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Indice

De Coloribus et Mixtionibus: Tradition and Transmission of the Most Widespread Text on Mediaeval Illumination

ABSTRACT: Il *De coloribus et mixtionibus* è uno dei testi più noti della letteratura tecnica medievale. Per quanto ci è noto, questo breve componimento dedicato alla preparazione dei pigmenti e alle loro mescolanze costituisce il trattato di miniatura più diffuso del Medioevo. Associato ad altre opere o in forma indipendente, in versione estesa o per estratti, il *De coloribus et mixtionibus* si conserva in più di sessanta manoscritti in tutta Europa, databili tra la fine dell'XI e il XVII secolo. Nel contributo si propone un'analisi aggiornata della complessa tradizione manoscritta e della trasmissione del trattato, seguita da alcune considerazioni sulla sua origine e diffusione e da un'edizione del testo.

ABSTRACT: *De coloribus et mixtionibus* is one of the best-known texts of the Mediaeval technical literature. As far as we know, this short work devoted to the preparation of pigments and their mixtures represents the most widespread treatise for illumination of the Middle-Ages. Associated with other known literary works or in independent form, in an extended version or in excerpts, the *De coloribus et mixtionibus* is preserved in more than sixty manuscripts throughout Europe, dating back to between the end of the 11th and the 17th centuries. This paper aims to present an updated analysis of the complex manuscript tradition and transmission of the treatise, followed by some considerations on its origin and diffusion and an edition of the text.

RESUMEN: El *De coloribus et mixtionibus* es uno de los textos más conocidos de la literatura técnica medieval. Esta breve composición dedicada a la preparación de pigmentos y sus mezclas constituye el tratado de miniatura más difundido de la Edad Media. Asociado a otras obras o en forma independiente, en versión ampliada o en extractos, el *De coloribus et mixtionibus* se conserva en más de sesenta manuscritos en toda Europa, que datan de finales del siglo XI al siglo XVII. La contribución propone un estudio actualizado de la compleja tradición manuscrita y transmisión del tratado, seguido de algunas consideraciones sobre su origen y difusión y de una edición del texto.

PAROLE-CHIAVE: *De coloribus et mixtionibus*, Miniatura, Colori, Storia tecnica dell'arte, Letteratura tecnica, Filologia, Manoscritti, Medioevo
KEYWORDS: *De coloribus et mixtionibus*, Illumination, Colours, Technical Art History, Technical Literature, Philology, Manuscripts, Middle Ages
PALABRAS-CLAVE: *De coloribus et mixtionibus*, Miniatura, Colores, Historia técnica del arte, Literatura técnica, Filología, Manuscritos, Edad Media

1. Introduction

Sensim per partes discuntur quaelibet artes.
(*De coloribus et mixtionibus*, prologue)

The conventional title *De coloribus et mixtionibus* (referred to as *DCM* going forward) denotes a widely-circulated treatise for illuminators, frequently copied throughout the Middle Ages. It is made up of three sections: a prologue in verse; seven recipes for the making of pigments for book decoration; a list of pigments suitable for use on parchment and a set of instructions on their mixtures and incompatibilities.

The earliest-known version of the text dates back to the 12th century, but the *DCM* circulated up to the 17th century all over Europe, in an extended form or in excerpts, independently or associated/incorporated to other works, with variants and translated. Clearly regarded as having a certain *auctoritas*, the *DCM* was the most widespread technical text on book decoration that the Middle Ages handed down, which for the first time provided a real "canon" for mixing pigments. Paradoxically, the *DCM*, which is preserved in various forms in more than sixty manuscript witnesses, has never received an overall critical study.

This paper is divided into five paragraphs. In the first, the studies dedicated to the *DCM* are examined, starting from the first edition of the text in the mid-19th century. The following paragraph is devoted to the analysis of the manuscript tradition. By means of a table showing the contents of each codex, it is possible to better comprehend the complex issue of the *DCM* tradition, understanding how its transmission took place and the other literary works it was connected with, such as *Mappae clavicula,* Theophilus' *Schedula diversarum artium* or *Liber de coloribus illuminatorum sive pictorum*. The fourth paragraph deals with an examination of the structure and content of the *DCM*, while in the fifth we suggest some considerations on the origin of the text. Finally, the last paragraph is devoted to the diffusion of the instructions for mixing pigments in the technical literature at least until the 16th century. Lastly, an edition of the *DCM* is proposed in the appendix.

2. State of the art

The best-known form of the *DCM* is constituted by the first rubrics of the manuscript Phillipps 3715 of the Corning Museum of Glass (12th c.). The codex was transcribed and published in 1847 by Thomas Phillipps, without any distinction between the opening sec-

tion of the manuscript and the following text of *Mappae clavicula* (and *Compositiones*).[1]

The question of the differentiation between the two works is first introduced by Ernst Berger (1897: 22, 26-29) and Guy Loumier (1914: 25), who recognise in the *DCM* text a later addition to the treatise known as *Mappae clavicula*, but it was not until the 1930s that Daniel V. Thompson (1933a: 66, n. 14) theorised the autonomous existence of this text as a coherent work intended for illuminators and proposed the conventional title *De coloribus et mixtionibus*.[2]

The insights of Thompson, however, are not considered in the almost contemporary works by Rozelle P. Johnson (1935a, 1935b, 1937), to whom we owe an important census of unpublished manuscripts containing, in more or less extended form, *Mappae clavicula*. Johnson did not yet have a clear distinction between the text of *Mappae clavicula* and that of *Compositiones*,[3] and between these two works and the *DCM*, so that in his publications he also includes codices that testify fragments of one or the other treatise or some parts of the *DCM* only. In his studies, Johnson does not name the *DCM* with this title or as an independent text, but merely divides it into sections, based on the content of Phillipps 3715: the hexameters at the beginning, indicated as AA; the next eleven recipes, named A1-A11; the prologue of *Mappae clavicula* and then the main body of work (actually, as we said, belonging to *Mappae clavicula* and *Compositiones*), numbered from 1 to 293.[4]

A few years later, Josef Svennung (1941) attributed only the 293 numbered chapters to *Mappae clavicula*, thus omitting the introductory hexameters and the initial recipes, but without going into the question of the *DCM*.

Eleanor Webster Bulatkin's contribution is fundamental in the advancement of *DCM*-related studies and in the definition of its textual autonomy. In her in-depth study on the origin and semantic evolution of the term *matiz*, the author identifies in the *DCM* the first attestation of the word. Drawing on Thompson, she writes that «both external and

[1] Phillipps 3715 includes *Mappae clavicula* (ff. 4r-24v) and *Compositiones* (ff. 24v-62r). These two works have long been wrongly considered a single text due to the frequent presence of both in the same manuscripts, the fragmentary state of some of them and the lack of knowledge of fundamental manuscript witnesses such as Città del Vaticano, Biblioteca Apostolica Vaticana, Reg. Lat. 2079 (12th c.). A clear distinction between the two works is due to the intuitions of Halleux–Meyvaert (1987) and then of Tolaini (2004), Baroni–Pizzigoni–Travaglio (2013), Baroni (2013), Baroni–Travaglio–Pizzigoni (2018), though some recent scholarly investigations seem to underestimate this distinction.

[2] Thompson mentions the *DCM* in numerous other contributions (for instance, Thompson 1935a: 410, n. 2), without ever delving into the question, and announces a study of the treatise, unfortunately never published, probably due to the ongoing war (Bulatkin 1954: 488, n. 101). In his review of Roosen-Runge's work, Thompson (1972) reaffirms the autonomy of the *DCM* and the broad diffusion of the text in Europe, hypothesising that the authority attributed to it was due to its origin from an important center such as Cluny.

[3] Johnson has devoted several studies to the *Compositiones* (Johnson 1933, 1935c, 1939).

[4] For convenience, we will keep here Johnson's numbering for the textual sections referable to the *DCM* (AA, A1-A11).

internal evidence seems to indicate that the tract *De coloribus et mixtionibus* is an independent text which bears no relation to the *Mappae clavicula*» (Bulatkin 1954: 489), also because the text does not appear in any of the manuscript witnesses of *Mappae clavicula* prior to the 12th century. Bulatkin is also responsible for a first summary of the manuscript tradition of the *DCM* on the basis of Johnson's census.

In 1974, Cyril S. Smith and John G. Hawthorne published the English translation of the MS Phillipps 3715, comparing and integrating it with the text preserved in the oldest MS 17 of the Bibliothèque Humaniste in Sélestat (10th c.). The scholars attributed two prologues to Corning's manuscript, «the first apparently relating only to the eleven unnumbered chapters on pigments» (Smith–Hawthorne 1974: 9), namely corresponding to the *DCM*. The first eleven recipes, in fact, although never named with the title assigned by Thompson, were evidently recognised as an addition to the following textual portion of the manuscript (and for this reason suitably with their own numbering, in Roman numerals), but, in any case, as an integral part of it, since the same *Mappae clavicula* was indicated as "a compilation of compilations" (Smith–Hawthorne 1974: 14-15). The authors then assert that «compilations almost never represent current knowledge […]. Contemporary technology is, however, to be found among the later accretions, especially the initial chapters on pigments (i to xi) […]» (Smith–Hawthorne 1974: 15-16).

Around the same time, Christian De Mérindol (1975) offered a remarkable comparative study of the artistic production of Corbie scriptorium in the 12th century and the recipes of the *DCM*.

It took scholars nearly two decades to find further observations on the *DCM*. In one of his contributions to the *Mappae clavicula*, Robert Halleux (1990: 178) touched only briefly on the question of the *DCM*, substantially suggesting that the texts have passed through the milieu of Spanish translators from Arabic.

In 1995, Francesca Tolaini (1995a, 1995b) published a study of the *Scripta colorum*, a treatise on illumination which shows considerable formal, linguistic and content affinities with the *DCM*. We will return to this treatise later, considered "the Italian exemplar" of the *DCM*. What is interesting here is that Tolaini, referring to the studies of Thompson and Bulatkin, reaffirms the autonomous existence of the *DCM* and identifies its possible structure, which, as we shall see, is found, in a more or less extended form and with variants, in numerous manuscripts belonging to the so-called "*DCM* family", often associated to well-known technical treatises.

Further advancement in the studies about the *DCM* is owed to Andreas Petzold (1995). His analysis of the earliest manuscripts of the *DCM* allowed to hypothesise an English origin of the text, at an earlier date than commonly proposed on the basis of the manuscript witnesses. The MS London, B.L., Royal 7 D ii, datable to the third quarter

of the 12th century, comes from Canterbury and contains, among texts of a primarily theological nature, seven recipes from the *DCM*. The MS London, B.L., Cotton Titus D xxiv, of the late 12th century, originates from a minor Cistercian house (Rufford in Nottinghamshire) and contains large sections of the *DCM* incorporated into a larger text on colours, entitled *De distemperandis coloribus*, and Anglo-Norman set of instructions on making colours. However, Petzold's most interesting observations concern the MS London, B.L., Cotton Nero A vii, which preserves two recipes of the *DCM*. These are found on a fragment of a leaf (f. 40v) taken from another manuscript, probably inserted here by Sir Robert Cotton in the 17th century. The leaf is datable paleographically to the end of the 11th century and it also probably comes from Canterbury. On the recto of the leaf is a copy of the inscription on Lanfranc's tomb: «It was no doubt for this inscription that Cotton cut out and inserted the fragment, inadvertently saving the recipes on the verso, which end in the middle of a word: "que est cir-"» (Petzold 1995: 60). However, the wide inner margin suggests that the leaf was originally inverted, so that the recipes were on the recto and the epitaph on the verso. Therefore, as there was not enough space for inserting the entire text of the *DCM*, it is likely that the codex contained only the two recipes or a little more. Based on the analysis of the three manuscripts, Petzold concluded that the *DCM* existed in England before the 12th century, at least «in an embryonic state» (Petzold 1995: 61), and that its origin must probably be sought there.

Sandro Baroni (1996: 128) recognised a real literary form – with a structure that suggests a possible mnemotechnical use – within the recipes of the *DCM* on the mixtures of pigments.[5] Similarly to Tolaini, Baroni then insisted on the wide diffusion of these instructions which survived, repeatedly reworked and translated, until at least the 15th century. Furthermore, the *DCM* is considered to be a part of those «literary materials elaborated or coming from other traditions» (Baroni 1996: 122) that were associated with *Mappae clavicula* during the Middle Ages.

Finally, a state of the art on the *DCM* is proposed by Silvia Bianca Tosatti in 2007,[6] who hypothesises parallelism between the precepts of the *DCM* and the contemporary figuration of the Ottonian age, with its innovative and abstracting characteristics and the use of saturated and bright colours, imitating the splendor of semi-precious stones and enamels.

We do not know of recent studies dedicated specifically to the *DCM*,[7] if not generic

[5] See also Baroni–Travaglio (2016: 72-73) and Baroni–Rinaldi–Travaglio (2018: 59).

[6] The chapter is taken up in part by Tosatti (2001: 26-33). The scholar will return briefly to the question in Tosatti (2011: 91-92).

[7] With the exception of Borea D'Olmo (2012), from which part of the observations presented here derives.

citations of the work in broader contributions on Mediaeval technical literature[8] or devoted to other treatises.[9] In general, it seems that the *DCM* does not draw proper attention from scholars and that it is often omitted or cited without any further in-depth analysis.[10]

3. The manuscript tradition and transmission of the *DCM*

The *DCM* or parts of it, with more or less extended variants, are currently attested in at least sixty-five manuscripts starting from the end of the 11th century and reaching up to the 17th century. The data can be obtained from the census carried out by Johnson (1935a, 1935b, 1937) in the 1930s, to which some other manuscripts have been added.[11]

The following table (cfr. Table 2), which includes codices containing even just one or two recipes of the *DCM,* shows a list of the sixty-five manuscripts witnesses, chronologically arranged, with the indication of their content and – where possible – of the folios and the works with which the *DCM* is associated.[12] For convenience, we use Johnson's numbering of the recipes (AA-A11). The prescriptions that contain significant variants are indicated in round brackets (X).

AA	Verse prologue	A6	Rouen green (verdigris)
A1	Vermilion	A7	Red and white lead
A2	Silver-blue	A8	List of pigments
A3	Blue made from copper	A9	Mixtures of pigments
A4	Blue vegetable	A10	Mixtures of pigments
A5	Greek green (verdigris)	A11	Incompatibilities

Table 1. Legend

[8] For instance, Clarke (2011) and (2013); Baroni–Travaglio (2016).

[9] This is the case, for example, of Brun (2015).

[10] The *DCM* does not appear, for instance, in Bordini (1991) or in Muñoz Viñas (1998).

[11] Trier, Stadtbibliothek, 1024/1936 4° (Halleux 1990: 178); London, British Library, Additional 41486 (Thorndike–Kibre 1963: col. 167; Clarke 2001: 82); Oxford, Merton College, 324 (Thorndike 1959: 6); Ferrara, Biblioteca Ariostea, Cl.II.147 (Travaglio 2009-2010). Unfortunately, due to current restrictions of the coronavirus epidemic, we have not been able to view and check all the manuscripts witnesses cited by Johnson, but only the half of them. For the rest, the recipes identified by Johnson are indicated. In some cases, it was possible to correct or implement the information provided by Johnson and, where necessary, the shelf marks of the manuscripts were updated according to the current library numbering.

[12] The manuscripts that preserve only similar recipes, with significant variants or translated into vernaculars, which we will discuss in paragraph 6, are not included.

MANUSCRIPT	LIBRARY	DATE	AA	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
Cotton Nero A vii (f. 40v)	London, British Library	end of the 11th c.[1]		X	X									
Phillipps 3715 (ff. 1r-4r) ***Mappae clavicula*** (and *Compositiones*)	Corning (New York), Museum of Glass	12th c.	X	X	X	X	X	X	X	X	X	X	X	X
Royal 7 D ii (ff. 20v-22v)	London, British Library	12th c.		X	X	X	X	X	X	X				
Cotton Titus D xxiv (ff. 128v-129r, 129v-130v)	London, British Library	12th c.		X	X	X		X	X		X	(X)	(X)	X[2]
Harley 3915 (ff. 118v-119r) **Theophilus'** ***Schedula***	London, British Library	12th c.		X	X						X	X	X	
Egerton 840 A (f. 6r) **Theophilus'** ***Schedula***	London, British Library	13th c.	X											
Sloane 342 (f. 132r)	London, British Library	13th c.		X	X	X	X	X						
Additional 41486 (ff. 104v-105v) ***Mappae clavicula*** (and *Compositiones*)	London, British Library	13th c.	X[3]	X		X		X	X	X				
Bodley 679 (ff. 31r-v) ***Mappae clavicula*** (and *Compositiones*)	Oxford, Bodleian Library	13th c.	X	X	X	X	X	X	X	X	X	X	X	X
Digby 162 (ff. 5v, col. II, 6r, col. I) ***Mappae clavicula*** (and *Compositiones*)	Oxford, Bodleian Library	13th c.	X	X	X	X	X							
Ee 6.39[4] (ff. 147r-148v) **Theophilus'** ***Schedula*** ***Mappae clavicula*** (excerpts)	Cambridge, University Library	13th c.	X	X	X	X	X	X	X	X	X	X	X	X
Cod. XXIX, plut. 30[5]	Florence, Biblioteca Medicea Laurenziana	13th c.				(X)		X		X				
125[6] **Liber de coloribus illuminatorum sive pictorum**	Oxford, Corpus Christi College	13th-15th c.								X	X			
Royal 12 B xxv (f. 252r)[7]	London, British Library	14th c.		X		X								
173 (ff. 189v-192r) ***Mappae clavicula*** **Theophilus'** ***Schedula*** (excerpts)	Oxford, Magdalen College	14th c.	X	X	X	X	X	X	X	X	X	(X)	(X)	X[8]
Hunterian 110[9] (ff. 9v-10v) ***Mappae clavicula*** (and *Compositiones)* ***Secretum philosophorum***	Glasgow, Glasgow University, University Library	14th c.	X	XX	XX	X(X)	X	X(X)	XX	X	X	X	X	X
Additional 32622 (ff. 5v-7r)[10] ***Secretum philosophorum***	London, British Library	14th c.		X	X				X					
Egerton 2852 (ff. 8r-9r)[11] ***Secretum philosophorum***	London, British Library	14th c.		X	X				X					
Harley 273 (ff. 210r-211v) **Liber de coloribus illuminatorum sive pictorum**	London, British Library	14th c.		X	X	X	X	X	X	X	X	X	X	X
Sloane 1754 (ff. 144v-146v) **Liber de coloribus illuminatorum sive pictorum**	London, British Library	14th c.		(X)	X	(X)	X	(X)	(X)	(X)	XX[12]	(XX)	(XX)	(X)[13]

[1] The dating refers to the fragment of leaf in which the recipes are found, inserted in the manuscript later (Petzold 1995)
[2] The manuscript preserves only an extract of A11 recipe.
[3] The manuscript holds only the first two lines of the verse prologue.
[4] MS 1131 in Johnson (1935b: 77).
[5] According to Johnson (1937: 90), the manuscript includes the A1, A2, A5, A7 recipes. Instead, as noted by Thorndike (1960: 66), «A5 and A7 correspond closely to the recipes for verdigris and minium» of the DCM (f.73
[6] According to Johnson (1935b: 80).
[7] According to Johnson (1935a: 75; 1935b: 79).
[8] The manuscript contains just a fragment of the A11 recipe.
[9] The MS Hunterian 110 is a descriptus of the MS Phillipps 3715, at least as far as the textual sections of the DCM, Mappae clavicula and Compositiones (Brun 2013: 207-208).
[10] According to Johnson (1935b: 78).
[11] According to Johnson (1935b: 78).
[12] The second recipe is just a fragment.
[13] The manuscript contains just a fragment of the A11 recipe.

