

Numeral Graffiti. Analysis and Development for the Manufacture of Dressel 20 Amphorae in the Province of Baetica

Francisco Javier HEREDERO BERZOSA¹

Abstract. *One of the most common types of marks on Dressel 20 amphorae before firing, the so-called numeral graffiti, serves as a sample to analyse the production regime of this type of packaging in the Roman province of Baetica. Through this article they analyse the characteristics of these marks and their relationship with Roman numerals, taking into account their origin and evolution, to find relationships with these graffiti. Likewise, through these inscriptions, both the organization and the productive capacity of a pottery workshop are also defined by the dimensions of its drying sheds.*

Rezumat. *Unul dintre cele mai comune tipuri de marcaje pe amforele Dressel 20 înainte de ardere, așa-numitele graffiti numerice, servește ca eșantion pentru analiza regimului de producție al acestui tip de ambalaj în provincia romană Baetica. Prin acest articol, autorul analizează caracteristicile acestor marcaje și relația lor cu numerele romane, luând în considerare originea și evoluția lor, pentru a găsi relații cu aceste graffiti. De asemenea, aceste inscripții pot fi indicii atât despre organizarea, cât și capacitatea productivă a unui atelier de producție..*

Keywords: numeral graffiti, Dressel 20 amphora, drying sheds, Baetica

Introduction

The manufacture of an amphora is organized on an evolutionary process that presumably seeks constant optimization. Hence, we have different amphora typologies: Ovoide 6, Oberaden 83, Haltern 71 and later what could be called its "star product", the Dressel 20, due to the enormous diffusion it had both in Rome and in several of its provinces;² and already at the end of its chronological development, the Dressel 23 or Tejarillo.³

The archaeological and epigraphic study of the pottery of the Dressel 20 amphorae has its origin in the studies of G. Bonsor in the twentieth century, through prospections between Seville and Córdoba and later in the Genil, between Écija and its mouth in the Guadalquivir. Numerous potteries were found here, the vestiges of which have testified to the production of these amphorae. Later, M. Ponsich continued in some way the study of the amphorae and its places of production of Baetica, in a systematic survey of this region that began at the end of the 60s of the twentieth century. These researchers have been followed by the work of G. Chic,⁴ J. Remesal and more recently of Juan Solís, Juan Moros and the Barea brothers.⁵

As for the places of distribution, the excavations carried out over several decades on Monte Testaccio have been fundamental for the study of this typological development. These

¹ Universidad Rey Juan Carlos. Laboratorio TestURJC. Email: fj.heredero.2024@alumnos.urjc.es. ORCID ID: <https://orcid.org/0009-0006-6887-892X>

² Through the Roman Open Data portal (<https://romanopendata.eu>), an exploratory interface developed within the framework of the European EPNet project, it is possible to geolocate epigraphic searches on a map of all the provinces of the Empire, in this case of Dr. 20.

³ BERNI 2008, 64; CESTEROS *et al.* 2024.

⁴ CHIC GARCÍA 1985; 1988; 2001.

⁵ BERNI 2008; REMESAL 2011a, 116-117; MOROS 2021; BOURGEON 2021; GONZÁLEZ TOBAR 2023.

excavations have been directed by professors Blázquez and Remesal and are a fundamental project of the CEIPAC research group and the Royal Academy of History.⁶

Subsequently, the work carried out in the prospections at the Testaccio during these years (see table in figure 1) has resulted in six publications.

The analyzed elements that have been published in these volumes are based on three core aspects resulting from different readings and analysis of their epigraphic sources. These are: stamps, *tituli picti* and graffiti, the latter being a marginal part due to the difficulty of their readings to be able to define a moderately explanatory testimony of those incisions *ante cocturam* in the Dressel 20 amphorae.

	TESTACCIO	CAMPAIGN	TOTAL, SAMPLES	IN COLLO/ BELL	IN VENTRE/IN PEDE	DATING
2001	I	1989/1990	105	9	91	S. II A.D.
2001	II	1989	294	28	92	S. II A.D.
2001	II	1991	374	59	143	220-224 A.D.
2001	II	1992	384	59	143	220-224 A.D.
2003	III	1993/1994	205	28	177	S. II A.D.
2007	IV	1995/6/97	241	77	164	246-254 A.D.
2010	V	1998/1999	358	70	247	207-223 A.D.
2014	VI	2000,2005	293	22	243	174,176,177,179 A.D.

Figure. 1 Data from the publications of the Testaccio I to VI volume series

But what has been determined about those graffiti and where the most work has been done has been to define their categorization, with a canonical division originally revealed in Rodríguez Almeida's publications: calendarial, numeral and anecdotal graffiti.⁷

Subsequently, thanks to the development of the CEIPAC database, with the final dump of the published inscriptions, the graffiti has been classified into calendarial, nominal, numeral and indeterminate, with those of the "indeterminate" type being a catch-all due to the complexity of their readings.

This new cataloguing through subsequent publications has been subdivided into other samples within each core element of the original classification.⁸

In this work, both the study of the numeral graffiti that have appeared in the Testaccio and their new proposed interpretations will be presented. The investigations that have been carried out on those incisions *ante cocturam* that have been found in many fragments of those amphorae, have generally been treated as a secondary topic of study.

Among them, numeral graffiti, an element of research from the production point of view of the workshop, since those supposed figures can possibly provide information on the methods that were used to control and account for the abundant amphora production; the rotations of material within an assembly line in its different phases, as well as the implementation of a

⁶ BLÁZQUEZ MARTÍNEZ J.M., REMESAL RODRÍGUEZ 1999; 2001; 2003; 2007; 2010; 2014,

⁷ RODRÍGUEZ ALMEIDA 1981; 1984; 1989; 1993.

⁸ OZCÁRIZ, PÉREZ GONZALEZ, HEREDERO 2020.

possible inventory within a *figlina*.

The Roman cardinals

Within the logistics chain, the concept of production could be defined as the realization of a process for the transformation of resources into goods, if they are tangible products, through the application of a certain technology.⁹

Likewise, production is applicable to the definition of terms of concatenated systems; that is, through industrial development through the use of certain material and human resources (inputs), so that through a certain procedure the realization of a finished product can be achieved (outputs). This structure can be applied to the manufacture of Dressel 20 amphorae. It should be entirely feasible that within a *figlina* there is something like a medium or long-term strategic plan to develop a production plan, which would then link to a manufacturing program with a firm commitment to the completion of a given batch.

In the case of Dressel 20 amphorae, the dynamics of these processes obey what was one or more assembly lines for the manufacture of amphorae in their different stages, following the concept of the economic batch of manufacture in a chain-type organizational system, where the work is carried out continuously according to a production program already accepted without a specific prior release of work orders.

The graffiti that have appeared in different parts of the packaging gives us the idea that those processes were labelled by some accounting element before proceeding to later phases, generating sufficient reasons to be able to assess that those writings with figures, which we designate with the name of "numeral graffiti", fulfilled the function of a dynamic inventory within the *figlina*, both in semi-finished elements (casings) and with the finished product (amphorae).

In order to better understand the interpretation of the incised marks on the Dressel 20 amphorae, of which a very high percentage could be numbers, it would be necessary to look for the origin of the Roman numerals in which, through different investigations carried out, they have their origin in the Panitalic world under a special Etruscan influence.

This situation should be perfectly possible, since the influence of the Etruscans in the Roman world is obvious both in religion, art and theater and also in many other aspects, such as the alphabet, which is entirely likely to have arrived in Rome through some cultural borrowing from the Etruscan civilization.

The historian Titus Livius, writing about the events in Rome in 310 B.C., states that at that time it was customary for Roman children to be instructed under Etruscan letters, (both in literature and writing) since, as he comments, "today (in an era contemporary to the historian) they receive training in Greek".¹⁰

If there was a strong influence of Etruscan culture in the Roman world, it would be perfectly acceptable that Roman numerical symbology may have had many similarities with that of the Etruscan civilization and this is corroborated by different philologists and historians (figure 2).¹¹

There are several theories about the origin of Roman numerals. Perhaps the most pertinent

⁹ ANAYA TEJERO 2015, 110.

¹⁰ *Caere educatus apud hospites, Etruscis inde litteris eruditus erat linguamque Etruscam probe nouerat. Habeo auctores uulgo tum Romanos pueros, sicut nunc Graecis, ita Etruscis litteris erudiri solitos* (Liv. IX, 36.3).

¹¹ Among others, I would like to mention more relevant authors that I will cite later such as De la Ramée, Capelli, Mommsen, Ifrah, Zangemeister, Gordon and Keyser.

and also the most widespread is that of the mathematician Petrus De la Ramée, a scholar of Latin in the sixteenth century.¹² De la Ramée theory is based on the fact that both Etruscan and Latin numbers in parallel situations have been used as a system of counting marks and have undergone some development and abbreviation of their forms. According to De la Ramée, Latin numerals were born by joining vertical rectilinear strokes, each of which multiplied by ten the previous pictogram composed of one or more of these strokes.

If the I equals the figure 1, when another equal figure is added to it, the value is multiplied by 10 creating the X sign. In the same way, if we add one more stroke, the figure of an asterisk * with a value of one hundred would be formed, which adding another line the value is one thousand [X]. Once these numbers have been constituted through a decimal system, the intermediate values would be obtained: 5 out of 10, 50 out of 100 and 500 out of 1000 (Figure 3).

>	I	Λ	X	⋈	*,)I(, C	[⊖]	⊕, ⊗	[⊖]	⊕
½	1	5	10	50	100	500	1000	5000	10000

Figure. 2 Etruscan numerals. KEISER 1988, 544.

It is not the objective of this paper to delve into the origin of Roman cardinals, since as different numeral marks on amphorae are analyzed, arguments that explain it will come up for debate, citing different scholars of Roman numerals. I would just like to explain two important theories that deserve reflection. One of them by P. Borel in the seventeenth century, who proposed that the signs V and X be considered pictograms, of which the first simulated a hand with the index finger and thumb and the second the X, with the hands crossed (*deux V joints par le pointe font un X qui vaut 10*). This theory is correct in itself, which has the historiographical support of older civilizations such as the Sumerian, Akkadian and even Egyptian through its hieroglyphics, it was later taken up by Mommsen, who stated that the signs I, V and X are prealphabetical because of "the different graphic principles that prevail in them" and their resemblance to the Etruscan numerals.¹³

According to Mommsen, for the rest of the symbols, the Romans used for such signs the three Greek aspirated consonants of the Chalcidian alphabet, which they did not need to use within the Latin alphabet, such as the letter chi (Ψ = 50), zeta (Ζ = 100) and phi (Φ = 1000), where the D "halbierte D" for 500.

