and to add detail to the context and intent for each one of these. A vivid picture of monetary production emerges. The different issuing authorities were usually intent on maintaining a decent standard while variously trying to put pressure on rivals or to harmonise their productions with their allies. All the analysed mints were commercial in character, though they were subject to the great political changes affecting Greece in this period, the ambitions of the Angevin dynasty, the various challenges which it faced in Athens, the Peloponnese, and the western Mainland, and finally the destructive arrival of the Catalans. In times of need, specifically military, these same mints could therefore rely on further bullion which reached them through internal or external political channels.

Η κοπή νομισμάτων κατά τη χρονική περίοδο 1289-1313 αποδείχτηκε ιδιαίτερα παραγωγική για τα νομισματοκοπία διαφορετικών πολιτειών της νότιας και της κεντρικής Ελλάδας. Οι νομισματικές κοπές έχουν οικονομική και πολιτική σημασία και ως εκ τούτου παρουσιάζουν ενδιαφέρον για τους σύγχρονους ιστορικούς. Οι γνώσεις μας πάνω στα νομίσματα βασίζεται σε νομισματικές (τύποι νομισμάτων) ή ιστορικές πηγές. Αυτή η εργασία έχει σαν στόχο να προσθέσει περαιτέρω λεπτομέρειες στην έρευνα των νομισμάτων μέσω της Αρχαιομετρίας. Πιο συγκεκριμένα, νομίσματα των κύριων νομισματοκοπείων της εποχής (Γλαρέντζα, Θήβα, Ναύπακτος) που ανασκάφθηκαν στην Αρχαία Κόρινθο μελετήθηκαν με δύο διαφορετικές μη καταστροφικές μεθόδους, τη φθορισμετρία των ακτίνων X (XRF) και τη φασματοσκοπία πλάσματος επαγόμενου από λέιζερ (LIBS). Οι μετρούμενες συγκεντρώσεις του αργύρου αλλά και των ιχνοστοιχείων υποστήριξαν τις προσπάθειές μας για κατάταξη των διαφορετικών τύπων νομισμάτων σε χρονολογική σειρά προσθέτοντας λεπτομέρειες για τη σύστασή τους. Μια ζωντανή εικόνα της νομισματικής παραγωγής αναδύεται. Οι διάφορες αρχές συνήθως προσπαθούσαν να διατηρήσουν τη ποιότητα των μετάλλων ενώ παράλληλα προσπαθούσαν να ασκήσουν πίεση στους αντιπάλους ή να εναρμονίσουν τις παραγωγές τους με τους συμμάχους τους. Όλα τα εξεταζόμενα νομισματοκοπεία είχαν εμπορικό χαρακτήρα, αν και είχαν υποβληθεί στις μεγάλες πολιτικές αλλαγές που επηρεάζουν την Ελλάδα αυτή την περίοδο, οι φιλοδοξίες της δυναστείας των Ανδεγαυών, οι διάφορες προκλήσεις που αντιμετωπίζουν στην Αθήνα, την

Πελοπόννησο και τη δυτική ηπειρωτική χώρα, και τέλος, η καταστροφική άφιξη των Καταλανών. Σε στιγμές ανάγκης, ειδικά σε περίοδο πολέμου, τα νομισματοκοπεία στηρίζονταν για την ανανέωση του χαλκού και του αργύρου σε εσωτερικές ή εξωτερικές πηγές.

