

De Coloribus: new perspectives on a series of recipes for making pigments within the *Compositiones lucenses* tradition

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1. INTRODUCTION

This study analyses written records on the making of pigments in Europe since the 8th century and contained in heterogeneous collections. The focal point of the paper is a series of about forty texts on pigment making for wall painting that I have conventionally termed *De coloribus*. It forms a large section of a recipe book on practical arts known as *Compositiones lucenses*, which is the first Western example of literature on artistic and architectural procedures that has ever survived. This collection was compiled between Antiquity and late Antiquity, collecting various sources, in part still fluid and unidentified [1]. The first specimen hails from the beginning of Carolingian times. This is the well-known manuscript 490 held at the Biblioteca Capitolare of Lucca, dated between 796 or 787-816 AD [2]. It comprises 160 titles for buildings foundations, military machines and incendiary mixtures, metal works, glass and skins colourings, dyes, pigments for wall application, descriptions and uses of stones, metal inks for writing, and parchment dyeing. Unlike other ancient and medieval sources, irretrievably lost or not reproduced in a literary diffusion, this recipe book extends beyond Carolingian times and endures in a tradition consisting of several other manuscripts, which can be collectively termed the '*Compositiones lucenses tradition*' (hereafter CLT). Current research indicates that the entire recipe book was transmitted by at least twenty-six manuscripts, most of which represent recent acquisitions. Nevertheless, its contents are seemingly continually changing and subject to reformulations and contaminations. In the subsequent examples, the recipe book exceeds 200 titles, with additions being made since the 9th century. An *Editio minor*, i.e. a specific nucleus of recipes from the *Compositiones lucenses* tradition, has also been circulated and systematically copied in the medieval manuscripts of Vitruvius' *De architectura*, which is the most important work on practical arts and architecture from Antiquity [3].

On the basis of new evidence, the section *De coloribus* on pigments making stands out as one of the most significant parts of the CLT, even though it was copied with much alterations and reshaping, both to its general contents and to the

order of its texts. This study aims to thoroughly investigate this section of the CLT.

2. RECIPES OF DE COLORIBUS

The sequence of forty texts in the *De coloribus* may be divided into three sections according to the specific colour pigments described. The product may be obtained using both vegetal and animal substances. In the end, the text informs us about the application on different supports (Figure 1).

The first eight texts describe the preparation of azure pigments and recommends several ingredients: violets, lilies, chelidoniums, and woods. The dosages of flowers and leaves are indicated, as well as how to work them to prepare their pulps for the extraction of dyes. Additional ingredients are also required for different hues and *De coloribus* lists verdigris, cinnabar, saffron, vitriol, white lead, and lime. The latter is probably obtained following the traditional calcination of oyster shell.

The reds of *De coloribus* are made up of two different compounds. One consists of vegetal ingredients added to mixtures of cinnabar or white lead. The other one uses animal ingredients such as the insect Kermes, here named *coccarin* or *vermiculus*, enriched with cinnabar and white lead. In a third section, several recipes refer to the preparations for various hues of *pandius*, which may refer to any mixture made from the combination of several ingredients, the interpretation of which is for the most still unknown to scholars. *De coloribus* lists at least the following ingredients and the quantity needed according to each combination: *lulacin*, cinnabar, white lead, *ficarim*, ochre, burnt copper, *quianus*, reseda luteola, saffron, terra verde, murices decoction, *siricum*, kermes decoction, madder decoction, *phynicis* decoction, galls, *calcitarin*, and so on. A final text that might have served as an *explicit* completes the sequence for pigment making. It provides further indications as to their application on various supports, informing us about the measurements necessary to ensure a good result. *De coloribus* advises that the pigments should be used directly on the wall, but in other cases the product needs to be mixed with wax for wood painting or isinglass for skins supports.