I	V	X	↯	C	Ɔ	(X) or ∞ or ⊕ or ⊙
1	5	10	50	100	500	1000

Figure. 3 Roman numerals. KEYSER 1988, 530

The numeral graffiti of the Testaccio

Within the basic classification of the graffiti of the Dressel 20, an important group within the four elements of this categorization (calendarial, nominal, numeral and indeterminate) has

¹² DE LA RAMÉE 1569.

¹³ MOMMSEN 1850, 19-20; 1877, 589-601; 1888, 152-156.

been established through the different campaigns on Mount Testaccio with a generic character, as "numeral graffito".

In turn, in all the publications of the Instrumenta series about the Monte Testaccio excavation, the same criterion has been assiduously used when interpreting this type of writing: numeral graffiti representing "minor figures" and "major figures" adjusting to the characteristics of a specific canon based on Roman numerals.

The millions of amphorae of Monte Testaccio have offered an unparalleled setting for researchers and archaeologists. Thanks to these data, it has been possible to apply a large quantitative analysis to the study of graffiti.

After making a selection of all the numeral graffiti of the last monographs of the excavation of the Testaccio, a corpus has been configured by means of a typological pattern of these marks, to try to establish new hypotheses when interpreting them. For example, a possible reading reveals that possibly the so-called indeterminate graffiti are abbreviated figures with signs. We could also propose the possibility that the graffiti classified as minor numerals were other types of marks, excluding the classic archetype that they have always been characterized as Roman numerals.

Starting with the largest figures, always starting from the quantity 100, a new one should be introduced: the numeral 50, which in my opinion can be confused with the graffito that we interpret as 110¹⁴ (a C divided by a secant stroke). (Figure 4).¹⁵

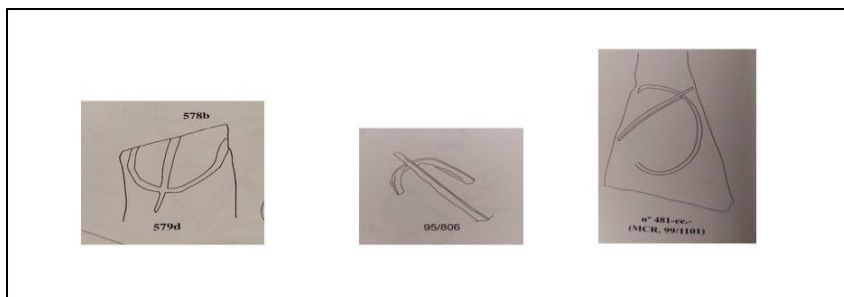


Figure. 4 Graffiti from the 1989/90 campaigns (BLÁZQUEZ, REMESAL 1999, 95 and 99).

Roman numerals were based on the additive system similar to the decimal based on the seven letters of the Roman alphabet (I, V, X, L, C, D and M) and to make a calculation in absolute values in the count of a supposed production (in multiples of five or ten), I believe that this number would not fit into its accounting configuration. since it is not divisible by ten. Therefore, it would be foreseeable that the numeral that we interpret as 110, according to different epigraphic records, could become the numeral 50 as represented in figure 10.¹⁶

Possibly the Roman numeral with a value of 50 has its origin from the division of an asterisk

¹⁴ REMESAL *et al.* 2007, 259.

¹⁵ Of the samples that I detail, I only expose the clearest ones since there are many of doubtful reading: REMESAL *et al.* 1999, 71, 13(a) and 13(b); REMESAL *et al.* 2007, 353, 579(d), 354, 581(a), 581(b), 581(f), 581(h); REMESAL *et al.* 2007, 273, fig 95/656, Figure. 95/604, Figure. 95/737, 274, Figure. 95/922, 95/1101, 96/341; REMESAL *et al.* 2010, 330, Figure. 481 (ee), 481(v).

¹⁶ ZANGEMEISTER 1887, 1017; CAPELLI 1928, 420; IFRAH 1981, 188; CIL I, 638, 1471, 1996. Also in CIL I2 2.585.E28, 638, 675, 676 and 677 there are examples with these signs.

in half and from that sign it underwent an evolution until it reached the letter L (figure 5), being documented the original sign seems to be from the time of Augustus.¹⁷

If we agree with a theory based on some kind of tonnage in which the count must be decimal, it seems to us that there should be a middle ground before the hundred, whole, divisible number in order to facilitate the possible computation of the industrial process.

Therefore, if we have not found the letter L (although it does appear in many laterician inscriptions) that could represent it, we could conjecture that this sign similar to the Greek letter "Ψ" could represent this figure.

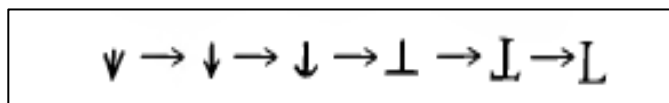
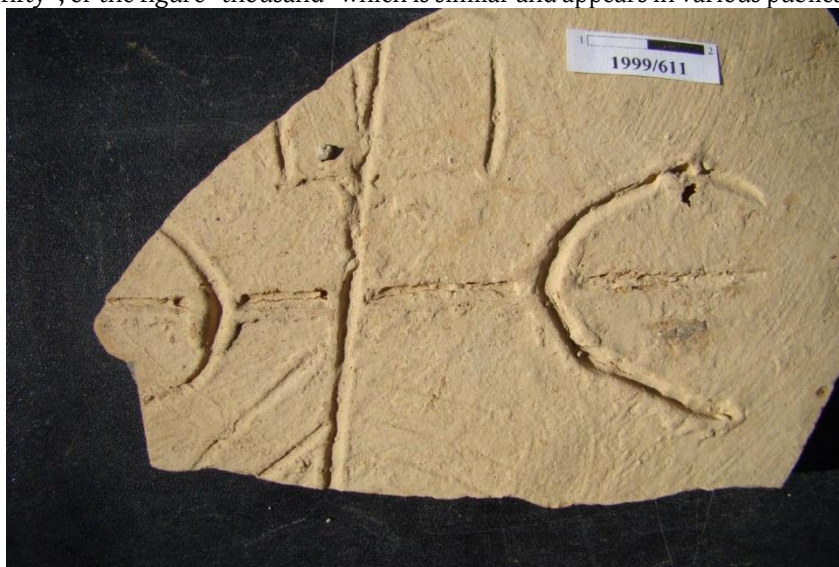


Figure. 5 IFRAH 1981, 188. (Figure. 16.27)

But it should also be stressed that, although the letter L has not appeared in any of the many pieces analysed in the excavations of the Testaccio, other types of letters related to figures have appeared if we consider them as acrophone symbols that can be, for example, C or M.

In the 1999 campaign, two double or composite graffiti were found.¹⁸ One of them, the one represented in figure 6, is composed of one or two possible figures that in the series have been catalogued as numeral graffiti.

The inscription is made up of two opposing semicircles, crossed by a perpendicular stroke, which could be, in my opinion, either the proposal put forward above of two digits with the cardinal "fifty"; or the figure "thousand" which is similar and appears in various publications.¹⁹



¹⁷ IFRAH 1981, 187-188. It is documented in CIL IV, inccr. 9934. Also on numeral 50: "The oldest known instances of the use of the letters L, D and M as numerals do not go back earlier than the first century BCE. As far as we know, the earliest Roman inscription which uses the letter L for 50 dates only from 44 BCE (CIL, I, inscr. 594). The earliest known use of the numerals M and D is in a Latin inscription which dates from 89 BCE, in which the number 1.500 is written as MD (CIL, IV, inscr. 590)".

¹⁸ BLÁZQUEZ, REMESAL 2010, 330, Figure. 481(y); 362, Figure. 506(j).

¹⁹ CAPELLI 1929, 421; IFRAH 1981, 188; Also in CIL X, 39.

Figure. 6 BLÁZQUEZ, REMESAL 2010, 362, Figure. 506 (j)

Our proposal would be that it is a representation, possibly with complementary information, which could perhaps have a different intentionality where you can see the marks of a trident and a palm leaf. These graffiti with arboriform or phytomorphic representations that we call "indeterminate", appear as *post-cocturam* marks on numerous *terra sigillata* tableware. They can have some meaning related to victory or triumph, truffled with a certain spiritual or material character that seems to have apotropaic or prophylactic purposes.²⁰

It is therefore a graffito composed of a scenario with two different interpretations: on the one hand, it can be a work or point of work determined as a day or similar in which the pictogram may also intend to represent the message by relating that quantity produced and, at the same time, manifesting itself through some identity of the operators.

We find many tridents and palms in isolation in the graffiti *ante cocturam* of the Dressel 20. It also happens with asterisks (we will try to identify and classify this pictogram later according to different interpretations). In the same way, figures also appear represented with rectilinear and curved crossed strokes in the form of reticular diagrams, etc., being noteworthy that this type of capricious marks in the Dr. 20 is a recurrent element from the writings found in the third century A.D.

Likewise, of the records that have been documented in this temporal context, this type of graffiti together with those of the numeral type begin to be more abundant with a total disappearance of the calendrical ones and a sharp decrease in nominal ones.

This situation could make us reflect on a possible restructuring of the different production processes, since the identifying elements that previously marked some mark on ownership in the traceability of the process are so scarce that it seems that they end up disappearing.

Another certainly controversial Roman cardinal that is open to different interpretations is the one that corresponds to the number one hundred. There are different readings of the various campaigns in which it is represented as an acrophone sign by the letter C or double C (see table attached at the end), but through different publications, in which the evolution of Roman numerals is represented, the asterisk could also be represented on the amphorae as an accounting element interpreted as a hundred.²¹

However, just as there are documented epigraphic records with the figure fifty that can corroborate the readings of that mark, the sign does not appear in any epigraphic file that is interpreted as a figure and that corresponds to any contextual element of the Roman period. However, this writing is represented in several parietal graffiti from Pompeii, in this case having been interpreted with the symbol of the denarius.²²

Although the origin of the number 100 comes from the Etruscan numerals (see figure 7), over the centuries, there are researchers who have recognized an evolutionary process until this number is identified with the abbreviated letter C which, although it is considered an acrophone sign, there are theories that do not share it since the sign C also belonged to the Etruscan numerals.²³

²⁰ HIDALGO MARTÍN, BUSTAMANTE ÁLVAREZ 2024, 172. In his article, a similar graffito is represented in a mortuary vessel with the same characteristics.