Florent #	Excavation area	Date month	Date day	Date year	Coin # on day	Alter-native #	Inventory #	Variety	Spot analysis #	Analysed spot colour	Cu	Cu Sd	Zn	Zn Sd	Ag	Ag Sd	Sb	Sb Sd	Au	Au Sd	Pb	Pb Sd	Bi	Bi Sd	Ag (LIBS)
01	Agora SE	6	8	1933	2	1236		FHA1	01c	red	61.5	0.1			37.6	0.1					0.75	0.01	0.028	0.009	36
02 (Fig3a)	Agora SE	6	9	1933	7 to 14	1235		FHA1	01d	red	66.1	0.1			32.7	0.1	0.195	0.026	0.143	0.017	0.83	0.01			16
									02c1	redish	76.9	0.1			22.4	0.1					0.14	0.01			
									02d1	redish	73.4	0.1			25.9	0.1					0.17	0.01			11
03	Agora SW	3	27	1933	2	879		FHI ⁺	02d3	white, crack?	64.3	0.1	0.69	0.02	34.6	0.1					0.34	0.02			53
									03d1	white	60.1	0.1	0.88	0.02	38.5	0.1			0.087	0.03	0.36	0.02	0.032	0.01	38
									03d2	white	60	0.1	0.73	0.01	38.8	0.1			0.076	0.02	0.37	0.01			
04 (Fig3b)	North of School	3	18	1935	19 to 22	149		FHI ⁺	04c	white	55.9	0.1			43.6	0.1			0.118	0.02	0.34	0.02			51
									04d	white	52.7	0.1			46.6	0.1			0.129	0.017	0.42	0.01	0.023	0.009	61
									05d	white	62	0.1			36.4	0.1	0.113	0.033	0.186	0.021	1.2	0.02	0.056	0.012	44
05	Agora SW	4	12	1960	60		1960-267	FHA1	05e	white-grey	63.2	0.1			35.5	0.1			0.081	0.019	1.1	0.02	0.059	0.011	28
									06d	white-pale red	55.8	0.1			43.3	0.1			0.123	0.018	0.59	0.01	0.051	0.01	53
									06e	white	57.1	0.1			42.1	0.1			0.131	0.017	0.56	0.01	0.044	0.009	
06	Agora SW	4	30	1960	18		1960-984	FHA1	07d	white-pale red	59	0.1	0.61	0.008	40	0.1			0.071	0.017	0.14	0.12	0.027	0.01	36
									07e	white	56.4	0.1	0.73	0.017	42.4	0.1					0.30	0.02			32
									08c	white	59.2	0.1			39.9	0.1					0.74	0.01	0.034	0.009	45
07 (Fig3c)	Agora SW	4	24	1961	19		1961-251	FHI ⁺	08d	white+red	52.2	0.1			46.5	0.1					1.1	0.02	0.028	0.011	62
									09c	white	29.4	0.1			69.4	0.1					1	0.02	0.11	0.01	
									09d	white+red	55.7	0.1			43.6	0.1	0.14	0.04			0.43	0.02	0.077	0.012	
08	Agora SC	5	15	1936	8 to 11	1006		FHI ⁺ or F5	10c	orange	64.4	0.1			34.9	0.1					0.53	0.02			10
									10d	orange	61.6	0.1			37.4	0.1			0.046	0.015	0.73	0.01	0.03	0.008	21
									11c	redish	54.9	0.1			44.1	0.1			0.082	0.016	0.56	0.01	0.024	0.01	60
09	Agora NE	2	19	1937				FHA1	11d	redish	56.1	0.1			42.9	0.1			0.148	0.017	0.48	0.01			26
									12c	grey	56.4	0.1			42.7	0.1			0.085	0.018	0.68	0.02	0.029	0.011	
									12d	white	63.7	0.1			35.4	0.1			0.079	0.019	0.67	0.02	0.057	0.011	44
10 (Fig3d)	Agora NE	5	15	1937				FHB	13c	white	50.7	0.1	1.00	0.02	47.7	0.1			0.122	0.018	0.31	0.02	0.035	0.01	49
									13d1	white	56.6	0.1	0.93	0.02	42	0.1			0.137	0.021	0.26	0.02	0.023	0.011	44
									13d2	redish	58.6	0.1	1.42	0.01	39.6	0.1					0.18	0.01			
11	Agora NE	5	14	1937				FHI ⁺	n/a																34
									15c1	white	59	0.1	0.91	0.01	39.2	0.1			0.099	0.017	0.71	0.01	0.042	0.01	33
									15c2	white	57.9	0.1	0.83	0.02	40.2	0.1					0.86	0.03	0.033	0.011	31
12	Agora SC	11	4	1937				FHI ⁺	15d1	white	58.3	0.1	0.77	0.008	39.8	0.1					0.89	0.01	0.056	0.01	48
									15d2	white	51.8	0.1	0.66	0.01	46.1	0.1			0.081	0.018	1.1	0.02	0.065	0.011	40
									16c	white-pink	60.2	0.1			39.2	0.1			0.131	0.02	0.35	0.02	0.024	0.01	29
13 (Fig3e)	Agora SC	12	3	1937				F5	16d	white-pink	57.6	0.1			41.6	0.1	0.14	0.03	0.066	0.018	0.55	0.01	0.022	0.01	34
									17c1	white	50.4	0.1			47.3	0.1	0.394	0.036			1.7	0.02	0.067	0.011	34
									17c2	white	51	0.1			46.8	0.1	0.42	0.04	0.092	0.02	1.6	0.02	0.08	0.01	33
14	Agora SC	12	4	1937				?	17d1	white	53.9	0.1			43.6	0.1	0.423	0.036	0.056	0.02	1.6	0.02	0.084	0.011	11
									17d2	white	54.4	0.1			43.5	0.1	0.449	0.045	0.19	0.03	1.3	0.1	0.095	0.014	36
									18c1	white	59.3	0.1			40.3	0.1					0.26	0.01			
15	South Stoa W	9	20	1937				FHA1	18c2	redish	66.8	0.1	2.20	0.1	30.7	0.1					0.23	0.02			31
									18c3	brownish	60.3	0.1			39.2	0.1	0.078	0.033	0.11	0.02	0.28	0.02	0.024	0.011	23
									18d1	white	55.4	0.1			44.1	0.1			0.102	0.019	0.32	0.02	0.024	0.01	37
16	Odeion Dump	4		1937		1418		FHA1	18d2	redish	52	0.1			47.5	0.1			0.098	0.016	0.3	0.01			40
									18d3	brownish	55	0.1			44.5	0.1			0.057	0.019	0.39	0.01			36
									n/a																
17 (Fig3f)	Lechaion Road	4	27	1927		1419		FHA1																	
18	Temple Hill S	6	16	1925		163		FHA																	
19							1963-901	FHI ⁺																	

Table 1: Analysed specimens of Achaia, Clarentza mint, Florent of Hainaut (1289-1297) from Corinth Excavations. The detection limits are 0.5(Zn), 0.07 (Sb), 0.06 (Au), 0.0

