

# On the Date and Contents of a Portuguese Medieval Technical Book on Illumination: *O livro de como se fazem as cores*

António João Cruz\* and Luís Urbano Afonso\*\*

---

*The book this article discusses is a late medieval Portuguese technical text on illumination written with Hebraic characters. It belongs to a miscellaneous manuscript at Parma's Biblioteca Palatina. Discovered in 1803, it was attributed to Abraham ben Judah Ibn Hayyim and dated to 1262. Soon some authors assigned it to the fifteenth century. The paper's watermarks, recently observed, confirmed the fifteenth century date. Yet, the possibility that this text could be a copy of an older original remains. However, the discussion of the historical context and the content also suggests that the original dates more probably from the fifteenth than the thirteenth century. In terms of structure and content this text should not be considered a treatise but a heterogeneous compilation which, besides the Hebraic marks, presents significantly alchemic, Castilian and Arabic influences.*

---

---

**Acknowledgement:** This article is an outcome of a project financed by the Fundação para a Ciência e Tecnologia, Portugal, entitled 'The Materials of the Image: Pigments on Portuguese Treatises from the Middle Ages to 1850' (reference POCI/EAT/58065/2004). The authors are indebted to Professor Kathleen Ashley (University of Southern Maine) for her assistance in the revision of this text.

---

\*Departamento de Arte, Conservação e Restauro, Escola Superior de Tecnologia de Tomar, Instituto Politécnico de Tomar. E-mail: ajcruz@netvisao.pt

\*\*Departamento de História, Faculdade de Letras, Universidade de Lisboa. E-mail: luisafonso@fl.ul.pt

---

**The Medieval History Journal**, 11, 1 (2008): 1–28

**SAGE Publications** ♦ Los Angeles/London/New Delhi/Singapore

**DOI: 10.1177/097194580701100101**

## Introduction

*O livro de como se fazem as cores*, that is, ‘The book on how to make colours’, is a Portuguese technical text which has some relevance to the knowledge of the materials used in medieval painting, especially in manuscript illumination. On the importance of this text we could mention its frequent inclusion in the catalogues of written sources with artistic and technical interest,<sup>1</sup> its occurrence in the major reference book devoted to the materials of medieval painting,<sup>2</sup> and its various editions, in the original Hebraic form,<sup>3</sup> in Roman characters<sup>4</sup> and in translation in Portuguese<sup>5</sup> and other languages.<sup>6</sup> Although it was well known, only a single copy of the text survives which is included in a miscellaneous volume from the fifteenth century comprising a total of 16 texts.<sup>7</sup>

The history of the manuscript is not known until the late eighteenth century, when it was included among the around 1,500 Hebrew manuscripts collected by the Italian priest, professor and bibliophile, Giovanni Bernardo De Rossi (1742–1831). In the original catalogue of his collection this manuscript was numbered at 945.<sup>8</sup> In 1816, this collection was

<sup>1</sup> For instance: Alexander, ‘A History of Art Materials’: 141; Bordini, *Materia e Imagem*: 32; Clarke, *The Art of All Colours*: 17–18, 103; Muñoz Viñas, ‘Sources for the History of Mediaeval Painting’: 117; Schlosser, *La Literatura Artística*: 49.

<sup>2</sup> Such as Thompson, *Medieval Painting*.

<sup>3</sup> Bernheimer, *Paleografia Ebraica*; Blondheim, ‘An Old Portuguese Work on Manuscript Illumination’: 99–118.

<sup>4</sup> Blondheim, ‘Livro de como se fazem as cores’; Strolovitch, ‘Old Portuguese in Hebrew Script’: 120–31.

<sup>5</sup> Strolovitch, ‘Livro de Como se Fazem as Cores’: 186–87; Sá, ‘O livro de como se fazem as cores’: 212–23.

<sup>6</sup> In Italian: Bernheimer, *Paleografia Ebraica*. In English: Abrahams, ‘A Work on Manuscript Illumination’: 94–98; Blondheim, ‘An Old Portuguese Work on Manuscript Illumination’: 119–35; Mann, *Jewish Texts on the Visual Arts*: 135–37; Strolovitch, ‘Old Portuguese in Hebrew Script’: 131–42; Strolovitch, ‘Livro de Como se Fazem as Cores’: 196–97. In Spanish: Espinosa Villegas, ‘O livro de como se fazem as cores’: 8–20.

<sup>7</sup> On the more recent catalogue of Parma’s Hebrew manuscripts only 15 texts are identified in MS 1959 (Richler and Beit-Arié, *Hebrew Manuscripts in Parma*: 472–73). However, the information on that catalogue allows us to add one more text concerning the rules of grammar, included in f.196v.

<sup>8</sup> De Rossi, *Manuscripti Codices Hebraici Bibliothecae*: vol. III: 21–22. De Rossi held the chair of Oriental languages at the University of Parma from 1769 to 1834. The importance of his collection was emphasised by the known Hebraist palaeographer and

acquired by the Duchess of Parma, Maria Luisa, for Parma's Biblioteca Palatina, where it still rests and where it is catalogued with the number 1959.<sup>9</sup> By connecting the text on colours with another text almost at the end of the volume, which included the name of its author, date and location in a colophon (f. 195v), Giovanni De Rossi believed that Abraham ben Judah Ibn Hayyim was also the author or the copyist of *O livro de como se fazem as cores* and that the manuscript was also completed at Loulé, in the south of Portugal (Algarve), in 1262. However, based on a palaeographical and linguistic analysis, Leopold Zunz questioned that date in 1864, as David Blondheim did in 1928, and others still later. These authors suggested a subsequent date for the text, namely the fifteenth or the sixteenth centuries, although the attribution to the thirteenth century continued to be accepted and referred to in the literature on technical sources of art.<sup>10</sup> It was recently revealed that the paper of the manuscript contains watermarks used during the fifteenth century, specifically between 1423 and 1488, a fact that does not eliminate the possibility of these texts being fifteenth-century copies of older originals.<sup>11</sup>

Although the information provided by the text on colours has been cited and used several times by scholars, the treatment of that information has been very uneven. Indeed, according to our knowledge, this text has never been studied in a systematic way, particularly in the context of the materials and of the techniques that are mentioned. In this article we first review the data and the arguments relating to the authorship and the date of its compilation. We then go on to discuss these issues in a new multidisciplinary perspective. On the one hand, we explore the context of production and reception of a technical text of this nature in Late Medieval Portugal; on the other hand, we follow up its content, i.e., its standing in the history of materials and the history of science. Finally, based on its content, we discuss the technical characteristics of the text and some of the influences that show up.

codicologist Malachi Beit-Arié: 'I would without any hesitation rate the De Rossi collection of the Biblioteca Palatina in Parma as the most important collection in the whole world, together with the collection kept in the Bodleyan Library of Oxford' ('Hebrew Manuscripts': 215).

<sup>9</sup> Richler and Beit-Arié, *Hebrew Manuscripts in Parma*: 472.

<sup>10</sup> For instance, this is the chronology given in a relatively recent manual on medieval sources for painting (Clarke, *The Art of All Colours*: 17).

<sup>11</sup> The complete references are presented in the next section.

## Problems of Dating and Authorship

*O livro de como se fazem as cores* occupies folios 1r to 20r of a miscellaneous volume which comprises 211 folios in all. The volume includes several texts of diverse length and language: 14 are in Hebrew, one in Portuguese and one in Spanish.<sup>12</sup> In spite of the thematic, linguistic and handwriting differences among these texts, the volume was composed as a whole, in terms of format, justification, number of lines, composition of books and decoration.<sup>13</sup> Indeed, each folio measures 144 mm by 102 mm, the text occupies a space of about 95 mm by about 55 to 65 mm and the average number of lines is 17.<sup>14</sup> According to the most recent textual, palaeographic and codicological analysis by Benjamin Richler and Malachi Beit-Arié,<sup>15</sup> the volume's content is as follows: the aforementioned Portuguese text with recipes for producing colours, which is the subject of this article (ff. 1r–20r); a calendar of regular and leap years with lists of the Torah reading (ff. 20v–28r); medical recipes and others in Spanish (f. 28v); scriptural passages written in *tefillin* (ff. 29r–30v); notes on the *masorah* (f. 31r); a commentary on *Ecclesiastes* (ff. 31v–34r); a midrashic extract (ff. 34v–35r); Asher b. Jehiel's *Asheri* (ff. 37r–77v); extracts from Abraham ben Nathan ha-Yarhi's *Sefer ha-Manhig* dating from 1294 (ff. 80r–138v); an extract from Moses ben Maimon's *Mishneh Torah* (ff. 139r–140v); the legend about the preparation of the Septuagint (ff. 141r–142r); Moses ben Maimon's *Mishneh Torah* (ff. 142v–184r); a *masorah* better described as a 'list of the oddly shaped letters found in an accurate Torah scroll by Abraham ben Judah ibn Hayyim' (ff. 184v–195v); rhymes about rules of grammar (f. 196v); liturgical poems (ff. 197r–210r); and an extract from the grammatical treatise *Sefer ha-Mikhlol* by David Kimhi (ff. 210v–211v). That is, except for the medical recipes in Spanish and for the colour recipes in Portuguese, this volume

<sup>12</sup> These numbers are not shared (or known) by all the authors who have researched on this topic. For instance, in an older study, Thérèse Metzger (*Les Manuscrits Hébreux copiés à Lisbonne*: 5) identified 11 texts in this volume, an account that is reduced to nine on a more recent publication concerning the fifteenth-century Galician illuminator Joseph Ibn Hayyim ('Joseph ibn Hayyim'), who was responsible for the so-called 'Kennicott Bible'.