²¹ ZANGEMEISTER 1887, 1017; KEYSER 2011, 542.

²² There are several examples that we find in CIL IV: 10042; 10106; 8203 and 4528

²³ The earliest known date for the Latin C figure is from 186 BC in CIL I (2), 2581 of Bacchanalibus, lines 9 and 18. While the Etruscan sign C = 100 is located in KEYSER (2011, 542) dated to the second century BC.

I	V	X	Ψ	✱	⊙	⊗
1	5	10	50	100	500	1,000

Figure. 7 IFRAH 1981, Figure. 16.26

The asterisk sign is repeated continuously in all the campaigns of the Testaccio. In all his publications there are quite a few representations of this mark, in some more than others since those dating from the third century are more abundant (see list at the end of the article).

In our view, there are enough reasons why the reading of this pictogram in the Dressel 20 cannot be argued with a representation of the figure one hundred. Although it could have all its characteristics, this Roman cardinal as an accounting element seems to be represented by the letter C which, on the other hand, this mark seems to have a certain resemblance and possibly the same intentionality as the other graffiti of the "indeterminate" type.

The appearance of asterisks on olive oil amphorae is still an extraordinary situation in the case of graffiti before firing. Normally this type of mark is abundantly catalogued in the *post-cocturam* graffiti represented in the *sigillatas* that usually appear on fragments of tableware and we do not know if it has a different meaning than that of the Dr. 20 amphorae. The vast majority of this group of graffiti are dated at the same time as those of Dressel 20 themselves, all of which are placed within the same context of the Roman Empire of that time.²⁴

Within the graffiti that we call "major numerals" a new epigraphic mark could be introduced, the one that corresponds to the number thousand, which has always been represented by the letter M.

From my point of view, there are other types of writings that can represent this cardinal, most of them in the belly and base of the amphora, with a certainly questionable and controversial reading, which can give rise to conflicting opinions for two reasons. The first is that, if we assume that this cardinal corresponded to the heading represented by the infinity sign ∞ , no higher figures have been found (in the event that it can be a figure as an accounting element as an inventory) within a pottery workshop. The second is that, creating a strong dependence on the former, it can give us some approximation of the productive capacity of that same *figlina*.

The infinite sign, according to contributions from several researchers²⁵, seems to have had an evolution of the previous Etruscan numerals (see figures 2 and 3), having an intermediate step with the signs $\otimes$ and $\oplus$.

This type of marking, in which they are identified with a circle or semicircle, delimiting a space in which the mark of a cross or cross is written, also appears in greater quantity in the excavations of the Testaccio dated to the third century AD.

It might be tempting to interpret them with the reading of the thousand quantity, since apart from appearing on an Etruscan medallion in which an abacus with that sign is

²⁴ MEZQUIRIZ DE CATALAN 1961; MAYET 1984; LANGNER 2001; FERET, SYLVESTRE 2008; OZCARIZ, UNZU 2011; PEREZ, ARRIBAS 2016; AGUILERA 2023.

²⁵ CAPELLI 1929, 27; IFRAH 1981, 188; ZANGEMEISTER 1887, 1018; GORDON 1983, 44; GORDON-GORDON 1977, 181-182.

presented,²⁶ it is a mark that appears in many publications within the evolutionary process of this type of epigram until reaching the final M.²⁷ (Figure 8).

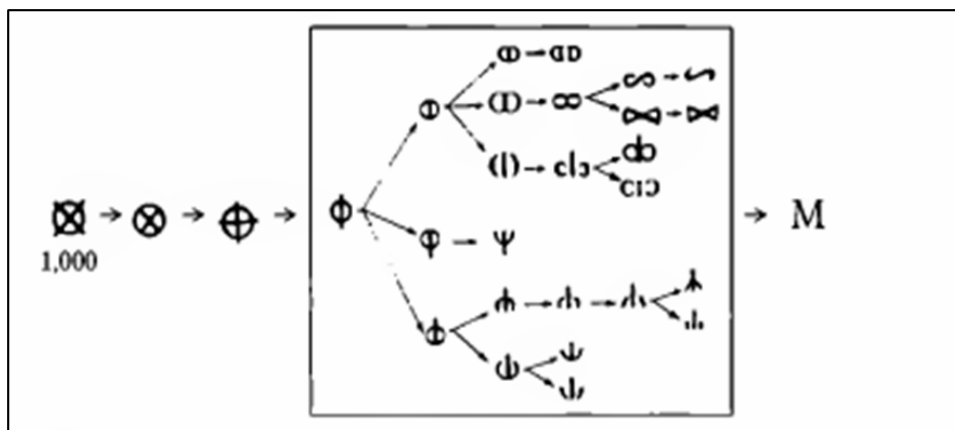


Figure. 8 IFRAH 1981, 186. (Figure 16.29)

But, as there are no epigraphic samples to corroborate it, it is not possible to know if they are figures or possibly marks as a product of certain counts in which, after there has been a first count, there has been a subsequent revision with another or other marks in strokes that may not have been simultaneous, since there is an example of graffiti of these characteristics with the *ductus* that, although it is similar, it apparently does not seem to be the same.

Returning to the sign, ∞ apart from being documented in several inscriptions (figure 9), there are several samples in different readings of the Testaccio, such as the previous marks, also from the third century,²⁸ which could be interpreted with this graffiti and with clearly defined characteristics with the figure thousand.²⁹

There are also certain situations parallel to this cardinal in the production of *tegulae*, such as that of a piece in Weissenburg (Bavaria), for which Gudea in an article proposes the following reading: *p(edales) mil(le vel milia)/cine(re vel cinerit)*.³⁰

²⁶ MENINGER 1958, 111. TORELLI, PALLOTINO 1966, 283-299, KEYSER 2011, 545.

²⁷ Among others, IFRAH 1981; BONFANFE 1983; ZANGEMEISTER 1887; GORDON, 1983; GORDON-GORDON 1957.

²⁸ Testaccio (2007), 275 (95/1+17); Testaccio (2010), 356 (502 a and 502 b)

²⁹ CIL 12 25.6. 1300; CIL VI 1251a; CIL I 594; 1853, CIL X 1019. GORDON, 1983; IFRAH 1981, 188

³⁰ WESCH-KLEIN 1990; GUDEA 1996, 475-482 esp. Figure. 1. First read by Wesch-Klein as: *P(...)/Antoni / Cin(eris)*.

If an abbreviation were to be considered, making a parallel situation of pottery workshops in the province of *Tarraconensis*, initials with the letter B have appeared in a pottery of Sant Vicent dels Horts that, although they are different scenarios, the method for the manufacturing procedures should be similar, so an analogous proposal could be valid within the same cultural context of the Roman world.³⁵

Taking into account these hypotheses, as with the letter D for five hundred³⁶, a possible theory could be corroborated regarding the normalization of a "quasi-decimal" numerical system, which would be made more accessible by being represented as a standardized formula, to organize the computation of a set of elements in their manufacturing phases.

In relation to the acronym R, it also appears in Capelli's abbreviations with the figure "eighty". But possibly that acronym could perhaps have other types of connotations different from the representation of a figure.³⁷ One could suggest the origin of the letter R of the Latin word *ratio* understood as counting, which, as Ifrah proposes in his article, is posed in Roman terms from the expression *rationem putare*.³⁸

There are several citations in classical sources in which these terms are used. One of them is in a work by Plautus (*Trinnumus*, 417): *...Postquam comedit rem, post rationem putat*. Cicero also uses it in his defense of Flaccus (*Flacc. XXVII*, 69), where it is cited: *Auri ratio constat; Aurum in Aerario Est*. Finally, Cato (*Ag. 1.5*) uses the expression *pro ratione* to express it as "in proportion" using that word with an arithmetical content.

As an example to highlight among the marks that we find on the Dr. 20 in which a letter R is represented, there is a very unique one in one of the Testaccio campaigns on the belly of the amphora located next to a calendar graffito.

The interpretation of this graffito, taking into account the classic quotes above, could be assessed that in this scenario composed of these two graffiti (acronym + date), the R could be interpreted as the mark of a specific control (not as a number), of a batch or batch of a production defined at the same time by that same calendar graffito.³⁹

In this sense, establishing a correspondence from a methodological point of view and based on the *titles* δ on the trade in Baetic olive oil, we find this type of letters crossed by a horizontal line, interpreted by Dressel as *r(eceptum)*.⁴⁰ Later Chic García interprets it as *r(atio)*.⁴¹ Rodríguez Almeida also gives this letter a more administrative character, reading it as *r(ecensitum)* in such a way that it was the certification of some kind of control.⁴²

If the numerals that are considered "major figures" through epigrams or acronyms could be grouped into accounting cycles with the number with the highest value that corresponds to the quantity of fifty and establishing an increasing order: fifty, one hundred, two hundred, five hundred up to the number one thousand as the highest figure, could the figure thousand be as a certain quantity that could cover a certain lot? For the same reason, if it is proposed that they

³⁵ BERNI 2021, 42. There are several initials "B" with a huge resemblance to those that appear in the Testaccio.

³⁶ CAPELLI 1928, 414. About this number, there are several authors such as Ifrah, Zangemeister, Gordon, Keyser, etc. who demonstrate it with the evolution of signs into figures as demonstrated in previous pages on the origin of the Roman cardinals.

³⁷ CAPELLI 1928, 418.

³⁸ GERSCHEL (1960) and IFRAH (1981, 194) propose that the term *ratio* means the expression of a count by means of a corresponding mark.

³⁹ RODRÍGUEZ ALMEIDA 1989, 35 Figure. 6

⁴⁰ CIL XV 2, I, 562

⁴¹ CHIC GARCÍA 1988, 72.

