Distinguishing colours
A colorimetric approach to architectural terracottas from Satricum (Le Ferriere, Latina)

Riemer Knoop

Abstract

The colours of the fired clays of architectural terracottas are among their most obvious characteristics. Breaking easily and being susceptible to wear and tear, they often appear without recognizable shape or form. The question is therefore frequently asked whether it is possible to classify an unadorned architectural terracotta fragment on the basis of the colour of its fired fabric alone. A corpus of pre-Roman material from the acropolis of the ancient city of Satricum (Le Ferriere, province of Latina, Italy) is used to consider this method of visual decision-making in terracotta classification, thanks to the categorical way in which colorimetric observations have been made for the large volume of finds. The use of Munsell colour classifications within macroscopic fabric descriptions is reassessed in light of the history of analytical study of this corpus of terracotta material.

The corpus

Since the late 19th century, some 35,000 fragments of architectural terracottas have been recorded during the excavations of the Mater Matuta sanctuary at Satricum.[1] The site has been intermittently investigated by Italian and Dutch teams, the former led by Museo Nazionale di Villa Giulia director Felice Barnabei and his inspector Ranuccio Mengarelli since 1896, the latter by archaeologists from the Royal Netherlands Institute and the universities of Groningen and Amsterdam from 1977 onwards. Since then, yearly campaigns have been carried out at Borgo Le Ferriere, while materials from previous excavations began to be systematically studied in the Villa Giulia, including the architectural terracotta corpus of ca 1,750 items.[2] Right from the start the terracotta finds had raised the keen interest of many scholars and the wider public alike. The finds of terracotta antefixes and other coroplastics from Satricum, in particular those of the early 5th-century phase of the sanctuary, came as a total surprise and were immediately recognized as of exceptional quality.

The bulk of the material was found from 1977 onwards on the Satricum acropolis. Over the years, the finds were made by a number of teams working with different research objectives, registration methods and preservation strategies. In the course of these campaigns, most plain roof-tiles were, after being counted, inventoried, and classified per excavation trench and unit, subsequently discarded. These selection choices were governed by the view that a large portion of the excavation areas on the Satricum acropolis then under consideration consisted of secondary deposits of finds dumped during the 1896-1898 campaigns. Wherever a primary deposition context was suspected, however, such as several settlement areas at the south and west parts of the acropolis or in the Archaic layers below the temples, more rigorous documentation and retention policies were adopted. The result is a very large but rather uneven database.

Classification

The classification principles went through several changes over the course of the decades, to end, in the late 1980s, with a five-fold, essentially chronological system. At its heart sit three very clearly definable, chronologically successive terracotta groups. On the basis of their figured parts and numerous parallels all over central Italy, these three are both well attributable in a cultural sense and precisely datable. Two additional groups have been identified. One is a large corpus of undecorated, roughly worked, dark-red compact fabrics, referred to as Dark Red; the other, a group of likewise undecorated fabrics that are very light, both in colour and density, called Late.

This five-fold classification is the end result of a long period of gestation. The key to understanding the three core groups was found in a petrographical analysis, carried out in the mid 1980s, aimed at testing a traditional classification

of antefixes.[3] The groups were dubbed after the areas their styles are thought to derive from: Caeretan, Campanian, and Latin (alternatively known as Late Archaic). The three correspond to elaborate, almost entirely preserved roof systems not yet fully published.[4]

Both to the naked eye and under the microscope, the fabrics of the central three terracotta groups show up as qualitatively different in a meaningful way. A quantitative study was carried out to identify both the texture of the clay matrix and the components that were added to the clay. In this filler analysis, eight groups of minerals were identified either already present or added as tempering material to the filtered clay, in the latter case perhaps to enhance the plastic and constructive properties of the finished products. Thus the hypothesis of 'guide minerals' was born, significantly present in all groups: plagioclase in the Caeretan and Campanian fabrics, leucite in the Latin/Late Archaic ones. The Caeretan material appeared furthermore to differ from the Campanian pieces by a decidedly more abundant presence of the plagioclase guide mineral. The success of this investigation made it possible to additionally classify non-figured fragments, not by microscope but with the naked eye, while also using macroscopic observations on colour, texture, density and porosity of the fired clay matrix, as well as the presence of grog (ceramic grit). The guide minerals were next shown to have originated from three quite distinct sources: an area north of Rome, a Phlegraean Fields deposit, and the Alban Hills, respectively. The ensuing triple classification into Caeretan, Campanian and Latin/Late Archaic could then be transferred to fragments of revetments and of plain roof-tiles lacking morphological features. To these, the two categories Dark-Red and 'Late' were later added. The main characteristics of all five are summarized in table 1.

The three central groups have been described elsewhere in detail, as part of the petrographical analysis referred to above, but research since has added valuable new insights. We therefore summarize here the observations on all five groups.