Digby 37 (f. 5r-v)[14] ***Secretum philosophorum***	Oxford, Bodleian Library	14th c.		X					X					
Digby 71 (ff. 86r-87v)[15] ***Secretum philosophorum***	Oxford, Bodleian Library	14th c.		X	X				X					
Digby 153 (ff. 148v-149r)[16] ***Secretum philosophorum***	Oxford, Bodleian Library	14th c.		X	X				X					
Rawlinson C 7 (ff. 52v-53v)[17] ***Secretum philosophorum***	Oxford, Bodleian Library	14th c.		X	X				X					
B.6.4[18] ***Secretum philosophorum***	Lincoln, Cathedral Chapter Library	14th c.		X	X	(X)		(X)	X					
Latin 7400A (ff. 28r, col. I-30r. col. I)	Paris, Bibliothèque Nationale de France	14th c.		X	X	X	X	X	X	X	X			
1939[19] (29v, 58v, 59r)	Lucca, Biblioteca Statale	14th c.		X						X				
Palat. Latin 1330 (f. 204v)[20]	Città del Vaticano, Biblioteca Apostolica Vaticana	14th-15th c.		X										
Additional 18752 (ff. 2r-3r)[21] ***Secretum philosophorum***	London, British Library	14th-15th c.		X	X				X					
Sloane 2584 (f. 7r-v)[22]	London, British Library	14th-15th c.				X								
H 277 ***Liber diversarum arcium***	Montpellier, Bibliothèque interuniversitaire, Faculté de Médecine	14th or 15th c.			X	(X)		X	X	(X)	(X)	(X)	(X)	(X)
Latin 6741 (ff. 43r, 54r, 57r-58r, 79r-81r) **Theophilus'** ***Schedula*** **Petrus de Sancto Audemaro** **Heraclius'** ***De coloribus et artibus Romanorum***	Paris, Bibliothèque Nationale de France	dated 1431	X	X	X	X	(X)	(X)	(X)	(X)		(XX)	(XX)	(XX)
Voss. Chym. octavo 6[23] (ff. 137r-138r)	Leiden, Bibliotheek der Rijksuniversiteit	15th c.				X	X	X	X	X		X		
1024/1936 4° (ff. 163r-164r)	Trier, Stadtbibliothek	15th c. or 16th c.[24]	X	X	X	X	X	X	X	X	X	X	X	X
Cotton Julius D viii[25] (ff. 85v-87v)	London, British Library	15th c.	X	X	X	X	X	X	X	X	X	X	X	X
Sloane 962 ***Secretum philosophorum*** (extracts)[26]	London, British Library	15th c.		X										
413/630 (ff. 2v-3r)[27] ***Secretum philosophorum***	Cambridge, Gonville and Caius College	15th c.		X					X					
O.1.57[28] (f. 18r)	Cambridge, Trinity College	15th c.		X				(X)	X					
O.1.58[29] (ff. 4v-5v) ***Secretum philosophorum***	Cambridge, Trinity College	15th c.		X	X	(X)		(X)	X					
O.2.40[30] (f. 10v) ***Secretum philosophorum***	Cambridge, Trinity College	15th c.		X		(X)		(X)						
O.7.23[31] (ff. 3r-4v) ***Secretum philosophorum***	Cambridge, Trinity College	15th c.		X	X	(X)		(X)	X					
Ii. iii. 17 (f. 36v)[32]	Cambridge, University Library	15th c.		X					X					
Sloane 2579 (ff. 5v, 6r, 7r)[33] ***Secretum philosophorum***	London, British Library	15th c.		X					X					
Digby 67 (ff.41r-42r)[34]	Oxford, Bodleian Library	15th c.		X	X	X	X	X	X	X				
Rawlinson C 212 (ff. 15r-16v)[35]	Oxford, Bodleian Library	15th c.		X	X	X	X	X		X				
Rawlinson D 1066 (ff. 1v-2r)[36] ***Secretum philosophorum***	Oxford, Bodleian Library	15th c.		X	X				X					

[14] According to Johnson (1935b: 79).
[15] According to Johnson (1935b: 80).
[16] According to Johnson (1935b: 80).
[17] According to Johnson (1935b: 80).
[18] According to Johnson (1935b: 77-78).
[19] According to Johnson (1937: 91).
[20] According to Johnson (1937: 91).
[21] According to Johnson (1935b: 78).
[22] According to Johnson (1935b: 79).
[23] According to Johnson (1937: 89).
[24] The manuscript is dated back to the 15th century by Schippergers (1964: 152) and to the 16th century by Keuffer (1888-1931: 156).
[25] Unfortunately, we were unable to view directly or to obtain a copy of this important manuscript due to current restrictions of the coronavirus epidemic.
[26] According to Clarke (2009: 51).
[27] According to Johnson (1935b: 77).
[28] 1081 in Johnson (1935b: 77).
[29] 1082 in Johnson (1935b: 77).
[30] 1144 in Johnson (1935b: 77).
[31] 1351 in Johnson (1935b: 77).
[32] According to Johnson (1935b: 77).
[33] According to Johnson (1935b: 79).
[34] According to Johnson (1935b: 79-80).
[35] According to Johnson (1935b: 80).
[36] According to Johnson (1935b: 80).

132 (ff. 2v-3v)[37] ***Secretum philosophorum***	Oxford, Corpus Christi College	15th c.		X	X				X					
277 (f. 33v)[38] ***Secretum philosophorum***	Oxford, Corpus Christi College	15th c.		X										
9 (ff. 85v, 89r, 90r)[39]	Oxford, Trinity College	15th c.		X	X				X					
324 (ff. 230v-231v)	Oxford, Merton College	15th c.		X	X	X	X	X	X	X				
Guelf. 627 Helmst. (f. 43r-v)[40]	Wolfenbüttel, Herzogliche Bibliothek	15th c.		X										
Guelf. 912 Helmst. (f. 97r)[41]	Wolfenbüttel, Herzogliche Bibliothek	15th c.				X								
Guelf. 1127 Helmst. (ff. 102v, 104v, 108v-109r) **Theophilus'** ***Schedula***	Wolfenbüttel, Herzogliche Bibliothek	15th c.	X	X	X	X[42]		X	X		X	X	X	X
Guelf. 19.1 Aug. 4° (f. 144r)[43]	Wolfenbüttel, Herzogliche Bibliothek	15th c.			X									
Ashb. 144 (ff. 158r-v)[44]	Florence, Biblioteca Medicea Laurenziana	15th c.		X				X		X				
F. VI 4 (f. 177r)[45]	Genoa, Biblioteca Universitaria	15th c.						X		X				
773 (f. 125r)[46]	Genoa, Biblioteca Civica Berio	15th c.									X			
1075 (ff. 35r-38r) **Scripta colorum**	Lucca, Biblioteca Statale	15th c.		X	X	X	X	X			X	X	X	
90 (f. 128v)[47]	Poppi (Arezzo), Biblioteca Comunale	15th c.			X				X					
Palat. 860 (ff. 3v-4r)[48]	Florence, Biblioteca Nazionale Centrale	15th-16th c.		X	X									
740 (f. 24r-v)[49]	Florence, Biblioteca Riccardiana	15th-16th c.			X	X								
Magl. XVI-118 (ff. 107v, 150r-v)[50]	Florence, Biblioteca Nazionale Centrale	16th c.		X	X			X	X					
Cl.II.147 (f. 80r)	Ferrara, Biblioteca Ariostea	16th c.											X[51]	
947 (f. 2v)[52]	Florence, Biblioteca Riccardiana	17th c.			X									
Sloane 781 (pp. 17-19) **Theophilus'** ***Schedula***	London, British Library	1699	X	X	X	X	X	X	X	X	X	X	X	X

[37] According to Johnson (1935b: 80).
[38] According to Johnson (1935b: 80).
[39] According to Johnson 1935b: 80.
[40] According to Johnson (1937: 88).
[41] According to Johnson (1937: 88).
[42] The manuscript contains only a fragment of the A3 recipe because the copying of the text was interrupted.
[43] According to Johnson (1937: 88).
[44] According to Johnson (1937: 90).
[45] According to Johnson (1937: 90).
[46] According to Johnson (1937: 90).
[47] According to Johnson (1937: 91).
[48] According to Johnson (1937: 89).
[49] According to Johnson (1937: 90).
[50] According to Johnson (1937: 89).
[51] The manuscript contains only a fragment of the A10 recipe. The so-called "Pseudo-Savonarola's recipe book" is a thematic collection, where every quire was designed to contain recipes copied from different sources dividing them by content (Travaglio 2016c). In the quire devoted to green colour, we find the passage related to the Greek green, in a version closer to the first handed down in London, Sloane 1754 (Liber de coloribus illuminatorum sive pictorum): Ferrara, Biblioteca Ariostea, MS Cl.II.147, f. 80r: «De viride colore. Viride incide de nigro, maptizabis de albo plumbo. Item misce viride cum albo plumbo, incide de viride, maptizabis illud de albo facto de plumbo». This quire of the Pseudo-Savonarola's recipe book contains also other passages of the Sloane 1754: (f. 79r) «De viride terestri molendum est […]» and «De viride greco. Viride de Gretia in vase eneo pones […]», corresponding to the recipes 1 and 6 of the first chapter of the Liber de coloribus illuminatorum sive pictorum according to the edition of Thompson 1926a: 282; (f. 80r) «De viridi. Viride nunquam de aceto distenperabis […]», corresponding to the recipe 20 of the same chapter according to the edition of Thompson 1926: 286.
[52] According to Johnson (1937: 90).

Table 2. List of the manuscripts of the *DCM* tradition.

On the basis of the examination of this table, certain observations may be made on the tradition and transmission of the *DCM*.

The most extended version of the *DCM* is found in nine manuscripts: Corning, Phillipps 3715 (12th c.) and its *descriptus* Glasgow, Hunterian 110 (14th c.); Oxford, Bodley 679 (13th c.); Cambridge, Ee 6.39 (13th c.) and its *descriptus* London, Sloane 781 (1699); Trier, 1024/1936 4° (15th c.);[13] London, Cotton Julius D viii (15th c.). To these we can add London, Harley 273 (14th c.) and Paris, Latin 6741 (1431), in which respectively only the

[13] Our gratitude to Dr. Eva Seidenfaden from the Stadtbibliothek of Trier to sending us information about the manuscript and its correct shelf mark.

verse prologue (AA) and the A8 recipe are missing.

Other five codices show an almost complete version: London, Cotton Titus D xxiv (12th c.; - AA, A4, A7);[14] Oxford, Magdalen 173 (14th c.; - A9, A10); London, Sloane 1754 (14th c.; - AA, A11); Lucca, 1075 (15th c.; - AA, A6, A7, A11); Wolfenbüttel, Guelf. 1127 Helmst. (15th c.; -A3, A4, A7). The missing recipes vary from manuscript to manuscript, but in general the prologue in hexameters (AA) seem to be missing more frequently, while the recipes for the making of pigments, at least from A1 to A6, are copied by all the mentioned codices.

While examining the codices that preserve the text of the *DCM* in an extended version, one can note that the recipes follow the *consecutio* AA-A11 only in half of them: Corning, Phillipps 3715 (12th c.) and its *descriptus* Glasgow, Hunterian 110 (14th c.); Oxford, Bodley 679 (13th c.); Cambridge, Ee 6.39 (13th c.) and its *descriptus* London, Sloane 781 (1699); Oxford, Magdalen 173 (14th c.); Trier, 1024/1936 4° (15th c.). We can assume that London, Cotton Julius D viii (15th c.) also follows the same sequence.[15] On the contrary, in London, Cotton Titus D xxiv (12th c.);[16] London, Sloane 1754 (14th c.);[17] Paris, Latin 6741 (1431);[18] Lucca 1075 (15th c.);[19] Wolfenbüttel, Guelf. 1127 Helmst. (15th c.)[20] the recipes are not contiguous, since the *DCM* is incorporated into other treatises according to an interpolation mechanism.[21]

Most manuscripts contain only a few recipes of the *DCM*, generally belonging to the second section (A1-A7). In this case it is not possible to distinguish whether they are real extracts from the *DCM* or rather isolated recipes with a common origin to those of the *DCM* but with an independent tradition.

The recipes on making pigments of the *DCM* alone (A1-A7 or A1-A8) are found in five manuscripts: London, Royal 7 D ii (12th c.; A1-A7); Paris, Latin 7400A (14th c.;

[14] The A9-A10 recipes contains additional formulas and the arrangement of the pigments is different. Moreover, the manuscript contains only a fragment of the A11 recipe.

[15] According to the indication of folios in Johnson (1935a: 74).

[16] A5, A6 (ff. 128v-129r); A1-A3, A8-A11 (ff. 129v-130v), within the *De distemperandis coloribus ad scribendum vel illuminandum*.

[17] A8, A9, A10, A11 (fragment), A8 (fragment), A9, A10 (fragment), A2-A4, A1, A5-A6 (ff. 144v-146v), within the *Liber de coloribus illuminatorum sive scriptorum*.

[18] AA (f. 43r); A5-A6 (54r); A2-A4 (57r); A1 (57v-58v); A9-A11, A7 (79r-81r). See below.

[19] A2, A3, A4, A1, A5, A8, A9, A10, within the *Scripta colorum.*

[20] AA (f. 102v); A8-A11 (ff. 104v); A2, A3 (fragment), A1, A5, A6 (ff. 108v-109r), within the Theophilus' *Schedula*.

[21] As we will see later, in Cotton Titus D xxiv the *DCM* is mingled with other technical recipes for book decoration, thus forming a text titled *De distemperandis coloribus ad scribendum vel illuminandum* (f. 127r; Petzold 1995); in Sloane 1754 it is contained within the *Liber de coloribus illuminatorum sive pictorum*; in Paris Latin 6741 it is dismembered and its recipes divided between the Theophilus' *Schedula diversarum artium*, the treatise of Petrus de Sancto Audemaro and the so-called Third Book of Heraclius; in Lucca 1075 it is contained within the *Scripta colorum*; in Guelf. 1127 Helmst. the recipes of the *DCM* interpolate the Theophilus' text.

A1-A8); Oxford, Digby 67 (15th c.; A1-A7); Oxford, Rawl. C 212 (15th c.; A1-A5, A7); Oxford, Merton 324 (15th c.; A1-A7). In two other manuscripts, this section is present in a partial form: London, Sloane 342 (13th c.; A1-A5); London, Add. 41486 (13th c.; AA, A1, A3, A5-A7).

The *DCM* (or parts of it) is contained in six manuscripts that preserve also *Mappae clavicula*:[22] Corning, Phillipps 3715 (12th c.) and its *descriptus* Glasgow, Hunterian 110 (14th c.); Oxford, Bodley 679 (13th c.); Oxford, Digby 162 (13th c.); London, Additional 41486 (13th c); Oxford, Magdalen 173 (14th c.). It would seem, therefore, that the *DCM* began to circulate as an addendum to *Mappae clavicula*, copied with this fundamental work on metallurgy that the Hellenistic world has handed down to the Latin Middle Ages (Baroni–Pizzigoni–Travaglio 2013). However, it is necessary to make an important distinction between two types of association. Only in Phillipps 3715 (and in its *descriptus* Hunterian 110), the text of the *DCM* is placed at the beginning of *Mappae clavicula*, preceded by the indication «Incipit libellus dictus Mappae clavicula» (f. 1r), even if it is only at the end of the last recipe of the *DCM* that begins the real prologue of *Mappae clavicula* (f. 4r), introduced by the indication «Incipit prologus sequentis operis». This suggests a clear and contiguous association between the two works. The same incipit appears in Trier, 1024/1936 4° (f. 163r): this manuscript does not contain *Mappae clavicula*, but testifies the association between it and the *DCM* still in the 15th-16th century.[23] It is interesting to mention that in the index of the alchemical books belonged to Dominicus, monk of the monastery of St Procolo in Bolonia, at the end of the 13th century, four *libri metrici* are cited, including one «dicitur Mappa clavicule [sic] per Robertum translata de arabico in latinum qui incipit 'Quere dei regnum prius et tibi cuncta dabuntur». Since we know that *Mappae clavicula* is not a work written in verse, it is clear that the passage refers to a manuscript in which the association between the *DCM*, with its *metricus* prologue, and *Mappae clavicula* was made.[24] On the contrary, in the other manuscripts, the *DCM*

[22] Only manuscripts containing the text of *Mappae clavicula* in an extended version are considered and not in a small number of recipes. Phillipps 3715, Bodley 679 and Hunterian 110 also contain the text of the *Compositiones*, while Digby 162 and Magdalen 173 preserve only a few recipes.

[23] It is likely that its antigraph was mutilated or incomplete or that the copyist of the codex today in Trier intentionally interrupted the copy at the end of the *DCM*, then continuing to compile the volume with other literary materials.

[24] The index is preserved in Palermo, Biblioteca Comunale, 4 Qq.A.10, ff. 389v-390v (Thorndike–Kibre 1963: col. 1191). The cited 'Robertus' has been identified in Robert of Chester by Steinschneider (1904: 72) and this would help to demonstrate that *Mappae clavicula* and the *DCM* passed through the *milieu* of the translators from Arabic (Halleux 1990: 178). According to Schipperges (1964: 151-152), the text of this book, now lost, would correspond to that preserved in Trier, Stadtbibliothek, 1024/1936 4°, f. 163r. Actually, the text cited in the Palermo index has not yet been identified in a manuscript and the Trier codex simply represents a witness of the *DCM* which, like Phillipps 3715, begins with the prologue in verse preceded by the words «Incipit libellus Mappe Clavicula dictus». In the Trier manuscript the verse prologue is also followed by an index of the *DCM*, absent in all other known codices: «Primo de vermiculo. II° De

is simply present within the same codex together with *Mappae clavicula* and other texts, thus testifying to an interest in the same subject by the compiler: in Bodley 679 the recipes of the *DCM* intersperse the text of the *Compositiones*;[25] in Digby 162 they are placed independently, with the hexameters at the end of the text; in Additional 41486 they are inserted after *Mappae clavicula*, *Compositiones* and other texts; in Magdalen 173 we find the *DCM*, other recipes and then *Mappae clavicula* seamless, without any prologue or title. In both cases, however, the fact that works like these, albeit of different content, were associated or copied together demonstrates not only the *auctoritas* recognised to them, but probably also the perception of a common antiquity of the texts. The *DCM-Mappae clavicula* association can be identified from the mid-12th century in Phillipps 3715[26] and then in the following century only in codices of the "α family" of *Mappae clavicula* (Baroni–Travaglio 2013), almost all of English or Northern European origin.[27] In these cases, it is generally the extended version of the *DCM* that is handed down or large portions of the text, with the exception of Digby 162. On the contrary, the *DCM* is absent in the manuscripts of the "β family", of predominantly Italian origin.[28]

Starting from the 12th-13th century, the *DCM* is copied with another capital technical treatise of the Middle Ages, the Theophilus' *Schedula diversarum artium*. Both texts are found in six manuscripts: London, Harley 3915 (12th c.); London, Egerton 840A (13th c.); Cambridge, Ee 6.39 (13th c.) and its *descriptus* London, Sloane 781 (1699); Paris, Lat. 6741 (1431); Wolfenbüttel, Guelf. 1127 Helmst. (15th c.).[29] Even in this case it is necessary to distinguish between different types of association. In two of the main codices of the tradition, Egerton 840A and Lat. 6741, the introductory hexameters of the *DCM* (AA) are used as a metric prologue to Theophilus' work, thus anticipating the preface of the first book (Johnson 1938: 87). In other manuscripts the *DCM*, in excerpts not contiguous (Harley 3915) or in the more extended version (Ee 6.39, Sloane 781), is copied at the end of the *Schedula*. Instead, Guelf. 1127 Helmst. contains the verse prologue at the end of

lazorio. III° De viride greco. 4° De viride rotomagense. V° De minio rubeo et albo. 6° De naturalibus coloribus in pergameno quot sunt».