Isabelle #	Excavation area	Date month	Date day	Date year	Coin # on day	Alternative #	Inventory #	Variety	Spot analysis #	Analysed spot colour	Cu	Cu Sd	Zn	Zn Sd	Ag	Ag Sd	Sb	Sb Sd	Au	Au Sd	Pb	Pb Sd	Bi	Bi Sd
01 (Fig5a)	New Museum	3	14	1931	2		1931-630	IVT	n/a															
02	New Museum	3	6	1931	4		1931-534	IVT	n/a															
03	Temple E	4	6	1932	15			IVA1	n/a															
04	Trial Trench for Museum	2	13	1931	5	70		IVA1	04c1	white	64.0	0.1			34.0	0.1	0.29	0.03			1.1	0.03	0.071	0.01
									04c2	crack	63.7	0.1			34.5	0.1	0.14	0.03			1.0	0.03	0.033	0.01
									04d	white	63.7	0.1			34.4	0.1	0.25	0.03			1.0	0.01	0.06	0.01
05	Agora SE	3	2	1934	80-81	1255		IVB1	05c	white/pink	66.3	0.1			33.3	0.1					0.39	0.02		
									05d	white/pink	66.3	0.1			33.3	0.1					0.39	0.02		
06 (Fig5b)	Agora SE	3	27	1934	2 to 11	1254		IVA1	06c1	pale yellow	64.0	0.1			35.3	0.1	0.11	0.04			0.55	0.02		
									06c2	pale yellow	54.6	0.1			44.6	0.1	0.10	0.04			0.60	0.02	0.036	0.01
									06d1	pale yellow	62.5	0.1			36.7	0.1	0.12	0.03			0.63	0.02		
									06d2	white	57.6	0.1			41.3	0.1	0.19	0.04			0.82	0.02	0.029	0.01
07	Agora SW	5	12	1934	11 to 24	1250		IVA1	n/a															
08	Agora SW	5	21	1934	1 to 23	1245		Y3	n/a															
09 (Fig5c)	Agora SW	5	12	1960	16		1960-1221	Y3	09c1	pale yellow	72.4	0.1	3.6	0.01	23.7	0.1	0.14	0.01			0.23	0.01		
									09c2	redish	75.5	0.1	4.1	0.01	20.3	0.1					0.14	0.01		
									09d	pale yellow	78.3	0.1	2.0	0.01	19.4	0.1					0.22	0.02		
10	Agora SW	5	24	1960	21		1960-1461	IVB1	n/a															
11	Agora SW	5	16	1961	18		1961-530	Y3	n/a															
12	Agora SW	5	18	1961	14		1961-579	IVB1	12c	white	68.1	0.1			31.2	0.1	0.17	0.03			0.55	0.02		
									12d	white	68.5	0.1			30.8	0.1	0.15	0.03			0.56	0.02		
13	South Stoa M	11	4	1936	1			IVA1	n/a															
14 (Fig5d)	Agora SC	5	2	1936	36 to 46			IVB1	14c	pale yellow	65.9	0.1			33.1	0.1			0.12	0.02	0.72	0.03		
									14d1	pale yellow	64.9	0.1			34.4	0.1			0.095	0.022	0.60	0.02		
									14d2	pale yellow	60.1	0.1			38.7	0.1			0.17	0.02	0.90	0.03		
15 (Fig5e)	Agora SC	4	29	1936	16			IVT	n/a															
16 (Fig5f)	Agora SC	4	1	1936	80 to 81	1009		IVB1	16c	white/pink	61.3	0.1			37.8	0.1	0.092	0.03			0.79	0.02		
									16d	white/pink	62.7	0.1			36.4	0.1	0.097	0.037	0.11	0.02	0.68	0.02		
17	South Stoa M	3	2	1936	1 to 12			IVA1	17c	white	55.4	0.1			43.6	0.1	0.093	0.038	0.14	0.02	0.70	0.02		
									17d	pale yellow	58.9	0.1			40.3	0.1	0.12	0.04			0.59	0.02		
18	Agora NE	2	18	1937				IVA1	18c	white/pink	57.4	0.1			41.7	0.1					0.91	0.02		
									18c1	white	60.5	0.1			38.3	0.1			0.17	0.02	0.90	0.03		
									18d	white/pink	56.1	0.1			42.9	0.1					0.95	0.02		
									18d1	white+red	52.5	0.1			46.4	0.1					1.0	0.03		
19	Agora NE	4	16	1937				IVA1	19c	black/yellow	59.0	0.1	39.4	0.1	0.39	0.04	0.11	0.02	0.53	0.02	0.087	0.01		
									19d	yellow	60.5	0.1	38.0	0.1	0.43	0.04	0.085	0.02	0.55	0.02	0.064	0.01		
20 (Fig5g)	Agora NE	4	26	1937				Y3	20c	pale red	75.7	0.1			22.8	0.1	0.12	0.03	0.15	0.02	0.68	0.02		
									20d	pale red	73.4	0.1	0.73	0.01	24.9	0.1			0.11	0.02	0.82	0.02		
21 (Fig5h)	Agora SC	10	21	1937				IVA1	21c1	white	48.5	0.1			50.6	0.1			0.087	0.021	0.74	0.02		
									21c2	white	51.7	0.1			47.2	0.1					1.0	0.02		
									21d	white	59.9	0.1			39.6	0.1					0.36	0.02		
22	Agora SC	11	5	1937				IVA1	22c	grey	60.4	0.1			37.8	0.1	0.39	0.04			1.3	0.03	0.049	0.01
									22d	grey	53.2	0.1			44.9	0.1	0.34	0.04	0.051		1.4	0.02	0.068	0.01
23	Agora South Stoa W	9	22	1937				IVA1	23c	white	58.9	0.1			40.2	0.1	0.38	0.04			0.46	0.02		
									23d	white	59.9	0.1			39.1	0.1	0.29	0.04			0.66	0.02	0.03	0.011

Table 2: Analysed specimens of Achaia, Clarentza mint, Isabelle of Villehardouin (1297-1301) from Corinth Excavations. The detection limits are 0.5(Zn), 0.07 (Sb), 0.06 (Au), 0.022 (Bi). N/a = not analysed. Sd standard deviation.