⁴² RODRÍGUEZ ALMEIDA 1989, 29-30.

were based on a simple additive based on whole decimal numbers with the smallest digit with a value of fifty, the order and distribution of the product in a warehouse should have a logical and at the same time simple arrangement: the product presented in rows or rows of fifty by fifty would offer an easy understanding for an agile verification in the counting of the material displayed in the drying warehouse.⁴³

Regarding the numeral graffiti that correspond to the "minor figures", these are generally located both on the belly and foot of the amphora and on the neck, having a limited numerical space with the interpretation of their readings between cardinal one and thirty, although sometimes (especially on the belly and foot) there are graffiti whose reading is interpreted with a higher value. These figures, according to Remesal, could be linked to a series of batches or batches within the productive capacity of a ceramist in a day.⁴⁴

For this reason, it is possible that these marks could have been used to control a certain consignment by differentiating it from the others for the drying process, and as it is a large-scale production and being large pieces, it was necessary to create some type of mark or label within certain time slots of each consignment.⁴⁵

Within any pottery industry, it is established that the drying process is the most individualized operation in a ceramics workshop where the evaporation method is generally involved, eliminating approximately 35% of the water contained within the mineral particles of the ceramic containers, and that two important factors act that complement each other: the speed of diffusion and the speed of evaporation.⁴⁶

The delicate drying process in ceramics and especially of elements with thick and irregular walls, such as the clay component of Dr. 20, the rhythm must be slow and constant, in which the speed of evaporation of the water that remains on its walls is not greater than that of diffusion of water from the interior to the surface of the ceramic mass, in order to avoid breakage. If the piece were to dry quickly, the clay particles on the surface would lose the water they contain and, when contracted, would prevent the volume of water inside from escaping to the outer surface, causing it to burst during firing (the amphora would appear dry on the outside, but would have moisture inside).⁴⁷

⁴³ On the basis of the accounting calculations of the production of amphorae, a comparison could be made on the loading capacity in the furnaces of the amphorae that were to be fired by means of production units or sub-lots. MOROS 2021, 118. Also in CARRATO *et al.* 2018, 307 We find several examples that, although several criteria must be taken into account such as the size of the ovens, the shape of the amphorae and the load arrangement, give results on a calculation based on a decimal numbering system based on a standardization that estimates between a few hundred and more than 650 amphorae.

⁴⁴ REMESAL RODRÍGUEZ 1977/78, 87-120.

⁴⁵ PEACOCK 1982, 66-67. According to the author, a good infrastructure was needed for the drying of amphorae so that the different shipments could be differentiated within the drying processes.

⁴⁶ STRADA, ESPINOSA DE LOS MONTEROS 1982, 327-328.

⁴⁷ The mechanism is similar in all pieces composed of different types of clays; however, factors such as the speed of drying can generate particular effects on each piece depending on its chemical nature, granulometry, its crystallographic nature and the type of treatments it received before reaching the drying phase. The main variations that occur during the drying phase are generated by the amount of residual water in the parts, their dimensions, their resistance to bending and the plasticity of the parts. The drying process works as follows: a ceramic paste is made up of clay particles divided by films of water that, when removed by evaporation, allow the particles to move. As the paste loses more moisture, these particles move closer together, causing the clay to contract until the water film is completely removed and the particles can no longer get closer. Therefore, when a piece is dried, the volume of the ceramic paste decreases proportionally to the amount of water removed, and with the removal of water, holes are formed in its structure (which are occupied by clay particles) and the piece contracts constantly until all the water has been removed. The effects of water removal are, in addition to the loss of volume and water of the parts due to

Therefore, the drying process must be controlled without leaving the part outdoors directly, since it has to be dried from the inside out slowly and through a hole as part of the manufacturing process in our case of a casing, a "chimney effect" would be created with a slow exit of water vapor from the inside to the outside (figures 12 and 13).

When the piece has lost much of its moisture, what potters call a leather hardness is created, in which its surface can be modified by scratching the irregular parts and remains that were created during turning.⁴⁸ To achieve that optimal hardness, there should be a quality control to evaluate through certain brands that the necessary standards are met to avoid possible failures or breakages before cooking.

Some minor numbers may possibly have witnessed that the drying process was being carried out correctly through continuous inspections, with various traces that were either superimposed on the previous ones or marked in adjacent spaces.

It could also be determined if they were temporary references that were taken so that both semi-finished and complete containers were exhibited in a drying warehouse, many of those graffiti with the marks X, XX or XXX and it is possible that they served to specify the number of days they needed for drying. On this assumption, there is an example of a graffito *ante cocturam* on a Dressel 20 in the region of Aosta, which could prove this hypothesis, the proposed reading of which is: *Gratus XX dies argilam*.⁴⁹

Likewise, the environmental conditions due to climatic circumstances in a *figlina*, in addition to being generally located on the bank of a river and having a higher humidity level than more distant areas, could be different depending on the time of year and it is clear that the drying time could logically vary according to the type of season and month in which the productive work was carried out.

The calendar graffiti, through the interpretation of its readings, have helped us to analyze that the production in a pottery could have an uninterrupted annual activity. For this reason, it could be deduced that there was a not very homogeneous and irregular development when applying the number of days needed for the drying of amphorae in optimal conditions: it is reasonable, therefore, to justify that possibly fewer days were needed in summer than in spring or autumn.⁵⁰

From the records that we have from Monte Testaccio on the numeral graffiti of smaller figures that have been analyzed, it would be necessary to evaluate their content and make a differentiation: those that have been found in *position in collo* (a more recurrent practice from the third century onwards) and *in campana*, and those that have been located in *ventre* and *in pede*

This appreciation is important, since in the necks of amphorae the figure usually does not exceed the X value, while in the belly and foot the figures are sometimes higher to even reach numerals greater than XXX. (Figure 11)

water evaporation, a change in the color of the paste, greater rigidity and an increase in its mechanical resistance. Data consulted in: <https://deshumificador.mx> (accessed on June 1, 2025).

⁴⁸ These reflections are the product of visits to different pottery workshop websites where the different manufacturing processes with a recurring idea about drying in which there has to be a slow development and in covered spaces. <https://www.tactodebarro.com>; <https://barroluz.com/el-secado-de-la-ceramica> (accessed on June 1, 2025).

⁴⁹ RÉMY, JOSPIN 1998, n°1.

⁵⁰ RODRÍGUEZ ALMEIDA 1984, 256; BERNI 2008, 35.

TESTACCIO			(I)	(II)	(III)	(V)	(X)	(XX)	(XXX)
I	IN COLLO/CAMPANA		2				2		
I		IN VENTRE/IN PEDE					7	3	7
II	IN COLLO/CAMPANA		19	16	3	6	21		
II		IN VENTRE/IN PEDE	10	2	1	7	34	20	10
III	IN COLLO/CAMPANA						1		
III		IN VENTRE/IN PEDE	3			1	3	2	
IV	IN COLLO/CAMPANA		10	10	2		14	1	
IV		IN VENTRE/IN PEDE		3			42	13	2
V	IN COLLO/CAMPANA		29	8	4	9	16		
V		IN VENTRE/IN PEDE	16	2	1	6	33	9	7
VI	IN COLLO/CAMPANA		4	1		5	13	1	
VI		IN VENTRE/IN PEDE	4	15	1	9	28	10	7

Figure. 11 Representation of minor numerals in the different campaigns of the Testaccio

If we evaluate the previous hypothesis of Aosta graffito, it would first have to be demonstrated that a casing with a volume of approximately 80 to 90% of its mass. For this reason, he possibly needed a number of days greater than X taking into account the season of the year. However, to dry the finished amphora with the neck and mouth upwards, even if there is less ceramic material, we must bear in mind that the drying time of the upper part needs a longer period than that corresponding to the belly. As the air circulation space was more limited, it would have to be considered that the finished amphora required a meticulous drying process with scrupulous precision to make it a sufficiently rigid body, since it had to support the weight of the wet upper part.

Therefore, it would be incongruous to take that reference due to the lack of marks with more than one X on the necks, since the drying time should be longer. It is not possible to know the reason why there are usually no numerals greater than X in the necks, but it is obvious that since there is this numerical difference between the base and a neck of the amphora there is some common point. It can be either the days of drying of each of the elements, or a routine quality control process until the necessary conditions for cooking are achieved. It is also important to evaluate that the leather hardness of the clay was possibly controlled with strokes after the first graffito until the necessary quality was achieved, since the drying time of a ceramic container is not constant due to various factors that have been mentioned above.

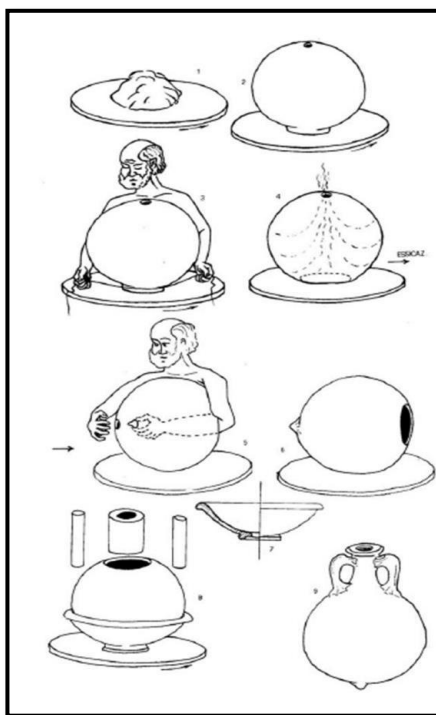


Figure. 12 Proposal for the assembly of a Dr. 20 amphora according to: RODRÍGUEZ ALMEIDA 1984, Figure. 67

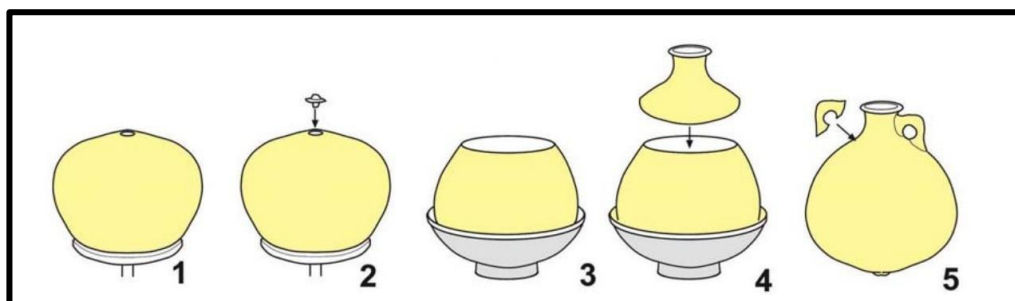


Figure. 13 Phases in the elaboration of the Dressel 20 amphora in BERNI 2008, Figure. 1

The previous interpretations have served to explore the content of numeral graffiti being argued exclusively under a numerical value both for a productive control (number of amphorae) and to mark temporal parameters (possibly days) with the function of controlling drying and supervising the quality of the production at the same time.