Dark Red terracottas are characterized by a very coarse fabric which shows dark red on the outside, and similar or lighter (but sometimes darker) in the core. The structure of the fired clay is heterogeneous, flaking easily in horizontal chunks and containing numerous, very varied particles, often quite sizeable. Characteristic are

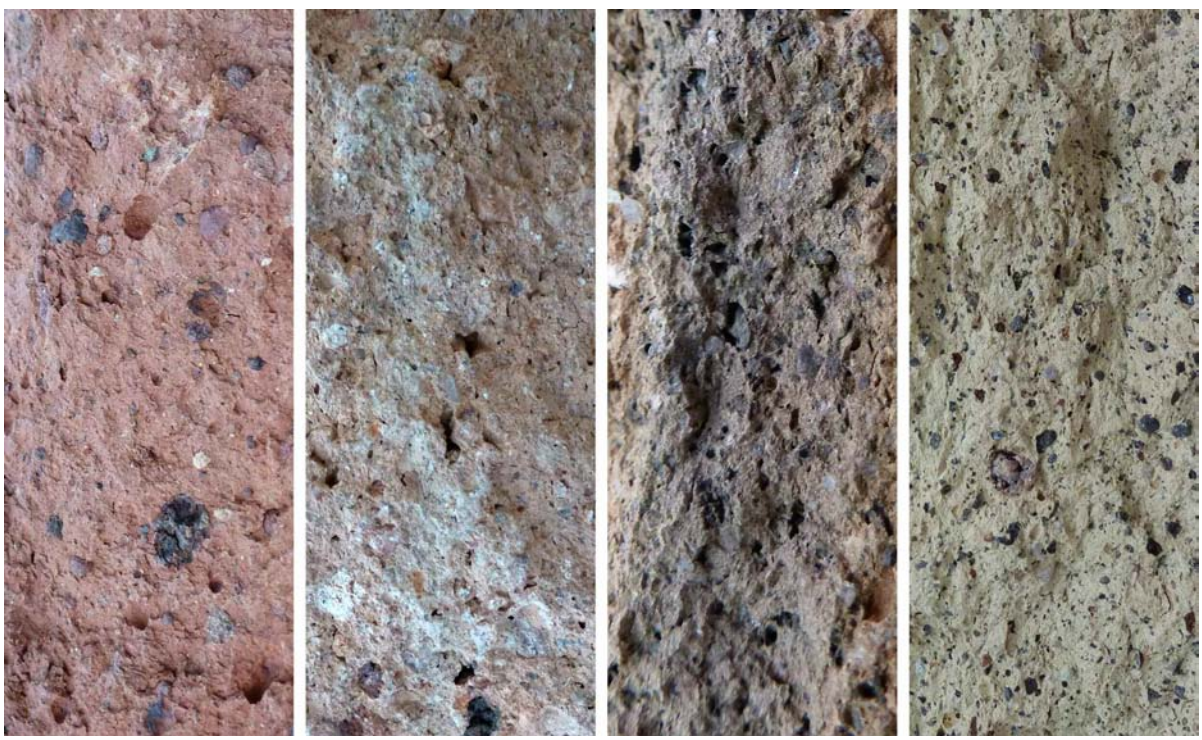

Fig. 1. Macroscopic photographs of cores (fresh breaks) of Groups I though IV fabrics (from left to right) architectural terracottas, Satricum acropolis. Each strip is about a cm (photo M. Gnade).

	DARK RED I	CAERETAN II	CAMPANIAN III	LATIN IV	Va	'LATE' Vb	Vc
Texture	coarse	coarse	Semicoarse	semicoarse	fine	semicourse	very coarse
Clay colour on surface	dark red	orange to yellowish pink	pink to light red/orange	creamy white greenish hues	white/pink	orange or cream+chunks	orange
Clay colour in core	dark red or darker	similar or lighter, with white chunks	grey, much mica	similar	similar	orange bands	similar
Surface treatment	smooth, black or red clay paint	smooth, buff slip, red clay paint	smooth (frequent smoothin marks) Black-ground	top smooth light slip (clay paint)	top smooth light slip	coarse light slip	coarse
Soffit treatment	coarse + gritty	coarse, not gritty	coarse, very gritty	uneven, coarse, slightly gritty	coarse, uneven, not smooth	uneven, coarse	coarse

Table 1. Characteristics of main architectural terracotta fabric groups from the Satricum acropolis (plain roof-tiles).

large lumps of rusty, reddish black ferromanganese (FeMn) nodules. Especially noteworthy are large pieces of mica and lumps of ceramic grit. The surfaces are made smooth (burnished) before firing, sometimes covered by a black, occasionally red, clay-paint. Typical are very frequent large black stains. The soffits of the plain tiles are typically coarse and covered with a layer of sandy gritty particles. This fabric occurs mainly in plain roof-tiles showing both the overlapping and nesting construction arrangements as in Acquarossa Types I and II (Wikander).[5]

The fabric in the second main group, 'Caeretan' (elsewhere also Ionian, or Etruscanized Ionian), similarly stands out clearly both to the naked eye and under the microscope. It is characterized by its coarse but compact nature and by the absence of FeMn nodules. It has been described as 'orange-firing clay with predominantly quartz, feldspar and tuff'.[6] The inclusions in the clay are small- to medium-sized grains, of which quartz and chalky particles are prominent, intermingled with some ceramic grit and/or tufa. In addition, the clay contains numerous volcanic minerals, together with glass and pumice lumps; there is a significant absence of leucite minerals. The clay has a characteristic pink to light red or light brown colour, with a similar or slightly lighter core. The surfaces of the clay are mostly covered with a layer of buff, light red to cream-coloured slip. A layer of bright-red to orange paint, applied either to the clay directly or on the slip, is seen in many roof-tiles. A team from Groningen University identified a peculiar fabric category not confined to architectural terracottas, termed 'oatmeal', during the investigations of the southern and western settlement areas on the acropolis.[7] This fabric is characterised by the exclusive presence of tufa as tempering material, which is perhaps the same as what in earlier petrographical analyses on Caeretan materials was identified as 'ceramic grit'.[8]