Philip of Savoy #	Excavation area	Date month	Date day	Date year	Coin # on day	Alter-native #	Inventory #	Variety	Spot analysis #	Analysed spot colour	Cu	Cu Sd	Zn	Zn Sd	Ag	Ag Sd	Sb	Sb Sd	Au	Au Sd	Pb	Pb Sd	Bi	Bi Sd	Ag (LIBS)
01 (Fig7a)	New Museum	4	1	1931	6		1931-769	PSI	01c	grey/redish	70.9	0.1	0.60	0.01	27.0	0.1	0.36	0.03	0.069	0.022	1.0	0.03			33
02	North of St. John's	4	25	1932	4	167a		PSA	01d	redish	65.6	0.1			32.6	0.1	0.37	0.03	0.12	0.02	1.3	0.03			34
									02c1	pale pink	66.9	0.1			31.7	0.1	0.26	0.03			0.73	0.02			
									02c2	white/pink	66.8	0.1			31.7	0.1	0.27	0.03			0.69	0.02			
03	Peribolos			1930		212		PSA	02d	white/pink	69.9	0.1			28.8	0.1	0.19	0.03			0.70	0.02			28
									03c	white	64.1	0.1			34.6	0.1	0.43	0.03	0.21	0.022	0.55	0.02	0.13	0.01	
									03d	white	67.0	0.1			31.6	0.1	0.54	0.03	0.20	0.022	0.57	0.02	0.13	0.01	
04	Temple E	10	13	1932	1125-1127	1003		PSI	n/a																
05	Agora SW	3	1	1934	8 to 9	1252		PSA	05c	grey	63.7	0.1	1.4	0.02	33.9	0.1	0.25	0.03			0.68	0.02			39.0
									05d	grey	63.6	0.1	1.4	0.02	34.0	0.1	0.20	0.03	0.076	0.022	0.67	0.02			
06	NW Shops	11	29	1963			1963-815	PSA	06c	dull grey, not metallic	59.3	0.1			39.3	0.1					1.3	0.03	0.054	0.01	39
									06d	redish	68.5	0.1			30.7	0.1					0.70	0.02			
									07c	grey	69.4	0.1	1.3		28.9	0.1					0.36	0.02			
07 (Fig7b)	Agora SC	5	2	1936	36 to 46			PSA	07d	grey	68.8	0.1	0.63		30.0	0.1	0.14	0.03			0.47	0.01			9.0
									08c	white	70.0	0.1			29.0	0.1	0.27	0.03	0.079	0.019	0.68	0.02			
08	Agora SC	5	20	1936	74 to 90			PSA	08d	white	61.9	0.1			36.9	0.1	0.25	0.03			0.95	0.02			58
									09c	white	63.4	0.1			35.1	0.1	0.46	0.03			0.94	0.02	0.045	0.01	
									09d	orange	65.1	0.1			33.3	0.1	0.45	0.03	0.06	0.02	1.0	0.01			
10 (Fig7c)	Agora NE	3	20	1937				PSB	10c	orange	68.6	0.1			30.4	0.1	0.09	0.03			0.69	0.01			30
									10d	orange	66.4	0.1			32.3	0.1	0.10	0.03			0.80	0.01			
11 (Fig7d)	Agora NE	4	26	1937				PSI	11c	pink	65.7	0.1			33.2	0.1	0.25	0.03			0.83	0.02			51
									11c2	pink	65.5	0.1			33.3	0.1	0.17	0.03			0.96	0.03			
									11d1	redish	68.8	0.1			30.0	0.1	0.25	0.03			0.92	0.01	0.035	0.01	
									11d2	crack	71.7	0.1			27.0	0.1	0.11		0.069		1.1	0.03			
									11d3	pink	71.4	0.1			27.6	0.1					0.90	0.02	0.044	0.01	
12 (Fig7e)	Agora SC	10	28	1937				PSB	12c	grey	71.9	0.1			26.3	0.1	0.25	0.03			1.1	0.01	0.034	0.01	35
									12d	grey	69.1	0.1			29.2	0.1	0.19	0.03			1.0	0.03	0.053	0.012	
13	Agora SC	10	30	1937				PSB	13c	white	63.9	0.1			34.7	0.1	0.43	0.04	0.098	0.022	0.86	0.03	0.033	0.01	46
									13d	white	67.8	0.1	0.42	0.01	30.6	0.1	0.31	0.03			0.85	0.03			
14	Agora SC	12	4	1937				PSA-B	14c1	orange	69.6	0.1	2.2		27.7	0.1	0.21	0.03			0.34	0.02			42
									14c2	crack	69.3	0.1	1.0		28.8	0.1	0.17	0.03			0.75	0.03			
									14d	orange	67.3	0.1	2.3		29.8	0.1	0.19	0.03			0.37	0.02			
15	South Stoa W	9	23	1937				PSA-B	n/a																
16	South Stoa W	10	8	1937				PSA	16c1	yellow	64.5	0.1			34.2	0.1	0.30	0.03			0.51	0.02			42
									16c2	white	62.1	0.1			36.6	0.1	0.35				0.44				
									16d2	crack	68.2	0.1			30.9	0.1	0.27	0.04	0.053	0.019	0.58	0.02			
17 (Fig7f)	Agora NC	10	15	1937				PSA	17c	white	68.1	0.1			30.9	0.1	0.27	0.04			0.74				
									17d	white	71.6	0.1			27.6	0.1	0.20	0.03			0.65	0.01			
18	Lechaion Road	6	24	1926				PSA	18c	'white	64.5	0.1	1.2	0.01	33.6	0.1	0.26	0.03			0.47	0.01			
									18d	white	69.4	0.1			29.4	0.1	0.20	0.03			0.45	0.01			
19	St. John's	10	5	1936	1 to 10			PSA	n/a																
20	St. John's	3	2	1935	21			PSB	n/a																

Table 3: Analysed specimens of Achaia, Clarentza mint, Philip of Savoy (1301-1304/6) from Corinth Excavations. The detection limits are 0.5(Zn), 0.07 (Sb), 0.06 (Au), 0.022 (Bi). N/a = not analysed. Sd standard deviation.