<sup>13</sup> Metzger, *Les Manuscrits Hébreux copiés à Lisbonne*: 4–5.

<sup>14</sup> Blondheim, 'Additional note': 284; Blondheim, 'An Old Portuguese Work on Manuscript Illumination': 97.

<sup>15</sup> Richler and Beit-Arié, *Hebrew Manuscripts in Parma*: 472–73.

mainly deals with liturgical, grammatical and theological matters related to the Torah.

In the beginning of the 13th text of this volume (f. 184v) there is a reference to the name of Abraham ben Judah Ibn Hayyim and the colophon of the text (f. 195v) records that Abraham ben Judah Ibn Hayyim completed it at Loulé (Algarve, Portugal) in the year 22. Giovanni De Rossi concluded that it was the Jewish year of 5022, that is, the year 1262 of the Christian calendar, because after the mention of the year 22 he read a reference to the sixth millennium after the creation of the world.<sup>16</sup> This practise of writing just the last two digits of the year seems to be more general, as it is shown by several other Jewish texts from the thirteenth century.<sup>17</sup> Giovanni De Rossi also identified an elaborated signature at the end of the first text of this volume, on folio 20r, or more precisely an ornate monogram in a ‘style common among Sephardic Jews’,<sup>18</sup> that he considered to be the one from Abraham ben Judah Ibn Hayyim.<sup>19</sup> Therefore, De Rossi considered that both texts were compiled in Loulé in 1262 and that Ibn Hayyim was responsible for both the 13th text and for *O livro de como se fazem as cores*. His only doubt was whether Ibn Hayyim was the author or a copyist. Sharing this idea, someone wrote in Hebrew, at folio 1r, that the volume in which the text on colours was included was entirely written by Rabbi ibn Hayyim, from Loulé, in 1262.<sup>20</sup>

<sup>16</sup> De Rossi, *Manuscripti Codices Hebraici Bibliothecae*: 22. De Rossi seems to have been quite creative here since no one else could ever identify the reference to the millennium following the year 22 (Blondheim, ‘Additional Note’: 283).

<sup>17</sup> An example of this situation, among others, appears on the signature of folium 11r of Lisbon’s MS Iluminados 72, signed by the copyist Josué ibn Gaon (Metzger, ‘Josué ben Abraham ibn Gaon’: 6).

<sup>18</sup> Blondheim, ‘Additional Note’: 283; Blondheim, ‘Note’: 135.

<sup>19</sup> De Rossi, *Manuscripti Codices Hebraici Bibliothecae*. A reproduction of the last page of this text including the decorated monogram can be found in Harold Abrahams (‘A Work on Manuscript Illumination’: plate II). Devon Strolovitch (‘Old Portuguese in Hebrew Script’: 131) also transliterates this monogram on the edition of the text on colours that he prepared for his Ph.D. dissertation: ‘abr<sup>h</sup>m b<sup>r</sup> y<sup>h</sup>ud<sup>h</sup> ç<sup>h</sup>’t ab<sup>n</sup> h<sup>y</sup>m’. Since this author does not refer to any difference in terms of handwriting it seems that he also assumed it to be the original.

<sup>20</sup> Blondheim, ‘An Old Portuguese Work on Manuscript Illumination’: 97. We follow the translation of this note given by Harold Abrahams: ‘This book is a collection of many important things, written by the scribe, Rabbi Abraham ibn Hayyim, of the town of Loule, in the fifth day of the month of Sivan [May], in the [Jewish] year 5022’ (‘A Work on Manuscript Illumination’: 98). As we have observed above, this volume includes several

This first attribution and dating of the text on colours, however, raised many doubts. To Leopold Zunz, in 1864, the Hebraic characters of the text seemed to be from the sixteenth century and the mentioned date did not seem to be from the same hand that had written the text.<sup>21</sup> For the same reasons, David Blondheim also inferred that the manuscript dated from a period later than the thirteenth century. However, it was evident to him that Abraham ben Judah Ibn Hayyim was the author of the 13th text of the volume, and not merely a copyist. Furthermore, he believed that Ibn Hayyim might have been the scribe or even the author of the text on colours, giving credit to the ornate monogram appearing at the end of the text on colours. The similarities between that name and that of José Ibn Hayyim, who concluded the illumination of a Bible at Galicia in 1476, to add to the common activity, led him to suggest that the two Ibn Hayyims were contemporary relatives and that *O Livro de como se fazem as cores* may have been written in Galicia during the fifteenth century. Consequently, to Blondheim, the Jewish year 22 bore no relation to the beginning of the fifth millennium, but it stood in relation to the third century of the fifth millennium, that is, 5222 and not 5022, corresponding to the year 1462 in the Christian calendar.<sup>22</sup>

Later, referring to the signature that appears at the end of the text on colours, Thérèse Metzger pointed out that the handwriting used in the abbreviated signature was different from the handwriting on the rest of the text—an interpretation to which we entirely subscribe. Furthermore, she added that it was not usual for Jewish writers and copyists of the thirteenth century to give their names in the form of a signature.<sup>23</sup> Indeed,

---

works by different authors, some of them identified by name or even dated. In addition, according to Thérèse Metzger (*Les Manuscrits Hébreux copiés à Lisbonne*: 4), this volume seems to have been copied by more than one copyist: '(...) plusieurs mains ont participé à la copie de ce petit volume (...)'

<sup>21</sup> Zunz, *Die hebräischen Handschriften in Italien*.

<sup>22</sup> Blondheim, 'An Old Portuguese Work on Manuscript Illumination': 97–98; Blondheim, 'Note': 89; Blondheim, 'Additional Note': 283.

<sup>23</sup> Metzger, *Les Manuscrits Hébreux copiés à Lisbonne*: 5–6. Therefore, this particular situation would have been quite strange. It seems that the signature was added by the same hand that was responsible for the decoration: 'Une main, un peu plus tardive que celle des copistes du volume de Parme, y a ajouté des ornements d'entrelacs, à la plume, sur plusieurs feuillets restés blancs. Un décor de ce genre entoure justement la signature sur le fol. 20r. Il paraît bien possible que ce soit cette main qui ait ajouté en même temps la signature, à des fins décoratives, en utilisant le seul nom qu'offrait le manuscrit.'

according to Thérèse Metzger, the common procedure in medieval manuscripts consisted of mentioning the name of the copyist or author only at the colophon or, in the case of copyists of the *masorah*, along micrographic inscriptions.<sup>24</sup> Therefore, the text on colours cannot be related with the author and the date mentioned in the 13th text of Parma's volume. Metzger considers that Abraham Ibn Hayyim was the author of the small Masoretic treatise completed in Loulé in 1262, but, despite the fact of being included in the same volume, this work and its author had nothing to do with the text, which Metzger considers a '15th-century anonymous and unlocated treatise on colours'.<sup>25</sup> According to Metzger, the book's handwriting and its original decoration, made with violet ink, pointed instead to the second half of the fifteenth century.<sup>26</sup>

Based on a philological approach, Devon Strolovitch concluded that the writing style and language clearly places the extant copy of *O Livro de como se fazem as cores* later than the thirteenth century.<sup>27</sup> According to him, this text, like other medieval Portuguese texts written with the Hebrew alphabet, is characterised by archaic language. The use of many

---

Remarquons de plus qu'il aurait été bien inusuel pour un copiste ou pour un auteur juif de cette époque de donner son nom sous forme de signature' (Metzger, *Les Manuscrits Hébreux copiés à Lisbonne*: 6). Without questioning the interpretation of Metzger, with which we agree, it must stay clear that Ibn Hayyim is not the single author mentioned in this volume. However, among the mentioned authors (e.g., David Kimhi, Moses ben Maimon, Abraham ben Nathan ha-Yarhi and Asher ben Jehiel) he was the single one that lived in a Portuguese village. We believe that this would be enough for someone to attribute to him the authorship of the text.

<sup>24</sup> Metzger, 'Josué ben Abraham ibn Gaon': 1. Even in this case, they sign their full name and use the personal pronoun 'I' before adding it. The most common expression is 'I (followed by the copyist's name), have copied this or this *masorah*'. Thérèse Metzger (p. 4) refers to the case of Lisbon's MS Iluminado 72, dating from 1300, where the copyist Josué ben Abraham ibn Gaon introduces his name on different folios of the *masorah*, no less than 20 times.