The majority of the recipes have a distinct paratactic structure that sets out all the directions for producing pigments. Ingredients, quantities and instructions are for the most part simply listed, omitting any redundant information. This approach was distinctive of the medieval man and reflects a typical expedient used to meet the interests of a readers' community to which, ideally, a recipe book should have been addressed. Recipes appear to have been an extraordinary vehicle for communicating a practical and useful function, which is almost always stated, although we cannot assume medieval readers always pursued it. At the same time, these written records seem to document only a restricted and limited segment of the practical know-how. Many ingredients are still difficult to identify and the technical progression of practical instructions seems to be overshadowed by an extensive use of cross-references. Formulas such as *sicut superius diximus*, *sicut superius dictum est*, or *sicut supra* are recurring linguistic features employed by scribes to replace superfluous or unnecessary information.

3. THE CLT MANUSCRIPTS CONTAINING DE COLORIBUS

The most ancient example of *De coloribus* is the just mentioned Lucca manuscript (Lucca, Biblioteca Capitolare, 490). According to scholars, it was written in the Lucca scriptorium at the turn of the 9th century. This is evident by the use of a Lucchese script, the presence of texts written by Lucca's bishop himself, and the contents that chronologically list the compilation between 787 (or 796) and 816 AD [4]. Just after the Lucca manuscript, another witness

was copied at the beginning of 9th century and discovered by the librarian of the Augustine library in Klosterneuburg (Klosterneuburg, Stiftsbibliothek, frag. s.n.) [5]. The codex has been seriously damaged and only four parchment folios, in two quires, have survived. Nevertheless, previous studies have assumed that the original collection might have been constituted by at least 119 recipes, given that the second-last recipe is numbered CXVIII [6]. A subsequent proposition comes from a 10th century manuscript from the Sélestat library, known to scholars for being a good witness of several texts related to architecture and art, such as Vitruvius' *De architectura*, Cetus Faventinus' *De diversis fabricis architectonicae*, and a collection of alchemical-metallurgic matter entitled *Mappae clavicula* (Sélestat, Bibliothèque Humaniste, 17) [7; 8]. In the 12th century, the CLT counts on two manuscripts. The first is the most notorious witness of *Mappae clavicula*, edited in 1847 by its former possessor Sir Thomas Phillipps and now preserved in the Corning museum of Glass (Corning, Museum of Glass, Phillipps 3175) [9; 10]. It comprises three works: a recipe book for illuminators known as *De coloribus et mixtionibus*, the alchemical collection on metals *Mappae clavicula*, and the CLT with significant linguistic modifications and textual additions [11; 12]. Almost coeval to the Corning copy, a Vitruvian manuscript formerly owned by the Queen Christina of Sweden is now conserved at the Vatican Library (Città del Vaticano, Biblioteca Apostolica Vaticana, Reg. lat. 2079) [13]. It is believed that this specimen is one of the most complete and linguistically best witnesses of the CLT [14]. The 13th century is rich in further examples. Two English manuscripts embed the CLT with