Philip of Taranto, Achaia #	Excavation area	Date month	Date day	Date year	Coin # on day	Alternative #	Inventory #	Variety	Spot analysis #	Analysed spot colour	Cu	Cu Sd	Zn	Zn Sd	Ag	Ag Sd	Sb	Sb Sd	Au	Au Sd	Pb	Pb Sd	Bi	Bi Sd	Ag (LIBS)
01	New Museum	3	23	1931	3	526	1931-699	PTB	01c	orange	68.7	0.1			30.4	0.1	0.32	0.04			0.55	0.02			24
02 (Fig9a)	New Museum	3	7	1931	21	525	1931-572	PTA	01d	orange	66.9	0.1			32.2	0.1	0.31	0.03			0.58	0.02			37
									02c	orange	66.4	0.1			32.1	0.1	0.29	0.03			1.2	0.03			30
									02d	orange	67.1	0.1			31.4	0.1	0.28	0.03			1.2	0.03			17
03 (Fig9b)	New Museum	3	7	1931	1	524	1931-550	PTA	03c	orange-pink	63.7	0.1	0.77	0.01	34.0	0.1	0.48	0.04			0.98	0.03			37
									03d	orange-pink	63.8	0.1			34.2	0.1	0.43	0.04			1.01	0.03	0.072	0.012	57
04 (Fig9c)	Agora SE	4	15	1935	19 to 25	909		PTB	04c	orange-pink	67.8	0.1			30.8	0.1	0.36	0.04			0.46	0.02			32
									04d	orange-pink	71.7	0.1			27.0	0.1	0.33	0.03			0.42	0.02			30
05	Agora SW	4	11	1960	18		1960-212	PTA	05c	orange-pink	64.8	0.1			33.3	0.1	0.34	0.04			1.5	0.04	0.059	0.012	30
									05d	orange-pink	63.1	0.1			35.0	0.1	0.47	0.04			1.4	0.03	0.066	0.012	26
06 (Fig9d)	NW Shops	11	29	1963			1963-814	PTB	06c	white/grey	66.2	0.1			32.4	0.1	0.28	0.04	0.19	0.02	0.85	0.02	0.083	0.01	46
									06d	orange-pink	74.3	0.1			24.8	0.1	0.25		0.089		0.58				40
07	Agora NE	3	15	1937				PTB	07c	orange	62.3	0.1			36.1	0.1	0.55	0.04			0.68	0.02			14
									07d	orange	64.0	0.1			34.6	0.1	0.51	0.04			0.57	0.02			
08	Agora NE	3	24	1937				?	08c	white	68.8	0.1			29.9	0.1	0.43	0.03	0.06	0.02	0.76	0.03			24
									08d	white	62.9	0.1			35.5	0.1	0.38	0.04	0.069	0.02	1.1	0.03	0.041	0.013	
09 (Fig9e)	Agora NE	5	14	1937				PTT	09c	orange-pink	73.0	0.1	0.63	0.01	25.1	0.1	0.41	0.03	0.092	0.02	0.83	0.03			30
									09d	orange-pink	74.8	0.1	0.69	0.01	23.4	0.1	0.41	0.03			0.73	0.02			14
10 (Fig9f)	Agora SC	10	28	1937				PTA	10c	orange-pink	67.2	0.1			31.1	0.1	0.42	0.04			1.2	0.03			43
									10d	orange-pink	69.3	0.1			29.1	0.1	0.38	0.03			1.3	0.02			29
11	South Stoa W	10	6	1937				PTA	11c	orange-pink	69.3	0.1	2.3	0.02	27.4	0.1	0.22	0.04			0.83	0.03			26.0
									11d	orange-pink	71.7	0.1	1.8	0.02	25.6	0.1	0.21	0.03			0.67	0.02			27.0
12 (Fig9g)	South Stoa W	10	13	1937				PTB	12c1	orange-pink	62.4	0.1			36.6	0.1	0.42	0.04			0.55	0.02			32
									12c2	crack	63.5	0.1			35.7	0.1	0.42	0.04			0.44	0.02			
									12d	orange	64.7	0.1			34.3	0.1	0.38	0.04			0.54	0.02			42
13	Agora NC	2	24	1938				PTA	13c1	yellow	68.0	0.1	2.7	0.03	28.3	0.1	0.33	0.03			0.68	0.03			
									13c2	white	60.8	0.1	4.1	0.03	33.9	0.1	0.36	0.04			0.79	0.03	0.042	0.011	38.0
									13d1	orange	67.6	0.1	3.5	0.03	27.9	0.1	0.35	0.03			0.64	0.02			21.0
14	North of Peribolos	4	22	1929		2057		PTB	13d2	white	57.5	0.1	1.5	0.02	39.3	0.1	0.46	0.05	0.073	0.02	1.1	0.03			
									14c	pink	62.8	0.1			35.0	0.1	0.59	0.04	0.11	0.02	1.4	0.03	0.07	0.013	48
									14d	pink	64.5	0.1			33.6	0.1	0.61	0.03	0.093	0.019	1.1	0.02	0.043	0.011	
15	North of Peribolos	5	17	1929		2058		PTB	15c1	white	48.3	0.1			50.1	0.1	0.49	0.05			1.1	0.03			75
									15c2	yellow	72.2	0.1			26.9	0.1	0.38	0.03			0.44	0.02			28
									15d	grey	67.7	0.1			31.4	0.1	0.40	0.04			0.52	0.02			
16 (Fig9h)	Corinth	5	19	1915		488		PTA	16c	white/yellow	66.2	0.1			31.7	0.1	0.22	0.03	0.092	0.022	1.7	0.04	0.049	0.013	36
									16d	white/yellow	65.3	0.1			32.6	0.1	0.16	0.03	0.075	0.022	1.9	0.04	0.05	0.01	24
17							1963-197	PTA	n/a																