[25] ff. 27r-30v, *Compositiones*; ff. 31r-v, *DCM*; ff. 31v-32v, *Compositiones*.

[26] The *DCM* is absent in the oldest codex of the *Mappae clavicula* tradition, the MS 17 of the Bibliothèque Humaniste of Sélestat (10th c.).

[27] Phillipps 3715: Flanders or England (Phillipps 1847: 183), Germanic area (Smith–Hawthorne 1974: 6), Northern France (Roosen-Runge 1967: 70); Oxford, Digby 162: England; London, Additional 41486: probably copied in Italy; Oxford, Bodley 679: probably England; Glasgow, Hunterian 110: England; Oxford, Magdalen 173: unknown.

[28] Madrid, Biblioteca Nacional, 19 (Kroustallis 2013): Santa Maria of Ripoll in Catalonia (Burnam 1912: 6) or Monte Cassino Abbey (García Avilés 2001: 116-120); Paris, BnF, Lat. 7418: Italy; Florence, Biblioteca Nazionale Centrale, Palatino 951: Southern Italy. For a summary of the *Mappae clavicula* manuscript tradition see Brun 2013.

[29] Oxford, Magdalen 173 (14th c.) contains also some excerpts of the Theophilus' *Schedula* (ff. 196v-201r), but the *DCM* is placed before *Mappae clavicula* (ff. 189v-191v).

the preface to the first book by Theophilus, which is interpolated with some recipes of the *DCM*: the formulas on mixtures (A8-A11), with variants (f. 104v), and the A1, A2, A5, A6 recipes (ff. 108v-109r).

The MS Lat. 6741, compiled by Jean Le Bègue in 1431 (Merrifield 1849: I, pp. 1-321; Tosatti-Soldano 1983), represents a particular case of "reuse" of the *DCM*. First of all, as we have seen, the hexameters are used as a verse prologue for the Theophilus' work (f. 43r). Then, the recipes on the making of pigments of the *DCM* became part of the treatise of Petrus de Sancto Audemaro, who placed them in the thematic order of his compilation: first the greens (f. 54r, A5-A6), then the blues (f. 57r, A2-A4) and the reds (f. 57v, A1). All the recipes, with the exception of that for artificial vermilion (A1), appear in a broader and more detailed version, as if they had been the object of an editorial review by the author of the compilation.[30] Finally, we find the instructions on the mixtures of pigments (A9-A11) and the A7 recipe within the so-called Third book of Heraclius (ff. 79r-81r). This text is an anonymous collection of prescriptions of various kinds later added to the two metric books of Heraclius' *De coloribus et artibus Romanorum* (Garzya-Romano 1996), which is testified with the indication «tercius liber et prosaicus Eraclii» only in this codex (f. 68v).[31] Here the A9-A11 recipes appear in two different contiguous versions and with different variants compared to the more common of the *DCM*. The first version of the A11 recipe (*De coloribus sibi contrariis*) is particularly interesting since it contains wider observations on the incompatibilities between pigments.[32] Observing the Jean Le Bègue manuscript, it seems that the so-called Third book of Heraclius contains literary materials "discarded" by the compiler, evidently since they were not considered useful for the purpose of his treatise. In this sense, what happened to the *DCM*, broken up into its three parts and dismembered, is emblematic.

Starting from the 14th century, some recipes common to the *DCM* are found into a treatise on liberal arts called *Secretum philosophorum*, which probably originated in England (Clarke 2009). In its first section, devoted to Grammar, some technical recipes for a *recta scriptura*[33] appear, among which the A1, A2 and A6 recipes of the *DCM* placed

[30] The A2 recipe contains a digression on the impurities of silver, probably added by Petrus de Sancto Audemaro. In the following recipe we also find some possible additions relating to the place in which to put the ampoule for a month. In the A4 recipe the additions attributable to Petrus de Sancto Audemaro have significantly modified the original recipe. The A5 recipe is similar to the version contained in Sloane 1754 (*Liber de coloribus illuminatorum sive pictorum*).

[31] Heraclius' so-called "Third book" is also preserved in London, British Library, Egerton 840 A (13th c.; ff. 20r-25r), but in an abridged version which does not contain, for example, the *DCM* recipes nor the reference to Heraclius.

[32] It should be noted that in the pseudo-Heraclius' compilation there are also other passages dedicated to the mixtures of pigments, derived in this case from chapter XXII of the Faventinus interpolation and displayed in a new order (Baroni 2016a: 131, nota 5).

[33] «Grammatica docet recte scribere et recte loqui. In ordine ex quo patet quod dividitur in duas

in their respective thematic sections (inks, reds, greens, blues). Actually, the only recipe that finds textual correspondence in the *DCM* is that for Rouen green (A6), while those for vermilion and silver-blue seem to be reduced versions of the A1 and A2 recipes. The *Secretum philosophorum* also preserves two recipes similar to the A3 and A5 for the preparation of Greek green and lime blue, but whose variants are so numerous as not to allow us to hypothesise a direct lineage between the texts. This "association" is found in at least fifteen manuscripts:[34] London, Add. 32622 (14th c.); London, Egerton 2852 (14th c.); Oxford, Digby 37 (14th c.; A1 and A6); Oxford, Digby 71 (14th c.); Oxford, Digby 153 (14th c.); Oxford, Rawl. C7 (14th c.); Lincoln, B.6.4 (14th c.);[35] London, Add. 18752 (14th c.); Cambridge, 413/630 (15th c.; A1 and A6); Cambridge, O.1.58 (15th c.); Cambridge, O.7.23 (15th c.); London, Sloane 2579 (15th c.; A1 and A6); Oxford, Rawl. D1066 (15th c.); Oxford, 132 (15th c.). To these Glasgow, Hunterian 110 (14th c.) must be added, which preserves recipes A1-A3, A5-A6 repeated twice: the first within the *DCM*, the second in association with the *Secretum philosophorum*. According to Johnson (1935a: 75 and 1935b: 80), London, Sloane 962 (15th c.) and Oxford, 277 (15th c.) contain only the A1 recipe within the *Secretum philosophorum*. The same occurs in Cambridge, O.2.40 (15th c.).[36]

During the 14th and 15th centuries the *DCM* continued to be read and copied. Sections of the text are incorporated into other treatises or used, mingled with thematically related recipes, to create new treatises. It is the case of the *Liber de coloribus illuminatorum sive pictorum* (14th c.; Thompson 1926a, 1926b), which preserves several recipes of the *DCM*, often with substantial variants, mingled with other technical prescriptions.[37]

partes. Ideo de prima parte dicendum est, scilicet, de recta sciptura. Sunt autem multe cautele circa sciptu-ram que paucis sunt note. Set quia nemo potest scribere sine debitis instrumentis, ideo de instrumentis eius primo dicendum est: color et materia quam debet scribi, et primo dicendum est de colore», prologue of the section on Grammar of the *Secretum philosophorum* in the MS Hunterian 110 (Clarke 2009: 53).

[34] Cambridge, O.1.58 and O.7.23 also contain the A2 recipe, albeit in a reduced version, not mentioned by Johnson, and a version with significant variants of the A5 and A7 recipes. It has not been possible for us to check all the codices of the *Secretum philosophorum* tradition, for which we can however hypotesise a similar composition. In the continuation of the research we reserve to verify the possible presence of the five recipes even where not indicated. For example, in his study on the *Secretum philosophorum,* Clarke (2009: 51) also cites the following manuscripts not mentioned by Johnson: Erfurt, Wissenschaftliche Allgemein-Bibliothek der Stadt, Amplonius Quarto 330 and Amplonius Quarto 361; London, BL, Additional 48179 and Harley 866; Cambridge, St. John College, 109 (E.6); Exeter, Cathedral Library, 3521; San Marino, California, Henry E. Huntington Library, HU 1051.

[35] The codex is quoted by Johnson (1935b: 77-78) who, however, could not analyse it directly. Not even for us it was possible to examine the manuscript, so we can only hypothesise that, similarly to most of the codices of the same tradition, it preserves the recipes A1, A2, A6 and, with variants, A3 and A5 within the *Secretum philosophorum*.

[36] According to Johnson (1935b: 77, 80; 1937: 89, 91), also the following manuscripts preserve a similar group of recipes, but do not contain the *Secretum philosophorum*: Cambridge, O.1.57 (15th c.; A1, A5, A6); Cambridge, Ii. iii. 17 (15th c.; A1, A6); Oxford, 9 (15th c.; A1, A2, A6); Florence, Pal. 860 (15th -16th c.; A1, A2); Florence, Magl. XVI.118 (16th c.; A1, A2, A5, A6); Poppi, 90 (15th c.; A2, A6).

[37] London, B.L., Sloane 1754, 14th c., ff. 142v-149r, *Incipit liber de coloribus illuminatorum sive*

Also the *Liber diversarum arcium*, a recipe book divided in four books preserved in the MS H 277 of the Bibliothèque interuniversitaire, Faculté de Médecine of Montpellier (14th-15th c.), contains numerous recipes of the *DCM*, divided into the various chapters that structure the compilation, some with significant variants (Libri 1849: 739-811; Clarke 2011).[38]

All the manuscripts containing the most extended version of the *DCM* have an English or North European origin (Northern France or Northern Germany).[39] The text and extracts of the *Secretum philosophorum* are also found «in manuscripts produced in England (or in an English-influenced foundation» (Clarke 2009: 51). At the best of our knowledge, there is only an Italian exemplar of the "*DCM* family": the 15th-century *Scripta colorum* published by Tolaini (1995a, 1995b). In this text on book illumination, preserved in the MS 1075 of the Biblioteca Statale of Lucca, eight recipes of the *DCM* are included in a wider dissertation on pigments (A1-A5, A8-A10), generally in a slightly different version and adapted to the new context (Lucca, Tuscany).

While studying the manuscript tradition in more detail, we can observe that the *DCM* had a particularly complex and articulated transmission. Summarising it for each century, we can note that:

- In the 12th century, the *DCM* circulated in its extended version associated with *Mappae clavicula* (and *Compositiones*), as testified by the manuscript Phillipps 3715,

pictorum; London, B.L., Harley 273, 14th c., ff. 209r-212v (no title); Oxford, Corpus Christi College, 125 (13th-15th c.), ff. 34r-36v, *Incipit liber de coloribus illuminatorum sive pictorum*. Sloane 1754, published by Thompson (1926a-1926b), contains in order: recipe A8; a version of the A9-A10 recipes similar to the second contained in the so-called Heraclius' Third book, which ends with the first line of the A11 recipe; a second version of the A9-A10 recipes, which begins with part of the A8 and ends with a portion of the A10; recipes A2 (= *DCM*), A3 (similar to *DCM*), A4 (= *DCM*), A1, A5-A7 (similar to *DCM*). The recipes generally constitute variants of the more widespread ones of the *DCM*, sometimes showing similarities with those contained in the treatise of Petrus de Sancto Audemaro. A7 recipe, on the other hand, is identical to the one incorporated in to the so-called Heraclius' Third book (Paris, BnF, Latin 6741). Harley 273, which does not include the incipit with the title of the work, contains all the *DCM* recipes without substantial variants and in the correct *consecutio*, with the exception of the A8 recipe: A8, A1-A11 (ff. 210r-211v). According to Thorndike (1959: 5), Oxford 125 should contain on f. 36r the A8 (as also indicated by Johnson 1935b: 80) and A7 recipes.

[38] According to Johnson (1935b: 85), the manuscript includes the A2, A5 and A6 recipes, but actually it contains: a variant of the A8 recipe (f. 82v, col. II); a variant of the A3 and A2 recipes (f. 82v, col. II); a variant of the A7 recipe (f. 86r, col. I-II); the A5 and A6 recipes (f. 87r, col. I-II); a significant variant of the section on the mixtures of pigments (A9-A11, f. 89v, col. I-II). In the third book on mural painting other instructions on mixtures are preserved, *Quomodo miscuntur colores* (f. 97r, col. II), based on the formula "mitte X et Y, fac Z, incide cum" or "mitte X et Y, incide cum Z".

[39] Phillipps 3715 (England, Flanders, Germanic area or Northern France); Hunterian 110 (England); Bodley 679 (England); Ee 6.39 (Lincoln, England); Sloane 781 (England); Cotton Julius D viii (England); Harley 273 (England); Latin 6741 (France, Paris?); Sloane 1754 (France?); Cotton Titus D xxiv (England); Guelf. 1127 Helmst. (Northern Germany). The place of origin of 1024/1936 4° and Magdalen 173 is unknown. Most of the oldest manuscript of the *DCM* tradition were also produced in England (Royal 7 D ii; Egerton 840A; Digby 162), in Germany (Harley 3915) or in France (probably Sloane 342).

but we find the text also independently of *Mappae clavicula*, in an almost complete version but untidily, with the recipes mingled with other technical prescriptions (London, Cotton Titus D xxiv: *De distemperandis coloribus ad scribendum vel illuminandum*). At the same time, some recipes circulated independently of the *DCM* (London, Royal 7 D ii, A1-A7 recipes) or incorporated into the Theophilus' *Schedula diversarum artium* (London, Harley 3915; cfr. Table 3).

12th century	
Extended version associated with *Mappae clavicula*	
Almost extended version within *De distemperandis coloribus ad scribendum vel illuminandum*	
"Excerpts" of the second section (A1-A7)	
"Excerpts" incorporated into Theophilus' *Schedula*	

Table 3. Scheme of the transmission of the *DCM* in the 12th century

- In the 13th century, "excerpts" of the second section of the *DCM* (A1-A7) continued to circulate in association with *Mappae clavicula* (London, Additional 41486; Oxford, Digby 162) and independently (London, Sloane 342; Florence, Plut. 30.29). Two manuscripts preserve the *DCM* in its more extended version: Oxford, Bodley 679, within *Mappae clavicula* (and *Compositiones*), and Cambridge, Ee. 6.39, at the end of the Theophilus' *Schedula*. The association with the latter work is testified also by London, Egerton 840A, which contains only the verse prologue (cfr. Table 4).

13th century	
"Excerpts" of the second section (A1-A7) associated with *Mappae clavicula*	
"Excerpts" of the second section (A1-A7) independently	
Extended version added to *Mappae clavicula*	
Extended version added to Theophilus' *Schedula*	
Verse prologue (AA) added to Theophilus' *Schedula*	

Table 4. Scheme of the transmission of the *DCM* in the 13th century

- In the 14th century, we find the more extended version of the *DCM* once again in association with *Mappae clavicula* (London, Magdalen 173; Glasgow, Hunterian 110) and then within the *Liber de coloribus illuminatorum sive pictorum* (almost complete and in the correct *consecutio* in London, Harley 273; dismembered and interpolated in London, Sloane 1754). At the same time, the A1, A2 and A6 recipes alone begun to circulate, generally within the *Secretum philosophorum* (Glasgow, Hunterian 110; London, Additional 18752, Additional 32622, Egerton 2852; Oxford, Digby 37, Digby 71, Digby 153, Rawlinson C7; Lincoln, B.6.4). One manuscript preserves the second section of the *DCM* (A1-A7) and the A8 recipe (Paris,

Latin 7400A; cfr. Table 5).

14th century	
Extended version associated with *Mappae clavicula*	
Extended version within the *Liber de coloribus illuminatorum sive pictorum*, in order or in disorder	
A1, A2 and A6 recipes within the *Secretum philosophorum*	
Second section of the *DCM* (A1-A7)	

Table 5. Scheme of the transmission of the *DCM* in the 14th century

- In the 15th century, three manuscripts contain the most extended version of the *DCM,* now circulating independently of *Mappae clavicula*: two of them (Trier, 1024/1936 4° and London, Cotton Julius D viii) contain its correct *consecutio*, while in the so-called Jean Le Bègue's manuscript (Paris, Latin 6741) the *DCM* is dismembered and mingled with other recipes due to the particular organisation of the codex. An almost complete version is testified by Wolfenbüttel, Guelf. 1127 Helmst., dismembered within the Theophilus' *Schedula*. Moreover, the only second section of the *DCM* has been continued to be copied, in "excerpts" mainly within the *Secretum philosophorum*, but also in a complete form (A1-A7; Oxford, Digby 67, Rawlinson C 212; Oxford, Merton 324). A particular version of the *DCM* is then contained in the *Liber diversarum arcium* (Montpellier, H 277) as well as in the *Scripta colorum* (Lucca, 1075; cfr. Table 6).

15h century	
Extended version independently of *Mappae clavicula*, in order or in disorder	
Almost extended version within the Theophilus' *Schedula*	
A1, A2 and A6 recipes within the *Secretum philosophorum*	
Second section of the *DCM* (A1-A7)	
Excerpts within the *Liber diversarum arcium*	
Excerpts within the *Scripta colorum*	

Table 6. Scheme of the transmission of the *DCM* in the 15th century

- "Excerpts" of the *DCM* are included in some codices between the 16th and the 17th centuries, mainly Italian, with the exception of London, Sloane 781, *descriptus* of Cambridge, Ee 6.39. The number of manuscript witnesses is destined to expand as further research progresses in other European contexts.

To sum up, from the 12th to the 17th century, the *DCM* circulated as follows (cfr. Table 7):

Extended version (or almost extended) in the correct *consecutio* or in disorder	• in association with *Mappae clavicula*	4
	• in association with Theophilus' *Schedula*	3
	• within the *Liber de coloribus illuminatorum sive pictorum*	2
	• within the *Scripta colorum*	1
	• dismembered (Jean Le Bègue manuscript)	1
	• independently	3
"Extracts" in the correct *consecutio* or in disorder	• second section (A1-A7), complete or partial	46
	• A1, A2, A6 within *Secretum philosophorum*	15
	• in association with *Mappae clavicula*	2
	• in association with Theophilus' *Schedula*	2
	• within the *Liber diversarum arcium*	1

Table 7. Scheme of the transmission of the *DCM*.

4. The structure and content of the *DCM*

The analysis of the manuscript witnesses has highlighted how the *DCM* is a work with an articulated and complex tradition, particularly lively and mobile, so much so that it is copied entirely or in part, in order or dismembered, with even significant variants, for at least six centuries, from the end of the 11th to the end of the 17th century. Up till now, the best-known and oldest version of the *DCM* – and the only one published so far – is the one preserved in the MS Phillipps 3715 of the Corning Museum of Glass (Phillipps 1847). What we observe in this codex is the "photograph" of the text at a given moment in the tradition, corresponding to its most extended known version.

In this important manuscript witness, the *DCM* is already characterised by a very precise structure, divided into three sections very distinguishable from each other in form and content: a prologue in hexameters, seven recipes for the production of pigments for book decoration and a list of pigments suitable for use on parchment followed by indications on their mixtures and incompatibilities.