The third, 'Campanian' fabric is semi-coarse, containing a high concentration of fine particles, especially augite, which results in a remarkably compact but at the same time brittle structure.[9] Mica particles are especially abundant here, while FeMn lumps are absent from the clay matrix. The fabric is invariably very hard to the touch. The dominant colour of the fired clay is pink to light red, with a distinct grey zone in the core. The surfaces, especially secondary areas, are often decorated in black- or red-ground technique, a unique feature within the Satricum corpus. Undecorated areas have a characteristic 'sandpaper' quality, in particular the flip-sides of the roof-tiles, which are additionally covered with a layer of sandy, gritty, and glassy particles. The fingerprint of this fabric as well as its almost unique isolation from all others has been independently underpinned by a very large-scale, detailed analysis of some 4,400 pottery and architectural terracotta samples.[10]

The fourth, 'Latin' or 'Late Archaic', fabric group is distinguished by a strikingly light-coloured, semi-course but not very compact clay which is well purified with a moderate amount of fillers of all colours, usually quite large. The mineral composition and secondary characteristics (firing temperature and analysis of pigments) were analysed four times, based on six samples taken from antefixes, thirteen thin sections of life-size statue fragments, and some forty samples taken from all members.[11] The fourth, largest analysis was car-

ried out by the Laboratory for Conservation and Material Studies of Groningen University.[12] In comparison with previous fabrics, these pieces are much more homogeneous in texture, containing 'angular grey-black, grey-brown, and some white mineral grains and rock fragments' in a 'very fine-grained, middle-hard matrix' of the fired clay. Characteristic is the occurrence in the temper of crushed lava containing leucite crystals (also in rock fragments), clinopyroxene and biotite.[13] At the surfaces the clay shows as off-white to cream and typically lacks a discolouring in the core, no doubt due to a very homogeneous firing. An additional greenish hue is often seen in the fired clay. A cream-coloured slip, or wash, covers the surfaces, concealing most of the fillers in the clay. Due to the relatively soft structure and low level of compactness of the fabric, however, the fragments in this group appear to withstand wear less easily than those in other groups. The soffits of pan-tiles are uneven and coarse but not markedly gritty.

Within this group, however, several 'transition zones' of classification around a clear-cut core group (conveniently dubbed 'Latin 1') have been identified. Representing less than one percent of the corpus, this regards a set of plain roof-tiles of slightly but consistently deviant fabrics (discarded and now beyond verification), called 'Latin 0'. The consistent nature of the variation suggests a batch that was mis-fired or contained slightly more variable temper. In addition, a rather loosely knit group of figured pieces of various fabrics remains, still with light-coloured clays but in various degrees differing from the Latin 1 pieces, and therefore dubbed 'Latin 2: Related Materials'. Difficult to assess, it comprises varying tile fabrics ranging from white throughout with hardly any particles whatsoever to extremely brittle and awkwardly if not defectively made orange fabrics that show multiple layerings of dark and white/ grey in cross section.

The fifth and last fabric group, 'Late', is not very homogeneous and is formed by pieces that are soft to the touch, with clays that are white throughout but otherwise lack distinctive features. For obvious reasons, it is left out of the colour analysis below.

Colour analysis

The easiest way to differentiate between the four fabric groups just discussed, short of using provenance indications or cultural tags, is by referring to them by their dominant colour name: dark-red, orange, pink, cream/white.[14] Such indications can be rationalized by using standardized and referenced notations, for instance those given in the widely used Munsell Color System for numerical colour description developed around 1900 in the US. In the description of many items in the Satricum architectural terracotta corpus, colour code observations have been made using the Munsell Soil Color Charts 1978 revised edition. A sample population of 457, or less than 1.5 per cent of the total of ca 35,000 Satricum fragments, have undergone this analysis. Of the figured fragments, the number of colorimetrically analysed pieces amounts to ca 10 per cent.[15] The resulting dataset, however, is problematic in various ways.

First of all, the method of standardized colour observation has been less than constant. No protocols were followed as to solar conditions, such as angle of light, time of year or day; or to the difference between open-air (field) and closed environment (field laboratory, museum) observation. Nor was there much awareness of colour perception deficiencies in individual observers or of the benefit of double-blind trials preceding actual colorimetric observations. Second, over the course of three and a half decades the hundreds of Munsell codes now available have been applied by dozens of researchers with different classification strategies in mind and regarding material, moreover, that is far from homogeneous. For example, it makes quite a difference whether fabric colours are observed on sherds directly upon leaving the ground, after cleaning, or after restoration; and whether the observed colour occurs on the surface, which can be covered by a layer of slip but which often is not, on a section of the surface especially scraped clean, or on a fresh break. The resulting bias cannot be countered easily, since, as was pointed out above, most of the non-figured, plain-tile pieces were discarded after summary descriptions. The problem is exacerbated by Munsell-coded observations being done in museums around the world with a view to comparative studies, but which are obviously even harder to replicate. The third issue is formed by the nature of the resulting dataset. Using Munsell colour codes means referring to a three-dimensional notation system comprising hue, value and chroma, or basic colour, lightness (grey scale) and purity (saturation). Hue, in the Satricum architectural terracottas, is restricted to two basic shades (red and yellow) and one intermediate (yellow-red) one, but in varying levels of intensity, totalling seven. The degree of continuity is debated.[16] Value refers to a ten-step range from dark to light, and chroma to a likewise, stepped range indicating the degree of saturation. To the best of my knowledge, its use thus far resisted