Table 4: Analysed specimens of Achaia, Clarentza mint, Philip of Taranto (1304/6-1313) from Corinth Excavations. The detection limits are 0.5(Zn), 0.07 (Sb), 0.06 (Au), 0.022 (Bi). N/a = not analysed. Sd standard deviation.

Naupaktos #	Excavation area	Date month	Date day	Date year	Coin # on day	Alternative #	Inventory #	Variety	Spot analysis #	Analysed spot colour	Cu	Cu Sd	Zn	Zn Sd	Ag	Ag Sd	Sb	Sb Sd	Au	Au Sd	Pb	Pb Sd	Bi	Bi Sd	Ag (LIBS)
01 (Fig11a)	New Museum	6	24	1931	4		1931-1200	DR1b	01c1	brown-uncleaned	68.6	0.1			30.6	0.1	0.41				0.35	0.02	0.053	0.012	13
									01c2	brown-cleaned, same as 1	68.6	0.1			30.1	0.1	0.40				0.38	0.02	0.06	0.012	
									01d	brown-orange	69.4	0.1			29.3	0.1	0.37	0.03			0.33	0.02	0.046	0.01	10
02 (Fig11b)	Temple E	10	7	1932	984 to 987	1006		DR2aiii	02c	pink	68.6	0.1			30.2	0.1	0.39	0.04			0.81	0.03			29
									02d	pink	68.7	0.1			30.2	0.1	0.29	0.03			0.80	0.03			32
03	Temple E	6	2	1932	778 to 781	1007		DR2aiii	n/a																
04 (Fig11c)	West of New House	2	5	1932	5	65		DR1e	04c	grey/pink	64.2	0.1	0.84	0.02	33.5	0.1					1.37	0.03			28
									04d	grey/pink	66.5	0.1	0.68	0.01	31.5	0.1					1.19	0.03			48
05 (Fig11d)	Agora SE	3	21	1933	03-Aug	1240		DR1f	05c	pink	70.1	0.1			29.1	0.1	0.16	0.03			0.58	0.02	0.04	0.01	51
									05d	pink	69.1	0.1			29.9	0.1	0.15	0.04	0.080	0.023	0.66	0.03	0.032	0.01	34
06 (Fig11e)	Agora SE	5	10	1934	64	1268		DR1b	06c	yellow	69.9	0.1			29.3	0.1	0.08	0.03			0.64	0.02			32
									06d	yellow	72.9	0.1			26.4	0.1	0.13	0.03			0.47	0.02			
07	Agora SE	4	12	1935				DR1b	n/a																
08 (Fig11f)	Agora SW	10	8	1934	30 to 54	1259		DR1c	08c	yellow	66.7	0.1			31.6	0.1	0.29	0.04			1.33	0.03			36
									08d	yellow	66.7	0.1			31.6	0.1	0.29	0.04			1.33	0.03			
09	Agora SE	5	17	1935	28 to 43	914		DR1c	n/a																
10 (Fig11g)	Agora SW	4	12	1933	3 to 7	884		DR1c	10c	yellow	66.0	0.1			32.4	0.1	0.35	0.04			0.83	0.03			33
									10d	yellow	68.0	0.1			31.1	0.1	0.33	0.04			0.58	0.03			34
11 (Fig11h)	Agora SW	4	7	1959	14		1959-50	DR1b	11c	white	69.6	0.1			29.6	0.1	0.14	0.03			0.72	0.03			31
									11d	white	70.1	0.1			29.1	0.1					0.61	0.02			35
12	Agora SW	4	4	1960	23		1960-22	DR1b	12c	grey-pink	70.4	0.1			28.5	0.1	0.46	0.04	0.056	0.021	0.60	0.03	0.046	0.013	30
									12d	yellow	73.5	0.1			25.3	0.1	0.52	0.03	0.070	0.019	0.58	0.02	0.052	0.011	30
13	Agora SW	5	12	1960	7		1960-1215	DR1b	13c	orange	66.1	0.1	1.19	0.02	32.0	0.1	0.20	0.04			0.46	0.02	0.037	0.013	
									13d	grey	71.1	0.1			27.6	0.1	0.14	0.03	0.062	0.018	0.54	0.02	0.031	0.011	
14	Agora SW	5	30	1961	34		1961-962	DR1b	n/a																
15 (Fig11i)	Agora NE	3	20	1936	6 to 7		1936-1012	DR1a	15c	orange	74.8	0.1			24.4	0.1	0.16	0.03	0.066	0.020	0.52	0.02			39
									15d	orange	70.1	0.1			28.8	0.1	0.18	0.03	0.069	0.017	0.78	0.03	0.057	0.011	29
16	Agora SC	4	29	1936	9 to 15			DR1c	16c	orange	69.9	0.1			29.3	0.1	0.24	0.03			0.51	0.02			58
									16d	white	68.9	0.1			30.3	0.1	0.28	0.03			0.53	0.02			42
17	South Stoa M	3	2	1936	1 to 12			DR2aiii	n/a																
18	Agora NE	3	15	1937				DR1b-e	18c	pink	68.7	0.1			30.8	0.1	0.15	0.03			0.32	0.02			29
									18d	Pink	70.2	0.1			29.3	0.1	0.13	0.03			0.38	0.02			
19 (Fig11j)	Agora NE	3	8	1937				DR1d	19c	orange/grey	67.0	0.1			31.4	0.1	0.13	0.03			1.11	0.03			34
									19d	orange/grey	71.7	0.1			27.1	0.1	0.074	0.031			1.08	0.03			34
20	Agora NE	4	26	1937				DR1f	n/a																
21	Agora SC	12	4	1937				DR1b	n/a																
22	South Stoa W	9	22	1937				DR1c	22c	yellow	73.0	0.1	0.67	0.01	25.7	0.1	0.30	0.03			0.31	0.02			28
									22d	white rough surface	56.2	0.1			42.5	0.1	0.34	0.03	0.133	0.020	0.79	0.01	0.047	0.01	
23 (Fig11k)	South Stoa W	10	2	1937				DR2aiii	23c	orange	76.8	0.1			22.4	0.1	0.32	0.03			0.46	0.02			31
									23d	orange	70.0	0.1			29.3	0.1	0.34	0.04			0.40	0.02			34
24	Agora NC	10	15	1937				DR1b	n/a																
25	Odcion Dump	4		1927	1424			DR1c-d	n/a																