4.1. *Verse prologue (AA)*

The *DCM* begins with a short metric composition, consisting of seven hexameters with internal disyllabic rhymes. These are Leonine verses, characterised by an internal rhyme between the two hemistiches, in caesura and at the end of the verse, widely used in Latin and Romance poetry during the Middle Ages.

Sensim per partes discuntur quaelibet artes.
Artis pictorum prior est factura colorum;
post ad mixturas convertat mens tua curas.
Tunc opus exerce, sed ad unguem cuncta coerce,
ut sit ad ornatum quod pinxeris et quasi natum.
Postea multorum documentis ingeniorum
ars opus augebit, sicut liber iste docebit.

Gradually, part by part, one learns every art.
In the art of painters, in the first place is the preparation of colours, then your mind should turn toward mixtures.
Then begin your work, and lead it to perfection, in order that what you have painted is beautiful and fresh.
Afterwards, as many talents have given testimony,
the art will advance the work as this book will teach.

The verses recall a sort of pedagogy of the *ars pictorum* made by steps: the making of colours and then the correct mixtures, followed by a meticulous execution and refinement where the art will be added to the work "placing it among the witnesses of ingenuity".

The formal analysis of the introductory passage in verse does not suggest chronological clues, but implies that the author must have been a person accustomed to metric composition. Even the presence of expressions that vaguely remember Horace and Cicero,[40] seems to prove the broad literary culture of this personality.

As anticipated, the hexameters also showcase an independent tradition from the *DCM*, as they appear associated with Theophilus' *Schedula diversarum artium* in some of its main witnesses. This was evidently due to the literary quality of the verses and the great mobility of the text, which could also use the mnemonic-oral vehicle in its diffusion.

As mentioned earlier, in the case of the MS Phillipps 3715, the association with *Mappae clavicula* is evident, not only because both texts were contiguously copied, but because the hexameters are preceded by the indication «Incipit libellus dictus Mappae clavicula» (f. 1r). Certainly, the verses that allude to the *ars pictorum* have nothing to do with the content of *Mappae clavicula*, however the prologue of the latter[41] and the

[40] We refer, for example, to the expression *ad unguem*, used by Horace to indicate a man of singular perfection («ad unguem factus homo», *Sat.* I, 5, 32).

[41] *Mappae clavicula*, prologue: «Multis et mirabilibus in his meis libris conscriptis, curae nobis fuit exponere commentarium, non ut attingentes sacros libros et multum laborantes nihilque efficientes videamus, sed distinguentes istam heresim fatali munere concessam, omnem picturam et laborem qui in ipsis actibus sunt, iuvemus ista volentibus perspicere, appellantes quidem huius compositionis cognominationem Mappae claviculam, ut omnis qui attigerit multa neque probaverit existimet clavis modo esse inhibitum. Sicuti enim clausis domibus sine clavi impossibile est facile potiri his quae in domibus sunt, ita et sine isto commentario omnis scriptura quae in sacris libris conscripta est clausum et tenebrosum sensum efficiet eius qui legerit. Coniuro autem per magnum deum qui invenerit nulli tradere nisi filio cum primum de moribus eius iudicaverit utrum possit pium et iustum sensum habere et ista conservare. Multa vero alia de virtutibus eorum quae conscribentur habens dicere digne, incipiens ab ipsis capitulis, nunc iam initium hic faciam»

hexameters of the *DCM* seem to suggest that only with practice – those precepts are collected in the literary works themselves – the profound meaning of the teachings can be understood.

4.2. *The recipes for the making of pigments (A1-A7)*

In accordance with the prologue («Artis pictorum prior est factura colorum»), the work begins with seven recipes for the production of pigments for book decoration. It is worth recalling that what we are going to describe is the *consecutio* of recipes testified by the manuscripts that preserve the most extended version of the *DCM*.

The first recipe (A1) is devoted to the manufacture of artificial vermilion[42] starting from a dose of quicksilver and two of sulphur (Thompson 1933a). The prescription, which had a wide diffusion from the 12th century, copied in many treatises and recipe books with numerous variants, actually explains a procedure already known in late antiquity. Through *Compositiones*,[43] we know that the technical procedure for the preparation of artificial vermilion was already known in the Latin Middle Ages before the dissemination of Arabic scientific works (Wallert 1990: 155; Kroustallis–Bruquetas 2014),[44] evidently derived from the Hellenistic-Roman tradition.

The reference to alchemical theories and, in particular, to the concept of the passage of matter through different states, is symbolised by the colours of the smoke that comes out of the ampoule, heating sulphur and quicksilver: first blue, then yellow and finally red like vermilion.[45]

Three recipes for the making of blue pigments follow, designated with the term *la-*

(Baroni–Pizzigoni–Travaglio 2013: 58).

[42] The recipe contains the term *vermiculum* (from which the Italian *vermiglione*, the French *vermeil*, the English *vermilion*), which deserves a clarification, given the frequent terminological confusion already originated in ancient times regarding red colours. The etymology of the word (from *vermis*, 'worm') is generally traced back to the cochineal and its respective colour, the kermes (formerly in the *Compositiones*: Lucca, Biblioteca Capitolare, MS 490, 8th c., f. 218r-v, *De pelle alithinae tinguere*; f. 225r-v, *Alia compositio vermiculi*). Although the term *cinnabar* existed, derived from the Greek κιννάβαριν, the red cinnabar (natural or artificial mercury sulfide) was generally indicated in the Roman world with the term *minium* (later used to designate the lead red), while in the Middle Ages the term *cinabrium* (and variants) is more frequently found. However, the term *vermiculum* to indicate cinnabar is found not only in the *DCM* starting from the end of the 11th century (London, BL, Cotton Nero A vii), finding then widespread diffusion in the following centuries, but also in a slightly earlier treatise, the *De clarea* (10th-11th c.; Baroni 2016b: 299-300). It is therefore likely that, at the end of the 11th century, the term *vermiculum* could mean both kermes and cinnabar.

[43] Lucca, Biblioteca Capitolare, 490, 8th c., f. 223v, *Operatio cinnabarin*; f. 229r, *Compositio cinnabarin alithinu mundi*.

[44] We refer, for example, to the works of Rhazes (865-925 CE) and Geber (c. 721-815), known in Europe only since the 12th century.

[45] We point out that the symbolism of the colours of the smoke coming out of the ampoule does not appear in the oldest witness, Cotton Nero A vii, nor in London, BL, Digby 162, which, as emerged from the studies of *Mappae clavicula* (Baroni–Travaglio 2013: 42), copied from a rather ancient manuscript.

zorium, without, however, any reference to lapis lazuli: silver-blue (A2);[46] a blue obtained from the exposure of copper and lime to vinegar vapours (A3);[47] finally, a blue achievable from *flores blavos,* blue-violet flowers (probably Gentian or Myosotis; A4).

Two recipes concern the production of green pigments. In the first case it is verdigris (Greek green), obtained by exposing copper to vinegar vapours (A5), according to a procedure similar to that described for blue. The second prescription is a variant, intended for making the so-called green of Rouen (A6), in which the exposure times are reduced and the foil is spread with soap before being subjected to the effects of the vinegar vapours.

Finally, we find a recipe for obtaining two colours starting from lead (A7). The first is a white pigment, commonly called white lead or *cerussa*, the second is an orange-red, called *minium* (red lead) or *cerussa usta*. However, the description of the two pigments in a single prescription would seem to be functional to the preparation of the second.

As Petzold (1995: 59) pointed out, these recipes «provided a vade mecum of pigments that might be manufactured comparatively easily, rather than having to be obtained from distant countries».

4.3. De diversis coloribus, De mixtionibus, Qui contrarii sibi sint colores *(A8-A11)*

The A8 recipe enumerates fourteen pigments suitable for use on parchment (*colores*

[46] When dealing with ancient recipes for the making of pigments, it is important to keep in mind that often the impurity of a single ingredient was enough to modify the final result. The procedure for obtaining silver-blue, widespread in the technical literature from the 12th century onwards, requires that plates of very pure silver be used to be subjected to the corrosive action of vinegar. On the contrary, as already pointed out by Thompson (1956: 154-155), copper impurities were required in the alloy to allow the formation of the characteristic blue-green efflorescence. The recipe of the *DCM* makes no mention of vinegar or other reagent to be added. As Thompson evidenced (1935b: 465, n. 37), «it is a striking illustration of the popularity of this recipe that the same omission occurs in transcripts found in at least ten other manuscripts». None of the manuscripts analysed contain a correct version of the A2 recipe, apart from Trier, Stadtbibliothek, 1024/1936 4° where, on f. 163r, col. II, we find the indication «accipe ollam novam quae nunquam fuit ad opus et mitte in eam laminas purissimi argenti quantas vis *et infunde acetum forte vel vinum*», probably added by conjecture by the copyist or in an earliest phase of the tradition.

[47] By subjecting the copper plates to the vapours of vinegar, a patina of verdigris, i.e. copper acetate, is formed. The addition of lime helps to facilitate the formation of a verdigris with a particular blue tone.

in pergameno):[48] blue,[49] vermilion,[50] dragon's blood, carmine, *folium*,[51] orpiment, Greek green (verdigris), *gravetum* (or *granetum*),[52] indigo, brown (*brunum*),[53] *crocus* (saffron), red or white lead, vine-charcoal black.[54] A recommendation for the tempering of pigments follows, made with egg glair (*glarea*), i.e. egg white whipped until stiff and left to rest to return to a liquid state.[55] In some manuscripts, it is specified that Greek green should not be tempered with glair.[56]

With a description that – as Tosatti (2007: 59) underlines – seems to echo Pliny's distinction between *austeri et floridi* colours (*Naturalis Historia,* XXXV, 30) and, more generally, a rhetorical form focused on dichotomy (Baroni 2016c), the pigments are here defined *spissi et clari*, that is dark/opaque and luminous/transparent.

The most original and well-known part of the *DCM* consists of the last three passages, which contain indications on how to mix and graduate pigments (A9-A10) and a brief reference to their incompatibilities (A11).

The rubrics A9 and A10 are arranged in a regular structure and short formulas which, replicated at least twenty-four times, scan the entire text.

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[48] Most manuscripts report this pigment sequence, with a few exceptions: London, BL, Cotton Titus D xxiv, f. 130r, does not contain *gravetum* and *brunum*, but adds *brasiletum rosam*; London, BL, Harley 273, f. 210r-v: «azorium, vermiculum, auripigmentum, viride grecum, sanguis drachonis, gravetum, indicum, caruminium, crocus, folium, brunum, minium album, nigrum»; Paris, BnF, 7400A, f. 30r, col. I, adds *rosa* e some possible glosses «nigrum bonum de carbonibus viti et melius de fumo incensi», «minium rubeum et album et melius album de apulia»; London, BL, Sloane 1754 adds *viride terrestre* in the first version of the A8 recipe; Montpellier, H 277, f. 82v, col. II adds *inclaustrum, viridis terra, ocrea, colores qui fiunt de suco herbarum et florum*; Lucca, Biblioteca Statale, 1075, includes a list with several variants: «azurum, vermiculum id est cinaprium, rosaceum, sanguis draconis, carminium id est laca, folium, auripimentum, viride grece id est terra viridis, viride ramum, indicum, crocus, cerusa id est minium, brunum, sinopia id est terra rubra, ocrea alba, ocrea rubra, brasil, album plumbum, nigrum».

[49] Typically referred to simply as *azorium*, it does not specify whether it is lapis lazuli or one of the blue pigments mentioned in the previous recipes (A2-A4).

[50] The list cites *vermiculum*, with probable reference to artificial vermilion (cfr. *supra*). In Lucca, Biblioteca Statale, 1075, *vermiculum id est cinaprium* is specified, while the Montpellier H 277 (82v, col. II) contains directly the entry *cinaprium*.

[51] It is not clear whether it is turnsole or the juice or extract of some other vegetable capable of producing colour variation between blue and pink based on the variation of ph (Guineau 1996).

[52] In the *Tabula de vocabulis sinonimis et equivocis colorum* (Paris, BnF, Latin 6741, f. 7r; Tosatti-Soldano 1983) one can find «Granetus est color de albo et viridi factus», so it should be a light green pigment.

[53] It should be a brown earth such as Sienna or Umber.

[54] Black is the only pigment for which the material useful for obtaining it is specified («nigrum optimum ex carbone vitis», Phillipps 3715, f. 2v), perhaps to distinguish it from the black used as ink.

[55] On the making of egg glair see *De clarea* (10th-11th c.; Thompson 1932; Straub 1964; Baroni 2016b).

[56] For instance: London, BL, Harley 273, f. 210v; Paris, BnF, Latin 7400A, f. 30r, col. I; London, BL, Sloane 1754. Instead, Paris, BnF, Latin 7400A, f. 30r, col. I, continues with other indications on the tempering of pigments, that could still be later *addenda*.

colour *misce cum* **colour**, *incide/incides de* **colour**, *matiza/matizabis de* **colour**
or
colour *incide/incides de* **colour**, *matiza/matizabis de* **colour**

Example:
Azorium *misce cum* **albo plumbo**, *incide de* **indico**, *matiza de* **albo plumbo.**
Carum minium *incides de* **bruno**, *matizabis de* **rubeo minio.**

For each colour these passages suggest a "ternary system", i.e. three gradations from dark to light: a medium value, that is the pure colour of the background, which can be generally obtained by mixing a pure pigment with white lead; a dark value, for which the verb *incidere* is used, which serves to shade, outline or trace in dark/to darken; finally a clear or light value, identified by the verb *matizare*, to highlight or outline clearly/to lighten (Bulatkin 1954: 498). The terms *incidere* and *matizare* are therefore antonyms: the *incisio* is made with a darker pigment than that of the background, while the *matizatura* is generally made with lead white.

As suggested by Baroni (1996), the text was evidently intended for memorization given the constant repetition of the same terms, in which only the name of the main pigment changed. Changing the names of the pigments or introducing new ones, the structure of the text remains unchanged. It is precisely this probable mnemotechnical use that facilitated the formation of variants and modifications in greater terms than other similar works handed down only in a written form. The analysis of the manuscript witnesses has in fact highlighted the presence of several versions of this section, which make it difficult even to hypothesise an original form. The most widespread version is the one preserved in Phillipps 3715, also found in Bodley 679, Cambridge Ee 6.39 (and Sloane 781), Harley 273, Sloane 1754 (second version), Wolfenbüttel Guelf. 1127 Helmst. and, most likely, Cotton Julius D viii.[57] The pigment sequence reflects faithfully the order stated in the previous list of recommended pigments to be used on parchment (A8), with the exception of *crocus*, which is correctly named after *brunum* but also moved before *indicum* by two positions (cfr. Table 8):

(A8) De diversis coloribus	**(A9-A10) De mixtionibus**
azorium	azorium
vermiculum	vermiculum vermiculum
sanguis draconis	sanguis draconis
carum minium	carum minium rosa de caro minio et albo plumbo

[57] As mentioned, it was not possible for us to examine the MS Cotton Julius D viii, which, according to Johnson (1935a: 74), would contain the most extended version of the *DCM*.

folium	folium folium
auripigmentum	auripigmentum
viride grecum	gladum viride viride (A10) viride grecum viride grecum
gravetum	gravetum
	crocus
indicum	indicum indicum
brunum	brunum rosa de bruno et albo plumbo
crocus	crocus
minium rubeum	minium rubeum minium rubeum carnatura de rubeo plumbo et albo
minium album	
nigrum	

Table 8. Correspondence between A8 and A9-A10 recipes

Those that appear as two recipes in Phillipps 3715, respectively titled *De mixtionibus* and *Temperatura* (A9-A10),[58] more likely made up originally a single prescription, as evidenced by other codices:[59] the A9 recipe, in fact, develops only six of the fourteen pigments listed for illumination, while the A10 continues where the previous recipe was interrupted, without any introductory gloss, including some rules for the tempering of pigments.

The following rubric (A11), which should concern the concordance between pigments, actually only briefly mentions them, at least according to the version handed down most frequently by the manuscript witnesses:[60] it is specified that the orpiment cannot be mixed with *folium*, green, lead red and lead white,[61] and that green cannot combine with *folium*. The exposition then continues with different themes: instructions for creating backgrounds in different colours; a recipe for chrysography with parchment glue, with no

[58] In this way also in London, BL, Harley 273, f. 211r-v: *De commixturis et matizaturis colorum diversorum* (A9)*, De distemperatione colorum diversorum* (A10), *De contrariis coloribus in uno loco* (A11); and in Wolfenbüttel, Herzog-August-Bibliothek, Guelph. Helmst. 1127, f. 104v. In Trier, Stadtbibliothek, 1024/1936 4°, f. 163v, this section of the *DCM* is divided in three recipes: *Si vis scire naturas et mixtiones colorum*, *De auripigmento, De temperatura*.

[59] For instance: London, BL, Cotton Titus D xxiv, Bodley 679, Sloane 781; Cambridge, University Library, Ee 6.39; Paris, BnF, Latin 6741, where A9-A10 appear as a single rubric.

[60] In Paris, BnF, Latin 6741, f. 79v, within the so-called Third book of Heraclius, a more extended version of the A11 recipe appears, entitled *De coloribus sibi contrariis*, while there is no reference to the instructions for painting backgrounds and draperies and for chrysography.

[61] Indeed, from a chemical point of view, the orpiment causes alteration when mixed with copper and lead compounds.

indication on how to grind the gold; finally, a procedure for representing draperies, where the terms *incide* and *matiza* reappear. We can hypothesise that these latter indications are a later addition, as some of the manuscripts that do not bear any trace of them also would suggest.[62]

These kinds of formulas arose from the need to keep in mind norms of mixtures or juxtaposition of colours and to avoid mixtures of pigments which could produce alterable colours and problems of incompatibility.

For the first time in the technical literature on practical arts we find a text that proposes a real "palette", a canon for the illuminator-painter indicating which pigments to use and how to create shadings and highlights through their juxtaposition / superimposition rather than their mixture.[63] Thus, for example, on a drapery uniformly painted in blue is superimposed a brushstroke of indigo to create the dark folds and a brushstroke of pure white to create the light folds, according to a three-colour scheme that is also repeated for the other pigments.

Therefore, it was not a real chiaroscuro with a naturalistic effect, but the attempt to render the modelling in a stylized form, at the same time giving the images a particular luminous result, perhaps to emulate the splendour of enamels and hard stones.

5. Considerations on the origin of the *DCM*

Before beginning to analyse the three sections in more detail, it is worth recalling that the text preserved in the manuscript Phillipps 3715 represents a "photograph" of the work conventionally named *DCM* at a given moment of the tradition, corresponding to its most extended and ancient known version. The three sections that make up the text are strongly characterised and would seem to constitute distinct literary elements with different origins, assembled for the first time in the 12th century – to which the MS Phillipps 3715 dates – or shortly before (end of the 11th century). Indeed, it seems possible to believe that we can name "*DCM*" an intelligent and systematic juxtaposition between a very short prologue in verse, recipes for the making of colours and instructions on the mixtures of pigments coming from different contexts.

The verse prologue (AA) seems to refer directly to the following recipes (Petzold 1995: 59), since it develops the same topics: the preparation of pigments (*factura colorum*) and their mixtures (*mixturae*) as fundamental elements to the art of painting. Perhaps

[62] London, BL, Cotton Titus D xxiv; Wolfenbüttel, Herzog-August-Bibliothek, Guelph. Helmst. 1127; Paris, BnF, Latin 6741.