Group	Hue		10R	2.5 YR	5 YR	7.5 YR	10 YR	2.5 Y	5 Y	(absolute)
I	**Dark Red**			39.8	30.9	6.5	22.8			(123)
II	**Caeretan**			50.0	50.0					(14)
III	**Campanian**			6.8	29.7	54.1	9.5			(74)
IV	**Latin**	Latin 0 Latin 1 Latin 2	1.9 0.4	1.9 14.4 6.1	7.5 1.0 13.4	9.4 9.6 17.1	11.3 17.4 22.0	11.3 5.2 6.1	5.7 43.5 2.4	(27) (261) (41)
	(total)									(540)

Table 2. Number of Munsell observations of the Satricum architectural terracottas, per hue (percentages).

comprehensive analysis in the archaeological fields of both ceramics studies and architectural terracottas.[17]

Munsell observations have been made on some 540 pieces in four of the five groups. All are reported below, divided over the relevant classes (*table 2*).

The colours in the main groups seem to prevailingly occur in distinct hues, made bold in the table (Dark Red in 2.5YR with some 5YR; Caeretan between 2.5YR and 5YR; Campanian in 7.5YR with some 5YR; Latin 0 between 10YR and 2.5Y; Latin 1 in 5Y; and Latin 2 between 7.5YR and 10YR, with some 5YR). There is, however, a large degree of overlap: reddish in Dark Red and Caeretan, lighter in Latin 0 and 1, with Campanian and Latin 2 taking a middle position. Combining them in a graphic representation (*fig. 2*) brings out the confusion: only hues 2.5Y and 5Y are both unambiguously specific and statistically relevant.

Now the practice of assigning standardized Munsell codes in archaeology tends to privilege the importance of scoring value and chroma variables, made easy by the physical type of arrangement of the very Munsell charts themselves, being organized in separate hue pages, but per page in value/chroma combinations. For anyone trying to establish typical colours for given fabric groups, the solution might be in disregarding the hue, focussing on value/chroma combinations instead. In this way, the awkward three-dimensionality of the Munsell coding system can be avoided. In doing so, moreover, the data lend themselves to decimal reworking, since the value and chroma

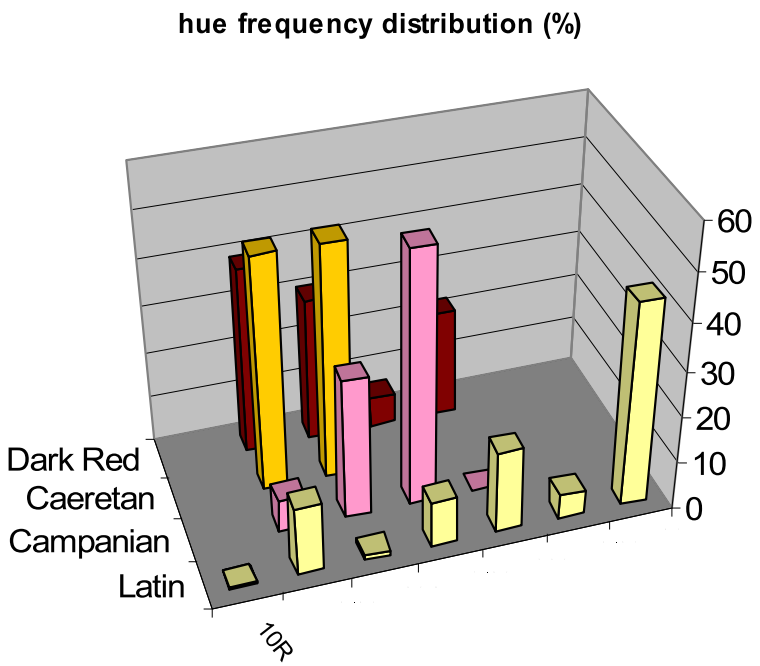

Fig. 2. Relative frequency of hue distribution of all fabrics, architectural terracottas, Satricum acropolis.