<sup>25</sup> Metzger, 'Joseph ibn Hayyim': 661.

<sup>26</sup> Metzger, *Les Manuscrits Hébreux copiés à Lisbonne*: 6. Entirely ignoring the fact of being the single text on the volume to be written in Portuguese, this author states that the text on colours could have been copied in Spain, adding that 'Il nous parait cependant plus espagnol que portugais'. These observations seem to have been made to deny the use of this technical text by the so called 'Lisbon school' of Hebrew illumination during the late fifteenth century, and to emphasise the dependence of this 'school' upon Hebrew Spanish models.

<sup>27</sup> Strolovitch, 'Livro de Como se Fazem as Cores': 185.

antiquated words in Portuguese, however, is interpreted by Vivian Mann as a strong basis for a thirteenth-century date. Due to the characteristics of the script, this author suggests that the text is a later copy of a lost original and that it should be related to other primitive treatises such as Theophilus' *The Various Arts* and one of the versions of *De coloribus et mixtionibus*.<sup>28</sup> Finally, in the catalogue of the Hebrew manuscripts of Parma's Biblioteca Palatina, Benjamin Richler and Malachi Beit-Arié, in 2001, pointed out that the miscellaneous volume includes works composed in the fourteenth century and revealed that it was written on paper with watermarks used between 1423 and 1488. Therefore, they announced that the year 22 must correspond to 1462 and that the entire volume, except for a few additions, might very well have been written by Abraham ben Judah Ibn Hayyim.<sup>29</sup>

To summarize, we can say that with the data known at the moment it is unquestionable that the manuscript with the text on colours in the Parma library dates from the fifteenth century, perhaps from the mid of the century, but it is not certain if it is the original or a copy. In this last case scenario it is not certain if the original also dates from the fifteenth century or if it is older. Besides, there is also no conclusive evidence regarding its authorship, whether Ibn Hayyim was the author of the original, or if he was the copyist and if he had any relationship with *O Livro de como se fazem as cores*. Our present state of knowledge also does not allow us to conclude that the text, either an original or a hypothetical copy, was finished in Loulé. In other words, the date of the text, unlike the date of Parma's manuscript, its authorship and the place where it was written, continue to be a matter of debate.

## Contexts of Production and Reception

In addition to the questions raised by the analysis of the manuscript and its content, there are a number of external questions that can be raised. These mainly refer to the contexts of production and reception of *O Livro*

<sup>28</sup> Mann, *Jewish Texts on the Visual Arts*: 134–35. Mann has misinterpreted some of the information presented in Parma's manuscript. Indeed, she states that the colophon with the date, place and author at f. 195v is on the text on colours, ignoring the fact that it actually belongs to a different text. Naturally, this mistake leads the author to a wrong attribution and dating of the Portuguese text.

<sup>29</sup> Richler and Beit-Arié, *Hebrew Manuscripts in Parma*: 472–73.

*de como se fazem as cores*, which is extremely specific and only interests a limited audience. In the first place, it would be very surprising to find any significant activity in Loulé relating to the preparation of pigments for artistic use in 1262. The Jewish community of Loulé is referred to in Portuguese documentation after 1269 and it is probable that it already existed during the Islamic rule of Algarve.<sup>30</sup> This Jewish community continued to flourish and Loulé's *judiaria* was one of the 31 documented in Portugal between the late thirteenth and the late fourteenth century.<sup>31</sup> This community could have been sufficiently significant to include members that were able to write religious texts in Hebrew, as seems to have been the case with Abraham ben Judah Ibn Hayyim. Nevertheless, during the thirteenth century, neither the village of Loulé nor the Portuguese Jews were known for a particular interest in the production of illuminated manuscripts. Further, since the Christian conquest of Algarve occurred in 1248 (only 14 years before the writing of the text on the Torah by Ibn Hayyim) it would be surprising that these communities in southern Portugal had such a good knowledge of Galaico-Portuguese that enabled them to put into Hebrew characters, a peculiar Portuguese text dealing with the preparation of colours for manuscript use. Finally, if it's certain that Ibn Hayyim wrote a Masoretic text in Hebrew, what would have been his interest in writing a technical text on colours in a language that had 'just arrived', so to speak, in Loulé? Finally, the search for Ibn Hayyim among the names mentioned in the known documentation of the thirteenth century in Algarve did not reveal any results.<sup>32</sup> Furthermore, there is no documentary evidence for the activity of Jewish painters or illuminators during the entire fourteenth and fifteenth centuries in Portugal.<sup>33</sup>

<sup>30</sup> From the early eighth century to 1248.

<sup>31</sup> Ferro, *Os Judeus em Portugal no Século XIV*: 21.

<sup>32</sup> Actually, the Jewish name *Hayyim*, which appears in Portuguese documents as *Haim*, is documented only in the fifteenth century. In Faro, near Loulé, there is mention of the shoemaker Haim Aliote in 1445, probably the same person who in 1450 appears as a farmer. Despite that, Loulé had several Jewish blacksmiths, shoemakers, farmers, physicians, and gunners, tenant farmers, tailors, shearers and weavers. In what concerns the whole Portuguese territory, there are references to Haim de Cáceres, Haim de Illescas (which was one of the King's tailors), Haim Navarro and another Haim identified as *Rico-Homem*, but none of them is referred to in connection with artistic practices (Ferro Tavares, *Os Judeus em Portugal no Século XV*: 69, 93, 131, 133, 284–85, 302).

<sup>33</sup> In her studies about late medieval Portuguese Jews, Ferro did not find a single Jewish painter or illuminator (Ferro, *Os Judeus em Portugal no Século XIV*; Ferro Tavares, *Os*

At this point it must be stressed that no Hebrew illuminated manuscript is known to have been produced in Portugal during the thirteenth century, although it was precisely in this period, around 1230, that the first Hebrew illuminated manuscripts were produced in Iberia, i.e., in Castile.<sup>34</sup> Until the end of the fourteenth century the main Iberian centres for this kind of production were all located outside Portugal, namely in Toledo, Soria, Tudela, Cervera, Huesca, Burgos, Barcelona or Saragoça, and also Perpignan. Besides, barring two or three exceptions from the first half of the fifteenth century, Lisbon only appears as an important production centre of Hebrew manuscripts by the second half of the fifteenth century, particularly after 1469.<sup>35</sup> As Lisbon was the ultimate centre for copying and illuminating manuscripts in the Iberian Peninsula, the production of these manuscripts achieved a great importance during the late fifteenth century.

In what concerns the idiosyncrasy of Lisbon as a production centre of Hebrew illuminated manuscripts, there are two different perspectives: one that emphasises its originality; the other that stresses its dependence on Castilian models, almost limiting its role to a scriptural activity and excluding any illumination. Gabrielle Sed-Rajna is an author that supports the first perspective, considering that the manuscripts produced in Lisbon show a great homogeneity in terms of decoration, conception and execution.<sup>36</sup> She stresses ‘the refined technique, the exquisite taste, and a highly stereotyped programme’ of the so-called ‘Lisbon School’, emphasising the ‘delicate filigree-work frames and panels, and particularly the beautiful burnished gold characters of the display script’, whose elaborated

---

*Judeus em Portugal no Século XV*). Nevertheless, this author was able to find three book binders, namely Samuel Caspim (1442, Lisbon), David Negro (1475, Lisbon) and Abraão Amado (1475, Lisbon), and eight Jewish parchment makers who were active during the fifteenth century, one of them called Haim Alioso (Ferro Tavares, *Os Judeus em Portugal no Século XV*: 375). In contrast, the number of goldsmiths among the Portuguese Jewish communities is impressive: 122 references between the years 1382 and 1496, including Haim Usque (Santarém, 1441, Coimbra, 1462), Abraão Anim (Lisbon, 1442) and Haim Porteiro (Santarém, 1442) (Ferro Tavares, *Os Judeus em Portugal no Século XV*: 605). Some of these goldsmiths were also active in Algarve, mainly in Faro and Tavira.

<sup>34</sup> Kogman-Appel, ‘Hebrew Manuscript Painting’: 191; Sed-Rajna, *Lisbon Bible*: 3. Outside the Iberian Peninsula, the oldest surviving illuminated Hebrew manuscripts date from the ninth century onwards. See Kogman-Appel, ‘Hebrew Manuscript Painting’.

<sup>35</sup> Metzger, ‘La masora ornamentale’: 106.