1. **Compositio lulaci** *Caucallide flore lini in mundi mamma viole duarum duarum supradicta*
2. **Flores neulacis quod grece tapsya dicitur alii camaleunta collige flores et repone et post hec**
3. **Lazurin diforon qui dicitur bifaces** *Flores neulacis comisce cum urina expumata secundum*
4. **Lazurin melini zonta** *Flores neulacis infunde in aceto et compone in vase sicut primum*
5. **Lazurin arinon** *Tolles florem de nealuca et defricas cum sapone sicut superius docuimus*
6. **Lazurin carnei coloris** *Tolle lazurin + I cinnabarin libram unam phymithin libram*
7. **Lazurin hunici zonta** *Tolle psimithin mundum et tritum libram unam lazurin + I*
8. **Lazurin ethizonta** *Tolle neulacis flores unctum ex sapone sicut superius lib. I et pone*
9. **Luseum vero de tribus spetiebus componitur hec concoquitur sic tolle lacca teres utiliter et**
10. **Compositio alithini** *Flores papaveris tribula et exprime et humorem qui exierit + I cinnabarin*
11. **A(lia) Cinnabarin + I lulacis sol II psimithin sol I trita bene repone ad solem**
12. **Alia compositio** *Vermiculi libras III vermiculi terreni qui in folia cedri nascitur libram unam*
13. **Alia compositio vermiculi** *Mitte vermiculi libram unam coccarin libram I coccarin nascitur*
14. **Item alia compositio vermiculi** *Vermiculi libram dimidiam alius vermiculi + VI lulaci + VI*
15. **De pandio lulacin** *Pandium luracin libras duas cinnabarin libram unam psimithin*
16. **Aliud pandium** *Lulacin libras II cinnabarin vero principalis lib. I lazurin lib. I*
17. **Alia compositio** *Lulacin + III psimithin + VIII*
18. **Item alia compositio** *Lulacin + I ficarin + I quianus + I pandius lib. psimithin lib. I*
19. **Alius pandius** *Quianus lib. I ocrea lib. II omnia trita comisce cum urina expumata*
20. **Item alius pandius** *Quianus lib. I calcuce caume tritum pulverem + I ficarin + ocrea + I*
21. **Primus pandius cinnabarin coloris** *Cinnabarin lib. I herbe luzie coctionem lib. I croco claro*
22. **Pandius cinnabarin** *Coloris cinnabarin + VI lacca autem decoctioni iotta crocum et VI*
23. **Pandius cinnabarin + I incausta spetiarum tritum + I tereris comisce et reponens in vase vitreo**
24. **Pandia vocantur omnes colores** *Pandius cinnabarin + I et sta teres bene in mortario et*
25. **Pandius viridis** *Terra viride + II cinnabarin + II terra comisce ac repone quem ad modum*
26. **Item pandius viridis** *Terra viride lib. I cinnabarin + I psimithin sol II ista teres in mortario*
27. **Item pandius viridis** *Terra viride lib. I ocrea + I cinnabarin + I trita et commixta omnia cum*
28. **Pandius ocrei coloris** *Ocrea munda lib. I cinnabarin z I ficarin sol. III omnia trita in*
29. **Pandius purpurei coloris** *Pandius purpurei coloris compositus ex III speciebus lulacin lacca*
30. **Pandius porphyrius iotta decoctionis conchilii lib.** *I cinnabarin + I siricum mundum + I omnia*
31. **Pandius porphyrius iotta conchilii libra I cinnabarin lib. II crocum + II omnia trita comisce**
32. **Pandius porphyrius iotta conchilii cinnabalin + I iotta de lacca et terens primum cinnabatin et**
33. **Pandius sub porphyrius iotta conchilii + I cinnabarin + I crocum + I iotta herbe luzie + III**
34. **Pandius cynnabarin + I iotta conchilii + I coctio rubie + II coctionem phinicus teres primum**
35. **Pandius tolle ius rubie et addis galle + III et teres utiliter et tolle ex iotta rubie II et mitte in vase**
36. **Quianus nascitur de rosa baltasion nascitur enim in locis humidis nascitur quidem ex rosa estivo**
37. **Quianus nascitur sic propter pensum ante commixtionem spetierum marmorem tritum bene**
38. **Pandius viridis quianus viridis lib. I psimithin + I ista comisce cum urina expumata**
39. **Pandius quianus lib. I cinnabarin + I trita cum urina expumata**
40. **Hec omnia exposuimus quamquam ex terrenis maritimis floribus vel herbis exposuimus virtutes**