Table 5: Analysed specimens of Despot of Romania, Naupaktos mint, Philip of Taranto (1296/8-1314) from Corinth Excavations. The detection limits are 0.5(Zn), 0.07 (Sb), 0.06 (Au), 0.022 (Bi). N/a = not analysed. Sd standard deviation.

Athens #	Excavation area	Date month	Date day	Date year	Coin # on day	Alter-native #	Inventory #	Variety	Spot analysis #	Analysed spot colour	Cu	Cu Sd	Zn	Zn Sd	Ag	Ag Sd	Sb	Sb Sd	Au	Au Sd	Pb	Pb Sd	Bi	Bi Sd	Ag (LIBS)
01	Trial Trench for Museum	2	13	1931	7	71		GR20A	n/a																
02 (Fig13a)	Agora SE	5	3	1933	36 to 43	1239	1933-1270	GR20Γ	02c	grey	65.0	0.1			33.7	0.1	0.37	0.03			0.55	0.02			29
									02d	yellow	61.5	0.1			36.9	0.1	0.42	0.04			0.83	0.03			
03 (Fig13b)	Agora SE	5	8	1934	51 to 52	1265		GR20A	n/a																
05	Christian Basilica	6	11	1935	50	38a		GR20Δ	05c	white	75.1	0.1	1.58	0.02	22.8	0.1	0.17	0.03	0.11	0.02	0.22	0.02			25
									05d	white	75.0	0.1	2.11	0.01	22.4	0.1	0.16	0.03		0.02	0.31	0.01			32
06 (Fig13c)	Agora SE	5	9	1935	45 to 46	913		GR20Z	06c	dull grey	67.5	0.1			30.6	0.1	0.20	0.03	0.18	0.02	1.41	0.03	0.11	0.01	33
									06d	dull grey	71.7	0.1			26.8	0.1	0.20	0.03	0.095	0.02	1.12	0.03	0.063	0.01	25
07	Agora SW	4	14	1960	35		1960-426	GR20Δ	07c	white	74.8	0.1			24.7	0.1					0.45	0.02			35
									07d	orange	69.4	0.1			30.1	0.1					0.45	0.02			41
09 (Fig13d)	Agora SW	5	5	1960	7		1960-1106	GR20Z	09c	white	67.4	0.1	0.88	0.02	31.0	0.1	0.27	0.03			0.49	0.02			30
									09d	pale orange-almost white	73.0	0.1	2.23	0.01	24.1	0.1	0.24	0.03			0.38	0.01			9
10	Agora SW	5	13	1960	23		1960-1240	GR20Z	10c1	orange-black	77.3	0.1			19.7	0.1	0.69	0.04			2.15	0.04	0.12	0.01	1
									10c2	light blue	79.6	0.1			18.5	0.1	0.56	0.03			1.22	0.03	0.075	0.012	
									10d	orange-black	78.0	0.1			19.7	0.1	0.67	0.02			1.58	0.02	0.11	0.01	34
11 (Fig13e)	Agora SC	4	2	1936	11 to 16			GR20A	11c1	white	68.5	0.1			30.8	0.1	0.24	0.03	0.073	0.02	0.36	0.02			23
									11c2	crack	76.3	0.1	1.00	0.01	22.2	0.1	0.15	0.02	0.064	0.016	0.28	0.01			
									11d	white	73.1	0.1	0.84	0.01	25.5	0.1	0.15	0.03			0.35	0.02			
12 (Fig13f)	Agora NE	4	26	1937				GR20Γ	n/a																
13	Agora NE	5	20	1937				GR20Z	13c	pink+black	76.0	0.1			23.5	0.1	0.20	0.02	0.199	0.02	0.083	0.021	0.053	0.011	19
									13d	pink	75.0	0.1			23.9	0.1	0.21	0.03	0.118	0.02	0.79	0.02	0.054	0.01	
14	Agora SC	6	3	1937				GR20Z	14c	white	71.6	0.1	0.59	0.01	27.1	0.1	0.25	0.03			0.47	0.02			36
									14d	white	72.7	0.1			26.1	0.1	0.26	0.03			0.58	0.01			42
15 (Fig13g)	Agora SC	6	3	1937				GR20Z	15c	dull grey	74.1	0.1			24.7	0.1	0.23	0.03	0.14	0.02	0.79	0.03			28
									15d1	orange	72.5	0.1			26.0	0.1	0.30	0.03	0.13	0.02	1.00	0.03	0.052	0.012	28
									15d2	white	75.9	0.1			22.9	0.1	0.28	0.03	0.09	0.02	0.82	0.03			
16 (Fig13h)	Agora SC	10	21	1937				GR20Δ	16c1	yellow	65.9	0.1			33.0	0.1	0.40	0.04			0.67	0.03			45
									16c2	dull yellow	64.8	0.1			34.2	0.1	0.37	0.04			0.65	0.03			42
									16d1	yellow	67.8	0.1			31.4	0.1	0.36	0.04			0.44	0.03			
									16d2	dull yellow	71.7	0.1			27.4	0.1	0.33	0.03	0.089	0.024	0.41	0.02			
17	Agora SC	10	25	1937				Γ?	17c	brown-orange	67.8	0.1	0.60	0.02	30.4	0.1	0.32	0.04			0.89	0.03			38
									17d	brown-orange	67.8	0.1			30.5	0.1	0.30	0.03			0.98	0.03			
18 (Fig13i)	South Stoa W	10	4	1937				GR20Δ	18c	brown-orange	67.1	0.1	2.72	0.01	29.0	0.1	0.31	0.03			0.88	0.01			28
									18d	brown-orange	71.1	0.1	2.75	0.03	25.2	0.1	0.31	0.03			0.64	0.02			
19	Agora NC	9	17	1937				GR20Z	19c	pink-white	74.0	0.1			23.7	0.1	0.53	0.03			1.20	0.03			23
									19d	white	69.0	0.1			28.7	0.1	0.53	0.04			1.30	0.03			
20	Agora NC	12	14	1937				GR20Δ	n/a																
21 (Fig13j)	St. John's S	4	28	1938				GR20A	n/a																