<sup>36</sup> Sed-Rajna, *Lisbon Bible*: 6.

programme appears for the first time in the so-called ‘Lisbon Bible’. It seems that these models have also influenced the first Hebrew printed books in Portugal, although other authors such as Thérèse Metzger, probably the best representative of the other perspective, do not share this conclusion.<sup>37</sup> Metzger observes that there are only 23 medieval Hebrew manuscripts that can be attributed with certainty to Portuguese manufacture. The oldest of these manuscripts dates from 1278. The other two are from the fourteenth century (1346 and 1391) and all the rest from the fifteenth. During the last third of the fifteenth century the majority of the manuscripts were copied in Lisbon (15 of the total) and it is only among these last ones that we find illuminated manuscripts. Thérèse Metzger believed that the artistic similarity between these manuscripts did not extend to other material aspects of the books—namely in what concerns the parchment preparation, copying practices, line division and Biblical canon—concluding that these manuscripts reveal a lack of standardisation.<sup>38</sup> Despite that, some of the manuscripts share a ‘surprising homogeneity’ in terms of decoration; the author suggests that between c.1470 and c.1490, the so-called ‘Lisbon School’ was nothing more than the heterogeneous, temporary, and accidental grouping of Jewish scribes and illuminators fleeing to Portugal from other territories in the Iberia Peninsula.

Their differences concerning the role played by illumination in the ‘Lisbon School’ notwithstanding, both perspectives recognise that this manuscript workshop was very active, until the last moment that Jews could live freely in Portugal. During this period, it produced or rearranged nearly 30 manuscripts, either in Lisbon (as is mentioned in the colophons) or in other cities and villages (but retaining the original models from the workshop).<sup>39</sup> Although some of the scribes working in Lisbon signed more than one manuscript (for instance, Samuel de Medina, Samuel ben Samuel Ibn Musa, and Eleazar ben Moses Gagosh), no manuscript carries the name of the artist responsible for its decoration.<sup>40</sup> It is obvious, then,

<sup>37</sup> Metzger, *Les Manuscrits Hébreux copiés à Lisbonne*: 1–10.

<sup>38</sup> Metzger, ‘Les manuscrits hébreux décorés à Lisbonne’: 771–72.

<sup>39</sup> Most of these manuscripts are Bibles or parts of the Bible. Even though not all of these manuscripts are decorated, all of them display a range of features that confirms the use of identical methods and, eventually, the same stencils. Sed-Rajna, *Lisbon Bible*: 6.

<sup>40</sup> Except for the numerous references to Jewish masorators, such as the prolific Ibn Gaon already mentioned (Metzger, ‘Josué ben Abraham ibn Gaon’: *passim*), this is a

that attending to the large production of Hebrew manuscripts in Portugal during the second half of the fifteenth century, a technical text on colours for illumination would have been considered useful or at least worthy of being copied.<sup>41</sup> Indeed, if there is no evidence of Hebrew manuscript illumination in Portugal during the thirteenth century—and therefore one could ask what would have been the usefulness at that time of a recipe book like *O Livro de como se fazem as cores*—the situation had completely altered two hundred years later.

### Other Technical Texts on Painting

*O Livro de como se fazem as cores* is the single medieval Portuguese technical source concerning artistic practices that have survived. However, we have reliable information that at least one more technical compilation on painting existed in Portugal during the Middle Ages: the *Mappae Clavicula*.<sup>42</sup> This information is particularly interesting because

---

problem common to Hebrew illuminated manuscripts produced elsewhere in Europe during the same period. Although Jewish illuminators are hard to identify, some of them are known, proving that Jews were not always dependent on Christian illuminators to paint Hebrew manuscripts. As examples of such artists, Katrin Kogman-Appel ('Jewish art and non-Jewish culture': 189) names Joseph Hatsartphati (who was active in Navarre around 1300), Joel ben Simeon (who, in the fifteenth century, migrated from Southern Germany to Northern Italy) and Joseph Ibn Hayyim (who, in 1476, concluded at La Coruña one of the most richly illuminated Hebrew manuscripts that is known).

<sup>41</sup> Naturally, we have no proofs that this text was used by these illuminators, as Thérèse Metzger (*Les Manuscrits Hébreux copiés à Lisbonne*: 6) strongly emphasises in order to deny the existence of anything that could be classified as a production centre of illumination in Lisbon: 'Il n'y a donc pas de preuve qu'il ait jamais pu être à la disposition des enlumineurs juifs de Lisbonne'. In spite of this, when one considers the number of illuminated manuscripts produced in Lisbon during a short span of time and the constant flux of Jewish refugees that had no contact with Portuguese language, the copy of that text on colours gains a new aspect.

<sup>42</sup> There is also a fifteenth-century Portuguese copy of Pseudo-Aristotle's *Secretum Secretorum* which belonged to the monastery of Alcobça (Nascimento, 'Circulação do livro manuscrito'; Sá, *Segredo dos Segredos*). It seems probable that this copy is the same one that the Portuguese king Edward I (1433–38) had in his library of 84 volumes in the early fifteenth century (Sá, 'Traduções portuguesas do século XV': 563; Sá, *Segredo dos Segredos*: XIV–XVII). The *Secretum Secretorum* seems to have been written in Arabic during the tenth century and included a few topics on alchemy and magic, mainly added during the thirteenth century. Nevertheless, contrasting with the *Liber Secretorum* (by the tenth-century Persian al-Razi)—one of the most practical and widespread medieval books

there are some similarities between the structure and the recipes described in both texts, although there is no clear match between the two.

This lost copy of the *Mappae Clavicula* is referred to in 1218 at Coimbra, at the Augustinian Canons monastery of Santa Cruz (Holy Cross),<sup>43</sup> which was one of the two Portuguese leading centres for manuscript illumination between the twelfth and the fourteenth centuries. The other, also a monastery, was the *scriptoria* of the Cistercian Abbey of Alcobaça, from which we still have approximately 350 medieval manuscripts. From the monastery of Santa Cruz, which was affiliated to the monastery of Saint Ruf of Avignon, we have approximately 100 medieval manuscripts, many of which are illuminated. The *Mappae Clavicula* copy was borrowed in 1218 by Master Gil, together with more scientific texts: three books on medicine, two books on geometry, three books on astronomy, two books from Cicero on rhetoric, one book on grammar as well a *Mapa Mundi*. The *Mappae Clavicula* was included in a miscellaneous volume with the *Macer Floridus* by Otto of Meung and the *Liber Lapidum* by Marbodius, among other smaller texts that are not specified.<sup>44</sup> A technical compilation like the *Mappae Clavicula* would have been of particular interest and it could have inspired the production of partial translations, commentaries or the adaptation of some recipes.

It should be added that the monastery of Coimbra seems to have been one where the presence of profane knowledge was stronger, at least until the middle of the thirteenth century, and it is not a surprise that the first Portuguese university was established in Coimbra, a city located in the centre of Portugal. The role played by this city as an interface between Christian, Arabic and Jewish cultures during the eleventh, twelfth and thirteenth centuries is particularly stressed by a great number of Portuguese medievalists studying the intellectual and cultural history of the country.<sup>45</sup>

---

on alchemy including several recipes for producing pigments (Clarke, *The Art of All Colours*: 49)—the main content of Pseudo-Aristotle's book was on the education of princes (emphasising topics on ethics, state craft, medicine and astrology). It should be noted that it does not include a single recipe for pigments. Therefore, we have brought it into this discussion only to avoid a possible confusion with al-Razi's *Liber Secretorum*.

<sup>43</sup> Cruz, *Santa Cruz de Coimbra*: 193, 201–4.

<sup>44</sup> It reads: 'Macer cum Lapidario et cum suis apendicijs et cum Mapa Clauicula ad aurum faciendum et cum [...] ad plantandas arbores et cum multjs experimentis'. Cruz, *Santa Cruz de Coimbra*: 193.

<sup>45</sup> Martins, *O Mosteiro de Santa Cruz*: passim.

It is indicative, for instance, that in the late eleventh century the first bishop of the restored diocese of Coimbra, D. Paterno, left in his will to the school of the cathedral an undetermined number of books in Latin and Arabic, as well as two Astrolabes.<sup>46</sup> This melting pot between Christian, Arabic and Jewish cultures certainly favoured the interest in scientific books and the emergence of translations of rare texts. Therefore, if we search for the possible sources of *O Livro de como se fazem as cores* we need to take this context into consideration. Unfortunately, this is a research path filled with empty spaces and it is impossible now to reconstruct the complete list of the available texts at the time as well as the processes of knowledge transference.<sup>47</sup>

### Materials, Equipments, Procedures and their Names

Although it might have benefited from older sources, the analysis of the content of *O Livro de como se fazem as cores* also suggests that it was composed after the thirteenth century.<sup>48</sup>

In the first place, the vocabulary used to name the materials, the equipments or the procedures relating to the preparation of colours or their uses suggests a later date. Indeed, in a set of 122 words, many corresponding to materials or objects of common use, only 50 per cent of the terms were known in a written form in the thirteenth century or before, according to the documentary corpus used by the *Dicionário Houaiss of the Portuguese Language*,<sup>49</sup> while 20 per cent had their first appearance in the fifteenth century or later (see Table 1). Of the 10 words that are documented only after the fifteenth century, nine correspond to terms of

<sup>46</sup> Nascimento and Meirinhos, *Catálogo*: LXIX. Among the remaining volumes from Santa Cruz's *armarium* there are fragments of texts that are even older than the foundation of that monastery in 1131. For instance, there are fragments of the *Lex Visigothorum* dating from the ninth century and several fragments from two books on medicine produced in Beneventine handwriting from the tenth century, namely the Pseudo-Orbasius *Commentaria in Aphorismus Hippocratis* and the Pseudo-Galenus *Alphabetum ad Paternum*. Nascimento and Meirinhos, *Catálogo*: 315.