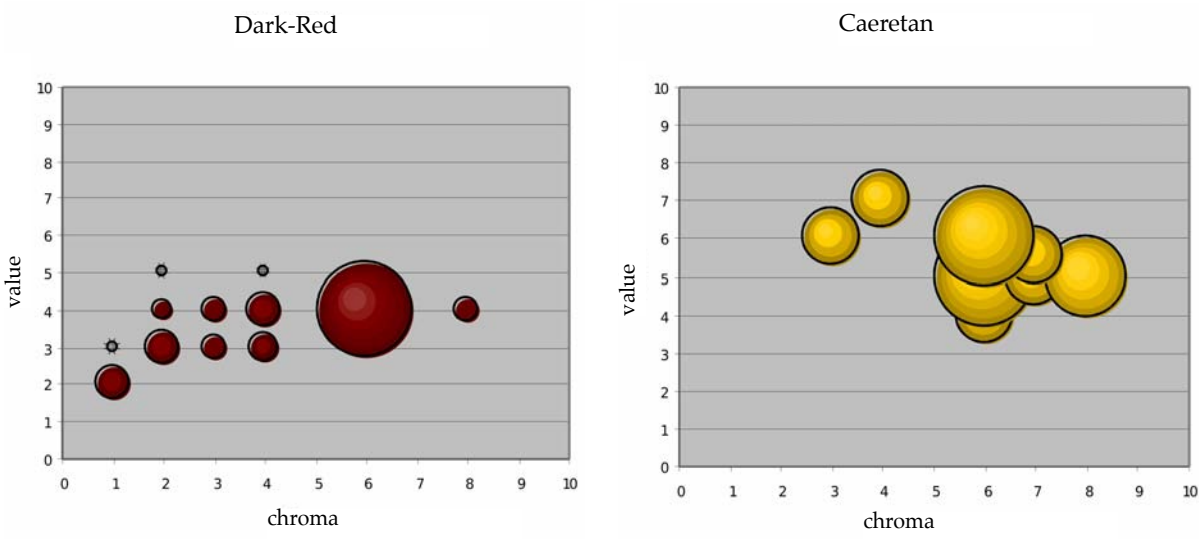

Fig. 3. Frequency distribution of Munsell colour observations (value/chroma) on sample populations, architectural terracottas from the Satricum acropolis. Left: Dark-Red (n = 123); right: Caeretan (n=14).

scores are arranged in stepwise successions, while the hues, indicating basic and intermediary colours, are not.[18] The intuition that chroma and value are more informative than hue is further confirmed by trial comparisons of a sample population using every possible two-dimensional chart, plotting hue, value and chroma three times, each time in a different combination of two against the remaining one (cfr. *fig. 7*). Leaving hue out of consideration offers the diagnostic tool easiest to use. The resulting graphs (*figs 3-4*) retain the familiar layout of the Munsell charts, i.e. chroma on the X axis and value on the Y axis. For all data, the numbers of occurrences in the samples are given as recalculated percentages of the total of items in the various fabric groups. In addition to presence and absence of observations, the frequency of any observed value/chroma combination is indicated by the relative size of the bubble in the graph.[19]

Discussion

The graphic representations in figures 3-4 help in assessing the measure of separation between the four fabric groups with regard to dominant colours, especially in the case of the Dark-Red fabrics against the other three. Various overlaps are, however, to be noted. In particular the separation between Caeretan and Campanian colours allows for some intermediary areas where value/chroma combinations occur that are common for both groups.

In addition, the discontinuity of colour observations in the Caeretan group and the large spread in the colour distribution of the Latin fabrics are noteworthy. In the former case, the non-continuous occurrences in the 6/3-7/4 range may be due to some very rare cases where, exceptionally, colour observations were taken from the core and slipped surface areas, respectively. The large spread in the latter case is caused by the combination, in the same graph, of the three subgroups Latin 0, 1, and 2 in the graph.

The question of whether any architectural terracotta newly found on the Satricum acropolis can be unequivocally assigned to any of the four fabric groups by noting only its value/chroma score, for instance when morphological features are missing, can be answered in two ways. First of all qualitatively (*fig. 5*): It can if and when the score in question falls outside the overlapping areas indicated above. For the Dark-Red, Caeretan and Latin groups, these are reasonably clear. For fabrics in the Campanian group, this is much less so. Hence perhaps some confusion in published reports between Campanian and Latin 0 plain roof-tiles. And hence, perhaps, also the triple, not quadruple, classification of Satrican fabrics, with two intermediary fabrics connecting them, in earlier publications.[20]

Second, and more fruitfully, a quantitative approach may be applied. An indication of the chances for a given piece, when classified in a transition area between any of the main classes,

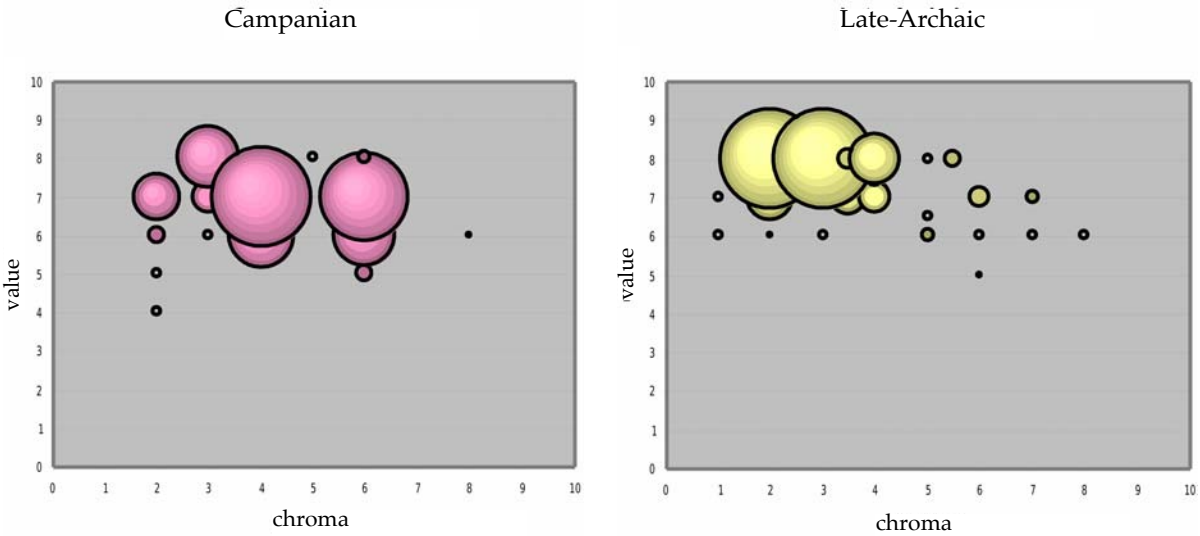

Fig. 4. Frequency distribution of Munsell colour observations (value/chroma) on sample populations, architectural terracottas from the Satricum acropolis. Left: Campanian (n = 74); right: Latin (n = 329).