But of these graffiti, it has never been proposed that they could be spatial identifying marks to differentiate the different consignments of casings or amphorae inside the shelf of a drying warehouse. This new hypothesis, which could even go beyond the proposals presented above, especially to define the temporal drying processes well, may generate the idea of an

organizational situation within the drying warehouse similar to the operation of a dynamic warehouse (Figure 14).



The stock of the drying warehouse would consist of a continuous rotation, generated by two references (casing and amphora) and based on the FIFO system of incoming and outgoing material marked by a transitory and temporary system (*first in-first out*). In order to have information on the shipment of the product, such as the quantity or drying time, it is necessary that these sets of elements are properly identified, since the arrangement on the shelves sometimes requires chaotic storage where the same references are not always located. Minor numeral graffiti can possibly perform this function.

Figure. 14 Example of dynamic material infed racking

Figure 15 shows two scenarios in which the possible material rotations of the two stored SKUs are recreated: Figure 15b for the semi-finished product (casings) and Figure 15c for the finished product (amphorae).

Based on the example in Figure 15a on a simple idea of a dynamic warehouse that, although in this case the displacement of the load is due to the effect of gravity, the idea can be similar to know the material arranged in racks.

For the first case of Figure 15b, graffiti can be of three types (X, XX and XXX) in which each inscription can be the content of a batch that corresponds to a specific number of elements. For example, graffiti X contains a certain number of product and a time reference different from XX and XXX that at the same time serves as a drying control label, and when it comes to subtracting it from the different groups for the second part of the process, it is known to be the oldest. In this way, the work could be facilitated in a simple way to establish a quality control in each batch.

In the case of Figure 15c, the graffiti that are generally known on the necks and that generally have the marks I, II and X, the process is similar but since it is a finished product, it should have another type of rotation to an external warehouse or for firing.

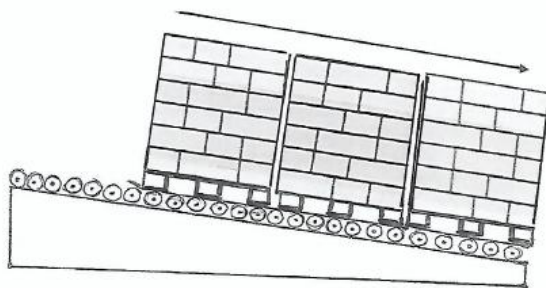


Figure. 15 (a) Dynamic storage proposal. ROUX 1997, 101

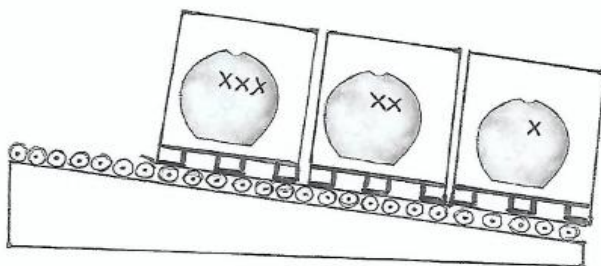


Figure. 15 (b) Dynamic storage for semi-finished products (housings) designed by the author

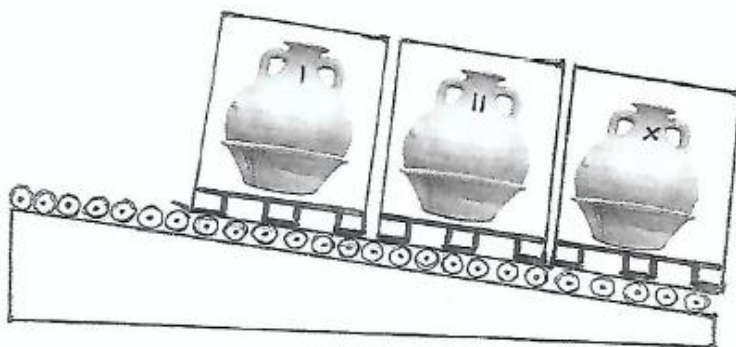


Figure. 15 (c) Dynamic storage for finished product (amphorae) designed by the author
Amphora drying warehouses

Literary, epigraphic and archaeological sources use the terms *figlina* or *navalia* that interpret concepts of what could have been an adaptable infrastructure such as the installation of a drying room within a pottery.

Therefore, as far as the *latericia* industry is concerned, we have an important sample in the content of several bricks in the museum of Zagreb, which can give us some light on the hypothesis we put forward about the drying warehouse/*navalia* relation.

In the collection of inscriptions CIL III, in inventory numbers 11378 to 11386 there is a group of graffiti on the surface of a series of bricks. Eight of them (later sesquipedales) are in perfect condition. Seven of these bricks were found in the Archaeological Museum of Zagreb and one more should possibly be in Prague, according to the CIL.

The most interesting is the text on brick No. 4 (figure 14) *III kal. Augustas Severus et Candidus in hoc navali CCCLXXX*. *Artemas et Eulymenus in alio navali CCCLXXX*), which mentions two pairs of workers and the number of 380 bricks per pair.

Here we find the phrase "*in hoc navali, in alio navali. Navalia*" which were, according to the standard meaning, "shipyards, arsenals" in the colloquial jargon of the potters of department stores, as rooms called drying sheds for the drying of *laterician* products.

The bricks had to dry for several weeks before firing, meaning those rooms had to be spacious protected from the sun and rain. These inscriptions on bricks accompanied in some way a certain amount of bricks from the workshop to the warehouses for drying. They were used to control the daily, monthly and total productivity of each of the workers or their partners and most likely the workers were paid according to the agreed quantity of products, which they were expected to deliver within a certain fixed period.⁵¹

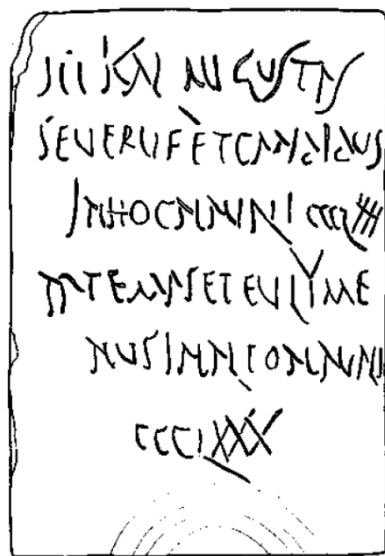


Figure. 14 CIL III 11382. Zagreb Archaeological Museum

⁵¹ MATIJAŠIĆ 1993, 127-133; MATIJAŠIĆ 1988, 203-215

It seems that, unlike the Greeks, in the Roman world, especially in the classical period, they had only one word to designate the places of shipbuilding: the *navalia*, the site where ships were built and repaired, and also the place where ships were beached (*subductae*) in dry dock to keep them in reserve until their return to port. Under the Empire, the term naval may have taken on by a final transformation, the general meaning of workshop like the *navalia* mentioned in the bricks of Siscia at Pannonia.⁵²

On the other hand, from the results of the research work carried out in excavations of various pottery workshops located in the western Mediterranean, it has been shown that generally these facilities had in common rectangular floors, sometimes isolated or also with another attached one forming an L and in some the same complex in the shape of an elongated and narrow U.

According to Mauné, it could have an explanation for purely artisanal reasons, since it was necessary to reconcile the need for a space for the storage of their production and the need to organize the work of the potters by subdividing the surface into cells.

These infrastructures most often served as productive hangars or for drying materials; They could also be used to house the workers if it was considered that some of them were equipped with a single floor.⁵³

As an example of the characteristics of the warehouses for the production or drying of the product, several examples of pottery excavations in both Spain and France are presented.

In the Vilaseca pottery workshop in the province of Tarragona, there are two large spaces located in the center of the workshop, active from the Augustan period until the end of the second century AD, the first measuring 12.90 x 5.80 metres and the second measuring 12.05 x 5.50 meters with a total area of 141 square metres.⁵⁴

In the excavation of the Almadra in Poblets (Alicante) several rectangular spaces of 15 x 7.6 meters have been discovered; 13 x 7.5 meters; 14.8 x 4 meters and 11.5 x 8 meters, all with an area of 362 square meters.⁵⁵

The workshop of the Collet de Sant Antoni in Calonge (Girona) together with about fifteen kilns, the floor of a possible rectangular warehouse of 44 x 9 meters has been discovered that it seems that due to these dimensions pottery was generally dedicated to producing wine amphorae.⁵⁶

Also in the excavation of Fenals in Lloret de Mar (Girona) from the Julio-Claudian and Vespasian period surrounding the pottery workshop of about 39 x 39 meters, the marks of a U-shaped plant with a length of 88 meters and a width of 7.5 meters have been identified, making

⁵²*Ephemeris Epigraphica* CIL II Supp. 927 p. 434 where he notes: *Navale similiter hic usurpatur ut portus cum in figlina Romana in CIL XV 408, 129: Op(us) dol(iare) ex pr(aediis) M(arci) Aureli Antonini Aug(usti) n(ostri) port(u) Lic(ini)*. Also in his *Variae*, Cassiodorus includes a letter from Theodoric (Var. 1.25, ca. 507-511 CE) that may refer to the repairs of the *Portus Julius*, which had been damaged (even possibly submerged) in the early sixth century: *dudum... propter Romanae moenia civitatis... portum Licini deputatis redditibus reparari iussu nostra constituit, ut viginti quinque millia tegularum annua inlatione praestaret, simul etiam portubus iunctis, qui ad illa loca antiquitus pertinebat et nunc diversorum usurpatione suggeruntur invasi*. On the *navalia* we have an interesting source from Livy in Liv VIII, 12: *Naves Antiatiarum partim in navalia Romae subductae, partim incensae, rostrisque earum suggestum in foro exstructum adornari placuit, Rostraque id templum appellatum*. And finally Vitruvius in Vit. 5, 12: *Circum enim portictus sive navalia sunt facienda sive ex porticibus aditus ad emporia, turresque ex utraque parte collocandae, ex quibus catenae traduci permachinas possint*.