<sup>47</sup> This is a subject that is difficult to analyse and that involves several dimensions, including the circulation of books. For a summary of the available knowledge on this topic see Nascimento, 'Circulação do livro manuscrito'.

<sup>48</sup> Our references are made to the Portuguese text published in Sá, 'O livro de como se fazem as cores': 212–23.

<sup>49</sup> Houaiss and Villar, *Dicionário da Língua Portuguesa*.

**Table 1**  
*Materials, Equipments and Procedures Mentioned in the Text, According to the First Known Used of the Portuguese Words*

<i>First Known Use</i>	<i>Materials, Equipments and Procedures</i>	
	<i>Number</i>	<i>Per cent</i>
Before thirteenth century	17	13.9
Thirteenth century	44	36.0
Fourteenth century	38	31.1
Fifteenth century	14	11.5
After fifteenth century	10	8.2

**Source:** Based on Houaiss and Villar, *Dicionário da Língua Portuguesa*.

restricted use (for instance, pigments) and so, considering the probable reduced number of technical texts in the corpus, it is not unexpected that those words might already have been in use before. The exception is the word *tigela* (bowl), with the oldest use dating from 1509. In the group of words dating from the fourteenth and fifteenth centuries, words of general use, like *clara de ovo* (egg white), *gema* (yolk), *vinagre* (vinegar), *javali* (wild boar), *colher* (spoon), *panela* (pot), *taça* (cup), *alguidar* (another type of large bowl), *barro* (clay), *papel* (paper), *forja* (forge), *estanho* (tin), and *lâmina* (metal plate), are much more common. Therefore, it is probable that the introduction of those words in the Portuguese language is more in agreement with the first known dates registered in the dictionary. For that reason, it seems reasonable to conclude that the words employed suggest a date not earlier than the fifteenth century for the text.

Another argument against a thirteenth-century date is provided by some of the materials mentioned in the book, namely the mosaic gold and the paper. Mosaic gold (*oro musico* or *ouro músico*) is a yellow pigment, corresponding to tin sulfide, and the manuscript prescribes two recipes for its preparation. It was employed above all in illuminated manuscripts, either as an imitation of gold or together with gold. Cennino Cennini, at the end of the fourteenth century, cautioned that ‘it might be used on panel too, but be as careful as of fire in using it’.<sup>50</sup> If we ignore *O livro de como se fazem as cores*, which has already been described as the text with the oldest reference to the pigment,<sup>51</sup> the published source with the oldest mention dates from the fourteenth century.<sup>52</sup> Likewise, of the 19 medieval unpublished manuscripts of a technical nature with references to mosaic gold listed by Daniel V. Thompson, none is from the thirteenth century or earlier, all being from the fourteenth and fifteenth centuries.<sup>53</sup> Besides, mosaic gold is mentioned only in 8 per cent of the fourteenth-century manuscripts (three manuscripts out of 37) and in 16 per cent of the fifteenth-century manuscripts (16 cases in 98 manuscripts). In agreement with these document references, chemical analyses has shown the use of mosaic gold in manuscripts from the fourteenth and, above all,

<sup>50</sup> Thompson, Jr., *The Craftsman’s Handbook*: 101.

<sup>51</sup> Córdoba de la Llave, ‘Un recetario técnico castellano’: 26; Fuchs and Oltrogge, ‘Utilisation d’un livre de modèles’: 314; Oltrogge, ‘Cum sesto et rigula’: 71.

<sup>52</sup> Partington, ‘Mosaic Gold’: 203.

<sup>53</sup> Thompson, Jr., ‘Trial Index’: 419–20.

fifteenth century,<sup>54</sup> but not in older documents. With other type of works the situation is similar,<sup>55</sup> with the exception of a Spanish polychrome sculpture where the pigment was identified in a thirteenth-century work.<sup>56</sup> Therefore, the probability of finding a reference to mosaic gold in a thirteenth-century document is much lower than the probability of finding it in a document of the fourteenth and especially of the fifteenth century.

Thompson says that in the oldest texts mosaic gold is named *aurum musicum* in Latin or with an equivalent designation in the case of other languages.<sup>57</sup> In Portuguese it would be *ouro musivo*, which is different from *ouro músico* as it appears in the text on colours.<sup>58</sup> In the fourteenth century, mosaic gold would have begun to be called *purpurinus* or something analogous, as it happens, for example, in Cennini's manual. Obviously, this suggests a fourteenth-century date, more than a fifteenth-century date, for *O livro de como se fazem as cores*. However, although the fifteenth-century technical texts that were better known 70 years ago, when the first edition of Thompson's book was published, showed the preferential use of the *purpurium* form, as in the treatises published by Merrifield,<sup>59</sup> we now know several texts from the fifteenth and sixteenth centuries where mosaic gold continued to be called *aurum musicum* or something similar.<sup>60</sup> Therefore, the evolution observed by Thompson does not seem so evident today and, accordingly, the mention of *aurum musicum* cannot be seen as implying an attribution to the fourteenth century. On the contrary, it so happens that one of these manuscripts—a Castilian work dated from 1460–80—names the pigment *oro musico*,<sup>61</sup> precisely like the work attributed to Ibn Hayyim. It is the only known text with this variation,<sup>62</sup> hence offering to *O livro de como se fazem as cores* a very important parallel to a fifteenth-century technical text.

<sup>54</sup> Eastaugh et al., *Pigment Compendium*: 268; Ross, 'Mosaic Gold': 175.

<sup>55</sup> Gordon et al., 'Fra Angelico's predella': 11; Richter and Harlin, 'Stuttgarter Karteispiel': 23; Speleers, 'Mosaic Gold'.

<sup>56</sup> Edwards et al., '13th century polychrome statue': 411.

<sup>57</sup> Thompson, *Medieval Painting*: 181–82.

<sup>58</sup> Ignoring the current accent, they differ only in one character, but the meaning is very different: *musivo* is related with mosaic, *músico* is related with music.

<sup>59</sup> Merrifield, *Treatises on the Arts of Painting*: XCIX, 54–55, 64–65, 458–61, 806–07. The first edition of the book dates from 1849.

<sup>60</sup> Anonymous, 'A Booke of Secrets'; Lehmann-Haupt, *The Göttingen Model Book*.

<sup>61</sup> Córdoba de la Llave, 'Un recetario técnico castellano': 45.

<sup>62</sup> Thompson, *Medieval Painting*: 181.

The other material that provides some information regarding the date of the book is the paper used to keep verdigris, mentioned in chapter 12 of the text on colours. The paper must have arrived in Portugal in the middle of the thirteenth century,<sup>63</sup> although the oldest known use of the word dates from 1344.<sup>64</sup> Its use became generalised only in the fifteenth century and the first paper mill was established in the country not before 1441.<sup>65</sup> In this context, the use given to the paper in the text makes little sense in the thirteenth or the fourteenth century, being much more probable in the fifteenth century. While the paper was not common, many other materials or objects can be used to keep verdigris or any other pigment. Moreover, the paper does not seem to have any particular advantage.

Besides mosaic gold and paper, there are two other materials that eventually may become interesting in this respect: *catassol* and gum Arabic. The first is mentioned in chapter 24 of the text and probably corresponds to turnsole, a dye obtained from the plant with the same name (*Crozophora tinctoria*).<sup>66</sup> Although already in use in the twelfth century, it seems that it did not gain prominence until the fourteenth century.<sup>67</sup>

<sup>63</sup> Marques, *Portugal na Crise dos Séculos XIV e XV*: 52. The first paper mill in Europe was established in Spain in 1151. The early paper of Europe was regarded with disfavour, being more expensive and more fragile than parchment. Hunter, *Papermaking*: 60.

<sup>64</sup> Houaiss and Villar, *Dicionário da Língua Portuguesa*: 2749.

<sup>65</sup> Marques, *Portugal na Crise dos Séculos XIV e XV*: 52.