[63] As Bulatkin (1954: 499) writes, «this shading is to be performed in the process of applying the colors rather than the mixture of them».

it was taken from another unknown work and adapted or, more likely, created specifically for this text when it was assembled to give it the dignity of a treatise, despite being linguistically incongruous with respect to the rest (Tosatti 2007: 50). Apart from the association with Theophilus' *Schedula*, which set forth its circulation independently of the *DCM*, the verse prologue appears only in the manuscript witnesses that preserve the more extended version of the *DCM*.[64]

More complex is the question concerning the seven recipes for the preparation of pigments (A1-A7), that are frequently found in manuscripts, all or in part, independently from the other sections of the *DCM*. For instance, the manuscript Royal 7 D ii, coeval to Phillipps 3715 (12th c.), contains only this section of the *DCM*.

It is not possible to prove indisputably that the seven recipes originated at the same time. The presence of only the first two rubrics in the oldest codex of the tradition, Cotton Nero A vii (end of 11th c.), may suggest that they constituted the original nucleus of the section. In any case, whether the recipes were composed contextually by a single author or, more likely, come from different sources and have then been assembled and adapted creating the text we refer to as *DCM*, several elements suggest that they constitute a unitary and coherent whole.

The prescriptions show a remarkable homogeneity of structure and terminology. From a technical point of view, five of them (A2, A3, A5, A6, A7) describe an analogous procedure, consisting of exposing silver, copper or led foils to vinegar vapours in order to obtain blue, green, white and red pigments. The repetition of the processing steps and materials is evident (for example, *ampulla/olla*, *cooperi et sigilla,* the expression *in circuitu*, the use of the verb *excutio*, etc.). Furthermore, at least in the most ancient manuscripts, all the recipes open with the formula «Si vis facere, accipe…», which is repeated seven times. Based on what many of the codices of the *DCM* tradition passed down, in some cases one can find also internal references between the recipes: the third one ends with the words «Istud lazorium non est tam bonum sicut aliud», clearly referring to the blue pigment of the previous recipe; the following one opens with «Tertium lazorium si vis

[64] The only two exceptions are London, BL, Additional 41486, which contains only the first two lines of the verse prologue with an obvious copy error (f. 104v: «Sensu per partes discuntur quelibet artes. Artis pictorum prior est iactura colorum») and five of the seven recipes for the making of pigments, and London, BL, Digby 162, which preserves only four of the seven recipes and the hexameters at the end (f. 7r). In the first case, we can hypothesise that the presence of the prologue together with an incomplete version of the *DCM* is due to a precise choice of the copyist. Additional 41486, in fact, is characterised by an apparent disordered arrangement of the contents, actually due to a precise organising will of the copyist, who has selected the portions of his interest of the works he was copying, even coming to dismember them (for instance, the prologues of *Mappae clavicula* and Heraclius' *De coloribus et artibus Romanorum* are moved to the end of the manuscript; Brun 2013: 204-205). On the other hand, in Digby 162 the copy of the *DCM* fills only half of the first column of f. 7r, thus resulting incomplete. The folio was in fact later filled in by a different handwriting.

facere», making explicit the fact that the two previous recipes were envisaged and that the three recipes on blue colours have been written one after the other.

Another element of continuity between the recipes is language, with no remarkable irregularities and relatively cultured compared to the usual one in the literature of practical arts. Even the repetition of terms, such as *lazorium* and *blavus*, suggests a certain textual unity.

Moreover, the order in which the pigments are presented seems to respect the economic cost of the metals used in their production, by decreasing the order of importance: quicksilver, necessary for the preparation of artificial vermilion; silver for silver-blue; copper, which could be used to produce a blue, but also two different greens; lead, with which it is possible to prepare white and red lead (cfr. Table 9).[65]

Quicksilver	Vermilion
Silver	Blue
Copper	Blue
Copper	Green
Copper	Green
Lead	Red lead (and white lead)

Table 9. Scheme of the metals used in the recipes.

It is also interesting to note that the recipes are arranged according to an inclusion mechanism, i.e. the opening colour is the same that closes the series (red) and the prescriptions included are two by two equal to each other (blue and green). To be precise, the colour that opens and closes is red-orange, while the included colour is blue-green (cfr. Table 10):

1)	Red (first quality)	A	2)	Red-orange	A
	Blue (first quality)	B		Blue-green	B
	Blue (second quality)	B		Blue-green	B
	Green (first quality)	C		Blue-green	B
	Green (second quality)	C		Blue-green	B
	Red (second quality)	A		Red-orange	A

Table 10. Scheme of the inclusion mechanism of the A1-A7 recipes

The brevity of the section and the fact that the recipes concern the preparation of a small number of colours (red, blue, green) by means of a few pigments would suggest that they originally constituted a treatise of rubrication, intended for decoration of letterheads

[65] The blue obtained from flowers would seem to be excluded from this scheme.

and titles, rather than a real treatise of illumination. As we said, the shades that could be produced following the instructions of the *DCM* were essentially two: red-orange and green-blue. In fact, the blues made from copper and those produced from silver – which if pure is not able to trigger the chemical reaction from which the pigment develops – do not have a distinctly blue colour, but a blue tending to green. The same goes for the two reds of the *DCM*: they are not bright red tones, but tend towards orange.

However, if it is true that the variety of pigments commonly used in Mediaeval illumination is missing from this section, it is also true that we do not find any reference to the use of pen, writing, or letters, normally present in these kinds of texts (Baroni–Travaglio 2016: 68-69; Baroni–Rinaldi–Travaglio 2018: 28-30), neither here nor in the verse prologue, where only the *ars pictorum* is mentioned. Moreover, in two recipes (A3 and A4) mediums other than parchment are cited (wood and wall).

As previously shown, a portion of this section started to circulate from the 14th century, generally within the *Secretum philosophorum*, resulting in an independent tradition for the recipes A1, A2 and A6, not coincidentally the first of each topic: red, blue, and green. Aside from the A6 recipe, the others seem to be reduced versions than those of the *DCM*. We cannot know whether these recipes originate from the *DCM*; they were probably already circulating independently of the *DCM* and in a simplified form, devoid of those editorial interventions that gave them the homogeneity we find in the *DCM*.

The A1-A7 recipes seem to derive in part from something more ancient, as the instructions for the manufacture of vermilion, coming from late alchemical treatises, and the association between procedures for the preparation of vermilion, lead white and verdigris evidenced.[66] However, we can hypothesise dating the recipes not prior to the 11th century, also due to the presence of the silver-blue and the Mediaeval Latin term *blavus*. The presence of the first two recipes of the *DCM* (A1-A2) in the MS Cotton Nero A vii testifies, if not the existence of the *DCM* in an embryonic state (Petzold 1995: 61), at least the circulation of this section in England at the end of the 11th century.

Let us turn now to the last four rubrics (A8-A11), which represent the core of the *DCM*. In this part of the text a certain homogeneity and continuity can be identified. First of all, the fourteen pigments listed in the A8 recipe are the same treated in the following rubrics (A9-A10), respecting the same order. Secondly, the A8 recipe is generally found only in manuscript witnesses that maintain the most extended version of the *DCM* or, in any case, in association with the subsequent section on mixtures.[67] It is therefore evident

[66] The frequency of this association is highlighted by Thompson (1933a: 64), who cites as an example the *Doctrine of Democritus* published by Berthelot (1893: 91-94).

[67] Except for: Oxford, Corpus Christi College, 125, that, based on Johnson (1935b: 80) and Thorndike (1959: 5), contains only A7-A8; Genoa, Biblioteca Civica Berio, 773, and Lucca, Biblioteca Statale,

that the four rubrics have been originated contextually. However, in this section we find a much wider variety of pigments than those illustrated in the previous section (A1-A7), with no indication of their production, evidently intended for a chromatically rich illumination. For this reason, it was proposed to classify the *DCM* as a "mixed treatise", i.e. a treatise for illumination which includes, in its first part, a treatise on rubrication (Baroni–Travaglio 2016: 70).[68] The hierarchy of pigments has also changed, with blue in the first place instead of vermilion, suggesting that the two sections had distinct origins and traditions.

The analysis of the manuscript tradition has highlighted the presence of at least ten versions of the section on mixtures. One, more widespread, is that of the more extended version of the *DCM*, starting with Phillipps 3715; the others are attested by other manuscript witnesses, from the 14th century onwards.[69]

It is also very likely that the well-known treatise *De clarea*, of which today only the first part dealing with the preparation of glair and other instructions for rubrication is preserved, originally contained a second part on the mixtures of pigments (*de colorum mixtione*), unfortunately lost. In fact, in its only manuscript witness,[70] the text of the *De clarea* stops abruptly on f. 5v with: «Puris, hoc est non mixtis coloribus, ut mirabiliter mixto strata inferius, superius umbrata colore, pictura sit variata, cum nimis […]». The

1939, that, according to Johnson (1937: 90-91), preserve, respectively, A8 and A1, A8; Paris, BnF, Latin 7400A, that contains A8 at the end of the seven recipes and does not include the mixtures.

[68] In this kind of text, a wider meaning of the term "illumination" is found, including the entire manuscript decoration executed with pen and brush.

[69] Cotton Titus D xxiv shows a distinct sequence and also two additional formulas, *brasiletum* (brasil wood) and *mosa* (probably a moss green, according to Petzold 1995: 62), also present in its version of the list (A8). The so-called Heraclius' Third book (Paris, BnF, MS Latin 6741) displays two other versions of this section: the first, in particular, contains pigments absent in the other variants analysed, such as *ocrum, biseth* (according to the *Tabula de vocabulis sinonimis et equivocis colorum*, Paris, BnF, MS Lat. 6741, f. 3r: «Bisetus vel Biseth folii est color minus rubeus quam folium»), *vergaut* (in the *Tabula de vocabulis sinonimis et equivocis colorum*, f. 14v: «vergaut est color qui est quasi ut azurium respectu coloris, non respectu materie»). The *Liber de coloribus illuminatorum sive pictorum*, as attested in London, BL, MS Sloane 1754, also contains two versions of the formulas on mixtures: the first corresponds to the more widespread version of the *DCM*, although incomplete; the second is distinct and shows some similarities with the second version of the so-called Heraclius' Third book. Two other versions are testified by the *Liber diversarum arcium* (Montpellier, H 277) and *Scripta colorum* (Lucca, 1075). A version of the recipes on mixtures absolutely different from the one of the *DCM* is preserved in Bruxelles, Bibliothèque Royale Albert Ier, 10 147-58, *Compendium artis picturae* (12th-13th c.; Silvestre 1954), which contains also excerpts of the Theophilus' book I and III. On f. 24v (n. 15 in Silvestre 1954: 122), we find instructions on how to grind pigments followed by a variant of the formulas of the *DCM* where the term *incidere* and *maticerare* appear. According to Thompson, this recipe would derive from that of the *DCM*. In a letter to Silvestre (1954: 97), he writes: «I am particularly interested in the freedom with which he [the compiler] paraphrases the widespread canon of the illuminator to which I have given the working siglum DCM». Oxford, Magdalen 173 also contains a much larger and interesting version of the section on mixtures, with indication on the tempering of pigments and formulas in which the terms *umbretur* and *matizetur* appear.

[70] Bern, Kantonbibliothek, A.91.17, ff. 1v-5v.

sentence contains some significant elements that bring it closer to the *DCM*: the mention of pure colour, the concept of mixtures of pigments and the term *umbrata,* i.e. "shaded". Similarly in the *DCM*, we notice not a real mixing of colours, but a juxtaposition of shadings and highlights in a background to obtain a *pictura variata* (Baroni 2016: 303-304). Moreover, with the exception of saffron, the pigments mentioned in the *De clarea* correspond to the first five enumerated in the list of the *DCM* (A8) and then developed in the following rubric (A9), although in a different order: *vermiculum, minium, saffranum, sanguis draconis, azorium, folium*. The hypothesis that the lost section on the mixtures of pigments of the *De clarea*, datable to the 10th-11th century, could represent the oldest Latin version of the formulas of the *DCM* is certainly suggestive, even if not provable.

What is certain, however, is that in the 11th century the technique to represent the modelling with a scheme of three colours described in the *DCM* appears to be commonly adopted, both in book decoration and in contemporary wood and wall painting (Rinaldi 2011: 90-91).

The original model of the *DCM* formulas on the mixtures of pigments could be a text written in Greek, as the curious term *matizare* (and its variants such as *maptizare* and *matiçare*) would suggest. The exhaustive study of Bulatkin (1954) showed that the *DCM* contains the first attestation of the word with the general meaning of "to lighten" or to apply «a color of light value […] over a color of medium value» (Bulatkin 1954: 498). The term would seem to derive from the Late Greek *lammatizein*, «attested as early as the eight century as a technical term of the painter's vocabulary in the meaning "to apply the graded values of the relief, to shade"» (Bulatkin 1954: 511). Unfortunately, no Greek version of the illuminator's canon of the *DCM* appears to have been preserved. However, the verb *lammatizein* is testified in the so-called *Mount Athos Manual Painter's Guide*, which contains several passages recommending a gradation in values similar to that described in the *DCM* (Bulatkin 1954: 501-504). Also the presence of the dragon's blood, a pigment not easily available in the late Middle Ages, suggests a certain antiquity of the text, making it conceivable to date it back to the 8th-10th century.[71]

In any case, the section on the mixtures of pigments was a particularly lively and mobile text, probably disseminated also orally. Evidently its mnemotechnical use favoured the contamination between oral and written text and therefore the proliferation of variants. It is also conceivable that these formulas had the function of regulating the executions within the same *scriptorium*, where different operators could alternate in the

[71] Less convincing seems Stover's interpretation of the term *matizare*. According to this author, the word, deriving from the Latin *haematites*, «is most likely a learned coinage invented in the second half of the eleventh century in Lanfranc's circle in England or Normandy» (Stover 2011: 104). In this respect, see Rinaldi (2016: 10).

decoration of a voluminous codex and where therefore the need to standardise different executions was important.

Finally, if we look at the text as a whole, we can observe that there are seven introductory hexameters as well as seven recipes on pigments, arranged according to an inclusion mechanism, and a list of fourteen pigments. This is not the moment to recall the symbolic value of this number, but rather to remember that the whole work, from the introductory hexameters to the formulas of mixtures, shows a marked mnemotechnical value.

To summarise, if the verse prologue was created specifically for this text, it seems possible to hypothesise different origins and traditions for the other two sections. In the 12th century, or shortly before, a text for manuscript illumination would have been composed, combining and adapting some coeval or slightly earlier recipes on the production of pigments with more ancient instructions on their mixtures, thus composing a treatise adhering to a systematic plan. The common origin of almost all manuscripts that preserve the more extended version of the *DCM*, i.e. the text assembled in all its three sections in a correct *consecutio*, strongly suggests an English origin.[72]

6. Diffusion of a genre: the formulas on the mixtures of pigments

In the technical literature on book decoration it is easy to find variants of isolated recipes of the *DCM*, both in Latin and in vernacular, distributed through Mediaeval treatises or compilations independently from the other sections of the text and differing slightly in form and content (Thompson 1936: 390, n. 10). Examples of the former are the *Tractatus de coloribus faciendis* (14th c.; Thompson 1936),[73] with variants of the A3 and A6 recipes, and the *Tractatus aliquorum colorum* (15th c.), which contains variants of the A7 and A2 recipes (Travaglio 2016a).[74] With regard to the translations in Italian

[72] An English origin of the *DCM* has already been suggested by Petzold (1995: 61), on the basis of the manuscripts Cotton Nero A vii, Royal 7 D ii and Cotton Titus D xxiv, which contain only some recipes of the *DCM*.

[73] Munich, Bayerische Staatsbibliothek, Clm 444 (ff. 214v-217v): (rec. 27, Thompson 1936: 390) «Item. Sic etiam potest fieri azurium. Accipe ampullam puri cupri et pone in ea calcem usque ad medium, et imple eam fortissimo aceto et cooperi et sigilla; et pone sub fimo calido et dimitte usque unum mensem. Postea aperi et invenies. Set hoc non valet nisi pictoribus in pariete, etc.»; (rec. 31, Thompson 1936: 392) «Si vis facere alio modo, sume laminas de cupro et unge eas bene cum sapone. Postea pone eas in potto novo et imple pottum aceto et cooperi et pone in loco calido et dimitte ibi per 24 dies. Postea aperi et rade tabulas sive laminas illas super tabulam planam et dimitte siccari. Et illud vocatur viride romanicum». A similar version of the A6 recipe is also found in the Pseudo-Savonarola's recipe book (Ferrara, Biblioteca Ariostea, Cl.II.147, 16th c., f. 78v; Travaglio 2009-2010: 257-549).

[74] Ferrara, Biblioteca Ariostea, Antonelli 861, *Tractatus aliquorum colorum* (ff. 2v-7v), f. 4r: «Ad faciendum çenabrium sive blacham. Accipe ollam novam et in ea plumbeas tabulas mitte cum aceto fortissimo usque ad unum mensem et quod est igiro tabulorum excutias in vase fictili et ponas ad ignem, semper

vernacular, examples are the versions of the recipes A1 preserved in the well-known Bolognese manuscript *Segreti per colori*[75] and in the treatises of Bartolomeo da Siena[76] and Ambrogio di Ser Pietro da Siena,[77] all dating back to the 15th century and containing the description of the yellow and red smokes that come out of the ampoule.[78]

As we have seen, the indications on the mixtures of pigments are the most original and meaningful part of the *DCM* and represent the first example of this type in the known technical literature. This section, with its regular structure and repeated formulas, can

movens ipsum colorem. Et quando fuerit color albus sicut nix, tolle de eo quantum vis et erit blacha fina, et reliqua mitte ad ignem ut fiat rubeus et erit çenabrium et tunc tolles ad refrigerandum eum»; f. 5v: «Ad faciendum bonum alçurum. Accipe ollam novam et mitte in ea laminas argenteas et imple ollam a çeto fortissimo et operi ollam et sigilla et mitte in vendemia quae proiecta est de torculari et bene cooperies, et cum sigillo bulla et serva diebus quindecim et operi ollam et florem que est circha laminam excute in vase vitrio» (Travaglio 2016a: 250, 252). In this case, the recipe is complete with respect to that of the *DCM*, correctly indicating the vinegar as a reagent.

[75] Bologna, Biblioteca Universitaria, 2861: «Ad faciendum cinabrium. Tolli una parte de argento vivo et doi parte de solfo giallo e necto e bene macinato, poi pone omne cosa in una bocia, et incoprila legiermente cum luto de sapientia. Poi la pone in lo fornello et dalli da prima el foco ligiero et copre la bocca de la bocia cum una tegola, e quando tu vedrai lo fumi giallo, continua lo foco per infino che vederai uscire el fumo rosso o vermeglio. Alora toli via lo foco e quando sarà freddo trovarai bello cinaprio» (Guerrini–Ricci 2007: 162).

[76] Siena, Biblioteca degli Intronati, L.XI.41, *Tractatus fratris Bartolomei de Senis* (ff. 34v-38v), f. 35r-v: «El modo di fare el cinabro d'ariento vivo et solfo. Piglia una parte d'ariento vivo et due parti di solfo, biancho o giallo, non inporta niente, et mettelo in uno vaso di vetro che sia facto studiosamente acciò. Et chuoprelo bene di terra da fare orciuoli, poi lo mette nel fornello et comincia affarvi fuocho leggermente. Et chuopre la boccha del vaso chor una teghola et, quando tu vedi che n'essce el fumo giallo, lassalo stare coperto tanto che vegha uscire el fumo rosso et quasi vermiglio. Allora non fare più fuocho, lassalo fredare, poi rompel vaso et chautamente ne chava fuori el cinabro» (the transcription is by Paola Travaglio). For a first edition of the treatise see Tosatti-Soldano (1978).