⁵³ MAUNÉ, BORGAUT 2020, 103.

⁵⁴ ROIG 2010; MOROS 2018; MAUNÉ, BORGAUT 2020, 930.

⁵⁵ GISBERT 1987; GISBERT 1999.

⁵⁶ NOLLA et al. 2002; NOLLA et al. 2004.

an area of 660 square meters.⁵⁷ (Figure 15)

Also in the shape of a U in the excavation of a large pottery center in L'Ermedàs in Cornellà de Terri (Girona), with a total area of 1300 square metres in three possible warehouses with the following dimensions: 42 x 9 meters; 38 x 9.50 metres and 23 x 8 meters. ⁵⁸ (Figure 16)

Finally, in Clots de Raynaud in Sallèles d'Aude (France), also surrounding two ovens could be a U-shaped warehouse with dimensions of 24 x 5.50 on the side floors and 23.50 on the central floor, with an area of 390 square metres. Also a little further away are two huge L-shaped elongated warehouses with dimensions of 98 meters by 11.5 meters and the other of 71 x 5.5 meters with an area of 1380 square meters.⁵⁹

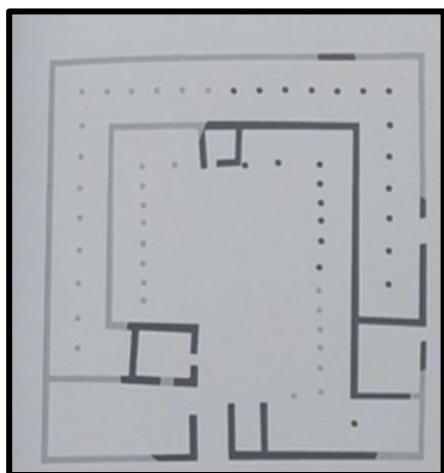


Figure. 15 MAUNÉ, BOURGAUT 2020, 107
Fenals in Lloret de Mar, (Girona)

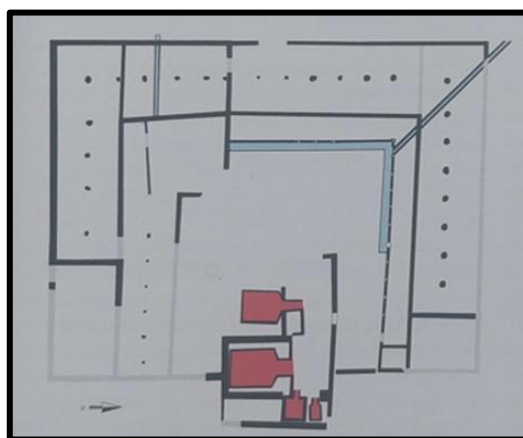


Figure.16 MAUNÉ, BOURGAUT 2020, 107
Ermendans in Cornellà de Terri (Girona).

In the valleys of the Genil and Guadalquivir rivers, remains of pottery industries with similar structures have also been found, such as the archaeological intervention in the excavation of Casilla de Malpica in Lora del Río (Seville), in which structures have been documented that constitute a complex of buildings made up of three rectangular and independent constructions. About 50 meters long with the interior pavement that must have been rammed earth. Above the presence of these bays, there is a space that presides over a channeling in the center, which seems to correspond to an open space, courtyard or street between two buildings.⁶⁰

Another similar case is found in the pottery of Las Delicias, one of the largest potteries known on the banks of the Genil. In 1997, the results of an emergency excavation led to the documentation of a large rectangular construction, measuring approximately 38 x 10 metres,

⁵⁷ TREMOLEDA 2000, 52-55; TREMOLEDA *et al.* 2017; 371 Figure. 382.

⁵⁸ TREMOLEDA *et al.* 2017.

⁵⁹ LAUBENHEIMER 2001.

⁶⁰ ARCAS *et al.* 2015.

although due to the erosive action of one of the walls its length is unknown. The structure is similar to that of the group of buildings excavated in Casilla de Malpica, with the same constructive characteristics of a building related to the manufacture and storage of different ceramic elements.⁶¹

And, finally, one of the best examples of what was the typical complex of pottery buildings for the manufacture of Dr. 20 has been revealed by the last emergency excavations at the Malpica 1 site, carried out in 2015 after the first ones carried out in 1997 (figure 18).

Due to the abundance of stamps that have been recorded from that *figlina*, it has been shown that it had a considerable size and it is recognized as an important production center between the Flavian period and the third century A.D.⁶²

At this site, the remains of a large structure composed of three elongated naves about 40 meters long and 4 meters wide were discovered, and in one of them the remains of a potter's wheel adjacent to one of the walls, possibly at the entrance of the nave, have been discovered.⁶³

These were separated by two alleys, one of them possibly being uncovered as it had a conduit for the evacuation of water. Some part of these galleries seems to be divided into compartments of about 10 square meters where they were possibly both workers' quarters and artisanal spaces for the organization of productive cells;⁶⁴ these being connected to those narrow and diaphanous warehouses, probably some of them as a drying room for the raw material that had been processed.⁶⁵

The conditions to be able to facilitate the storage of a product and that the location and extraction of any element in storage has easy access, from a rationally technical perspective, is that there must be a warehouse with an open structure and that the longitudinal space is in proportion to the material stored (I would like to give as an example, the corridors that are distributed between shelves in libraries). Therefore, it seems that it is common sense that, as in the case at hand, as it is an amphora drying warehouse, where there are different parts of the process in manufacturing when drying takes on great importance, with a continuous transfer of inputs and outputs of finished or semi-finished product, it is normal for the warehouse to be long and narrow so as not to create any impediment when selecting or subtracting any product. component for assembly.

Drying is a crucial step in the production chain of all types of ceramics since, if drying is not carried out under optimal environmental conditions, it can considerably increase the risk of cracks during firing. As explained above, the process of drying a ceramic material by evaporation has a dehumidifying mechanism by which water is removed from the clay bodies to ensure proper firing of the pieces. This is why, at the beginning of drying, the pieces should not be exposed to direct sunlight in summer. This step then had to be carried out inside buildings, in the shade and shelter from inclement weather and it was imperative that the potters scrupulously ensure themselves for a uniform drying of the products, otherwise there would be a risk of losing the entire batch and taking into account the massive nature of the Dr.

⁶¹ SÁEZ *et al.* 1997, 573. According to the authors, "the morphology of these areas allows, hypothetically, to relate them to the work of making (*cubicle*) and storing the amphorae (*horrea*). The architectural scheme that combines large naves with square-tending rooms seems frequent in artisanal pottery and has been maintained to the present day in some places in the Mediterranean".

⁶² MOROS 2024, 231.

⁶³ BOURGEON 2021, 574.

⁶⁴ GARCÍA 1998, 123; REMESAL 2000, 584.

⁶⁵ BOURGEON 2021, 584 figure 690 as a proposal for one of the bays of the drying facilities

20 amphora, It must have been a particularly slow operation.⁶⁶

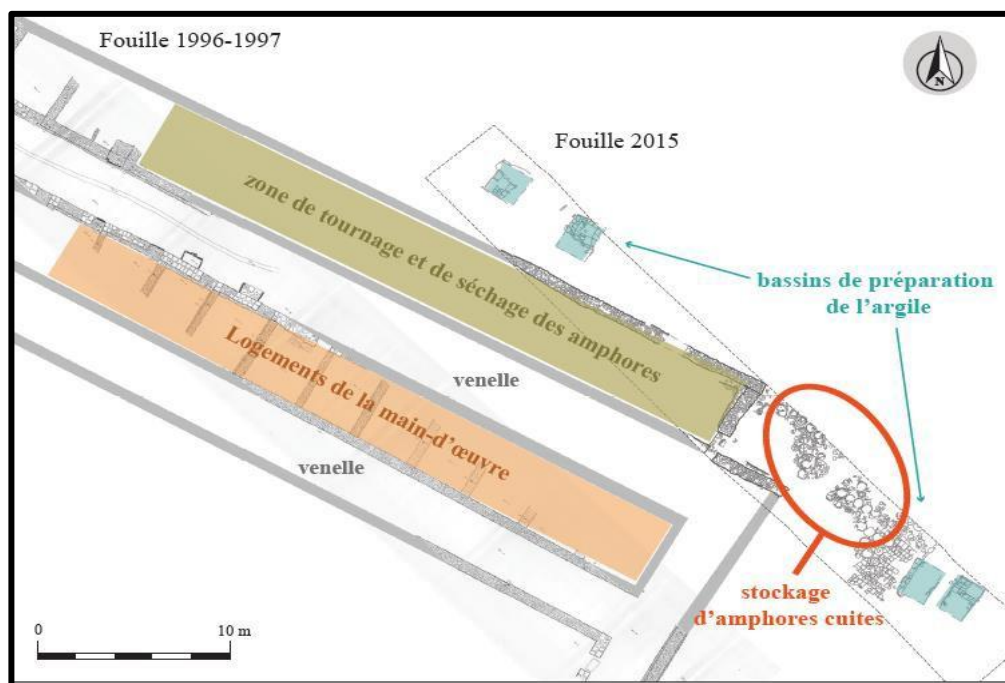


Figure 18. BOURGEON 2021, 584 Figure 690.

I would like to expose, as an example, of the results obtained in the last excavations of Malpica and with the appearance of a supposed drying room of Dressel 20 units with an approximate area of 40 x 4 meters (see figures 20 and 21), a scenario with the provision for drying of a certain number of products, in which there had to be a continuous spatial exchange of casings and finished amphorae between the workshops and the drying warehouse (see figure 19).

The arrangement of the containers is represented in certain locations in order to facilitate the work for the sake of a possible count, where the last spaces in blue could be indicative elements by means of a mnemonic system of the completion of the batch (in this case 100 units on the first floor). A situation similar to production using the KANBAN drag system, in which when the work of the last operation is finished, a signal is sent to the previous execution to inform it either of the end of the process or that it must start a new order through a labeling system.⁶⁷

If we consider two meters as the manageable height of a person to be able to control the material, especially due to the need for both hands to handle it and without the requirement

⁶⁶ BOURGEON 2021, 585.