<sup>66</sup> Based on a Portuguese treatise on painting dating from 1615, it was already said that *catassol* is a green dye obtained from iris (Eastaugh et al., *Pigment Compendium*: 88, 199). However, neither does this colour correspond to the mulberry's colour (*color como morado*) mentioned in *O Livro de como se fazem as cores*, nor does the described procedure, that involves the extraction of the dye with urine, have similarities with the procedures used for iris green. With this information alone we can suggest the hypothesis that *catassol* corresponded to the mentioned turnsole or, alternatively, to orchil, a dye obtained from lichens (namely from *Rocella tinctoria*). The resulting dye is chemically similar in both cases and presents a colour that, according to the pH, can be varied between blue and red, passing through violet. In relation to the interpretation of old texts, it is frequently difficult to distinguish between the two dyes and, therefore, the confusion between them is also common. Although the recipe is incomplete, the mention of grains and the exposure of dyed cloths to vapours of urine seem to point very clearly to the turnsole. As much as it is possible to understand, the described procedure seems to be very similar to a preparation procedure of turnsole that was adopted in France until the nineteenth century. Peregó, *Dictionnaire*: 523–25, 737–39.

<sup>67</sup> Thompson, *Medieval Painting*: 144.

This suggests a date of not earlier than the fourteenth century for the text. The second, gum, is the medium more frequently mentioned in the text and in two cases gum Arabic is specifically identified (see Table 2).

**Table 2**  
*Contents of O livro de como se fazem as cores*

<i>Chapter</i>	<i>Subject</i>	<i>Agglutinant Mentioned</i>
1	Making and tempering mosaic gold	Gum
2	Making and tempering mosaic gold	Arabic gum
3	Laying gold leaf (mordant gilding)	Animal glue
4	Laying gold (attrition gilding)	Egg white and gum
5	Making silver blue	—
6	Tempering silver blue	Arabic gum and egg white
7	Tempering <i>azul d'acre</i> (ultramarine blue)	Egg white and gum
8	Making and tempering brazil	Gum
9	Making brazil	—
10	Making red lead from lead white	—
11	Making verdigris (from copper)	—
12	Making and tempering verdigris (from brass)	Gum
13	Making carmine (lac)	—
14	Making carmine (but the recipe misses the colorant)	—
15	Making vermilion	—
16	'Gilding' a sword or a knife with copper	—
17	Black dyeing bone or wood with olive oil and sulphur	—
18	Red dyeing bone or wood with lac	—
19	Black dyeing bone or wood	—
20	Green dyeing bone or wood with verdigris	—
21	Making bone pulp for chess pieces	—
<i>Missing chapters</i>		
24	Making and tempering <i>catassol</i> (turnsole)	Gum
25	Laying gold leaf (mordant gilding)	Egg white
26	Tempering blue	Egg yolk and gum
27	Making and tempering brazil and others colours	Egg white
28	Tempering green	Egg yolk and gum
29	Tempering blue	Egg white
30	Tempering carmine	Egg yolk
31	Tempering saffron	Egg white
32	Tempering orpiment	Egg yolk
33	Tempering indigo	Gum and egg yolk

(Table 2 continued)

(Table 2 continued)

Chapter	Subject	Agglutinant Mentioned
34	Tempering blue	Gum and egg yolk
35	Mixing colours	—
36	Laying gold leaf (mordant gilding)	Gum and egg white
37	Mixing blue and carmine	Gum and egg white
38	Laying gold leaf (mordant gilding)	Animal glue and gum
39	Burnishing gold and silver leaf	—
40	Making glue from parchment	Animal glue
41	Making ochre colour by mixture of vermilion and <i>jalde</i> (orpiment)	—
42	Making varnish (oil varnish)	—
43	Making adhesive for gold leaf from bran	Stark
44	Making and tempering brazil	Gum
45	Making green lake from lily	—

By decreasing the order of importance, it also refers to egg white, egg yolk, animal glue and starch, the last two being reserved for the application of gold. In general, gum Arabic and egg white were the most important media used in illumination in the Middle Ages, but it seems that while in the eleventh century it was usual that the colours were tempered with egg white, in the fourteenth century this was done predominantly with gum Arabic. That substitution of gum Arabic for egg white was especially important in the case of the blue pigments and also in the case of colours applied with a brush.<sup>68</sup> In accordance with this general trend, we can affirm that although gum Arabic is referred to since the early thirteenth century in some Portuguese medieval medical recipes treatises, namely in the *Thesaurus Pauperum* by Petrus Hispanus (future pope, John XXI), it was not a very common ingredient.<sup>69</sup> Moreover, in a Portuguese treatise of painting published in 1615 gum Arabic is the main constituent of the media used in illumination and the egg yolk is never mentioned.<sup>70</sup> This also suggests a date for the text as a whole that is not earlier than the fourteenth century.<sup>71</sup>

<sup>68</sup> Levey, 'Mediaeval Arabic Bookmaking': 8; Thompson, *Medieval Painting*: 56–57.

<sup>69</sup> Pereira, *Obras Médicas de Pedro Hispano*.

<sup>70</sup> Veliz, *Six treatises in translation*; Ventura, *Arte da Pintura*.

<sup>71</sup> However, before one uses this information to support the chronology of *O livro de como se fazem as cores*, it is necessary to review the data now available on the use of turnsole and gum Arabic in medieval manuscript illumination.

We must note that we consider that during a process of copying, which might have existed in the case of *O livro de como se fazem as cores*, the change of content is less probable than the change of form. Therefore, we think that the approach presented here is not a variant of the approaches already pursued based on formal aspects, but rather a different one.

## Characteristics and Influences

*O livro de como se fazem as cores* has been classified as a treatise on a medieval craft.<sup>72</sup> However, a careful reading raises some questions in this respect. If a treatise is considered a written account—ordered, coherent and more or less systematic on a certain subject, even taking into account medieval standards, as offered, for instance, by Theophilus's and Cennino Cennini's treatises—*O livro de como se fazem as cores* can hardly be considered a treatise. That is the reason why we have avoided the use of the term 'treatise' for it. To start with, the order of the text is very deficient (see Table 2). The text begins with indications concerning the preparation and use of some pigments in manuscripts (chapters 1–15), among which are included two chapters on the application of gold leaf (chapters 3–4). The following recipes teach how to gild or give colour to metal, bone and wood objects (chapters 16–20) and how to make chess pieces (chapter 21). After two missing chapters, we find several others dealing with the preparation of pigments or inks (chapters 24, 26–34, 41, 44–45) that alternate with still others on gilding (chapters 25, 36, 38–39, 43), on the mixtures of colours or pigments (chapters 35, 37) and on the preparation of glue (chapter 40) and varnish (chapter 42). It is possible to point out other examples of lack of organisation in even more detail. Probably the most significant case is chapter 27. It begins with instructions on how to prepare a pink ink from brazil-wood and its mixtures, but the following paragraph, unexpectedly, is devoted to the main colours and the next one is about the dilution of egg white with the sap of a fig tree.

Regarding the coherence of this text, or lack thereof, the employment of different systems of nomenclature for the materials may be noted. For

<sup>72</sup> Clarke, *The Art of All Colours*: 17; Mann, *Jewish Texts on the Visual Arts*: 134; Morgan, 'Manual, Manuscript'.

instance, in the first chapters there are marks of an alchemic nomenclature in which the metals are identified through the associated planets—sun in the case of gold, moon in the case of silver and Jupiter in the case of tin.<sup>73</sup> But this does not happen in the case of mercury, which always appears in these chapters as *fugitivo* or *azougue* (or variants of these words now obsolete). In other chapters there are references to gold (chapters 4, 16, 25, 36, 38–39, 42–43), silver (chapters 39, 42) and tin (chapters 42), and they are never identified through the associated planets. In the same way, copper always appears with the usual name (chapters 11, 19) and never as Venus. In addition, silver is mentioned with a third name of Latin origin—*argen* (chapter 39). Mercury is named *fugitivo* or *azougue* in the beginning, but in other chapters it is mentioned as *argen vivo*, that is quicksilver, a form not common in Portuguese. Another indication of the heterogeneous character of this text is given by the use of different materials in identical situations. For instance, a wild boar's tooth is recommended in one case for burnishing gold (chapter 3), a tooth of a pig or a horse in another (chapter 25) and a pig tooth in three other cases (chapters 36, 38, 43). Taken together this suggests that the text is a collection of recipes compiled from several sources and not an original coherent book. The duplication of procedures also suggests the same conclusion, although this was also common to other texts such as the *Mappae Clavicula*. For instance, there are two recipes on the preparation of mosaic gold (chapters 1–2), four on the preparation of rose colour from brazil-wood (chapters 8–9, 27, 44), two on the preparation of verdigris (chapters 11–12), two on the preparation of carmine (chapters 14–15), six on the tempering of blue (chapters 6–7, 26, 29, 33–34) and several on gilding, as already mentioned. Another aspect that seems interesting is the ignorance or at least the inattention manifested in one of the recipes. In effect, in chapter 14, which is dedicated to the preparation of a carmine ink, the material responsible for the colour is missing.