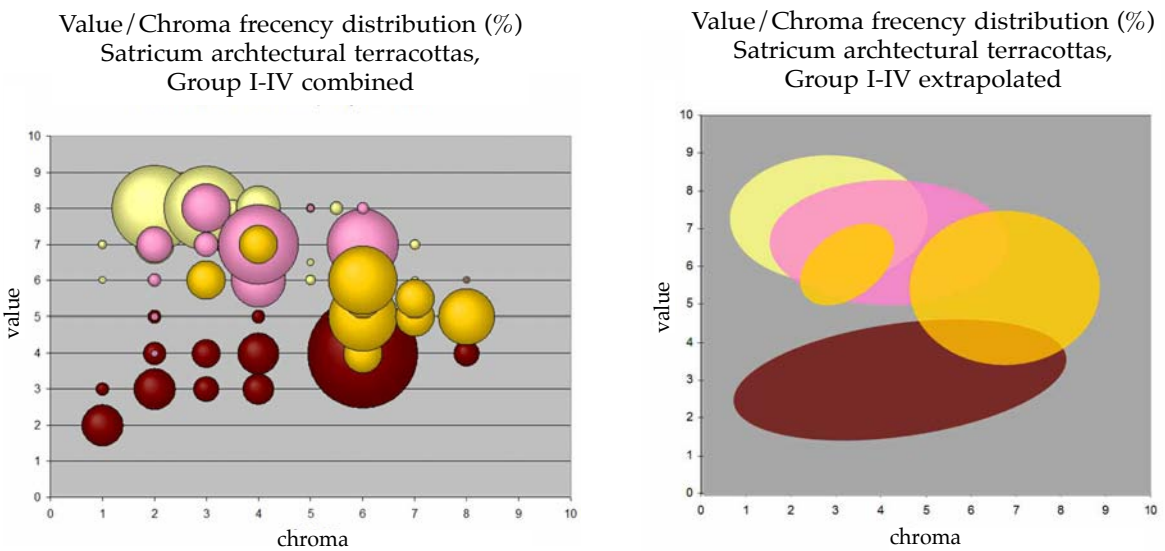

Fig. 5. Frequency distribution of Munsell colour observations (value/chroma) in combined (left) and extrapolated (right) Satricum sample populations of architectural terracotta and roof-tile fabric groups.

is given in the graph in figure 6, where the number of sample data per fabric group are corrected to represent the entire populations of each group, totalling some 60,000 pieces.[21] The frequency separation between Dark-Red, Campanian and Latin is very clear now, with the Caeretan colours being statistically quite hard to differentiate from those in the Dark-Red and Campanian groups.

Finally, this exercise points to a conclusion of a different kind. Caution is called for when using objectified observations. In itself their relevance is doubtful. Generally, colour coding is one of a series of strategies with which to achieve reliable separations in large corpora of material, in addition to observations on, e.g., texture and temper composition. The point of this study had been to try to simplify the use of the Munsell charts in such contexts. The result is that archaeological determination on colour alone is only possible in exceptional cases, for instance if no other strategy

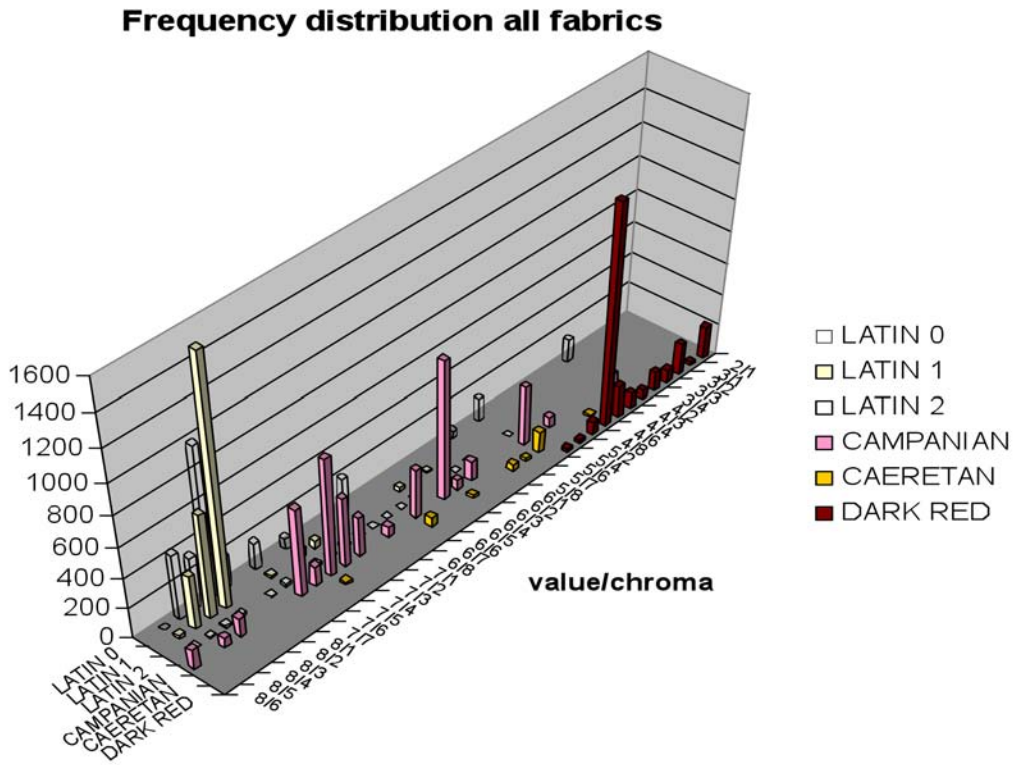

Fig. 6. Absolute frequency of value/chroma distribution of all Satricum acropolis architectural terracotta fabric groups.