[77] Siena, Biblioteca degli Intronati, I.II.19, *Ricepte daffare più colori* of Ambrogio di Ser Pietro da Siena (ff. 99r-106r), f. 103r: «Tolle una parte d'ariento vivo et solfo, bianco o giallo, due parti et mecte in una ampolla, la quale sia stata bene intrisa di terra daffare orciuoli mescolata con cimatura di panni. Dapoi mectela affuoco leggiere et cuopre con la tegola la bocca dell'ampolla et, quando tu vedi uscire dall'ampolla el fumo giallo, tiella tanto cuperta che tu veghi escirne el fumo rosso et quasi vermiglio. Allora levala dal fuoco et troverai nell'ampolla perfecto cinabro» (the transcription is by Paola Travaglio). The treatises of Bartolomeo and Ambrogio di Ser Pietro da Siena appear to have striking similarities, suggesting that they «must stem from the same origin. Both stem from another, earlier, unknown text» (Wallert 2013: 112; see also Travaglio 2009-2010: 553-672). On the similarities with the aforementioned *Tractatus aliquorum colorum,* see Travaglio (2016a: 240-246), while, for a first edition of the text by Ambrogio di Ser Pietro da Siena, see Thompson (1933b).

[78] According to Tolaini (1995b: 56, n. 82), isolated recipes common to the *DCM* are also found in Erfurt, Wissenschaftliche Allgemein-Bibliothek der Stadt, Amplonius Quarto 189 (13th-14th c.; Thompson 1935c); Città del Vaticano, Biblioteca Apostolica Vaticana, Pal. Lat. 1339 (14th c.); Paris, BnF, Lat. 6514 (13th-14th c.); Cambridge, Gonville and Caius College, 181 (13th-15th c.). In any case, further research, both in the technical literature in Latin, in Italian vernacular and in the other European languages, would certainly allow to find numerous other examples. For instance, according to Johnson (1937: 90), the MS Ashb. 349 of the Biblioteca Medicea Laurenziana in Florence (15th c., f. 54v) contains the A1 recipe in Italian vernacular. Johnson himself wrote, citing this manuscript, that «this proves the translation of these recipes into Italian. This one manuscript should not be taken as an indication that there are not many others in Italian and other languages. I made absolutely no effort to find the recipes in any language except Latin» (Johnson 1937: 90).

be considered a literary genre in its own right, for which the conventional name "*tabula* of mixtures" has been proposed (Baroni–Travaglio 2016: 121-122).[79] Derived from the well-known *Tabula de vocabulis sinonimis et equivocis colorum* of the Jean Le Bègue's manuscript,[80] the term *tabula* defines a text organised as a kind of table or scheme, evidently intended for memorization, where the structure can remain fixed and it would be possible to change the names of the elements/pigments.

To the same "literary genre" belong other texts concerning the mixtures of pigments that are frequently found in technical literature from the 12th century onwards. It is impossible to say that these texts derive from a common source, but they certainly share the content, the intentions and, in some cases, the structure, showing over time a technical evolution in favour of increasingly complex colour applications and naturalistic representations.

A similar text is contained in the coeval first book of the Theophilus' *Schedula diversarum artium*, where he describes in detail how to mix the pigments to paint flesh tones, hair and draperies (chapters X-XIV). The "construction of colour" is undoubtedly more articulate and richer compared to the *DCM*, with multiple shades overlapping or juxtaposed (Tosatti 2011: 92-93) and also mixtures with different proportions of white and multi-colour. Not by chance Bulatkin (1954: 501) defined this passage an expanded version of the recipes of the *DCM* (A9-A10), which was especially evident in the section that Theophilus dedicated to the portraying of garments (chapter XIV). From the three basic steps of the *DCM* (medium-value, dark-value/*incidere*, light-value/*matizare*), we transition here to five or six steps (cfr. Table 11):

- a medium value to fill in (*implere*) the figure, as in the *DCM*;
- two operations for the application of the dark value (*incidere* in the *DCM*): make the lines (*fac tractos*) with the medium-dark and make the outer shadow (*fac umbram exteriorem*) with the darkest-dark; three operations for the application of the light value (*matizare* in the *DCM*): lighten the first time (*illumina primum*) with a medium-light; lighten above (*illumina superius*) with a lighter-light, and make the highlights (*fac subtiles et raros tractos*) with the lightest-light.[81]

[79] In the technical literature on book decoration different "literary genres" have been identified, related to the specialised practitioners involved in the production of manuscripts: treatises of chrysography, argyrography and purple codices; treatises of rubrication; treatises of illumination; "mixed" treatises (rubrication and illumination); treatises on a single colour; table of mixtures; treatises for *apparatores* (Baroni–Travaglio 2016; Baroni–Rinaldi–Travaglio 2018).

[80] Paris, BnF, Latin 6741.

[81] For instance: «*Imple* uestimentum cum rubeo, et si rubeum pallidum sit, adde modicum nigri. Inde misce amplius nigri cum eodem, et *fac tractus*. Deinde misce modicum rubei cum cenobrio, et *illumina primum*. Post haec adde modicum minii cum cenobrio, et *illumina superius*. Imple uestimentum cum cenobrio, et misce cum eodem modicum rubei, et *fac tractus*. Deinde misce modicum minii cum cenobrio

I. Medium value	*imple*
II. Dark value *incidere*	1. *fac tractus* 2. *fac umbram exteriorem*
III. Light value *matizare*	1. *illumina primum* 2. *illumina superius* 3. *fac subtiles et raros tractos*

Table 11. Schematic comparison between the instructions of the *DCM* and the passage of Theophilus on the mixtures of pigments (from Bulatkin 1954: 501)

The Cennini's *Libro dell'arte* (Frezzato 2003; Broecke 2015) also contains indications that recall the instructions of the *DCM*, although the shades of colour are already intended here to a volumetric and naturalistic effect and the text does not show the typical mnemotechnical structure. In particular, chapters LXXVII-LXXX, devoted to the painting of iridescent silk fabrics on wall (in fresco and *secco*), describe how to create shadings (*aombrare/ombrare/dare gli scuri*) and highlights (*biancheggiare*) on a background (*campeggiare*).[82]

Another example can be found in the *De arte illuminandi* (Pasqualetti 2009: LXVI-LXVII), however far from the mnemotechnical structure and the stylised representation of modeling of the *DCM*. Chapter XXIX (*Ad faciendum primam investituram cum pinzello*) describes the creation of backgrounds (*investitura*), where generally, as seen in the *DCM*, the pigments are mixed with lead white, on which to make shadings of pure colour (*umbrare*).[83] To shade with glazes, the *quasi universalis* use of the *rosetta senza corpo*[84] or violet *pezzuola* (clothlet) is suggested.[85] We then find indications on how to achieve a *cangiacolore*, which is an iridescent colour imitating the silky garments, equivalent to the *cangiante* of Cennini, obtaining by shading a primary colour (blue or red) with a com-

et *illumina primum*. Post haec illumina cum simplici minio. Ad extremum misce modicum nigri cum rubeo, et *fac exteriorem umbram*. Misce purum uiride cum ogra, ita ut de ogra plus sit, et *imple* uestimentum. Adde eidem colori modicum de suco et parum rubei, et *fac tractus*. Misce eidem colori unde implesti album, et *illumina primum*. Adde plus albi, et *illumina exterius*. Misce etiam cum superiori umbra plus suci et rubei et parum uiridis, et *fac umbram exteriorem*» (Dodwell 1961).

[82] For instance: «LXXVII. Se vuoi fare un vestir d'angielo, cangiante in frescho, *campeggia* il vestire di due ragioni incarnazione, più schura e più chiara, sfummante bene per lo mezo della fighura. Poi nella parte più schura *aombra* gli schuri con azzurro oltramarino, e lla charnazione più chiara *ombra* con verdeterra, ritochandolo poi in secco. Et nota che ogni cosa che llavori in frescho, vuole essere tratto a ffine e ritocchato in seccho con tempera. *Biancheggia* il detto vestire in frescho all'usanza che tt'ò detto degli altri» (Frezzato 2006: 123).

[83] «Item omnes colores misti cum cerusa possunt et debent umbrari in fine cum puro colore non mixto cum albo» (Pasqualetti 2009: 150).

[84] The *rosetta* is a red lake obtained by precipitating and fixing the brazil wood on an inorganic mineral base. In the Mediaeval technical literature on book decoration two kinds of *rosetta* are often mentioned: a *rosetta con corpo*, that is opaque, and a *rosetta senza corpo*, transparent and useful to shade and glazing.

[85] «… illa rosa incorporea est quasi universalis umbra ad omnes colores, et similiter quasi facit peczola violata» (Pasqualetti 2009: 152).

plementary one (green).[86] In the following chapter (XXX, *Nota modum incarnandi facies et alia membra*), dedicated to the *chiaroscuro* rendering of the flesh tones, in addition to the terms *investire* ("to fill in the background") and *umbrare* ("to shade"), also *rilevare/ clarificare* (in the sense of "giving the lights, lightening") and *facere profilatura* (probably with the meaning of "outlining, profiling") are added,[87] as in the *L'ordine del miniare a penello*[88] (Pasqualetti 2009: LXVI-LXVII).

The typical structure with repetitive formulas of the *DCM* is found in some texts in Italian vernacular. We refer, for example, to a short text preserved in the MS L.XI.41 of the Biblioteca degli Intronati of Siena (second quarter of the 15th c., fol. 39r), entitled *L'ordine del miniare a penello* (Tosatti-Soldano 1978).[89] The text explains how *onbrare/ adonbrare*, *profilare* and *rilevare* each colour, that is to darken, profile and highlight, and it is based on the repetition of the formulas "se vuoi onbrare X, vuolsi onbrare con Y", "se vuoi profilare X, vuolsi profilare con Y", "se vuoi profilare et adonbrare X, fa con Y", "se vuoi rilevare X, vuolsi rilevare con Y".[90] As Tosatti (2007: 54) suggests, the use of

[86] «Item multipliciter possunt colores misceri et facere *cangiacolore*, ut vulgariter loquitur, sive nominatur, videlicet azurium mistum cum cerusa umbrari cum viridi et rubeum similiter cum viridi» (Pasqualetti 2009: 152).

[87] «XXX. Si vis facere incarnaturam faciei vel aliorum membrorum, primo debes *investire* locum totum quem debes incarnare de terra viridi cum multo albo, ita quod modicum appareat viriditas et liquido modo, deinde cum terrecta que fit ex glauco et nigro et indico et rubeo, liquido modo reinvestiendo proprietates figurarum et *umbrando* loca debita. Deinde cum albo et modicum de viride *releva vel clarifica* loca elevanda sicut pictores faciunt; postmodum vero habeas rubeum cum pauco albo et colora loca que debent esse colorata, et lento modo da de eadem materia super loca *umbrata*, et finaliter cum multo albo et pauco rubeo, sicut vis colorare incarnaturam, liquidissimo modo totam incarnationem linias, sed magis loca *relevata* quam *umbrata*. Et si figure essent nimis parve, quasi non tangas nisi loca *relevata*, et in fine iterum *releva* melius cum albo puro, si vis, et fac album in oculis et nigrum, et *fac profilaturas* in locis debitis cum rubeo et nigro et modicum de glauco mixtis vel cum indico, si vis, aut nigro, quia melius est, et apta ut scis; et hec superficialiter sufficiant dicta» (Pasqualetti 2009: 154-156).

[88] See below.

[89] The text, anonymous, is inserted between the recipes for the manuscript illumination of Bartolomeo da Siena (ff. 34v-39r) and a short treatise on the proportions of the human body and animals (*Delle misure d'ogni animale*) of Buonamico da Firenze (ff. 39v-40r).

[90] Siena, Biblioteca degli Intronati, ms. L.XI.41, f. 39r, *L'ordine del miniare appenello*: «L'ordine di chi volesse imparare a miniare sie questa: Se vuoi *onbrare* aççurro mescholato colla biacha, vuolsi *onbrare* con l'aççurro puro. Se vuoi *onbrare* aççurro puro, vuolsi *onbrare* con l'aççurro temperato col tuorlo dell'uovo. Se vuoi *profilare* aççurro, vuolsi *profilare* con l'indico e con la peççuola. Se vuoi *onbrare* el verde, vuolsi *onbrare* con l'onbra del verçino. Se vuoi *profilare* el verde, vuolsi *profilare* con l'indico et con l'onbra del verçino. Se vuoi *profilare* et *adonbrare* la rosetta, fa con l'onbra del verçino. Se vuoi *profilare* et *adonbrare* la porporina, fa con l'onbra del verçino. Se vuoi *profilare* et *adonbrare* el minio, fa con l'onbra del verçino. Se vuoi *profilare* et *adonbrare* el cinabro, fa con l'onbra del verçino. Se vuoi *profilare* et *adonbrare* el giallo, fa col çaffarano o con l'onbra del verçino. Se vuoi *rilevare* l'açurro e la rosetta, el cinabro e la porporina, e predetti colori voglionsi *rilevare* con la biaccha. Se vuoi *rilevare* el verde, el minio, vuolsi *rilevare* o col giallolino, o con l'arçicha e con la biaccha. Sappi che l'aççurro sta bene chon ogni cholore. Ad fare la biffa, tolle açurro e rosetta e macina insieme, et vuolsi *onbrare* con l'açurro e *profilare* con quel chessi profila l'açurro, cioè con l'indico et con la peçuola. Se vuoi *onbrare* et *profilare* el nero, fa con l'onbra del verçino» (the transcription is by Paola Travaglio).

the verb *rilevare* is a «clear indication of the volumetric purpose of the operation […]; in addition a distinction is made between *profilare* and *ombrare*, that is, between the outlines and the darks, which have become true shadows».[91] As in *De arte illuminandi,* the shading is generally made with the *ombra del verzino* (Brazil-wood lake), which allows to obtain a glazing effect.

Another example is a text contained in the MS D 437 inf. of the Biblioteca Ambrosiana of Milan (16th c.),[92] which provides instructions for grinding (*tridare*), lighten (*fare chiaro*) and darken (*umbrare*) the pigments (f. 11r-v: *Quanti solo li colori che si dieno tridar su la pietra porfiritica*).[93]

The well-known Bolognese manuscript also preserves a short recipe, probably a fragment of a larger text, which testified to the wide circulation of formulas on mixtures. The text describes how to create shadows and lights on a green, blue and red background:

[91] Original quote: «chiara indicazione del fine volumetrico dell'operazione […], in più si distingue tra *profilare* e *ombrare*, cioè tra i contorni e gli scuri, divenuti vere ombre».

[92] The manuscript contains prescriptions for inks (ff. 1r-v), the 13th-century treatise for illumination *Liber colorum secundum magistrum Bernardum* (ff. 2r-7v; Travaglio 2016b) and various technical recipes (ff. 7v-17v).

[93] Milan, Biblioteca Ambrosiana, D 437 inf., ff. 11r-v: «Quanti sono li colori che si dieno tridar su la pietra porfitica. Quattro sono li colori che si convieno tridar su la pietra porfirea per la loro durezza, cioè l'oro pimento, e lo cenabrio, e lo zenolin, e l'azzurro, quando bisognasse tridarlo. Come se trida el cenabrio e i altri colori. Lo cenabrio se *trida* con aqua e *fasse chiaro* con biacha et *umbrase* con cenabrio puro, e lo puro *umbrase* con lacha. Et nota che, quanto più lo se maxena, ello deventa più vermeio e pluicresse. Come se trida la lacha. La lacha se *trida* con lessiva e *fasse chiara* con biacha et *umbrase* con lacha pura. Et nota che solo questo color se trida con lessiva, et tutti li altri con aqua. Come se trida l'endego. L'endego trido con aqua se fa de pluy colori con la biacha più scuri et men scuri, e *umbrase* con endego, messeda con un puocho de biacha. Come se trida el minio. Lo minio *trida* con aqua, se può *far chiaro* con biacha, et *umbrasse* con cenabrio puro. Come se trida el enoli. Lo zenolin *trida* con aqua, se può *far chiaro* con biacha, et *ombrasse* con ocrea o con bollo arminicho. Come se trida l'oro pimento. L'oro pimento *trida* con aqua, se *umbra* con ocrea o d'oro pimento meseda. Come se può far lo zenolin scuro e chiaro. Tuo verde se può far de zenolin, meseda con endego scuro e chiaro. Item lo verde come si può fare de oro piumento. Item lo verde se può fare e l'oro piumento et endego mesedado scuro chiaro, et *umbrasse* tutti doi con il suo verde medesimo, et *umbrasse* alcuna volta con aqua verde de pomelle, la quale se *fa chiara* con occrea et con oro piumento. Come l'occrea se *fa chiara* con la biacha o con etc. L'occrea *trida* con aqua, se *fa chiara* con la biacha o con oro piumento, et *umbrasse* con bollo arminio. Et lo bollo armenicho non è se non da umbrare e da profilar. Come la biacha se fa scura con lo negro. La biacha se fa scura con lo negro e perfilase con essa; lo negro se fa chiaro con la biacha puocho et assai. Come se fa la roseta senza corpo. La roseta senza corpo se fa cussì: tuo el legno del braxillo e raxialo sottilmente con el cultello, o con vero, e metilo in uno bichiero con lesiva forte e neta e puocha, e metine un puocho de aqua de gomma forte. E può tuo un puocho de lume de roza e bruxala molto ben, si che ella si possa disfar a muodo de polvere e, spolverizada, meseda con lesiva con lo braxillo in lo bichiero e metilo a bolir. E boya tanto che'l se consumi lo terzo e tuollo dal fuogo e fradallo e metti in ovra con la penna et è buona da fiorire le minie de cinabrio. Come se fa la rosetta con corpo. La rosetta con corpo se fa come io ho detto di sopra, ma mettese più lume de roza e può se tuol uno quarello nuovo, el quale non habbia tocha aqua, e fasse un buxo in esso, ma che el non passa, e mettese le ditte confetion in lo buxo dello quarello e getta via la lessia e reman la confetion, e non se mette aqua de gomma. A voler far umbra da volti. Tuo verde tra biacha, negro e cenabrio insembre, overamente verde tra biacha insembre soli. Come l'oricello *se fa chiaro* con la biacha. L'oricello *trida* con aqua, si *fa chiaro* con biacha et *ombrasse* con esso in stesso pluy scuro» (the transcription is by Paola Travaglio).

«campeggia de X, Y è l'ombra sua, Z è il suo relevo».[94]

The presence of instructions on the mixtures of pigments also in the *Livro de como se fazem as cores* ("The book on how to make colours")[95] and in the so-called *Strasbourg manuscript* (Neven 2016), respectively in Portuguese transliterated into Hebrew characters and in Old Middle German[96], is a further evidence of the widespread diffusion of this kind of text also through translations into vernaculars, not only Italian.

7. Conclusions

Those who deal with Mediaeval technical literature on arts are familiar with its richness and complexity, not surprisingly defined by Schlosser (2000: 21) «the most original part of Mediaeval artistic literature».

The modalities of formation and transmission of these works are particularly intricate (Baroni–Travaglio 2016): they are almost never static texts, slavishly copied, but "mobile and lively", modified over time by editorial interventions, not always easily identifiable.