Concerning the influences in *O livro de como se fazem as cores* the first to be noted is obviously Hebraic: the text was written with Hebrew characters and it was included in a Hebrew miscellaneous volume. However, we can also detect less evident connections. For instance, the alchemic influences were already mentioned in relation to the use of

<sup>73</sup> Crosland, *Historical Studies in the Language of Chemistry*: 79–81.

planets' names for metals, but there are other details, precisely in the initial chapters, that confirm this association. For instance, in chapter 2, the mosaic gold just prepared, which is compared to gold in the book, is referred as *tua obra*, that is, 'your work'. In this context the resonance to the alchemic Great Work seems evident.<sup>74</sup> In chapter 1 is referred a glass dome (*redoma de vidro*), which is equipment that must have been common to an alchemic laboratory,<sup>75</sup> but less probable in a painter's workshop or a *scriptorium*. In fact, all the other containers used in the preparation of pigments and inks mentioned in the book are made of ceramic, metal, shell or horn. In the same chapter is described an ash bath, that is, a process of indirect heating that certainly owes much to the variety of heating devices common in alchemic laboratories.<sup>76</sup> Another interesting detail is the use of a mortar for grinding pigments (chapters 1, 8, 44). It is a common equipment in a laboratory,<sup>77</sup> but in the painter's or illuminator's workshop it is usually replaced by a flat stone, namely of porphyry.<sup>78</sup> However, although the first two chapters are filled with so many alchemic marks, instead of *sal armoniaco* (probably the ammonium chloride),<sup>79</sup> which is the name found in alchemical texts, we have the mention of *sal arménico* (corresponding to *sal armenicum*), that is, salt from Armenia, a rare form with origin in Latin texts, uncommon in alchemic contexts.<sup>80</sup>

Other visible influences in the text are of Spanish origin. Strolovitch already mentioned these influences, which, with respect to the language, differentiate three situations: direct use of Castilian words; adaptation of Castilian words to the Portuguese orthography; and, contrariwise, employment of Portuguese words, now out of use, with a Castilian type spelling.<sup>81</sup> Some of these marks in the orthography can be attributed to

<sup>74</sup> Laszlo, *Alquimia*: 47–48; Read, *From Alchemy to Chemistry*: 31 and following pages.

<sup>75</sup> Brock, *The Chemical Tree*: 23; Kibre, 'The Alkimia Minor': 272–73.

<sup>76</sup> Brock, *The Chemical Tree*: 23; Holmyard, 'Alchemical Equipment': 733–34.

<sup>77</sup> Brock, *The Chemical Tree*: 23

<sup>78</sup> Gettens and Stout, *Painting Materials*: 293–94. For instance, it is mentioned by Cennini (Thompson, Jr., *The Craftsman's Handbook*: 21) and is represented beside the illuminator in a manuscript of the mid-twelfth century (Alexander, *Medieval Illuminators*: 18) and in many medieval painters' workshops (see, for instance, Binski, *Painters*: 2, 9, 10).

<sup>79</sup> Corresponding to the Latin forms *sal armoniacum*, *harmonicum*, *armoniak* or *ammoniac*, so frequent in the alchemic literature. Crosland, *Historical Studies in the Language of Chemistry*: 106; Stillman, *Alchemy and Early Chemistry*: 240, 250–51.

<sup>80</sup> Read, *From Alchemy to Chemistry*: 196; Stillman, *Alchemy and Early Chemistry*: 245.

<sup>81</sup> Strolovitch, 'Old Portuguese in Hebrew Script'.

an eventual copyist of the manuscript and may not exist in a hypothetical original text. However, it is also possible to find other Castilian influences at a deeper level, which would exist in the original. Perhaps the most interesting situation is provided by the word *azumbre* (chapters 13–14), a Spanish capacity measure corresponding to about 2 litres, but that does not exist in Portugal.<sup>82</sup> Another case is the word *sabana* (also in chapter 14). In Castilian it designates a linen fabric,<sup>83</sup> but it was not found in any of the Portuguese dictionaries we have consulted.

Given the technical nature of the text and its alchemic influences the great number of words of Arabic origin are not unexpected, as already pointed out by Strolovitch. Many of these words are part of Portuguese language today (or were in the past), as *açafrão* (saffron), *alguidar* (a bowl), *almofariz* (mortar), *alvaiade* (an archaic name for white lead), *azeche* (an archaic form of vitriol), and *azougue* (an archaic name for mercury).<sup>84</sup> Therefore, it is possible that the vocabulary of Arabic origin does not necessarily imply a direct Arabic influence. Moreover, as alchemy in Europe in the Middle Ages was deeply linked to the Arab world, it is necessary to approach this subject in more detail.

## Conclusion

*O livro de como se fazem as cores* is a book that does not seem to be in accordance with the historical context of Portugal, especially of the Algarve, in the thirteenth century. On the contrary, it is entirely in accordance with the context of the fifteenth century, when Portugal was a relevant centre for Hebrew manuscript production and illumination. The materials, the equipments and the procedures mentioned in the text on colours also suggest a date not earlier than the fifteenth century. Therefore, this text should not be considered a thirteenth-century production and should not be attributed to Ibn Hayyim, the author of a Masoretic treatise composed in 1262 in Loulé which is included in the same miscellaneous volume where we can find *O livro de como se fazem as cores*. This text is a heterogeneous compilation of colour recipes that presents neither the organisation nor the coherence of a medieval treatise on colours used

<sup>82</sup> Houaiss and Villar, *Dicionário da Língua Portuguesa*: 471; Marques, ‘Pesos e medidas’; Real Academia Española, *Diccionario*, vol. I: 524.

<sup>83</sup> Real Academia Española, *Diccionario*, vol. 6: 1.

<sup>84</sup> Ferreira, *Dicionário Aurélio*; Houaiss and Villar, *Dicionário da Língua Portuguesa*.

in book illumination. Besides the Hebraic context revealed in the characters of the book, the text also presents significantly alchemic, Castilian and Arabic influences, which indicates that it was composed from a variety of sources.

## References

- Abrahams, Harold J. 1979. 'A Thirteenth-century Portuguese Work on Manuscript Illumination', *Ambix*, vol. 26(2): 93–99.
- Alexander, Jonathan J.G. 1992. *Medieval Illuminators and their Methods of Work*, New Haven, London.
- Alexander, S.M. 1969. 'Towards a History of Art Materials—A Survey of Published Technical Literature in the Arts. Part I. From Antiquity to 1599', *Art and Archaeology Technical Abstracts*, vol. 7(3): 121–61.
- Anonymous. 1996. 'A Booke of Secrets', in Jack C. Thompson (ed.), *Manuscript Inks*, Portland.
- Beit-Arié, Malachi. 2002. 'Hebrew Manuscripts and the Singularity of the Collection of the Biblioteca Palatina in Parma', *Materia Giudaica*, vol. 7(2): 213–16.
- Bernheimer, Carlo. 1924. *Paleografia Ebraica*, Firenze.
- Binski, Paul. 1991. *Medieval Craftsmen. Painters*, Toronto.
- Blondheim, David S. 1928. 'An Old Portuguese Work on Manuscript Illumination', *Jewish Quarterly Review*, vol. 19: 97–135.
- . 1929. 'Note on "An Old Portuguese Work on Manuscript Illumination"', *Jewish Quarterly Review*, vol. 20(1): 89–90.
- . 1930. 'Livro de como se fazem as cores', in John D. Fitz-Gerald and Pauline Taylor (eds), *Todd Memorial Volumes. Philological Studies*, New York: 71–83.
- . 1930. 'Additional Note on "An Old Portuguese Work on Manuscript Illumination"', *Jewish Quarterly Review*, vol. 20(3): 283–84.
- Bordini, Silvia. 1995. *Materia e Imagem. Fuentes bibliográficas de las técnicas de la pintura*, Barcelona.
- Brock, William H. 1993. *The Chemical Tree. A History of Chemistry*, New York.
- Clarke, Mark. 2001. *The Art of All Colours. Mediaeval Recipe Books for Painters and Illuminators*, London.
- Córdoba de la Llave, Ricardo. 2005. 'Un recetario técnico castellano del siglo XV: el manuscrito H490 de la Facultad de Medicina de Montpellier', *En la España Medieval*, vol. 28: 7–48.
- Crosland, Maurice P. 1978. *Historical Studies in the Language of Chemistry*, New York.
- Cruz, António. 1964. *Santa Cruz de Coimbra na Cultura Portuguesa da Idade Média*, Porto.
- De Rossi, Giovanni Bernardo. 1803. *Manuscripti Codices Hebraici Bibliothecae*, 3 vols, Parma.
- Eastaugh, Nicholas, Valentine Walsh, Tracey Chaplin and Ruth Siddall. 2004. *Pigment Compendium. A Dictionary of Historical Pigments*, Oxford.