⁶⁷ The KANBAN method was established in Japan in the 50s through a protocol for the replenishment of a stock, in which there was a communication system to generate production orders and replenishment of materials. This system arose from the replenishment rules in American supermarkets. When the products are removed from the shelves and each product is labelled and at the checkout, it collects all the references sold by issuing a replenishment order to the warehouse, which in turn sends another replenishment order to suppliers and manufacturers. ANAYA 2015, 128.

of auxiliary elements to access higher areas; With the distribution in successive adjoining openings to deposit the ceramic elements with a width of 75 centimeters and a height of 1 meter, our proposal is that the optimal arrangement for their storage would be through the placement of shelves to store two floors of amphorae and in this case, the capacity of the drying warehouse being 200 units (figures 20 and 21).⁶⁸

This calculation could be used as a frame of reference and, due to the capacity of a drying warehouse, can be documented as the justification of an artisanal testimony and at the same time serve as a suggestion to shed some light on the volume of what the production could cover in a *figlina*. As an example of any industrial exploitation, there had to be a total synchrony between the pottery, its manufacturing volume and the warehouse to deposit a stock for drying.

For the same reason, it is suggested that one of the conditions that the stamping in the amphorae was not generalized in all units, because the capacity of that drying warehouse already indicated the number of elements contained in a given batch and if it was not necessary to count the production one by one, for the same reason an individualized stamping would not be needed either.⁶⁹

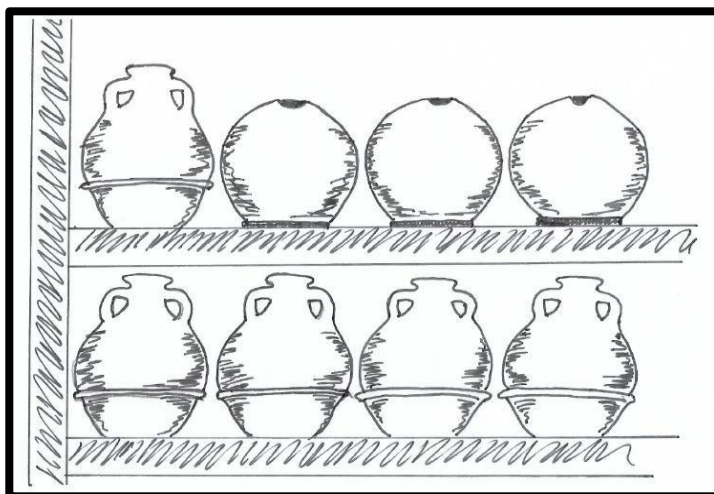


Figure 19. Possible location of semi-finished (casing) and finished (amphorae) products on the shelf of a drying warehouse. The amphorae (approx. 30 kilos) with the basin, as they weigh more, occupy the lower part of the shelf to prevent detachment (own elaboration).

⁶⁸ In CARRATO *et al.* 2018, 313, a detailed study is carried out on the capacity of amphorae in an oven in Las Delicias (191 units) in which there is a certain similarity in the number of amphorae proposed for a drying warehouse of these dimensions. Possibly this is a coincidence, but a new hypothesis could also be supported about the cause-effect relationship between the capacity or batch of amphorae in an oven and a drying warehouse.

⁶⁹ MOROS 2021, 112.



Figure 20.
Elevation
corresponding to one
of the walls of the
warehouse with a two-
metre-high shelf on
two levels in which
semi-finished product
(casings) and finished
product (amphorae)
are interspersed

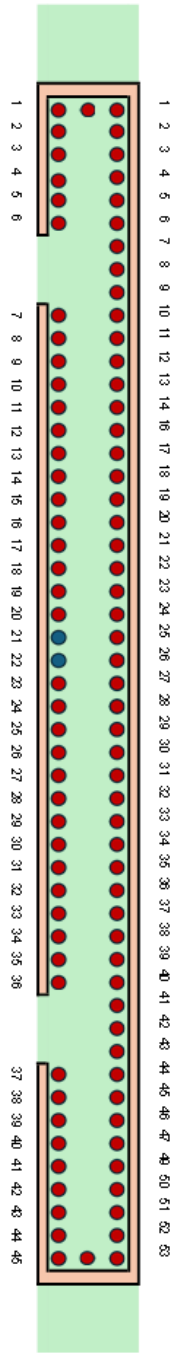


Figure 21.
Floor of a 40 x 4
meter drying
warehouse for
Dressel 20
amphorae with a
space between
each element of
75 centimeters
for a capacity of
100 units

It is relevant to note that already at that time the potter's trade and especially to know how to make this type of amphorae, should be a very specialized profession, with a very integral and truly exhaustive knowledge of the way of working in an artisan environment that is not very permeable, having created a school in a production linked to a nucleus possibly with a certain family structure, where knowledge was passed down through generations.

This trade, which was supposedly created by itinerant crews⁷⁰, which moved from *figlina* to *figlina* throughout the area, over the years had to improve and perfect its *modus operandi* under the control of a volumetric norm and marked by standards on the morphology of the containers, which at the same time created an industrial base, a patent that was developed over decades.⁷¹

By means of tests with current methodologies, such as experimental archaeology, we have tried to understand the dynamics of that group that could well be the origin of the creation of a guild such as stonemasons, wickers, boatmen, etc. that, although we know that this type of corporation arose from the Middle Ages, they were already outlined since Antiquity with the existence of several professional levels within each workshop.

Although the slave regime entailed other nuances in the functioning of the *officinae*, it could already be configured in a system imposed by categories with the supposed hierarchy formed by a master or foreman, journeymen and apprentices.

Conclusions

In this article, we have tried to find new interpretations of certain incisions in the Dr. 20 amphorae before firing, which can possibly be figures comparing them with the Roman cardinal ones, while at the same time demonstrating their origin from the Etruscan numerals.

With this hypothesis, it has been attempted to demonstrate that, if in the Roman world the numbering system of the Latin alphabet (I, V, X, L, C, D, M) was used to represent figures similar to the current decimal system, there are certain signs such as those that correspond to the amount "fifty" or "thousand" that could determine a remittance or the computable element of the development of an industrial transformation for the creation of Dr. 20.

On the other hand, the amount "one hundred" represented by the sign of an asterisk as an accounting unit has been rejected, as no epigraphic record from the Roman period has been found to corroborate it. Regarding the acronyms C, D and M it seems that they could correspond to figures, while the acronym R in my opinion, the conditions are met for it to possibly be an element of control.

With regard to graffiti that are called minor numerals, usually with one or more digits with the X mark, a new interpretation has been developed apart from the previous ones, which can be all their readings concatenated in the same process marked by the following parameters: quantity control-quality control-temporality control.

Regarding quantity control, authors such as Remesal have positioned themselves by interpreting this type of graffiti as a quantity derived from a productive phase, for example, a working day.

But new hypotheses are also opened about these graffiti. In one of them, it is proposed that they do not have to be figures but marks to testify to the finish and hardness of the clay by

⁷⁰ REMESAL 2011b.

⁷¹ COTO SARMIENTO 2019, 139-140.

means of a random procedure, which can determine the drying process through quality control.

Our reasoning has been based on the fact that, if in the bellies of the casing there are many cases of figures greater than X, in the necks and mouths of the amphorae most of the cases are only represented by graffiti with a single X (they also appear with a V or an II, but I think it is a similar situation since it can be an unfinished X).

Another scenario is that they can mark a temporary reference within the stock of a drying warehouse to control the inflows and outflows of stocks by means of a dynamic pushing system of both the semi-finished material (casings) and the finished product (amphorae).

The storage of a *figlina* that exercised the functions of a drying room, clearly should be the *Sancta Sanctorum* of a pottery workshop, where all the work carried out in the manufacture of the Dr. 20 had to be compensated under a slow drying process, to avoid possible fractures in the amphorae when they were going to be fired.

The drying warehouses, as has been demonstrated in various excavations, should be long and narrow for easy handling and possibly a standardization of their production capacity.

In other words, due to the dimensions of the drying warehouses of a pottery, with an orderly and logical arrangement of the elements displayed on shelves, it would be possible to discern how much volume of manufacture could come out of that workshop.

By way of conclusion, the *graffiti* that we call numerals or indeterminate must have been established, to mark the different processes within the manufacturing field in the manufacture of amphorae of a *figlina*.

Those incisions in the ceramic objects, which were made during the different stages before and during the drying process, should possibly be labels or slogans within a common language among that artisan collective, which does not have any identity element and is very difficult to find out what many of them could represent.

Consequently, there were groups of people (*figuli*) within this type of fairly specialized associations, made up of either *servi* or people in freedom, possibly a large majority of whom had no knowledge of writing or knew how to count.

These crews have been stipulated by previous studies that they were presumably itinerant. They should be exclusive and unique with the application of some kind of communicative agreement between them, with the transmission of their professional knowledge through a certainly corporatist language of incised marks on the amphorae; in very varied and recurrent graffiti representing ties, wavy, reticulated lines, etc. that to date have not been could be clarified.

The leaders or ringleaders of those crews may have received the order and ordered the lot for a limited time under the supervision of the *offinator*, who with an absolute command of writing should have a superior power or command in the activity of the workshop. While in the *figlina*, there should always be a permanent staff for the preparation and supply of materials such as clay or other types of raw materials, also for the maintenance of the facilities, monitoring of drying and preparation of the ovens for firing.

The pottery industrial activity, especially from the third century A.D. onwards that developed in the valleys of the Genil and Guadalquivir, left us a very specialized cultural landscape within the productive context of the Dr. 20 amphorae; where its actors communicated through graffiti that have raised many lucubrations when it comes to making them. It is important to continue researching, as there is still much to be done.