Figure 1 - Recipes of *De coloribus*, from: Città del Vaticano, Biblioteca Apostolica Vaticana, Reg. lat. 2079, ff.77r-79v

alchemical texts, including *Mappae clavicula*. One has undoubtedly been compiled in the Saint Augustine monastery in Canterbury and was donated to the Bodleian Library in 1612 (Oxford, Bodleian Library, Bodley 679). The other was given to the Bodleian Library in 1634, but was previously in Sir Kenelm Digby's collection (Oxford, Bodleian Library, Digby 162) [15]. Another 13th century manuscript has probably Italian origins, given that a piece of paper with Italian writings has been used for its binding. However, the interruption of the transcription on f. 100v suggests that it might have been dismembered (London, British Library, Add. 41486). In Italy, two CLT manuscripts were copied in the 14th century. The first is a Parisian codex that belongs to a group of codices transmitting the same *florilegium* (Paris, Bibliothèque National de France, lat. 7418), although it seems that this is the only witness of the same family that holds *De coloribus*. The other example is a manuscript written in southern Italy in which the CLT forms a seamless nucleus with *Mappae clavicula* and the treatise *De diversis artibus* by the monk Theophilus (Firenze, Biblioteca Nazionale Centrale, Pal. 951) [16]. Three further manuscripts – one dated to the 14th century and two to the 17th century – have been recognised as *descripti*, i.e. direct copies from previous examples that provide corroborating evidence as to the circulation of the CLT, which was much wider than initially thought (Glasgow, University library, Hunterian 110; Leiden, Rijksuniversiteit Bibliotheek, VFC 33; Siena, Biblioteca degli Intronati, C.V.24). The contents of the overall collection of the CLT consisting of twenty-six manuscripts are extremely heterogeneous: each individual manuscript seems to represent a different arrangement, depending on the texts availability or personal interest of the scribe. To the best of our knowledge, thirteen manuscripts

each contain one or more text-units from *De coloribus*. The data generated by the analysis of the global contents of the CLT, reported in a provided diagram (Figure 2), shows that the section *De coloribus* devoted to pigment making constitutes a highly significant percentage of each arrangement, which seems to confirm the value attributed to them by previous collectors who selected these recipes rather than others. In the diagram, each blue line shows the extent of titles from *De coloribus* compared to the remaining texts of the CLT.

The amounts are expressed in percentages to prevent distortions that might be due to the specific features of each manuscript. The actual volume of the sequence inside the CLT is shown. The results indicate that the Klosterneuburg manuscript, although fragmentary, is made up of nearly 40% of recipes from *De coloribus*. The majority of witnesses range between 10-20%, but the Oxonienses Bodley 679 surpasses that 20% compared to its global contents of the CLT. On the contrary, the five remaining manuscripts are all under 10%.

4. DE COLORIBUS: CONTENTS AND ORDERING

It is distinctive that each witness of *De coloribus* transcribes a unique amount of texts displayed in a peculiar order. Indeed, care must be taken in basing the comparison solely on the most ancient manuscript and we ought to consider instead that earliest manuscripts are not necessarily the most reliable. In fact, the data reveals that the arrangement in the most ancient Lucca manuscript is apparently overturned and suggests that the Vatican manuscript might contain the best textual example of this. A provided graphic (Figure 3) attempts to verify that the sequence of text-units, i.e. *consecutio*,