- Edwards, H.G.M., D.W. Farwell, E.M. Newton, F.R. Perez and S.J. Villar. 2000. 'Raman Spectroscopic Studies of a 13th century Polychrome Statue: Identification of a "Forgotten" Pigment', *Journal of Raman Spectroscopy*, vol. 31(5): 407–13.
- Espinosa Villegas, Miguel Angel. 1996. 'O livro de como se fazem as cores de Abraham bar Yehudah ibn Hayyim', *Cuadernos de Arte de la Universidad de Granada*, vol. 27: 7–22.
- Ferreira, Aurélio Buarque de Holanda. 1999. *Dicionário Aurélio Eletrônico Século XXI. Versão 3.0*, CD-Rom.
- Ferro, Maria José Pimenta. 1970. *Os Judeus em Portugal no Século XIV*, Lisboa.
- Ferro Tavares, Maria José Pimenta. 1982–84. *Os Judeus em Portugal no Século XV*, 2 vols, Lisboa.
- Fuchs, Robert and Doris Oltrogge. 1990. 'Utilisation d'un livre de modèles pour la reconstitution de la peinture de manuscrits', in *Pigments et Colorants de l'Antiquité et du Moyen Age. Teinture, peinture, enluminure. Études historiques et physico-chimiques*, Paris: 309–23.
- Gettens, Rutherford J. and George L. Stout. 1966. *Painting Materials. A Short Encyclopaedia*, New York.
- Gordon, Dillian, Martin Wyld and Roy Ashok. 2002. 'Fra Angelico's predella for the high altarpiece of San Domenico, Fiesole', *National Gallery Technical Bulletin*, vol. 23: 4–19.
- Holmyard, E.J. 1956. 'Alchemical Equipment', in Charles Singer, E.J. Holmyard, A.R. Hall and Trevor I. Williams (eds), *A History of Technology*, vol. 2, Oxford: 731–52.
- Houaiss, Antônio and Mauro de Salles Villar. 2003. *Dicionário Houaiss da Língua Portuguesa*, 6 vols, Lisboa.
- Hunter, Dard. 1978. *Papermaking. The History and Technique of an Ancient Craft*, New York.
- Kibre, Pearl. 1940. 'The Alkimia Minor Ascribed to Albertus Magnus', *Isis*, vol. 32(2): 267–300.
- Kogman-Appel, Katrin. 2001. 'Jewish Art and Non-Jewish Culture: The Dynamics of Artistic Borrowing in Medieval Hebrew Manuscript Illumination', *Jewish History*, vol. 15: 187–234.
- . 2002. 'Hebrew Manuscript Painting in Late Medieval Spain: Signs of a Culture in Transition', *Art Bulletin*, vol. 84(2): 246–72.
- Laszlo, Pierre. 1997. *O que é a Alquimia?*, Lisboa.
- Lehmann-Haupt, Hellmut. 1978. *The Göttingen Model Book. A Facsimile Edition and Translations of a Fifteenth-Century Illuminators' Manual*, Columbia.
- Levey, Martin. 1962. 'Mediaeval Arabic Bookmaking and its Relation to Early Chemistry and Pharmacology', *Transactions of the American Philosophical Society*, vol. 52(4): 1–79.
- Mann, Vivian B. (ed.). 2000. *Jewish Texts on the Visual Arts*, Cambridge.
- Marques, A.H. de Oliveira. 1979. 'Pesos e medidas', in Joel Serrão (ed.), *Dicionário de História de Portugal*, Porto: 67–72.
- . 1987. *Portugal na Crise dos Séculos XIV e XV*, Lisboa.
- Martins, Armando. 2003. *O Mosteiro de Santa Cruz de Coimbra na Idade Média*, Lisboa.

- Merrifield, Mary P. 1999. *Medieval and Renaissance Treatises on the Arts of Painting*, New York.
- Metzger, Thérèse. 1972. 'La masora ornamentale et le décor calligraphique dans les manuscrits hébreux espagnols au Moyen Age', in *La Paléographie Hébraïque Médiévale*, Paris: 87–116.
- . 1977. *Les Manuscrits Hébreux copiés et décorés à Lisbonne dans les derniers décennies du XVe siècle*, Paris.
- . 1984. 'Les manuscrits hébreux décorés à Lisbonne dans les dernières décennies du XVe siècle', in *L'Humanisme Portugais et l'Europe*, Paris: 761–80.
- . 1990. 'Josué ben Abraham ibn Gaon et la masora du Ms. Iluminado 72 de la Biblioteca Nacional de Lisbonne', *Codices Manuscripti*, vol. 15(5): 1–27.
- . 1996. 'Joseph ibn Hayyim', in J. Turner (ed.), *The Dictionary of Art*, 661–62.
- Morgan, Nigel J. 2005. 'Manual, Manuscript', <http://www.groveart.com/>; last accessed 21 July 2005.
- Muñoz Viñas, Salvador. 1998. 'Original Written Sources for the History of Mediaeval Painting Techniques and Materials: A List of Published Texts', *Studies in Conservation*, vol. 43(2): 114–24.
- Nascimento, Aires and José Meirinhos (ed.). 1997. *Catálogo dos Códices da Livraria de Mão do Mosteiro de Santa Cruz de Coimbra na Biblioteca Pública Municipal do Porto*, Porto.
- Nascimento, Aires. 1993. 'Circulação do livro manuscrito', in G. Lanciani and G. Tavani (eds), *Dicionário de Literatura Medieval Galega e Portuguesa*, Lisboa: 155–59.
- Oltrogge, Doris. 1998. '«Cum sesto et rigula», l'organisation du savoir technologique dans le Liber diversarum artium de Montpellier et dans le De diversis artibus de Théophile', in Bernard Baillaud, Jérôme de Gramont and Denis Hüe (eds), *Discours et Savoirs: Encyclopédies Médiévales*, Rennes: 67–99.
- Partington, J.R. 1934. 'The Discovery of Mosaic Gold', *Isis*, vol. 21(1): 203–6.
- Perego, François. 2005. *Dictionnaire des Matériaux du Peintre*, Paris.
- Pereira, Maria Helena Rocha (ed.). 1973. *Obras Médicas de Pedro Hispano*, Coimbra.
- Read, John. 1995. *From Alchemy to Chemistry*, New York.
- Real Academia Española. 1726–1739. *Diccionario de la Lengua Castellana*, 6 vols, Madrid.
- Richler, Benjamin and Malachi Beit-Arié. 2001. *Hebrew Manuscripts in the Biblioteca Palatina in Parma*, Jerusalem.
- Richter, Ernst-Ludwig and Heide Harlin. 1976. 'The "Stuttgarter Karteospiel"—Scientific Examination of the Pigments and Paint Layers of Medieval Playing Cards', *Studies in Conservation*, vol. 21(1): 18–24.
- Ross, Janet L. 1973. 'A Note on the Use of Mosaic Gold', *Studies in Conservation*, vol. 18(4): 174–76.
- Sá, A. Moreira de. 1960. 'A próxima edição de três traduções portuguesas inéditas do século XV', *Boletim Internacional de Bibliografia Luso-Brasileira*, vol. 1(4): 563–85.
- . 1960. 'Abraão B. Judah Ibn Hayyim. O livro de como se fazem as cores', *Revista da Faculdade de Letras da Universidade de Lisboa*, vol. 4: 210–23.
- . (ed.). 1960. *Pseudo Aristóteles. Segredo dos Segredos*, Lisboa.

- Schlosser, Julius. 1993. *La Literatura Artística. Manual de fuentes de la historia moderna del arte*, 4th edition, Madrid.
- Sed-Rajna, Gabriëlle (ed.). 1988. *Lisbon Bible 1482. British Library Or. 2626*, Tel-Aviv.
- Speleers, L. 1999. 'An Early Example of the Use of Mosaic Gold', *Zeitschrift für Kunsttechnologie und Konservierung*, vol. 13(1): 50–54.
- Stillman, John Maxson. 1960. *The Story of Alchemy and Early Chemistry*, New York.
- Strolovitch, Devon. 1999. 'Selections from a Portuguese Treatise in Hebrew Script: Livro de Como se Fazem as Cores', *Cornell Working Papers in Linguistics*, vol. 17: 185–96.
- . 2005. 'Old Portuguese in Hebrew Script: Convention, Contact, and Convivência', unpublished PhD Dissertation, Cornell University, Cornell.
- Thompson, Daniel V. 1956. *The Materials and Techniques of Medieval Painting*, New York.
- Thompson, Jr, Daniel V. 1935. 'Trial Index to Some Unpublished Sources for the History of Mediaeval Craftsmanship', *Speculum*, vol. 10(4): 410–31.
- . (ed.). 1960. *Cennino d'Andrea Cennini. The Craftsman's Handbook. The italian Il Libro dell'Arte*, New York.
- Veliz, Zahira (ed.). 1986. *Artists' Techniques in Golden Age Spain. Six Treatises in Translation*, Cambridge.
- Ventura, Leontina (ed.). 1982. *Arte da Pintura. Symmetria e perspectiva Composta por Philippe Nunes*, Porto.
- Zunz, L. 1864. *Die hebräischen Handschriften in Italien. Ein Mahnruf des Rechts und der Wissenschaft*, Berlin.