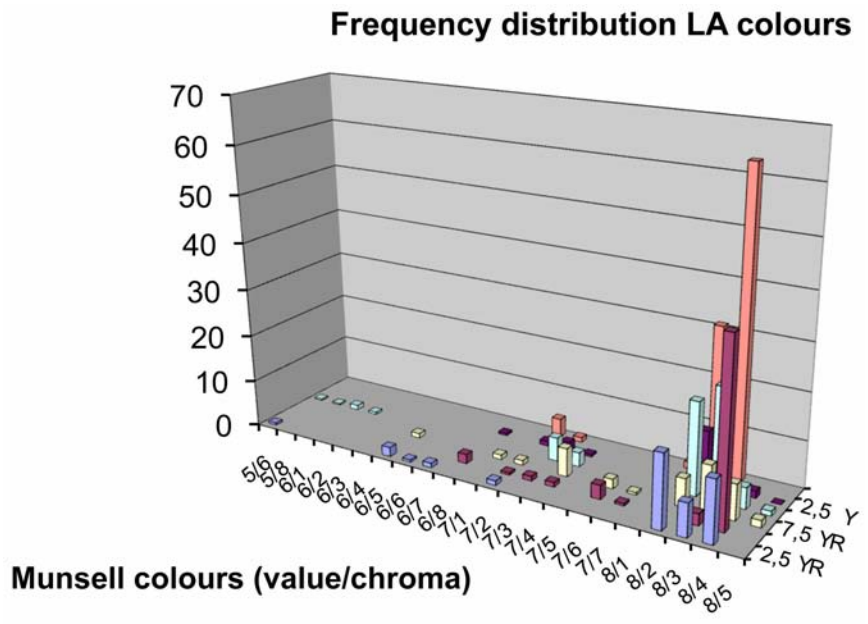

Fig. 7. Relative frequency of value/chroma distribution of Late Archaic (Group IV) architectural terracotta fabric from the Satricum acropolis.

is possible and statistical probabilities are already known. More to the point, I feel Munsell observations in pottery or on terracottas to be most significant when (1) carried out under standard viewing conditions and either (2) applied to studies into the very merits of using Munsell codes themselves or (3) when studying batches of fired products from the same kiln, workshop of production area and/or comparing them with others. To me this is another way of saying that while an observed fabric colour is the result of a complex sequence of selecting and working primary and secondary materials, of firing temperature and oxidation/reduction techniques, of post-production processes and age-long wear and tear, as well as of post-depositional, retrieval and preservation circumstances, it remains clear that any meaningful classification depends on the validity of the question asked.

Notes

1 Full bibliography in *Satricum* 1997.

2 Knoop 1987, Lulof 1996. Most recently: Lulof 2011. A comprehensive study of all the materials and a reconstruction of the successive temple roofs was made possible by a grant from NWO, the Netherlands Organisation for Scientific Research, grant.no. 365-61-002, for the project 'Three Central-Italic Roof Systems: Architectural Terracottas from the Sanctuary of Mater Matuta at Satricum', a co-production of the author and Dr. P.S. Lulof, University of Amsterdam. The publication has been under preparation for several years. This article was originally an appendix of it. I wish to thank Prof. Marijke Gnade and Jill Hilditch, University of Amsterdam for their kind remarks on the text.

3 Knoop 1987, appendix B; Kars et al. 1987. See also Kars et al. 1990.

4 Most recently: Knoop and Lulof in Gnade 2007, 32-42, and Lulof 2011.

5 Wikander 1993, 25-29. Knoop in Gnade 1992, 89-98

6 Attema et al. 2001, 393, Appendix 2, Family II: 'SAT II.AD*J.vps(1-4).ab, porosity +'. Illustrated www.lcm.rug.nl/lcm/teksten/teksten_uk/fabric_sat_2adj.htm.

7 Maaskant 1992, 25 and 87; Bouma 1996, II, 42 and 45; discussed by Gnade 2002, 42, with n. 139.

8 Knoop 1987, 227. Identification tufa with grit: personal communication prof. H. Kars, Free University, Amsterdam.

9 Knoop 1987, 196, 227-231.

10 A.J. Nijboer, Method of Fabrics Research and Classification, in Attema et al. 2001, 321-396, especially 367-376, Fabric 9; specified elsewhere as an orange-firing clay with a predominance of quartz and feldspar; containing a high concentration of moderately well to poorly sorted particles, especially augite.

11 Kars et al. 1987, Lulof 1996, 12-16.

12 Attema et al. 2001, 375, fabric 12: 'SA II/III.E.ps-vps(1-4).a, coarse fritty/leucite-lava and leucite-tuff.'

13 Knoop 1987, 231; Lulof 1996, 12-16.

14 Or: 'red, orange and pale', with the transitional shades 'red to orange' and 'orange to pale'. See the colour classification criteria of A.J. Nijboer in Attema et al. 2001, 367-370, fig. 21.