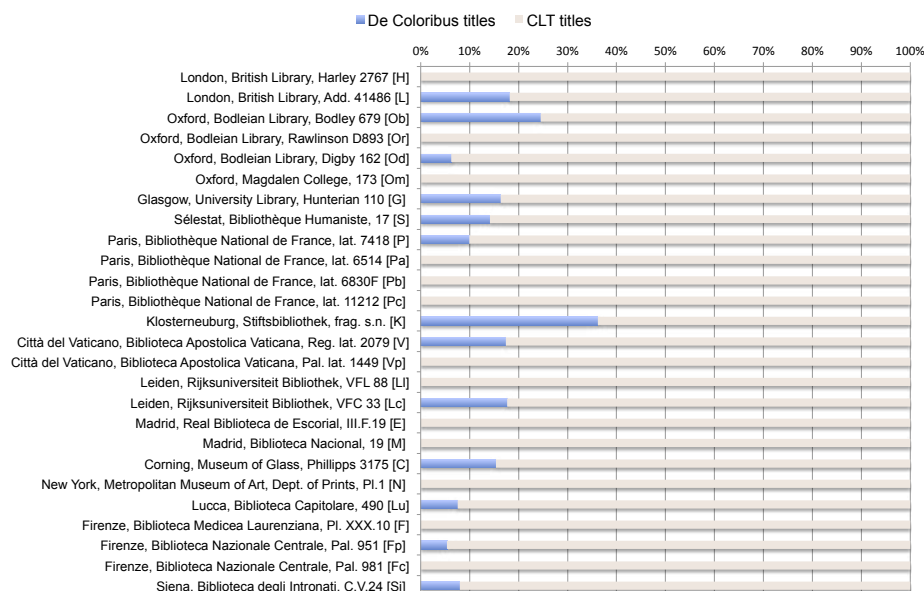


Figure 2 - Percentage of De coloribus titles compared to overall contents of Compositiones lucenses tradition (CLT) according to the manuscripts

has been severely altered in some manuscripts of the same CLT such as the Lucca manuscript, which does not seem to be reliable in the study of this literature.

The diagram pictures the *consecutio* of six selected manuscripts of *De coloribus*. The x-axis registers the sequence of the Vatican manuscript Reg. lat. 2079, designated as the role model. The y-axis records the *consecutio* of five witnesses chosen for the comparison. Each point of the diagram represents the ordinal position of a given recipe in both the Vatican and the matched example. For instance, every triangle has two coordinates, one for Corning numbering and another for the Vatican's *De coloribus*. As a result, Sélestat and Corning manuscripts contain collectively 39 out of the 40 text-units and only one recipe has not been transmitted. The 9th century Klosterneuburg manuscript contains merely 15 recipes, although orderly copied. By contrast, both the Lucca and Florence examples provide a disjointed sequence, visibly incomplete and unordered. The distances between the points graphically indicate that several recipes of Vatican's *De coloribus* are absent in the two Italian witnesses.

On these grounds, we would expect that some manuscripts were much more related than others and that the Lucca manuscript was the most altered. A further analysis on the *consecutio* given by the thirteen witnesses of *De coloribus* lead to one crucial question that this section attempts to answer: is it possible to determine the hypothetical and most extensive sequence accountable for the effective ordering provided by the majority of manuscripts?

Given the centrality of the issue for the present aims, it seems fair to suggest applying the Spearman's rank correlation coefficient, i.e. a nonparametric indicator of correlation (ρ) to statistically measure the connection between

two ordinal variables as the *consecutio* of text-units given by two manuscripts. The results are shown in the diagram together with the correspondences of recipes between Vatican's *De coloribus* and five other manuscripts. A perfect correlation occurs when Spearman's coefficient is +1 since the variables are arranged consecutively identical, or consecutively specular when -1. When applied to the Vatican-Sélestat pair Spearman's measure calculates a +1 value, meaning that the manuscripts are strongly correlated because the first unit in both Vatican's and Sélestat's *De coloribus* exactly matches, and similarly for the rest of the sequence. However, Spearman's coefficient only determines the correlation between pairs of variables, i.e. equal text-units from two manuscripts. If there is not a recipe in just one of the two arrangements, the statistical dependence cannot be calculated. This deficiency, however, has not modified the sequence structure and the rate of relationship. For instance, recipe no. 31 in Vatican's *De coloribus* has no correspondence with any text-unit of the Sélestat manuscript, and therefore the correlation is calculated on 39 pairs of texts, but still equals a +1. As a result, the Spearman's correlation coefficient resists the elimination of one or more units and can be positively applied even on the Lucca manuscript. In the latter, however, the value is -0.5: a negative coefficient which indicates only a modest inverse correlation with Vatican's sequence.