Table 6: Analysed specimens of Athens, Thebes mint, Guy II de la Roche (1287-1308) or Walter of Brienne (1309-1311), obv. legend GVI.DVX from Corinth Excavations. The detection limits are 0.5(Zn), 0.07 (Sb), 0.06 (Au), 0.022 (Bi). N/a = not analysed. Sd standard deviation.

Continu- uous #	Variety	Face	Fe	Ni	Cu	Zn	Ag	Sn	Sb	Pb	Bi	Au
1 (Fig14a)	GR20A	Obverse	0.022	0.083	75.452	0.214	23.376	0.032	0.236	0.557	0.029	<0.2
		Reverse	0.256	0.087	71.188	0.222	27.028	0.033	0.257	0.887	0.041	<0.2
2	GR20Z	Obverse	0.343	0.148	76.417	0.199	22.196	0.031	0.157	0.498	0.011	<0.2
		Reverse	0.053	0.125	76.21	0.238	22.669	0.029	0.158	0.506	0.012	<0.2
3 (Fig14b)	GR20Γ	Obverse	0.047	0.159	82.554	0.252	16.263	0.026	0.29	0.398	0.011	<0.2
		Reverse	0.057	0.129	75.787	0.215	22.813	0.031	0.343	0.605	0.02	<0.2
4 (Fig14c)	GR20B	Obverse	0.011	0.077	71.988	0.218	26.806	0.034	0.221	0.617	0.027	<0.2
		Reverse	0.04	0.126	75.924	0.236	23.077	0.031	0.091	0.454	0.021	<0.2
5	GR20A	Obverse	0.049	0.119	82.002	0.23	16.949	0.03	0.239	0.367	0.015	<0.2
		Reverse	0.036	0.109	81.943	0.228	16.983	0.031	0.244	0.412	0.014	<0.2
6 (Fig14d)	GR20Z	Obverse	0.034	0.114	79.801	0.232	19.403	0.03	0.097	0.276	0.013	<0.2
		Reverse	0.039	0.126	80.902	0.219	18.344	0.032	0.058	0.268	0.014	<0.2
7 (Fig14e)	GR20E	Obverse	0.058	0.111	78.758	0.239	19.59	0.091	0.108	0.999	0.046	<0.2
		Reverse	0.064	0.116	80.84	0.214	17.546	0.099	0.099	0.772	0.03	<0.2
8 (Fig14f)	GR20Δ	Obverse	0.029	0.114	79.642	0.26	19.175	0.03	0.252	0.478	0.019	<0.2
		Reverse	0.038	0.117	79.1	0.25	19.742	0.031	0.22	0.485	0.016	<0.2

Table 7: Analysed specimens of Athens, Thebes mint, Guy II de la Roche (1287-1308) or Walter of Brienne (1309-1311), obv. legend GVI.DVX, from the UK coin trade. The detection limits are 0.5(Zn), 0.07 (Sb), 0.06 (Au), 0.022 (Bi). N/a = not analysed