In the huge amounts of treatises and recipe-books handed down by the Middle Ages, the *DCM* occupies a privileged place: it is undoubtedly the most copied and widespread

[94] Bologna, Biblioteca Universitaria, 2861: «A campegiare e fare fogliami. Se tu voli fare fogliami, campeggia prima de quelli collore che tu voli e lassali sciucare bene de vantaggio. Se tu campeggie de verde, la pezola de lo giglio è l'ombra sua e el zallulino è lo suo relevo. Se tu campeggie de azurro, l'ombra sua è la pezola pavonaza e la biaccha è el suo relevo. Se tu campeggie de rosso, el suo relevo è el verzino» (Guerrini–Ricci 2007: 170).

[95] Parma, Biblioteca Palatina, 1959, 15th c., ff. 1-20: «[XXXI…] Se quizeres matizar con el [o açafrão] do azul been moido, quanto a terça parte, e não mais. [XXXIV…] e deita sobre el [o azul] para matiza-lho carmin o do brasil. [XXXV] Se quizeres colorar con azul branco, matiza con azul puro. E se quizeres colorar con carmin, matiza con carmin o con brasil o con vermelhon. E se quizeres colorar indio alvo, matiza en el con verde puro. E se quizeres colorar con azarcon, matiza sobre el carmin o brasil e vermelhon. E se quizeres colorar con vermelhon, matiza con brasil o con carmin. Pero as cores todas se podem matizar con negro» (Villela-Petit 2011: 14, n. 41). «Chapter XXXI. If you wish to temper saffron in order to write with it, add white of egg to it […]. If you wish to shade with it [saffron], add well ground blue to it, as much as a third and no more […]. Chapter XXXIV […] and pour over it carmine or brazil-wood to shade it. Chapter XXXV. If you wish to color with light blue, shade it with pure blue. If you wish to color with carmine, shade it with carmine or brazil-wood or vermilion and if you wish to color with indigo shade it with pure green. And if you wish to color with red lead, shade it with carmine or brazil-wood or vermilion. And if you wish to color with vermilion shade it with brazil-wood or carmine. But all colors may be shaded with black» (Blondheim 1928: 131-132). The verb *matizare* is intended here as "to shade" (Bulatkin 1954: 461). On the *Livro de como se fazem as cores* see in particular Strolovitch (1999), Cruz–Afonso (2008), Afonso–Cruz–Matos (2013). The lexical similarities between these passages and the mixtures of the *DCM* are pointed out by Villela-Petit (2011: 14): the verb *matizare* does not indicate here "to highlight", but, on the contrary, "to shade", and the instructions of the Portuguese manuscript seems to return to a binary mode (light background, dark shades) rather than the ternary mode of the *DCM*.

[96] The MS Strasbourg, Bibliothèque Nationale et Universitaire, A.VI.19 was destroyed during the 1870 fire in the library, but fortunately a copy of the recipe book made by Sir Charles Eastlake is preserved. The contents of the manuscript has been dated to the beginning of the early fifteenth century (Neven 2016).

treatise devoted to book decoration. The *DCM* is in fact preserved, in extended form or in extracts, in more than sixty manuscripts throughout Europe, thus covering a very long period of time (late 11th-17th c.).

Firstly, what is the *DCM*? We have seen that this conventional title denotes a work consisting of three sections: a verse prologue, seven recipes for the preparation of pigments to be used on parchment and a set of indications for their mixtures and incompatibilities. This is the oldest and most extended known form of the text, handed down for the first time in the 12th century by the MS Phillipps 3715 and then by other codices between the 13th and the 17th centuries.

The prologue (AA) was probably created specifically for the *DCM*, while for the other two sections it seems possible to hypothesise a distinct origin. The seven recipes (A1-A7) constitute a homogeneous and coherent whole in terms of language, structure and procedures described. Internal references between the recipes have also been identified. This section seems to date back to the early 12th century or the end of the 11th century and perhaps was originated from a "nucleus" represented by only A1 and A2 recipes, as the oldest manuscript witness of the tradition testifies (Cotton Nero A vii, end of the 11th c.). The third section (A8-A11) is also characterised by an evident textual homogeneity, but the set of indications for the mixtures of pigments represents a "canon" for illuminators of more ancient origin, probably translated from the late Greek between the 8th-10th centuries. The *DCM* is therefore the result of a systematic and accurate composition and adaptation of different textual portions in order to create a coherent and well-structured treatise, provided with a prologue and devoted to the *ars pictorum*: firstly, the preparation of colours (*factura colorum*) and then the mixtures (*mixturas colorum*). The composition of the *DCM* occurred most likely in England in the 12th century or, at the earliest, at the end of the 11th century.

The analysis of the manuscript tradition, based on Johnson's indispensable census but updated to the most recent advances in studies, has allowed to better outline the complex transmission of this text. The *DCM* was frequently copied throughout the late Middle Ages up to the 17th century, all over Europe, in complete version or in excerpts, independently or added to/mingled with other treatises, reworked and dismembered. Clearly regarded as having a certain *auctoritas*, also thanks to the fact of having been assembled with care in a clear form and with strong roots in tradition, the *DCM* was copied also in periods when the application of its instructions was out of common use (Tolaini 1996: 305).[97]

Starting from the 12th century, the *DCM* circulated in its most extended version,

[97] Currently, Thompson's suggestive proposal to attribute the text's «basis of a powerful authority» to Cluny is not supported by documentary evidence (Thompson 1972).

firstly as an *addendum* to *Mappae clavicula* and then mainly associated or copied with important technical treatises that act as "attractor": again, *Mappae clavicula* and the Theophilus' *Schedula diversarum artium*. Less frequently the *DCM* is copied in an independent form, while it is often found, with more or less variants, incorporated into other treatises or recipe books, such as the *Liber de coloribus illuminatorum sive pictorum,* the *Scripta colorum*, the *Liber diversarum arcium* and the so-called "Jean Le Bègue manuscript".

However, the manuscript tradition has highlighted that, as early as the 12th century, some parts of the *DCM* circulated separately, such as A1, A2 and A6 recipes frequently found within the *Secretum philosophorum*. In this case it is generally not possible to distinguish whether they are real excerpts from the *DCM* or rather isolated recipes with an independent tradition. What is certain is that in the preserved manuscripts we frequently find all or some of the seven recipes for the making of pigments and that the prologue in verse of the *DCM* is used for the Theophilus' *Schedula diversarum artium*; on the contrary, in no codex de we find only the section on the mixtures of pigments of the *DCM*.

This last section, for which the name "*tabula* of mixtures" is proposed, represents the most original part of the *DCM*. With its regular structure and repeated formulas, it was probably written for mnemotechnical use and gave rise to a real "literary genre" to which many other texts widespread in the technical literature belong, at least until the 16th century.

To conclude, further information useful for outlining the tradition of the *DCM* may certainly derive from further censuses of manuscripts in the European context. In any case, this study, although not exhaustive, has broadened our horizon to the fascinating history of a text that has spanned centuries and continues to "speak" even in distant times.

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Appendix. The edition of the *De coloribus et mixtionibus*

The large number of *lectiones adiaphorae* and the lack of sufficient distinctive innovations in the manuscript witnesses analysed makes it impossible to build a *stemma codicum* and to propose the reconstruction of the original text. This is quite common in the Mediaeval technical literature: indeed, texts such as the *DCM* are characterised by an active tradition, i.e. by a strong mobility and a substantial number of interventions by copyists, often difficult to identify.

It was therefore decided to present the text contained in the oldest witness of the tradition, the MS Phillipps 3715 of the Corning Museum of Glass (*C*, 12th c.), noting in the *apparatus criticus* the variants of other manuscripts that preserve the *DCM* in the most extended version: Oxford, Bodleian Library, Bodley 679 (*Ob,* 13th c.); Cambridge, University Library, Ee 6.39 (*Ca*, 13th c.); London, British Library, Harley 273 (*H*, 14th c); Trier, Stadtbibliothek, 1024/1936 4° (*T*, 15th c.).[98] Recipes numbers have been added for ease of reference.

In *C* and in *Ob* the *DCM* is associated with *Mappae clavicula* and *Compositiones*: in the first case, it is placed at the beginning of *Mappae clavicula*, in the second the recipes of the *DCM* intersperse the text of the *Compositiones*. *Ca* contains the *DCM* at the end of the Theophilus' *Schedula*, while *H* preserves the *DCM*, without the prologue, within the *Liber de coloribus illuminatorum sive pictorum* and in *T* the *DCM* is copied independently of the other texts.

On the basis of the collation of the manuscripts, certain considerations may be made:

- All manuscripts contain an error in the A2 recipes. To produce the silver-blue it is in fact necessary that the silver plates be subjected to the corrosive action of vinegar, but the recipe makes no mention of vinegar or other reagent to be added. Only *T* contains a correct version of the recipe, with the indication «infunde acetum forte vel vinum». It is most likely a gloss added by the copyist by conjecture.
- *Ob* does not contain the titles and the incipits of the recipes, with the exception of the titles of A3, A4 and A11. Moreover, this manuscript includes numerous variants with respect to the texts preserved by *C, Ca, H* and *T.* As observed in the edition of *Mappae clavicula* (Baroni–Pizzigoni–Travaglio 2013: 44-45), the copyist

[98] The MSS Glasgow, University Library, Hunterian 110 (14th c.) and London, British Library, Sloane 781 (1699) were excluded since they are *descripti*, respectively, of *C* and *Ca.* Unfortunately, as mentioned before, it was not possible to obtain a copy of the MS Cotton Julius D viii of the British Library.

of *Ob* would seem to have made an extensive editorial intervention on the text: for instance, he standardised verbs to the imperative; often inverted nouns and adjectives; made extensive use of pronouns to avoid repetitions; simplified or modified some sentences to make them clearer (for example, A1, «in circuitu ampulle ignem lentissimum de carbonibus»), mainly in the final section of the recipes.

- *Ca* contains few variants compared to *C*, mainly relating to some technical terms such as *azorium*, *cerasa, granetum* and the error *navum* for *blavus*.
- *H* contains clearer titles than *C* and glosses («neque carum» A3; «Nigrum istud distempera de glarea ovi sicut vermiculum», A8), perhaps explainable as modifications of the copyist when the recipes were inserted into the *Liber de coloribus illuminatorum sive pictorum*. In the A9 recipe a *saut du même au même* is visible.
- *T* contains possible glosses in the A2 (see above) and A5 recipes («vel XVI») and some reductions (it eliminates, for instance, the explanation of *vindemia* «que est proiecta de torculari» in the A2; the last part of the A10 and the indications for chrysography of the A11).
- *C* has only been corrected in two cases: in recipe A6 the verb *ponere* or *mittere* is missing, while it is present in the other manuscript witnesses. In the A11 recipe, *Ob, Ca* and *T* contain a sentence absent in *C* and *H*: «Rubeum plumbum vel album non concordat cum auripigmento». It is actually a sort of repetition, since the recipe already explained that the orpiment does not agree with red and white lead. It is likely, therefore, that the sentence was present in the archetype, since it is in line with a repetitive mnemotechnical logic.

[AA] Sensim per partes discuntur qu(a)elibet artes.
Artis pictorum prior est factura colorum,
Post ad mixturas convertat mens tua curas.
Tunc opus exerce, sed ad unguem cuncta coerce,
Ut sit ad ornatum quod pinxeris et quasi natum.
Postea multorum documentis ingeniorum
Ars opus augebit, sicut liber iste docebit.

[A1] **De vermiculo**

Si vis facere vermiculum, accipe ampullam vitream et lini deforis de luto et sic accipe unum pondus vivi argenti et duo pondera sulfuris albi aut crocei coloris. Et mitte ipsam ampullam super III aut IIII petras et adhibe ignem in circuitu ampulle ex carbonibus, ignem tamen lentissimum, et sic cooperies ampullam ex parvissima tegula. Et quando videris fumum exire ex ore ampullae blavum, cooperi. Et quando exierit fumus crocei coloris, iterum cooperi. Et quando videris exire fumum rubeum quasi vermiculum, sic tolle ignem et habes vermiculum optimum in ampulla.

[A2] **De lazorio**

Si vis facere lazorium optimum, accipe ollam novam que nunquam fuit in opus et mitte in eam laminas purissimi argenti quantas vis et sic cooperi ollam et sigilla et mitte ipsam ollam in vindemia que est proiecta de torculari. Et illic bene cooperi de ipsa vindemia et serva bene usque ad XV dies et sic aperies ipsam ollam et illum florem qui est in circuitu laminarum argenti excuties in nitidissimo vase. Quod si amplius volueris habere, iterum fac quod supra scriptum est.

[A3] **Item**

Si aliud lazorium volueris facere, accipe ampullam purissimi cupri et mitte in eam calcem usque ad medium et sic imple illam fortissimo aceto. Et ita cooperi et sigilla et tunc mitte ipsam ampullam in terra aut in alio aliquo calido loco et

C, ff. 1r-4r; *Ob,* f. 31r-v; *Ca*, ff. 147r-148v; *H,* ff. 210r-211v; *T*, ff. 163r, col. I-164r, col. I.

1-7 Sensim…docebit : *om. H*; **7** *post* docebit : *add*. Primo de vermiculo, II. De lazorio, III. De viride greco, 4. De viride rotomagense, V. De minio rubeo et albo, 6. De naturalibus coloribus in pergameno quot sunt *T*; **8** De vermiculo : *om. Ob, Ca*, Quomodo facias vermiculum *H*; **9** Si vis facere vermiculum : *om. Ob* – lini deforis de luto : afforis obline cum argilla *Ob* – et sic : postea *Ob*; **10** unum pondus : partem I *Ob* – vivi argenti : argenti vivi *Ob* – pondera : *om. Ob* – *post* coloris : *add.* et mitte haec in ampullam vitream *H*; **11** ipsam ampullam : ampullam ipsam *Ca* – aut : vel *H* – petras : lapides *Ca* – *ante* adhibe : *add.* tunc *H*; **12** ignem…lentissimum : in circuitu ampulle ignem lentissimum de carbonibus *Ob* – ignem tamen lentissimum : tamen ignem lentissimum *Ca* – sic : *om. Ob* – *post* cooperies : *add.* os *H* – ampullam : ampulle *H* – ex parvissima tegula : cum tegula parva *Ob*; **13** et quando…vermiculum : et considera fumum ac vaporem ex ore ampulle exalantem et dum blavus exierit ad hoc sic dimittatur et dum crocei coloris similiter. Cum vero rubei coloris exierit fumum quasi vermiculum *Ob* – ex ore ampulle: de ampulla *H* – blavum : navum *Ca*; **14** *post* fumus : *add.* exire *H*; **15** sic : *om. Ob* – habes : habebis *H*; **16** optimum in ampulla : in ampulla optimum *T*; **17** De lazorio : *om. Ob, Ca*, Quomodo facias azorium *H;* **18** Si vis…optimum: *om. Ob* – lazorium : azorium *Ca, H* – ollam novam : novam ollam *H* – que…opus : *om. H* – in opus : ad opus *T*; **19** eam : eas *H* – *post* vis : *add.* et infunde acetum forte vel vinum *T* – sic : postea *Ob* – *post* ollam : *add.* bene *Ob*; **20** ipsam ollam : eam *Ob* – que…vindemia : *om. T* – torculari : torolari *Ob* – et illic…usque ad : et de ipsa bene cooperi ollam et dimittes sic per *Ob*; **21** sic : postea *Ob* – aperies : aperi *Ob* – ipsam : *om. Ob*; **22** illum : *om. Ob* – argenti : *om. Ob* – argenti…vase : in mundissimo excute vase et reserva *Ob* – excuties : excucias *Ca* – *post* excuties : *add.* in vase mundissimo et ad solem sicca *H*; **23** volueris habere : habere volueris *H* – iterum : iterato *Ob* – quod…est : secundum disciplinam iam dictam. Istud lazorium obtimum est *Ob* – supra scriptum : supradictum est vel scriptum *T*; **24** Item : *om. Ca*, Quomodo facias azorium alias *H* – *post* Item : *add.* aliter *Ob*; **25** Si aliud…facere : *om. Ob* – lazorium : azorium *Ca, H* – accipe ampullam : ampullam accipe *H* – purissimi cupri : cupri purissimi *Ob*; **26** sic : postea *Ob* – illam : eam *Ob, H* – fortissimo aceto : aceto fortissimo *Ob* – ita : *om. Ob* – *post* cooperi : *add.* eam bene *Ob*; **27** et sigilla : atque sigilla *Ob* – *post* sigilla : *add.* ampullam *T* – tunc : *om. Ob, H* – ipsam ampullam : eam *Ob* – terra : terram *H* – alio : *om. Ob, H* – calido loco : loco calido *Ob*;

ita dimitte usque ad unum mensem et postea aperies ampullam. Istud lazorium non est tam bonum sicut aliud, tamen valet ad lignum et maceriam.

[A4] **Item**

Tertium lazorium si vis facere, accipe flores blavos et tere et exprime in mundissimo vase. Et fac prius campum in ligno et in pargameno de albo plumbo et mitte desuper quando fuerit siccum ipsum colorem. Et tantum ita fac usque quo videas ipsum colorem esse similem lazorii.

[A5] **De viridi**

Si vis facere viride grecum, accipe ollam novam et mitte in eam laminas purissimi cupri et sic imple ipsam ollam fortissimo aceto.
Et ita cooperi et sigilla et mitte ipsam ollam in aliquo calido loco aut in terra et ita dimitte usque ad sex menses et tunc aperies ipsam ollam et que in ea inveneris mitte super tabulam ligneam et mitte ad solem siccare.

[A6] **Item**

Si vis facere viride rotomagense, accipe laminas purissimi cupri et lini ipsas laminas in circuitu de optimo sapone et mitte ipsas laminas in novam ollam et sic imple ipsam fortissimo aceto. Et ita cooperi et sigilla et pone in aliquo calido loco usque ad XV dies et ita aperies ollam et excuties laminas super tabulam ligneam et mittas ad solem siccari.