The high ranks of correlation between the Vatican manuscript and the Sélestat-Corning *consecutio* can be further rationalised. I exclude the possibility that any of these manuscripts is a *descriptus*, i.e. a direct copy, because it appears more reasonable that they are all related to the same literary material. On logical grounds, I suggest that the three manuscripts have simply maintained the same sequence of recipes during

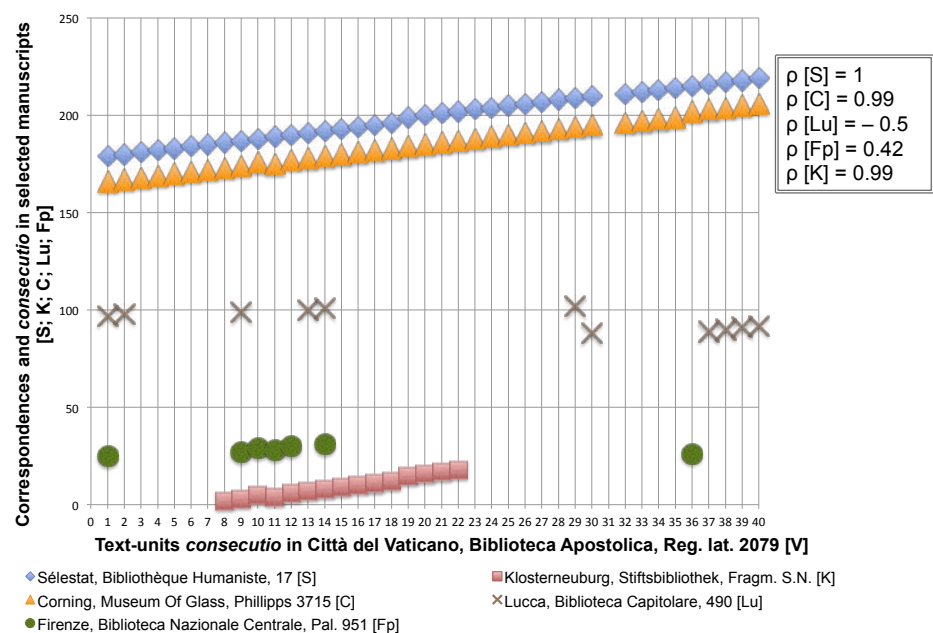


Figure 3 - *De coloribus*: Text-units Correspondences and Spearman's Rank-Order Correlation Coefficient (ρ)

the copying process. In stark contrast, the Lucca and Florence manuscripts have intercepted the same written flow of *De coloribus*, but have both partially transcribed it. Moreover, the Lucca sequence presents an inverse tendency, but at the time the cause behind this *consecutio* distortion remains a speculation.

5. CONCLUSIONS

De coloribus is the most ancient sequence devoted to pigment making transmitted from Antiquity to the Middle Ages. It constitutes a large part of recipes in many CLT manuscripts that individually contain a unique arrangement of texts.

This study has shown that thirteen CLT manuscripts contain *De coloribus* and has documented its exact extension of forty recipes into three sections individually devoted to azure, red, and *pandius* pigments, with concluding instructions on their application. The diagrams clarify the relationships between witnesses and point out additional crucial factors. On the one hand, it has been verified that the Lucca specimen is evidently not an accurate and reliable source. Instead, the study of the Vatican manuscript has been suggested as the role model for this sequence. Moreover, the degree of correlation between six selected manuscripts has been demonstrated confirming that unlike other examples, Lucca's *De coloribus* is not only incomplete but inversely transmitted.

Even though the historical literary sources on crafts and artisan knowledge have roots in Antiquity, *Compositiones lucenses* is the first case in which literary sources on art productions appeared in Europe and recipes and written records represent themselves as artefacts and cultural products that deserve to be studied for their intrinsic features. This paper has provided a new perspective of this first ensemble of painting pigments named *De coloribus*, which paved the way for the subsequent emergence of new written evidence on craft experience that from the 14th century focused exclusively on the production of pigments.

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