Annexes

Summary of the data from the different Testaccio campaigns

TESTACC	CAMPAÑA	TOTAL	IN COLLO/	IN VENTRE/IN	DATACIO	NOMINAL	CALENDARIA	NUMERALES	NUMERALES	SIGLAS	SIGNC	INDETERMINA
20X I	1989/1990	1	9	9	S. II	4	2	2	6	7	0	5
20X I	1	2	2	9	S. II	1	0	6	0	10 (B,R)	2	1
20X I	1	3	5	1	220-224	1	0	1	2	13 (B,R)	2	1
20X I	1	3	5	1	220-224	1	0	1	2	13 (B,R)	2	1
20X II	1993/1994	2	2	1	S. II	3	5	1	7	0	1	1
20X I	1995/6/97	2	7	1	246-254	1	0	6	2	1	3	7
20I V	1998/1999	3	7	2	207-223	2	1	9	1	2	4	2
20I V	2000,2005	2	2	2	174,176,177,1	3		1	4	4	2	1

TESTACCIO	CAMPAÑA	TOTAL MUESTRAS	IN COLLO/ CAMPANA	IN VENTRE/IN PEDE
I	1989/1990	105	9	91
	CODIGO IDENT.	PAGINA	FIGURA	POSICION
ASTERISCO	11 (e)	70	9	ventre/pede
	11 (f)	71	10	ventre/pede
SIGLA B	17 (c)	72	11	ventre/pede
	17 (e)	72	11	ventre/pede
	17 (a)	71	10	ventre/pede
C PARTIDA (50)	13 (b)	71	10	ventre/pede
	13 (a)	71	10	ventre/pede
SIGLA M	18	72	11	ventre/pede
II	1989	294	28	92
II	1991	374	59	143
II	1992	384	59	143
	CODIGO IDENT.	PAGINA	FIGURA	POSICION
ASTERISCO	559 (a)	346	61	collo/campana
	577 (e)	352	67	ventre/pede
	577 (g)	352	67	ventre/pede
SIGLA C	561	347	62	collo/campana
	578 (a)	353	68	ventre/pede
	578 (c)	353	68	ventre/pede
C PARTIDA (50)	579 (d)	353	68	ventre/pede
	581 (a)	354	69	ventre/pede
	581 (b)	354	69	ventre/pede
	581 (f)	354	69	ventre/pede
	581 (h)	354	69	ventre/pede
CÍRCULO CON (X)	581 (c)	354	69	ventre/pede
	581 (d)	354	69	ventre/pede
	602 (b)	358	73	ventre/pede
	606 (b)	361	76	ventre/pede
SIGLA B	584 (d)	355	70	ventre/pede
TRAZOS ONDULADOS	603 (a)	359	74	ventre/pede
	603 (n)	359	74	ventre/pede

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TESTACCIO	CAMPAÑA	TOTAL MUESTRAS	IN COLLO/ CAMPANA	IN VENTRE/IN PEDE
IV	1995/6/97	241	77	164
	CODIGO IDENT.	PAGINA	FIGURA	POSICION
ASTERISCO	95/1189	282	33	<i>in pede</i>
	95/166	276	27	<i>in pede</i>
	95/350	276	27	<i>in pede</i>
	96/464	276	27	<i>in pede</i>
	95/644	276	27	<i>in pede</i>
SIGLA C	95/652	273	24	<i>in pede</i>
	95/830	273	24	<i>in ventre</i>
	95/882	273	24	<i>in ventre</i>
	95/921	273	24	<i>in ventre</i>
	95/1271	273	24	<i>in pede</i>
C PARTIDA (50)	95/656	273	24	<i>in pede</i>
	95/604	273	24	<i>in pede</i>
	95/737	273	24	<i>in pede</i>
	95/806	273	24	<i>in pede</i>
	95/922	274	25	<i>in pede</i>
	95/1101	274	25	<i>in ventre</i>
	96/341	274	25	<i>in ventre</i>
Círculo con (X)	95/1172	265	16	<i>in collo</i>
	96/410	265	16	<i>in collo</i>
	95/847	274	25	<i>in pede</i>
	96/76	274	25	<i>prope pedem</i>
	96/816	274	25	<i>in pede</i>
	97/29	274	25	<i>in ventre</i>
	97/113	274	25	<i>in pede</i>
	95/242	280	31	<i>in ventre</i>
	95/465	280	31	<i>in ventre</i>
	95/920	281	32	<i>in ventre</i>
	95/967	281	32	<i>in ventre</i>
	95/1088	281	32	<i>in pede</i>
	97/145	281	32	<i>in pede</i>
	97/149	281	32	<i>in pede</i>
SIGLA R	95/97	264	15	<i>in collo</i>
	95/388	264	15	<i>in collo</i>
	95/519	264	15	<i>in collo</i>
	95/853	264	15	<i>in collo</i>
TRAZOS ONDULADOS	95/554 a+b	277	28	<i>in ventre</i>
	95/520	277	28	<i>in ventre</i>
	95/575	277	28	<i>in ventre</i>
	95/738	277	28	<i>in ventre</i>
	95/1259	277	28	<i>in pede</i>
LAZOS	95/79	264	15	<i>in collo</i>
	95/188	264	15	<i>in collo</i>
	85/214	264	15	<i>in collo</i>
	95/970	264	15	<i>in collo</i>
	95/484	264	15	<i>esp. interansal</i>
	95/113	265	16	<i>esp. interansal</i>
SIGLA M	95/83	264	15	<i>in collo</i>
	95/243	264	15	<i>in collo</i>
	95/478	264	15	<i>in collo</i>
	96/505	264	15	<i>in collo</i>
	95/1078	264	15	<i>in collo</i>
	95/1109	264	15	<i>in collo</i>
SIGLA R	95/97	264	15	<i>in collo</i>
	95/388	264	15	<i>in collo</i>
	95/519	264	15	<i>in collo</i>
	95/853	264	15	<i>in collo</i>
INFINITO	95/1+17	275	26	<i>in ventre</i>
SIGLA D	95/1071	263	14	<i>in collo</i>

TESTACCIO	CAMPAÑA	TOTAL MUESTRAS	IN COLLO/ CAMPANA	IN VENTRE/IN PEDE
V	1998/1999	358	70	247
	CODIGO IDENT.	PAGINA	FIGURA	POSICION
ASTERISCO	461 (a)	313	36	<i>in labro</i>
	461 (b)	313	36	<i>in labro</i>
	498(a)	354	77	<i>in ventre in pede</i>
	498(d)	354	77	<i>in ventre in pede</i>
	498(c)	354	77	<i>in ventre in pede</i>
	498(e)	354	77	<i>in ventre in pede</i>
	498(f)	354	77	<i>in ventre in pede</i>
	498(g)	355	78	<i>in ventre in pede</i>
SIGLA C	477 (c)	325	48	<i>in ventre</i>
	477 (d)	325	48	<i>in ventre</i>
C PARTIDA (50)	481 (ee)	330	53	<i>in ventre in pede</i>
	481 (y)	330	53	<i>in ventre in pede</i>
CÍRCULO CON (X)	481 (e)	326	49	<i>in ventre in pede</i>
	481 (b)	327	50	<i>in ventre in pede</i>
	481 (f)	327	50	<i>in ventre in pede</i>
	481 (g)	327	50	<i>in ventre in pede</i>
	481 (o)	328	51	<i>in ventre in pede</i>
	481 (r)	329	52	<i>in ventre in pede</i>
	480 (u)	329	52	<i>in ventre in pede</i>
	481 (v)	329	52	<i>in ventre in pede</i>
	482 (w)	330	53	<i>in ventre in pede</i>
	506 €	361	84	<i>in ventre in pede</i>
SIGLA R	460 (a)	313	36	<i>in collo</i>
LAZOS	462 (a)	313	36	<i>in collo</i>
	499 (a)	355	78	<i>in ventre in pede</i>
	499 (b)	355	78	<i>in ventre in pede</i>
SIGLA B	495 (a)	351	74	<i>in ventre in pede</i>
	495 (b)	351	74	<i>in ventre in pede</i>
SIGLA CC	486 (a)	333	56	<i>in ventre in pede</i>
	486 (d)	333	56	<i>in ventre in pede</i>
	486 (b)	334	57	<i>in ventre in pede</i>
	486 (c)	334	57	<i>in ventre in pede</i>
	486 (e)	334	57	<i>in ventre in pede</i>
INFINITO	502 (a)	356	79	<i>in ventre in pede</i>
	502 (b)	356	79	<i>in ventre in pede</i>

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TESTACCIO	CAMPAÑ	TOTAL MUESTRAS	IN COLLO/ IN CAMPANA	IN VENTRE/ IN PEDE
V	2000,2005	29	2	24
	CODIGO	PAGIN	FIGUR	POSICIO
ASTERISCO	1148 (14)	52	1	<i>in ventre in pede</i>
SIGLA C	1144 (2)	51	1	<i>in ventre in pede</i>
	1144 (6)	51	1	<i>in ventre in pede</i>
	1144 (7)	51	1	<i>in ventre in pede</i>
	1144 (11)	51	1	<i>in ventre in pede</i>
	1144 (9)	51	1	<i>in ventre in pede</i>
	1144 (10)	51	1	<i>in ventre in pede</i>
CÍRCULO (X)	1148 (1)	51	1	<i>in ventre in pede</i>
CÍRCULO CON (I)	1173 (1)	53	2	<i>in ventre in pede</i>
	1173 (2)	53	2	<i>in ventre in pede</i>
	1173 (3)	53	2	<i>in ventre in pede</i>
SIGLA R	1170 (2)	52	2	<i>in ventre in pede</i>
	1170 (3)	53	2	<i>in ventre in pede</i>
	1170 (4)	53	2	<i>in ventre in pede</i>
	1170 (6)	53	2	<i>in ventre in pede</i>
SIGLA B	1167 (1)	52	2	<i>in ventre in pede</i>
	1167 (4)	52	2	<i>in ventre in pede</i>
	1167 (5)	52	2	<i>in ventre in pede</i>
	1167(7)	52	2	<i>in ventre in pede</i>
	1167(9)	52	2	<i>in ventre in pede</i>
	1167(10)	52	2	<i>in ventre in pede</i>
SIGLA D	1168 (1)	52	2	<i>in ventre in pede</i>
	1168 (4)	52	2	<i>in ventre in pede</i>
	1168 (2)	52	2	<i>in ventre in pede</i>
SIGLA M	1169 (1)	52	2	<i>in ventre in pede</i>

TESTACCIO	CAMPAÑA	TOTAL MUESTRAS	IN COLLO/ CAMPANA	IN VENTRE/IN PEDE
I	1993/1994	2	2	1
ASTERISCO	CODIGO IDENT.	PAGIN	FIGU	POSICI
	99	3	5	<i>prope pedem</i>
SIGLA C	944 (b)	3	4	<i>in</i>
	945	3	4	<i>in</i>

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