[A7] **De minio**

Si vis facere minium rubeum vel album, accipe ollam novam et mitte in eam tabulas plumbeas et imple ipsam ollam fortissimo aceto. Et ita cooperies et sigillabis et mittes ipsam ollam in calido loco et ita dimitte usque ad unum mensem. Et postea accipe ollam et discooperies et quod fuerit in circuitu tabularum plumbearum excuties in alio vase fictili. Et sic pones ad ignem et

28 ita dimitte : dimitte ita *Ob* – unum : *om. Ob* – aperies : aperi *Ob* – lazorium : azorium *Ca, H*; **29** istud…maceriam : et erit composition illa lazorium sed non tan bonum sicut aliud tamen ad lignum valebit et ad maceriam *Ob* – tam bonum : optimum neque carum *H – ante* maceriam : *add.* ad *H*; **30** Item : *om. Ca,* Tertio modo azorium *H – post* Item : *add.* aliter *Ob*; **31** Tertium…facere : *om. Ob* – lazorium : azorium *Ca, H*; **32** mundissimo vase : vase mundo *Ob* – prius : *om. Ob* – et : vel *H* – pargameno : pergameno *Ob, Ca, T*; **33** fuerit siccum : siccatum fuerit *H* – tantum : totiens *Ob* – usque quo : quousque *Ob*; **34** colorem : *om. Ca* – esse similem lazorii : similem esse azorio *H* – lazorii : azorii *Ca;* **35** De viridi : *om. Ob, Ca*, De viridi de Grecia *H,* De viride greco *T*; **36** Si vis…grecum : *om. Ob*; **37** purissimi cupri : cupri purissimi *Ob*; sic : postea *Ob, om. H* – ipsam ollam : eam *Ob* – fortissimo aceto : aceto fortissimo *Ob*; **38** ita : *om. Ob – post* cooperi : *add.* postea *Ob* – et sigilla : atque sigilla *Ob* – mitte ipsam ollam : ipsam ollam mitte *Ca*; ipsam ollam : *om. Ob* – in aliquo calido loco : in loco calido *Ob – ante* aliquo : *add.* alio *T*; **39** ita dimitte : dimitte ita *Ob* – usque ad : per *Ob – post* menses : *add.* vel XVI *T*; tunc aperies : postea aperiatur *Ob*; **40** *ante* que : *add.* florem *Ob* – mitte…siccare : sicca ad solem super tabulam ligneam et hic erit […] viride graecum *Ob*, in sole siccabis *H*; **42** Item : *om. Ob, Ca*, De viridi rotomagensis *H,* De viride rothomagense *T*; **43** Si vis…rotomagense : *om. Ob* – ipsas laminas : eas *Ob, H*; **44** *post* circuitu : *add.* et *T – ante* mitte : *add.* postea *Ob* – ipsas laminas : eas *Ob* – novam ollam : ollam novam *Ob* – sic : *om. H*; **45** ipsam : *om. Ob,* ollam *H – post* ipsam : *add.* ollam *Ca, T* – ita : *om. Ob – post* cooperi : *add.* bene *Ob,* ollam *Ca, T* – et sigilla : atque sigilla *Ob* – pone : *om. C,* mitte *Ca.* – in aliquo calido loco : in loco calido *Ob – post* loco : *add.* pone *T*; **46** usque ad : per *Ob,* usque *Ca – post* dies : *add.* reponatur *Ob* – ita : postea *Ob,* tunc *H* – aperies : aperiatur *Ob* – ollam : *om. Ob* – excuties : excucias *Ca* – laminas : lamine *Ob*; **47** mittas…siccari : ad solem siccari dimitte. Istud viride rothomangense […] *Ob* – mittas : pones *H,* mitte *T* – siccari : siccare *H*; **48** De minio : *om. Ob, Ca*, Quomodo facias minium *H,* De minio rubeo et albo *T*; **49** Si vis…album : *om. Ob*; **50** tabulas : laminas *Ob – ante* imple : *add.* postea *Ob* – ipsam ollam : eam *Ob* – ipsam : *om. H* – fortissimo aceto : aceto fortissimo *Ob* – ita : *om. Ob* – cooperies et sigillabis : cooperi et sigilla *Ob, H*; **51** mittes : dimittatur *Ob*, pone *H*– ipsam ollam : *om. Ob, H* – calido loco : loco calido *Ob* – et ita…mensem : per mensem I *Ob* – usque ad : *om. Ca*; **52** postea…discooperies : postea aperi eam *Ob* – accipe ollam : *om. H*; **53** tabularum : laminarum *Ob* – plumbearum : *om. Ob, H* – excuties : excute *Ob* – alio : aliquo *Ca*; – sic : *om. Ob*;

semper movebis ipsum colorem. Et quando videbis ipsum colorem effectum album sicut nix tolles de illo quantum tibi placuerit. Et ipse color vocatur cerussa. Reliquum vero dimittes ad ignem et semper movebis usque quo sit factus rubeus sicuti aliud minium et ita tolles de igne et dimittes in ipso vase refrigerare.

[A8] **De diversis coloribus**

Colores in pargameno spissi et clari hii sunt. Azorium, vermiculum, sanguis draconis, carum minium, folium, auripigmentum, viride grecum, gravetum, indicum, brunum, crocus, minium rubeum vel album, nigrum optimum ex carbone vitis. Hii omnes colores destemperantur a glarea.

[A9] **De mixtionibus**

Quod si volueris scire naturas et mixtiones istorum colorum et qui sunt sibi contrarii diligenter aurem appone.

Azorium misce cum albo plumbo, incide de indico, matiza de albo plumbo.

Vermiculum purum incides de bruno aut de sanguine draconis, matizabis de auripigmento.

Vermiculum misces cum albo plumbo et facies colorem qui vocatur rosa, incides de vermiculo, matizabis de albo plumbo.

Item facies colorem de sanguine draconis et de auripigmento, incides de bruno, matizabis de auripigmento.

Carum minium incides de bruno, matizabis de rubeo minio.

Item facies rosam de caro minio et albo plumbo, incides de caro minio, matizabis de albo plumbo.

Folium incides de bruno, matizabis de albo plumbo.

Item misces folium cum albo plumbo, incides de folio, matizabis de albo plumbo.

Auripigmentum incides de vermiculo et ipsi matizatura non est quia stercorat omnes alios colores.

Tamen si vis facere gladum viride, misces auripigmentum cum nigro, incides de nigro, matizabis de auripigmento.

54 et semper movebis : continue move *Ob* – ipsum colorem : *om. Ob* – videbis : videris *Ob, H* – ipsum colorem…nix : album illud effectum quod est in vase quasi esset nix *Ob* – effectum : *om. Ca*; **55** tolles : tolle *Ob* – de illo : ex eo *Ob,* de eo *H* – tibi placuerit : volueris *Ca, H* – ipse : iste *Ob* – vocatur cerussa : cerusa vocatur *Ob* – cerussa : cerasa *Ca*, cerusa *H, T*; **56** Reliquum…refrigerare : Reliquum partem ad ignem dimitte donec fiat rubea et continue move et cum rubescat sicut aliud minium tolle de igne et sine refrigerare in ipso vase et ita facit tam minium album quam etiam rubeum *Ob* – vero : *om. Ca, T* – quo : *om. H* – factus : *om. H* – rubeus : rubeum *H*; **57** tolles : tollas *T* - dimittes…refrigerare : ipso vase dimitte refrigerare *H*; **58** De diversis coloribus : *om. Ob,* De indico colore ante invenies *Ca*, De coloribus *H,* De naturalibus coloribus *T*; **59** azorium…nigrum : azorium, vermiculum, auripimentum, viride grecum, sanguis drachonis, gravetum, indicum, caruminium, crocus, folium, brunum, minium album, nigrum *H* – auripigmentum : auripimentum *Ob* – pargameno : pergameno *Ob, Ca*; **60** carum : clarum *Ob* – auripigmentum : auripimentum *H* – gravetum : granetum *Ob, Ca*; **61** rubeum vel album : album vel rubeum *Ob* – vel : et *T*; **62** *post* vitis : *add.* Nigrum istud distempera de glarea ovi sicut vermiculum *H* – destemperantum a glarea : cum glarea distemperantur *Ob* – destemperandum : distemperandum *Ca, H, T – post* glarea : *add.* excepto viridi greco *H*; **63** De mixtionibus : *om. Ob, Ca*, De commixturis et matizaturis colorum diversorum *H,* Si vis scire naturas et mixtiones colorum *T*; **64** Quod si volueris scire : Ut scias *Ob* – mixtiones : commixtiones *Ob*; **65** aurem appone : attende *Ob*; **66** de albo plumbo : cum albo plumbo *Ob*; **67** incides : incide *Ob* – matizabis : matiza *Ob*; **68** auripigmento : auripimento *Ob, H*; **69** misces : misce *Ob* – cum : ad *T* – facies : fiat *Ob,* facias *T* – incides : incide *Ob*; **70** matizabis : matiza *Ob*; **71** auripigmento : auripimento *Ob, H*; **72** auripigmento : auripimento *Ob, H*; **73** carum minium : carominium *H* – incides de bruno : *om. Ca* – rubeo minio : minio rubeo *Ob*; **73-75** de rubeo minio…matizabis de : *om. H (saut du même au même)*; **77** misces folium : folium misces *H*; **78** *ante* auripigmentum : *add.* De auripigmento *T* – auripigmentum : auripimentum *Ob, H* – ipsi : ipsa *H*; **80** Tamen…viride : Tamen si vis gladum viridem facere *Ob* – misces : misce *Ob* – auripigmentum : auripimentum *Ob, H* – incides : incide *Ob* – cum : ad *T* – de : cum *Ca*, ad *T*; **81** matizabis : matiza *Ob* – de : cum *Ob, T* – auripigmento : auripimento *Ob, H*;

Si vis facere similem, accipe azorium, misces cum albo plumbo, incides de azorio, matizabis de albo plumbo; et quando fuerit siccum, cooperies de claro croco.

[A10] **Temperatura**

Viride grecum distemperabis cum aceto, incides de nigro, matizabis de albo quod fit de cornu cervi.

Item misces viride cum albo plumbo, incides de viride, matizabis de albo plumbo.

Gravetam incides de viride, matizabis de albo plumbo.

Crocum incides de vermiculo, matizabis de albo plumbo.

Indicum incides de nigro, matizabis de azorio.

Item misces indicum cum albo, incides de azorio, matizabis de albo plumbo.

Brunum incides de nigro, matizabis de rubeo minio.

Item facies de bruno et albo plumbo rosam, incides de bruno, matizabis de albo plumbo.

Item misces crocum cum albo plumbo, incides de croco, matizabis de albo plumbo.

Minium rubeum incides de bruno, matizabis de albo plumbo.

Item misces minium cum bruno, incides de nigro, matizabis de rubeo plumbo.

Item facias carnaturam de rubeo plumbo et albo, incides de vermiculo, matizabis de albo plumbo.

[A11] **Qui contrarii sibi sint colores**

Modo si vis scire qui colores sibi sunt contrarii hoc est.

Auripigmentum non concordat cum folio nec cum viridi, nec rubeo plumbo, nec cum albo. Viride non concordat cum folio. Rubeum plumbum vel album non concordat cum auripigmento.

Si vis facere campos, fac pulcram rosam de vermiculo et albo. Item fac campum de folio distemperato calce. Item fac campum de viridi distemperato cum acceto. Item fac campum de ipso viridi et, quando fuerit siccum, cooperies de caule.

Si vis scribere de auro, accipe pulverem auri et distempera cum glute ipsius

82 accipe…plumbo : misce azorium cum albo plumbo *Ob* – misces : misce *H* – incides : incide *Ob*; **83** matizabis : matiza *Ob* – de : cum *Ob* – cooperies : cooperi *Ob*; **85** Temperatura : *om. Ob, Ca,* De distemperatione colorum diversorum *H*, De temperatura. *T*; **86** viride : viridi *Ca* – distemperabis : distempera *Ob* – incides : incide *Ob* – matizabis : matiza *Ob* – *post* albo : *add.* plumbo *H*; **88** misces : misce *Ob, T* – incides : incide *Ob* – viride : viridi *Ob, Ca, H* – matizabis : matiza *Ob, Ca*; **89** gravetam…plumbo : *om. Ob* – gravetam. : gravetum *H* – matizabis : matiza *Ca*; **90** incides : incide *Ob* – matizabis : matiza *Ob*; **91** incides : incide *Ob* – matizabis : matiza *Ob*; **92** misces : misce *Ob* – incides : incide *Ob* – matizabis de albo plumbo : de albo plumbo matiza *Ob* – de : cum *H* – de : cum *H*; **93** incides : incide *Ob* – matizabis : matiza *Ob* – minio : plumbo *H*; **96** Item misces crocum…incides de vermiculo, matizabis de albo plumbo : *om. T* – misces : misce *Ob* – incides : incide *Ob* – matizabis : matiza *Ob, Ca*; **98** incides : incide *Ob* – de bruno : cum bruno H – matizabis : matiza *Ob*; **99** misces : misce *Ob* – incides : incide *Ob* – matizabis : matiza *Ob*; **100** facias : fac *Ob,* facies *Ca, H* – incides : incide *Ob* – matizabis : matiza *Ob*; **101** plumbo : *om. Ca*; **102** Qui contrarii sibi sint colores : Isti igitur sunt colores sed iam deinde modus sibi invicem concordantes *Ob, om. Ca*, De contrariis coloribus in uno loco *H*, De commentarii (?) vel recapitolatione *T*; **103** Modo…est : Colores sibi sunt contrarii sunt hii *Ob* – hoc est : hii sunt *H*; **104** auripigmentum : auripimentum *H* – viridi : viride *T* – *ante* rubeo : *add.* cum *Ob, Ca*; **105** Rubeum plumbum vel album non concordat cum auripigmento : *om. C, H* – et : de T; **107** Item fac campum de folio…acceto : Item fac campum de folio distemperato cum acceto. Item fac campum de folio distemperato cum calce *H – marg*. Item fac campum de viridi distemperato cum aceto *H*; **108** Item fac campum de viridi distemperato cum acceto : *om. Ca*; **109** quando fuerit siccum : quando siccatum fuerit *H* – siccum. : siccatum *Ob* – cooperies : cooperi *Ob, H – ante* caule : *add.* cum *Ob* – caule : calce *H*; **110** Si vis scribere…aurpigmento : *om. T – ante* scribere : *add.* aut *Ob* – accipe : et operare *Ob – ante* auri : *add.* ipsius *H* – pulverem auri : pulveriza aurum *Ob* – glute : glutine *Ca*;

pargameni in quo debes scribere et ad ignem de ipso auro cum glute scribe. Et, quando littera sicca fuerit, bruni de planissima petra aut de dente apri. Item si inde volueris vestimentum aut pictura aliam facere sicut superius dixi, aurum mittes in pargameno, incides de incausto aut de indico et matizabis de
115 auripigmento.

111 pargameni : pergameni *Ca* – gluten ipsius pargameni : glute cartineo *Ob* – in quo…scribere : *om. Ob* – de ipso auro cum glute scribe : de ipsa commixtione scribe *Ob* – glute : glutine *Ca*; **112** sicca fuerit : fuerit sicca *Ca* – sicca : siccata *H* – bruni : burni *H* – bruni…pietra : frica de dente apri vel de planissima petra *Ob* – *ante* de planissima : *add.* ea *H* – aut : vel *H* – Item : Et *H* – Item…dixi : Si vestimentum vel aliud inde volueris facere ut superius deinde *Ob;* **113** dixi : diximus *H* – aurum mittes : mitte aurum *Ob*; **114** pargameno : pergameno *Ca* – incides : incide *Ob* – matizabis : matiza *Ob*; **115** auripigmento : auripimento *Ob, H.*

AA
Gradually, part by part, one learns every art.
In the art of painters, in the first place is the preparation of colours,
then your mind should turn toward mixtures.
Then begin your work, and lead it to perfection,
in order that what you have painted is beautiful and fresh.
Afterwards, as many talents have given testimony,
the art will advance the work as this book will teach.

A1 *Vermilion*
If you wish to make vermilion, take a glass ampoule and coat the outside with clay. Then take one part by weight of quicksilver and two of white or yellow sulphur and put the ampoule on three or four stones. Surround the ampoule with a charcoal very slow fire and then cover the ampoule with a tiny tile. When you see that the smoke coming out of the mouth of the ampoule is blue, cover it. When yellow smoke comes out, cover it again. When you see red smoke like vermilion coming out, take away the fire and you have excellent vermilion in the ampoule.

A2 *Blue*
If you want to make excellent blue, take a new pot that has never been used and put in it sheets of the purest silver, as many as you want, and then cover the pot and seal it. Set the pot in the must that is discarded from a wine-press, and there cover it well with the must and preserve it well for fifteen days. Then uncover the pot and shake out the efflorescence that surrounds the sheets of silver in a shining bowl. If you want to have more, repeat what has been written above.

A3 *Again*
If you wish to make another blue, take an ampoule of the purest copper and put lime into it halfway up, and then fill it with very strong vinegar. Cover it and seal it. Then put the ampoule in the earth or in some other warm place and leave it there for one month. Later uncover the ampoule. This blue is not as good as the other, nevertheless it is useful on wood and wall.

A4 *Again*
If you wish to make a third kind of blue, take blue flowers, grind them and squeeze [the

juice] *into a very clean bowl. Earlier, on wood and parchment, make the ground with white lead and, when it is dry, put this pigment on top. Continue making it in this way, until you see the pigment is like blue.*

A5 *Green*
If you wish to make Greek green, take a new pot and put sheets of the purest copper in it. Then fill the pot with very strong vinegar, cover it and seal it. Put the pot in some warm place or in the earth and leave it there for six months. Then uncover the pot and put what you find in it on a wooden board and leave it to dry in the sun.

A6 *Again*
If you wish to make Rouen green, take sheets of the purest copper and smear them all over with excellent soap. Put the sheets into a new pot and then fill it with very strong vinegar. Cover it, seal it and put it in some warm place for fifteen days. Then uncover the pot, shake the sheets over a wooden board and leave it to dry in the sun.

A7 *Minium*
If you wish to make red or white minium, take a new pot and put lead sheets in it. Fill the pot with very strong vinegar, cover it and seal it. Put the pot in a warm place and leave it there for one month. Afterwards take the pot, uncover it and shake out whatever surrounds the lead sheets into another earthen pot. Then set in on the fire and stir the pigment continuously. When you see the pigment become white like snow, take away as much as you like of it and that pigment is called ceruse. Put the rest on the fire and stir continuously, until it becomes red like other minium. Then take it away from the fire and leave it in the pot to cool.

A8 *Various pigments*
The pigments opaque and transparent [to be used] *on parchment are the following: blue, vermilion, dragonsblood, carmine, folium, orpiment, Greek green, gravetum, indigo, brown, saffron, red or white minium, the best black from vine charcoal. All these pigments are tempered with glair.*

A9 *Mixtures*
If you want to know the nature and mixtures of these pigments and which ones are incompatible with each other, listen carefully.
Mix blue with white lead, darken with indigo, lighten with white lead.
Darken pure vermilion with brown or dragonsblood, lighten with orpiment.
Mix vermilion with white lead and make the pigments that is called rose, darken with vermilion, lighten with white lead.
Again, make a pigment with dragonsblood and orpiment, darken with brown, lighten with orpiment.
Darken carmine with brown, lighten with red minium.
Again, make rose pigment from carmine and white lead, darken with carmine, lighten with white lead.
Darken folium with brown, lighten with white lead.
Again, mix folium with white lead, darken with folium, lighten with white lead.
Darken orpiment with vermilion and there is no lightening for it, since it taints all other

pigments.
If you want to make gladus *green, mix orpiment with black, darken with black, lighten with orpiment.*
If you want to do similarly, take blue, mix it with white lead, darken with blue, lighten with white lead; and when it is dry, cover it with clear saffron.

A10 *Tempering*
Temper Greek green with vinegar, darken with black, lighten with white made from stag horn.
Again, mix green with white lead, darken with green, lighten with white lead.
Darken gravetum *with green, lighten with white lead.*
Darken saffron with vermilion, lighten with white lead.
Darken indigo with black, lighten with blue.
Again, mix saffron with white lead, darken with saffron, lighten with white lead.
Darken red minium with brown, lighten with white lead.
Again, mix minium with brown, darken with black, lighten with red lead.
Again, make flesh-colour pigment with red and white lead, darken with vermilion, lighten with white lead.

A11 *Pigments that are incompatibles with each other*
If you want to know which pigments are incompatibles with each other, this is the way. Orpiment is not compatible with folium, green, red or white lead. Green is not compatible with folium. Red or white lead is not compatible with orpiment.
It you want to make grounds, make a beautiful from vermilion and white. Again, make a ground from folium tempered with lime. Again, make a ground from green tempered with vinegar. Again, make a ground from green itself and, when it is dry, cover it with cabbage. [juice].
If you want to write in gold, take powdered gold and temper it with glue made from the same parchment as that on which you are to write, and write with the gold and glue close to the fire. When the letter is dry, burnish it with a very smooth stone or a boar's tooth. Again, if you want to make a garment or another painting, as I said above, put the gold on the parchment, darken with ink or indigo, and lighten with orpiment.

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