15 Some 250 by ourselves, supplemented by data from Attema et al. 2001, Maaskant 1987 and 1992, and Bouma 1996.

16 See explanations at http://en.wikipedia.org/wiki/Munsell_color_system (accessed August 1, 2012) with reference to http://web.archive.org/web/20030813092028/www.adobe.com/support/techguides/color/colormodels/munsell.html.

17 Critical literature on the use of Munsell coding in archaeology is scarce. See, however, Frankel 1980, Gerharz et al. 1988, Frankel 1994, Franklin 2009, and Stanco et al. 2011. Since early 2012, a downloadable Munsell application (mColorBook) has become available for iPad and iOS: http://itunes.apple.com/us/app/mcolorbook/id485611271?mt=12.

18 Interesting but not easily accessible alternatives for decimal (and digital) reworking of Munsell data are found in, e.g. www.cis.rit.edu/mcsl/online/munsell_data/real.dat. The stepwise succession of chroma on the hue pages proceeds with different intervals, however.

19 Using Microsoft Office 2003 Excell 'bubble type' of chart. The sizes of the bubbles are adjusted for maximum clarity.

20 Nijboer 1998, 87f, fig. 25; and Nijboer in Attema 2001, see above, footnote 10.

21 The totals for Dark-Red (estimated 25,000) and Latin 0 (30,000) have been brought down by a factor 10, in order to render the graph in Fig. 6 readable.

Bibliography

Attema, P.A.J./A.J.Beijer et al. 2001, Pottery Classification: Ceramics from Satricum and Lazio, Italy, 900-300 BC, *Palaeohistoria* 43/44, 321-396.

Bouma, J.W. 1996, *Religio Votiva: the Archaeology of Latial Votive Religion* I-III, Groningen.

Frankel, D. 1980, Munsell Colour Notation in Ceramic Description: An Experiment, *Australian Archaeology* 10, 33-37.

Frankel, D. 1994, Color Variation on Prehistoric Cypriot Red Polished Pottery, *JFA* 21/2, 205-219. Stable link: http://links.jstor.org/sici?sici=0093-4690%28199422%2921%3A2%3C205%3ACVOPCR%3E2.0.CO%3B2-3.

Franklin H.H. 2009, Analysis of a Pueblo III Potsherd Collection from LA 161967 South Valley, Albuquerque, New Mexico, *Pottery Southwest* 28/1, 2-23.

Gerharz, R.R./R. Lantermann/D.R. Spennemann 1988, Munsell Color Charts: A Necessity for Archaeologists?, *Australian Journal of Historical Archaeology* 6, 88-95 [= Munsell-Farbtafeln: Eine Notwendigkeit für Archäologen?, *Acta Praehistorica et Archaeologica 18*, 1986, 177-187].

Gnade, M. 1992, *The Southwest Necropolis of Satricum. Excavations 1981-1986*, Amsterdam.

Gnade, M. 2002, *Satricum in the Post-Archaic Period. A Case Study on the Interpretation of Archaeological Remains as Indicators of Ethno-Cultural Identity*, Leuven.

Gnade, M. 2007 (ed.), *Satricum. Trenta anni di scavi olandesi* (exhibition catalogue Le Ferriere, Latina), Leuven.

Kars, H./J.G. Moltzer, R.R. Knoop 1987, Petrography of Archaic antefixes from Satricum, *BABesch* 62, 57-65.

Kars, H./R.D. McDonnell 1990, A Petrological and geochemical study of Late Archaic Statuary from Satricum, *Natuurwetenschappelijke afdeling ROB, Intern rapport* 90/6.

Knoop, R.R. 1987, *Antefixa Satricana. Sixth-century architectural terracottas from the sanctuary of Mater Matuta at Satricum*, Assen/Wolfeboro.
Lulof, P.S. 1996, *The RidgePole statues from the Late Archaic Temple at Satricum (Le Ferriere)*, Amsterdam.
Lulof, P.S. 2011, The Late Archaic miracle. Roof decoration in Central Italy between 510 and 450 BC, in *Deliciae Fictiles* IV, Oxford, 23-31.
Maaskant, M. et al.1987 and 1992, *Settlement Excavations at Borgo Le Ferriere ("Satricum") I and II*, Groningen.
Nijboer, A.J. 1998, *From Household Production to Workshops. Archaeological evidence for economic transformations, premonetary exchange and urbanisation in central Italy from 800 to 400 BC*, Groningen.
Satricum 1997: Proceedings of the Satricum Centennial Congress (1887-1997) in *Mededelingen van het Nederlands Instituut te Rome/Antiquity* 56, 1-203.
Stanco, F./D. Tanasi/A. Bruna/V. Maugeri 2011, Automatic Color Detection of Archaeological Pottery with Munsell System, *Proceedings of 16th International Conference Image Analysis and Processing ICIAP 2011* (Ravenna, Italy, September 2011), 337-346. http://unict.academia.edu/FilippoStanco/Papers/968528/Automatic_Color_Detection_of_Archaeological_Pottery_with_Munsell_System (accessed August 6, 2012)
Wikander, Ö. 1993, *Acquarossa* VI.2. *The Roof Tiles. Typology and Technical Features*, Stockholm.

Alexander Boersstraat 7
NL-1071 KT Amsterdam
r.knoop@upcmail.nl